CHAPTER XV

THE PHARYNX

HAMILTON BAILEY

TONSILS AND ADENOIDS

Surgical Anatomy.—The conception that the lymphadenoid tissue of the naso-pharynx is Nature's barrier to bacterial invasion can be fostered, and the ætiology of certain cervical inflammations can be visualised and better understood, if Waldeyer's inner and outer rings (fig. 365) are studied. *The faucial tonsils* are the largest and most important moieties of the inner ring. Tonsillar tissue normally contains crypts, usually tortuous, that extend right through the tonsillar substance to the external capsule. These crypts can, and often do, harbour pus and micro-organisms. Clothing the lateral two-thirds of the circumference of each tonsil is the capsule, a well-defined structure composed of fibrous and elastic tissue, and muscle fibres. The medial third of the circumference lies between the pillars of the fauces and, being bereft of covering, is readily accessible to clinical examination.

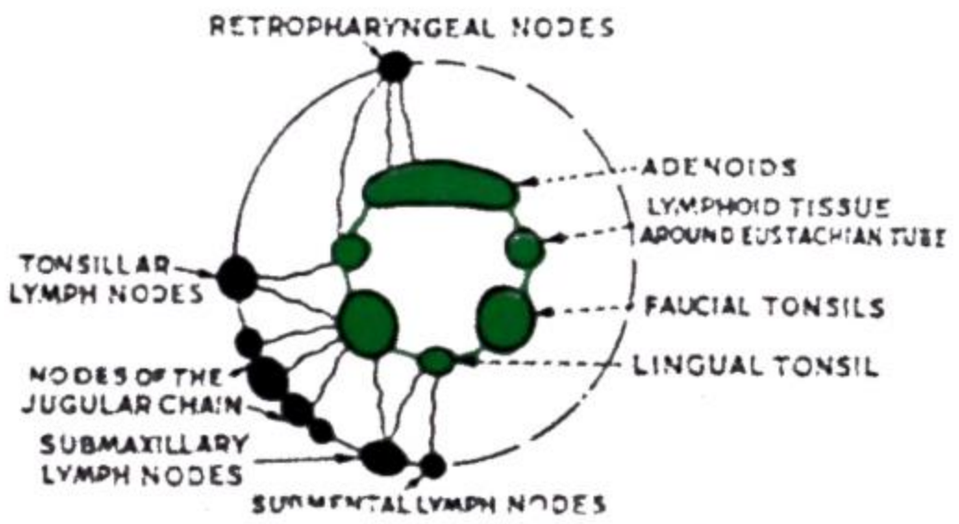

FIG. 365.—Waldeyer's rings. Inner ring—first barrier to infection; outer ring—second barrier.

The tonsil has an exceptionally good blood supply (fig. 366). It is well to bear in mind the vulnerable but infrequent anomaly of the internal carotid artery forming a complete circular coil (fig. 366, inset), but it is reassuring for those who enucleate tonsils with a guillotine to know that they drag the tonsil away from this dangerous zone (Brown Kelly).

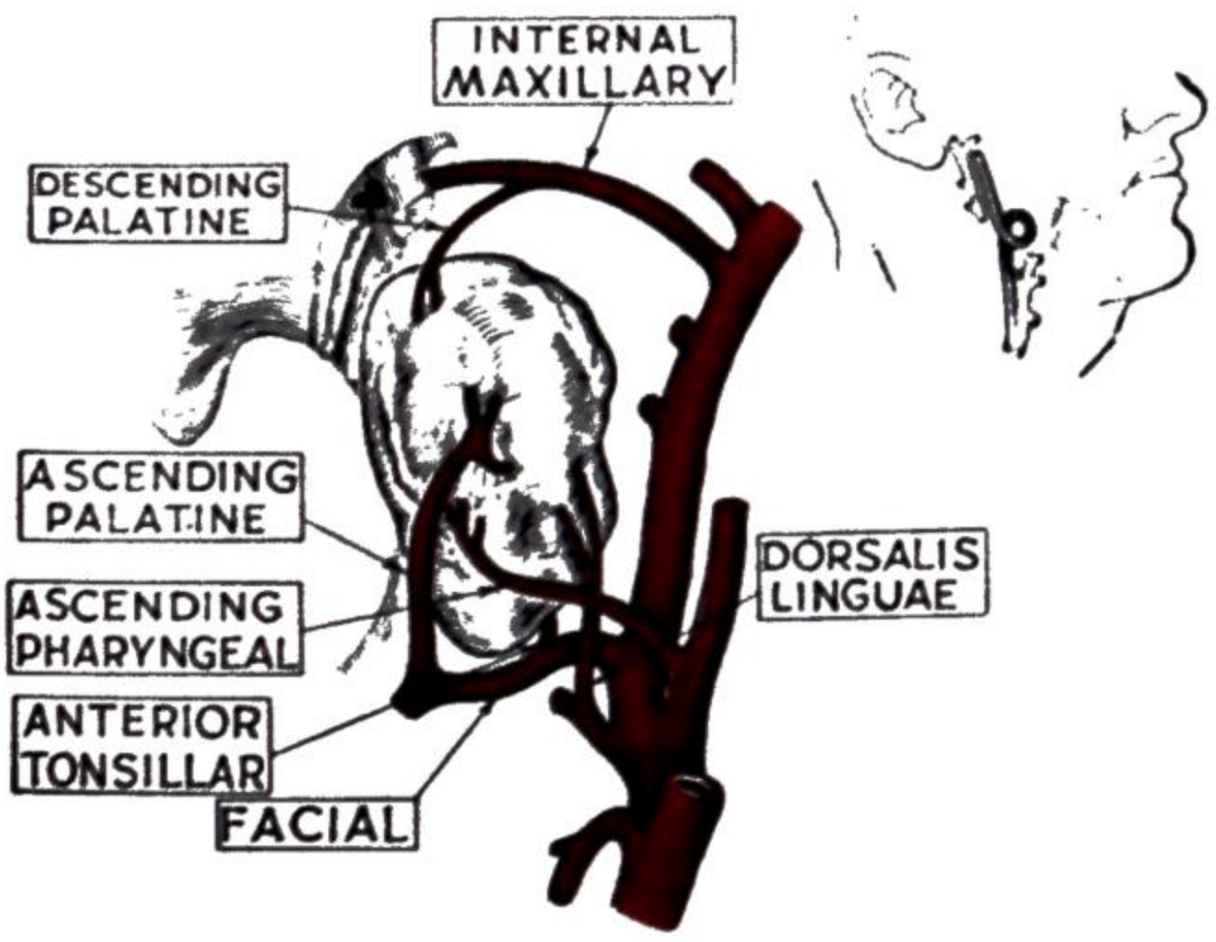

FIG. 366.—The arterial supply of the tonsil. (*After R. H. Fowler.*) (Inset) Internal carotid artery forming a complete circular coil. (*After A. Brown Kelly.*)

ENLARGEMENT OF THE TONSILS AND ADENOIDS

Enlarged tonsils are not necessarily infected; a certain amount of hypertrophy is common in early childhood. As adult life approaches, the tonsils, together with other lymphoid tissues, tend to atrophy. Excessive hypertrophy is often bilateral. Occasionally, the tonsils are so large that they almost meet in the middle line.

Wilhelm von Waldeyer, 1836–1921. Professor of Pathology, Berlin.
Adam Brown Kelly, 1865–1941. Surgeon to Ear, Nose, and Throat Department, Victoria Infirmary, Glasgow.

Enlarged Adenoids.—The 'pharyngeal tonsil' is present at birth but undergoes atrophy at puberty, although remnants of it often persist into adult life. The most common period for the occurrence of adenoid vegetations is between the ages of four and fourteen, and a damp climate favours their development. Enlarged adenoids consist of masses of lymphoid tissue covered by ciliated epithelium and supported by a delicate framework of fibrous tissue. The whole mass is divided by deep clefts, which in the recently removed specimen (fig. 367) can be seen so completely to separate the intervening hillocks that they may be likened to the leaves of a book.

FIG. 367. — Mass of adenoids removed from a child of three years. (*The late A. Logan Turner, Edinburgh.*)

Considerable adenoid hypertrophy causes the patient to snore loudly at night and to breathe through the open mouth, giving that well-known vacant expression (fig. 368). Added to this, hearing is impaired by the hypertrophied lymph-adenoid tissue obstructing the orifice of the Eustachian tubes, and infections of the upper respiratory tract occur frequently.

FIG. 368.—The adenoidal facies. Tonsillar hypertrophy is a usual accompaniment. (*Dr. Bruce Williamson, London.*)

Acute follicular tonsillitis is a common condition characterised by pyrexia associated with a sore throat, the most usual causal organism being a streptococcus. On examination the tonsils are swollen, and yellow spots due to pus exuding from the tonsillar crypts can often be discerned. The lymph nodes of the neck are usually enlarged and painful. The condition must be distinguished from diphtheria, and ulceration due to *Borrelia vincenti* by a rapid bacteriological examination of a smear. Mild cases may resemble the small 'snail track' ulcers of secondary syphilis.

Treatment.—Aspirin is administered to relieve pain, and gargles of glycerol-thymol are soothing. When the infection has subsided, the question of the advisability of tonsillectomy, or removal of a portion of tonsillar tissue left behind at a previous tonsillectomy, will arise.

Chronic tonsillitis is sometimes associated with hypertrophy. During early childhood chronically inflamed tonsils are usually soft, but by the time puberty has been reached frequently they have become indurated and adherent, due to recurrent attacks of inflammation and subsequent fibrosis. The tonsillar lymph node of the jugular chain is usually palpable.

Sometimes pus and débris can be expressed from infected tonsillar crypts. In suitable instances suction of the tonsils enables a bacteriological examination to be made.

Bartolommeo Eustacchio, 1524–1574. Professor of Anatomy, Rome.
Jean Hyacinthe Vincent, 1862–1950. Professor of Medicine, Val-de-Grâce (Military) Hospital, Paris.

TONSILLECTOMY[1]

While indiscriminate extirpation of tonsils and adenoids is to be deprecated, there can be no question that removal of greatly hypertrophied and infected tonsils and adenoids confers enormous benefits upon the individual. In children particularly, when this source of recurrent infection and respiratory obstruction has been removed, the general condition improves remarkably.

Indications.—1. Hypertrophy of such a degree as to cause respiratory obstruction. Usually such examples are associated with adenoids.

2. Recurrent attacks of acute tonsillitis.

3. When the tonsils are considered to be a focus of infection, e.g. aggravating rheumatoid arthritis or thyrotoxicosis. In the latter condition the tonsils should not be removed until the thyrotoxicosis has been cured.

4. Tuberculous cervical adenitis when the tonsils are suspected of being the primary focus of infection.

Operation.—Tonsils can be removed by dissection or by enucleation with a guillotine. About 30 per cent. of patients undergoing tonsillectomy without pre-operative antibiotic therapy develop transient bacteræmia, similar to that observed after tooth extraction. Cases of acute and subacute bacterial endocarditis and septicæmia have resulted from this bacterial deluge, especially in cases of infected tonsils. Pre-operative treatment with penicillin for several days, and for several days after operation, is advised.

Dissection.—This method is more exact and bleeding is far less in evidence. Either local or general anæsthesia can be employed. The mouth is kept open and the tongue depressed with a Davis's gag. The tonsil is seized with vulsellum forceps. An incision is made through the mucous membrane (fig. 369), and the capsule of the tonsil is exposed. The tonsil is removed by dissection, starting at the upper (palatal) pole. When the pedicle is defined, it is severed by a wire snare.

By Enucleation with the Guillotine.—When the tonsils have been removed with the guillotine (fig. 370) considerable hæmorrhage occurs. This soon ceases when the pharynx has been cleared with swabs upon a holder, and ice-cold water, which should always be in readiness, is applied to the face. The patient is kept in the operating theatre until the bleeding has ceased and the air-way is clear.

FIG. 370.—A guillotine.

After-treatment of Patients who have undergone the Guillotine Operation.—Until the patient has recovered consciousness he should be kept with his head low and well over to one side

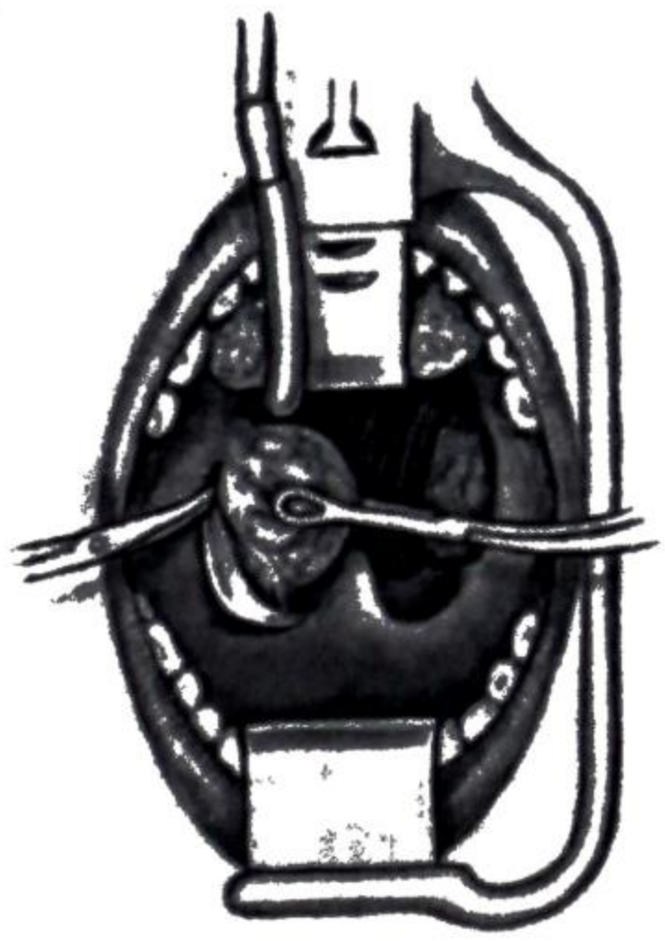

FIG. 369.—Removal of the tonsils by dissection. Davis's gag in place.

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[1] Should a recently tonsillectomised patient contract poliomyelitis, he is liable to contract the more lethal bulbar type. Tonsillectomy is therefore contraindicated during an epidemic of this disease.

The original Davis's gag was invented by Dr. Davis, of Boston, Mass. Edmund G. Boyle, Anæsthetist St. Bartholomew's Hospital, perfected it.

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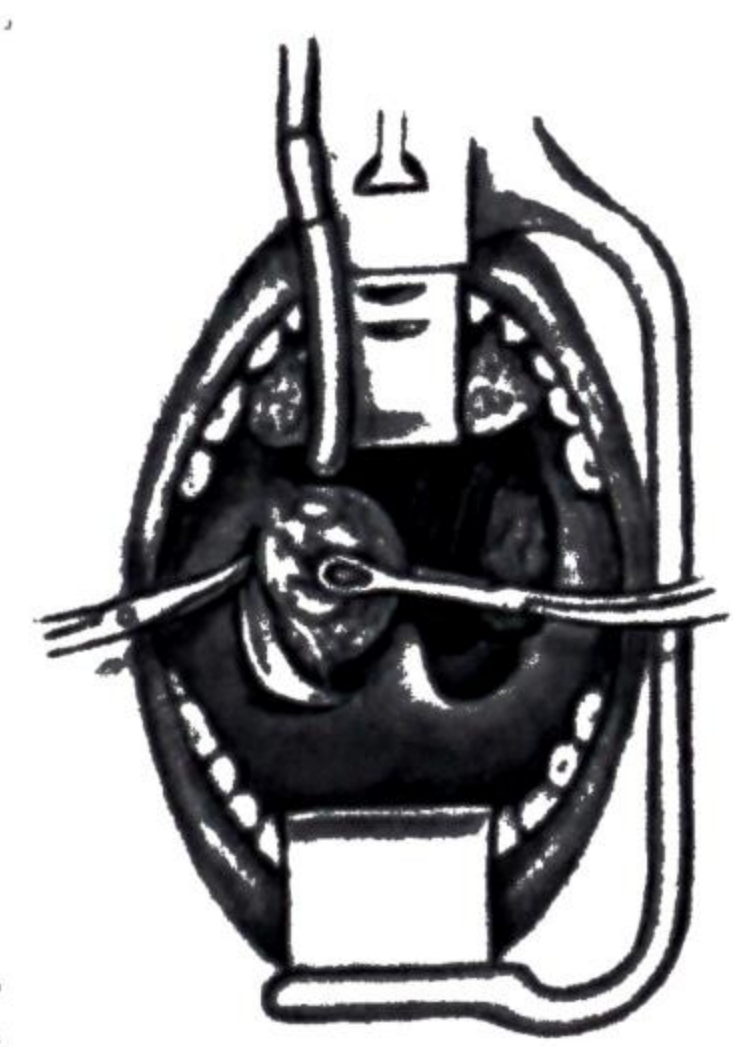

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FIG. 371.—Position of patient after tonsillectomy.

(fig. 371). On no account should he be permitted to lie on his back or be left unattended.

Hæmorrhage after Tonsillectomy.—The main disadvantage of the guillotine operation is that occasionally serious renewed hæmorrhage occurs from the tonsillar bed. In such cases prompt measures are necessary. The most important of the immediate measures are: (1) removal of clot from the tonsillar bed (fig. 372), (2) the application of pressure and styptics by means of a swab on a holder, (3) the administration of morphia. If bleeding persists in spite of these measures, the patient should be returned to the operating theatre, and under general anæsthesia the bleeding-point sought and ligated. When the bleeding-point cannot be found, coaptation of the pillars of the fauces with sutures will arrest the hæmorrhage. These stitches should be removed after twenty-four hours. The usual methods of replenishing the circulation after loss of blood must be invoked.

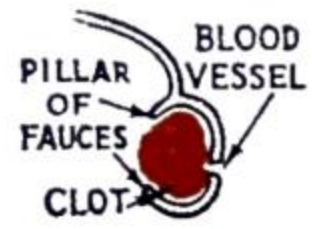


FIG. 372.—Hæmorrhage from the tonsillar bed may be due to clot preventing the surrounding musculature from contracting. (*After Lee McGregor.*)

Removal of adenoids is usually undertaken at the conclusion of an operation for tonsils. Adenoids are removed with a guarded curette (fig. 373) pressed against the roof of the nasopharynx (fig. 374) and then carried backward and downward with a firm sweeping movement. The after-treatment is similar to that described above. Reactionary hæmorrhage can almost always be stopped by sitting the patient bolt upright. If this is not quickly successful, after removal of clots a succession of swabs dipped in hydrogen peroxide, applied on a holder, remedies matters unless a tag has been overlooked, in which case the tag must be removed with punch forceps.

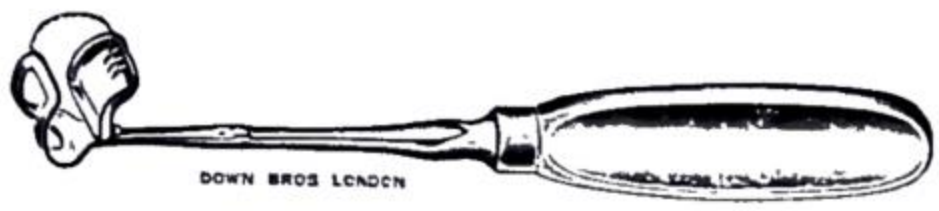


FIG. 373.—St. Clair Thomson's adenoid curette.

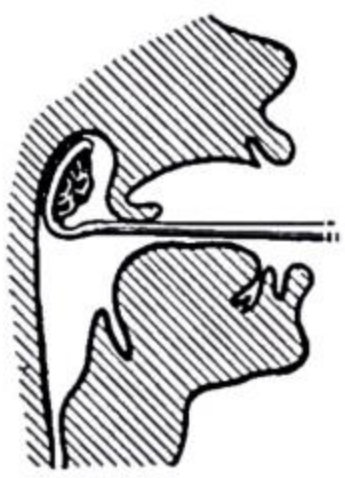


FIG. 374.—Curettage of adenoids.

MALIGNANT TUMOURS OF THE TONSIL

Both carcinoma and lymphosarcoma occur in the tonsil. The diagnosis in many instances is not easy. Any unilateral enlargement of the tonsil occurring in adult life should be regarded with suspicion. After a Wassermann reaction has been performed to exclude syphilis, a biopsy is often required to confirm the diagnosis.

Carcinoma of the Tonsil (85 per cent.).—The patient is commonly an elderly man and pain is the leading symptom. The pain is severe and radiates to the ear, and, unlike that of tonsillitis, is unilateral. The breath is foul. Later bleeding occurs, and as the ulcer deepens the loss of blood may be copious.

Treatment.—If the condition is diagnosed sufficiently early, tonsillectomy may suffice. In later cases the growth can be excised as described in lateral pharyngotomy (p. 282). In advanced cases irradiation can be employed, often with temporary benefit. The five years' survival rate after treatment is 25 per cent.

Lymphosarcoma of the tonsil (15 per cent.) has the reputation of being very malignant. While this is true if it is allowed to grow beyond the peritonsillar bed, the condition is by no means hopeless in its early stages. The patient, who, it should be noted, is usually between fifty and sixty years of age, complains of a lump in the throat, which in the early stages is painless. Thick speech is a common symptom,

Sir St. Clair Thomson, 1859–1943. Surgeon, Ear, Nose and Throat Department, King's College Hospital, London.

and the tonsil appears large and pale. Later, the growth spreads, and often forms a swelling of the palate, which many times has been mistaken for a peritonsillar abscess, and incised. Once the barrier formed by the capsule of the tonsil has been broken, the growth extends rapidly into the neck, often forming a swelling behind the angle of the mandible. While the cervical lymph nodes soon become involved, a swelling in this position is likely to be an extension of the primary growth. Later still bleeding, dysphagia and dyspnœa foretell that the end is not far distant.

Treatment.—If the tonsil is removed before the peritonsillar capsule has been invaded, the expectation of a cure is high. When the growth has extended beyond the capsule deep X-ray therapy usually brings about temporary improvement, but recurrence is almost inevitable.

PERITONSILLAR ABSCESS *v.n.* QUINSY

As its name implies, a peritonsillar abscess is due to suppuration occurring outside the capsule of the tonsil, most usually in the tissues of the soft palate (see fig. 375). The route of infection appears to be by way of the supra-tonsillar fossa. As a rule the abscess is unilateral, but it is not uncommon for the contralateral side to become involved a few days later. The condition is rare in children, the incidence being highest in adult males. The general symptoms are often severe. Extreme pain is experienced in the tonsillar region, radiating to the ear and to the side of the neck. Swallowing is so painful that saliva dribbles from the mouth; speech is thick and muffled. Owing to the fact that the patient can only open the mouth to a slight extent, examination is often difficult. With good illumination a diffuse swelling of the soft palate, most in evidence near the superior border of the affected tonsil, will be seen. The swelling displaces the œdematous uvula to the contralateral side.

Treatment, in the early stages, is the same as that for acute follicular tonsillitis. In addition, penicillin should be administered intramuscularly. If suppuration occurs, evacuation of pus in the following manner should not be delayed.

A bistoury is prepared by winding a strip of strapping around the blade so that only 1 cm. ($\frac{2}{5}$ inch) of the tip projects. The head of the anæsthetised [1] patient is held in the hyperextended position over the end of the operating table, and the assistant should be in readiness to mop up pus, or remove it by suction, at the crucial moment. An incision is made in the position shown in fig. 375, which is usually described as midway between the base of the uvula and the third upper molar tooth. Dressing forceps are now pushed firmly *directly backwards*. As soon as pus is encountered, the forceps are opened widely and withdrawn. Some surgeons remove the affected tonsil and thereby drain the abscess effectively.

FIG. 375.—Peritonsillar abscess, showing site of incision.

Parapharyngeal abscess is similar to the above, but the maximum swelling is behind the posterior faucial pillar, and there is little or no œdema of the palate. The abscess is opened with a really blunt instrument, such as a tongue depressor. Often the gloved finger will suffice (E. Watson-Williams).

[1] In adult patients surface anaesthesia is the safest.

Eric Watson-Williams, Contemporary. Consulting Aural Surgeon, Bristol Royal Infirmary.

RETROPHARYNGEAL ABSCESS

Two forms occur :

Acute.—*Between* the prevertebral fascia and the pharynx [1].

Chronic.—*Behind* the prevertebral fascia.

Acute retropharyngeal abscess is seen most commonly in children under the age of four. It is the result of suppuration of the lymph nodes that occupy the space. The prevertebral lymph nodes are most luxuriant during the first year of life; this explains why the highest incidence of retropharyngeal abscess occurs in early infancy. The portal of entry is the tonsils or the middle ear.

In infants the condition is sometimes very acute, and accompanied by rigors, convulsions and vomiting. The neck is held rigidly, usually on one side, saliva dribbles from the child's mouth, and feeds are regurgitated. *Difficulty in breathing is the leading symptom* and this should always be the signal to examine a child's throat. The posterior wall of the pharynx is swollen. This is sometimes only visible when the base of the tongue has been depressed firmly. On digital examination a localised soft cushion-like projection can be felt on the posterior pharyngeal wall. The only condition with which acute retropharyngeal abscess is likely to be confused is laryngeal diphtheria.

A less acute form is seen in older children as a complication of middle-ear disease.

Treatment.—The anæsthetised child is held upside-down, and a pair of dressing forceps guided by the finger is thrust into the abscess cavity, the contents of which are evacuated before the patient is laid prone. Suitable antibiotic therapy is prescribed.

FIG. 376. — Chronic retropharyngeal abscess secondary to tuberculous disease of the cervical vertebræ.

Chronic retropharyngeal abscess is sometimes due to an extension of tuberculosis of a cervical vertebra (fig. 376), and this possibility should always be confirmed or eliminated by suitable radiographs of the cervical spine. With the decline in the incidence of bone tuberculosis in this country retropharyngeal abscess from this cause is now encountered less frequently than formerly. Cases of chronic retropharyngeal abscess due to tuberculous retropharyngeal lymph nodes are less uncommon. When the collection of pus is large, in addition to the retropharyngeal swelling, there is a fullness behind the sternomastoid on one side. A chronic retropharyngeal abscess must never be opened into the mouth, for such a procedure will lead to secondary infection. The pus should be evacuated by an incision behind the sternomastoid. The dissection towards the retropharyngeal space is conducted carefully until the abscess is opened. The cavity is then mopped dry and the wound closed. Suitable treatment of the underlying tuberculous lesion must then be instituted.

[1] The buccopharyngeal fascia divides this fascial compartment down the middle, hence an acute retropharyngeal abscess is always to one side of the midline.

DIVERTICULUM OF THE PHARYNX

Congenital lateral diverticulum is really a blind internal branchial fistula (p. 186) opening into the fossa of Rosenmüller (the pharyngeal recess). Occasionally such a fistula becomes greatly distended and food lodges within it.

Pharyngeal Pouch.—Ætiology.—The inferior constrictor muscle is made up of two portions—the upper oblique fibres (thyropharyngeus) of each side that interdigitate posteriorly, and the lower fibres (cricopharyngeus) that are arranged transversely, and function as a sphincter. Between these two sets of fibres there is a weak area in the middle line posteriorly, known as Killian's dehiscence which is marked by a dimple (fig. 377) in the overlying mucous membrane. The lower (sphincteric) portion of the cricopharyngeus constantly maintains enough tone to prevent the entry of air into the œsophagus during inspiration (Sir Victor Negus). If for some reason the cricopharyngeus fails to relax during swallowing, the brunt of the force on the bolus falls on Killian's dehiscence; so commences a pharyngeal pouch (fig. 378). As time goes on, the sac becomes larger and fills with food at every meal. Unable to expand posteriorly because of the resistance of the vertebral column, the pouch turns outwards, usually to the left (fig. 379), and obtrudes itself into the side wall of the neck.

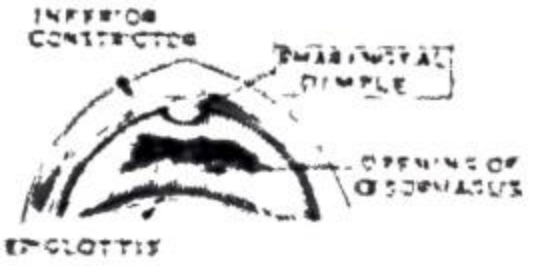


FIG. 377.—The pharyngeal dimple.

FIG. 378.—Pharyngeal pouch protruding between the thyropharyngeal and cricopharyngeal portions of the inferior constrictor of the pharynx. *(After Sir Victor Negus.)*

FIG. 379.—Museum specimen of a pharyngeal pouch, showing compression of the adjacent œsophagus. *(British Journal of Surgery.)*

Summarising.—Unrelenting spasm of the cricopharyngeus muscle is the most important ætiological factor in the production of a pharyngeal diverticulum.

Clinical Features.—Patients suffering from this condition are usually, but not necessarily, elderly, and it is twice as common in men as in women.

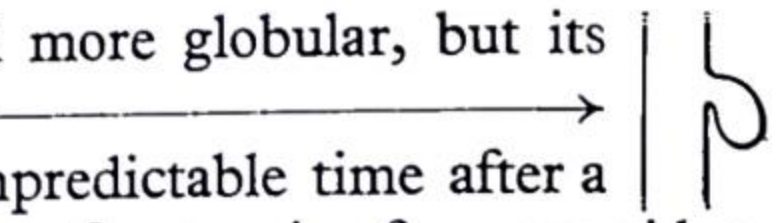
There are three stages in the development of symptoms. Rarely does the patient present during the first stage.

Stage 1.—As shown by a lateral radiograph after a barium swallow, there is a small diverticulum directed towards the vertebral column, viz.→

Usually a small pharyngeal diverticulum is symptomless, and the finding of it is accidental during the course of a barium meal. Occasionally it gives rise to symptoms identical with those of lodgment of a foreign body in the throat. Extirpation of the diverticulum should not be attempted at this stage.

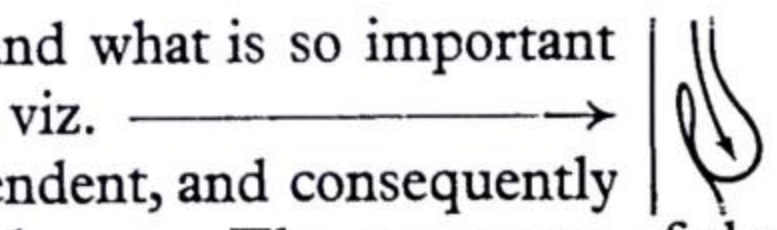
Johann Rosenmüller, 1771–1820. Professor of Anatomy and Surgery, Leipzig.
Gustav Killian, 1860–1921. Professor of Otolaryngology, Berlin.
Sir Victor Negus, Contemporary. Consulting Surgeon, Ear, Nose and Throat Department, King's College Hospital, London.

Stage 2.—The diverticulum is larger and more globular, but its mouth still lies in the vertical plane, viz. ——→



Regurgitation of undigested food at an unpredictable time after a meal, during the swallowing of the next meal, or after turning from one side to the other at night, is the chief complaint. Sometimes the patient is awakened from sleep by a feeling of suffocation, followed by a violent fit of coughing. Infrequently an abscess of the lung results from food inspired from the pouch. Removal of the pouch is indicated.

Stage 3.—The pouch has become larger, and what is so important is that its mouth looks horizontally upwards, viz. ——→



The fundus of the pouch has become dependent, and consequently when the pouch is full it compresses the œsophagus. The symptoms of the second stage persist; in addition, there are gurgling noises in the neck, especially when the patient swallows. In about one-third of cases the pouch is large enough to form a visible swelling in the neck : sometimes such a pouch can be seen to enlarge when the patient drinks. Nevertheless, when this stage has been reached the symptom that transcends all others is increasing dysphagia, and in a large number of instances it is this symptom alone that compels the patient to seek relief. However, even at this stage a few intelligent patients acquire a knack of overcoming their disability. It is recorded that Lord Jeffrey, a Scottish nobleman, was in the habit of emptying his pouch with a large silver spoon after every meal. Other sufferers have found that they can swallow their food better if the pouch is full, and accordingly take porridge as a first course. Notwithstanding these ingenious devices, eventually there is progressive loss of weight due to semi-starvation, and cachexia is sometimes extreme.

Radiography.—If a pharyngeal pouch is suspected, a very thin emulsion of barium should be used for the barium swallow; a thick mixture often requires much washing through a tube to remove the barium from the pouch. Within reasonable limits, the longer the symptoms persist the larger does the pouch become. Quite often the fundus of the sac will be seen invading the superior mediastinum. Radiologically the antero-posterior appearance of a barium-filled pouch can be simulated closely by a partial septum obstructing the commencement of the œsophagus. Therefore, if this mistake is to be avoided a semi-lateral view (fig. 380) also must be taken. In this view the overflow of barium emulsion into the œsophagus often can be seen to come from the top of the pouch—not from the bottom, as is the case with an œsophageal web.

FIG. 380.—Lateral radiograph of a pharyngeal pouch after barium has been swallowed.

Œsophagoscopy or bouginage is quite unnecessary for diagnosis, and in this condition it is particularly dangerous. On many occasions the tip of the instrument has entered the pouch and has perforated its fundus,

which is thin and fragile, and mediastinitis has resulted. In the case of a small horizontally-placed pharyngeal diverticulum this ban can be lifted.

Treatment.—When the diverticulum is a small one, and the symptoms confined to slight difficulty in swallowing, with the above reservation, the occasional passage of an œsophageal bougie may keep more serious symptoms in abeyance. In these circumstances a conservative course should be followed, because a small pouch is much more difficult to remove than a large one.

In cases where the pouch is of a considerable size, operation is strongly advised, because progressive symptoms are inevitable. When emaciation is extreme a preliminary temporary gastrostomy occasionally is required.

Formerly the operation was performed in two stages to minimise the dreaded complication of mediastinitis, but with careful pre-operative preparation that includes washing out the pouch and the administration of systemic antibiotic therapy before and after operation, the one-stage operation now carries a very low mortality. The operation can be conducted under local anæsthesia or endotracheal general anæsthesia.

Operation.—The pouch is approached through either a transverse incision at the level of the cricoid cartilage, or, as many prefer, an oblique incision following the anterior border of the left sternomastoid. The first step is to mobilise the lateral lobe of the thyroid gland. It is necessary to ligate and divide the middle thyroid veins, and sometimes the inferior thyroid artery in addition. When this has been completed, the lateral lobe is retracted forwards, and the carotid sheath is retracted backwards. At this stage a large stomach tube is passed by the anæsthetist and it enters the pouch ; the tube is guided by the surgeon from the pouch into the œsophagus, and there it remains during the operation as a helpful guide in determining the limits of the neck of the sac during the later stages of the dissection.

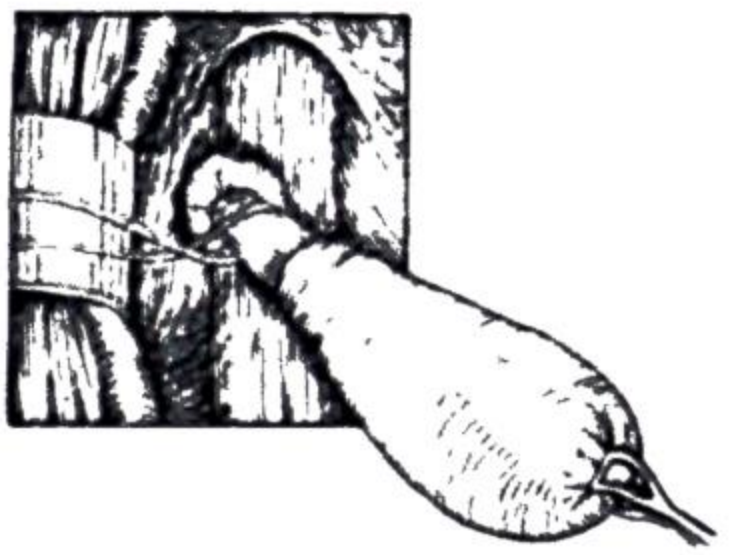


FIG. 381. — Double ligation of the mucous membrane of the neck of the sac. Note that a cuff of the superficial layers of the neck of the sac has been dissected back. This will be sutured over the stump. *(After Frank Lahey.)*

The walls of the sac vary in thickness ; in some cases they are so thin that great care must be taken not to tear them. Having freed the pouch completely, a cuff of the outer layer of the pouch is dissected from the mucous membrane. This permits of the closure of the neck of the sac, which must be performed very accurately in two layers (fig. 381); alternatively, if it is considered that the neck of the pouch is too wide for this procedure, the neck of the sac is clamped and, after the pouch has been excised with the diathermy knife, the stump is closed in two layers in the same manner as a duodenal stump is closed after partial gastrectomy. The wound is closed with drainage.

After-treatment.—The patient is fed through an indwelling transnasal gastric tube for three days. Fluids only are permitted for the next three days. After this, semi-solids are given, and the diet is then increased gradually.

Complications :

1. **Infection.**—As stated previously, severe infection of the wound and the mediastinum is now infrequent.
2. **Pharyngeal Fistula.**—Usually the fistula closes spontaneously.

NEOPLASMS OF THE PHARYNX

Surgical Anatomy.—In as far as neoplasms of the pharynx are concerned, the clinico-anatomical divisions of the pharynx into various component parts (fig. 382) is of over-riding importance.

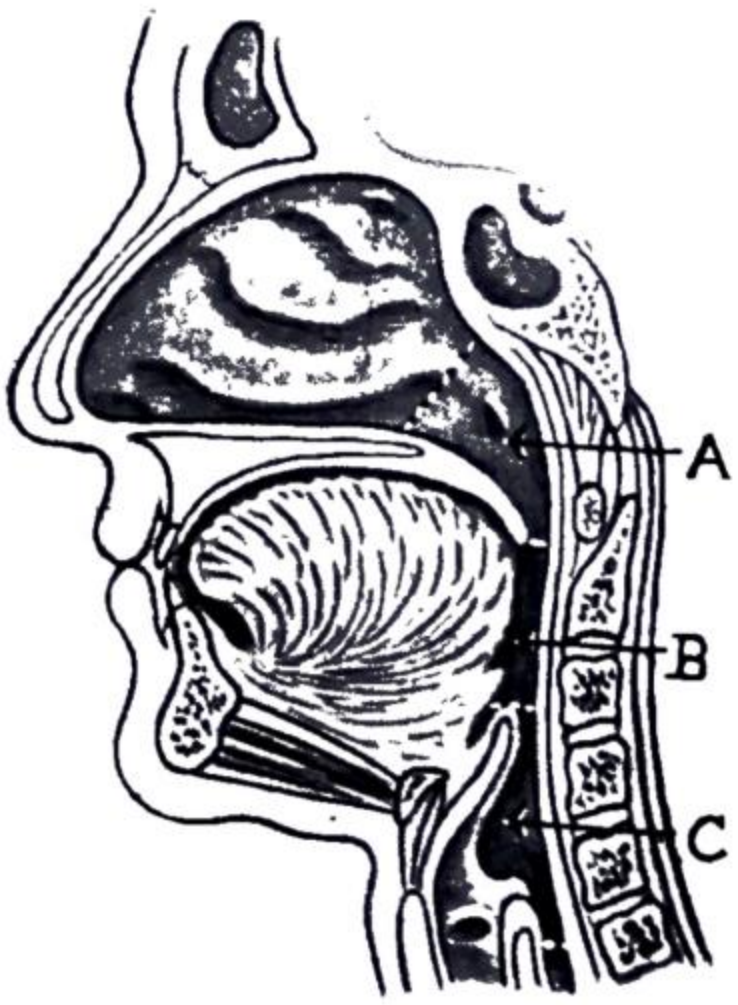


FIG. 382.—The component parts of the pharynx. (*a*) Nasopharynx: (*b*) oropharynx: (*c*) laryngopharynx, the antero-superior portion of which contains the inlet of the larynx, and is known as the epilarynx.

The nasopharynx (*syn.* the epipharynx) is that portion of the pharynx lying above the level of the soft palate which forms its incomplete floor. With the exception of this floor, the nasopharynx has rigid, immovable walls. Each Eustachian tube opens into the antero-lateral wall of the nasopharynx just behind the posterior end of the inferior turbinate. Above and behind this orifice is the pharyngeal recess, or fossa of Rosenmüller.

The oropharynx (*syn.* the mesopharynx) extends from the inferior border of the soft palate to the lingual surface of the epiglottis. In the sulcus between the back of the tongue and the anterior (lingual) surface of the epiglottis lie a median glosso-epiglottic and a right and left pharyngo-epiglottic fold. The corresponding depression on either side of the glosso-epiglottic fold is known as the vallecula (see fig. 383).

The laryngopharynx is the longest of the three divisions of the pharynx and it diminishes in width from above, downwards. It extends from the tip of the epiglottis to end opposite the body of the sixth cervical vertebra, where it is continuous with the œsophagus. It is convenient to subdivide the laryngopharynx into the *epilarynx* above and the *hypopharynx* below, the dividing line being at the level of the upper border of the cricoid cartilage (Sir Stanford Cade). As has been explained on p. 275, except during deglutition the lowest part of the hypopharynx is kept closed by tonic muscular contraction. In the antero-superior portion of the laryngopharynx lies the inlet of the larynx, and it is the immediate environs of this inlet that are known as the epilarynx (fig. 383). The inlet of the larynx faces almost backwards, and is bounded above by the epiglottis, laterally by the aryepiglottic folds, and below by the short interarytenoid fold. On the lateral side of each aryepiglottic fold lies a blind recess—the piriform fossa.

Each and all the structures mentioned above are well recognised sites of origin of a carcinoma.

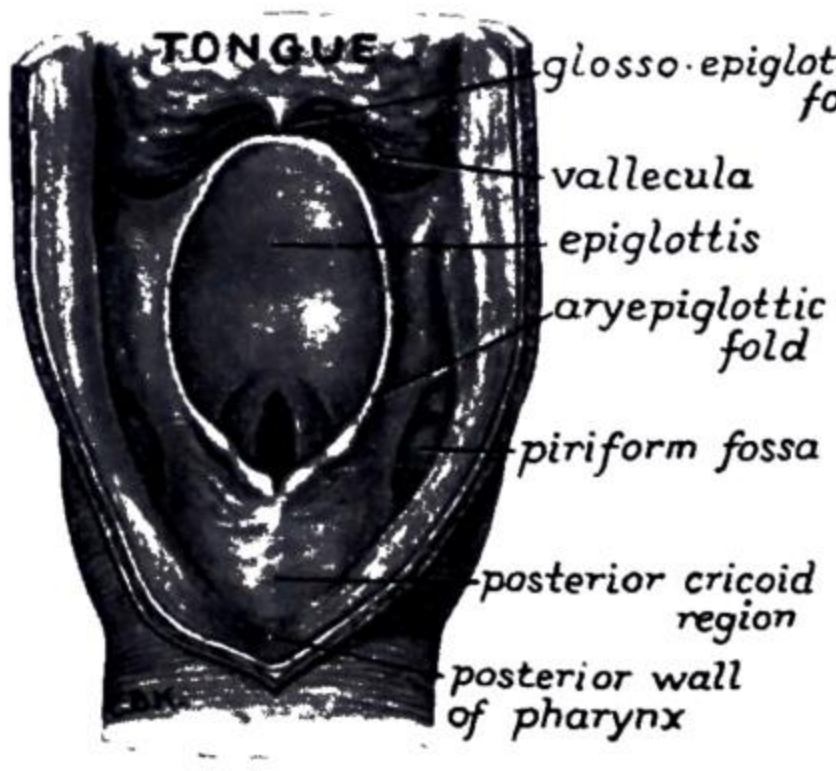


FIG. 383.—The epilarynx: the valleculæ are shown also. In, or on, all the structures labelled a carcinoma can arise.

The benign tumours, papilloma and lipoma, can arise in any part of the pharynx. They are extremely rare, and save to mention that they should be excised, no further reference to them will be made.

TUMOURS OF THE NASOPHARYNX

Benign:

Angio-fibroma[1].—Although its local behaviour is the antithesis of benignity, this tumour is not malignant, for it never metastasises, neither does it *infiltrate* tissues. However, on account of its ability to send tentacles into first one and then the other nasal fossa, and from thence into the accessory nasal sinuses, and above all because

[1] Formerly called nasopharyneal tumour which is ambiguous.

Sir Stanford Cade, Contemporary. Surgeon, Westminster Hospital, London.

of its power to cause pressure necrosis of bone, it is a highly destructive tumour. As a result of these intrusions the tumour expands the nose, may fill the antra and in turn expand the cheek, and cause the palate to bulge, and at times invades the ethmoid and produces a frog face. Occasionally an angio-fibroma of the nasopharynx extends into the pterygoid fossa, and even into the cranial cavity.

FIG. 384.—Angio-fibroma of the naso-pharynx removed by operation. One-third scale. *(C. A. Dichton.)(British Journal of Surgery.)*

Nasopharyngeal angio-fibroma is a reddish, firm tumour (fig. 384) covered with normal mucous membrane. Ulceration seldom occurs unless the tumour is traumatised. Histologically it is composed of immature fibroblasts and blood-vessels; in the comparatively early stages cavernous blood-vessels predominate. In long-standing cases fibrous tissue is more plentiful.

Clinical Features.—This tumour is almost confined to juvenile male patients. Appearing at the age of puberty, if the patient survives secondary complications, when sexual maturity is established, i.e. at twenty to twenty-five years of age, the tumour commences to regress. Although nasopharyngeal angio-fibroma is rare, when a boy presents with progressive nasal obstruction, recurrent epistaxis, a purulent nasal discharge and a firm mass in the nasopharynx, this clinical entity should spring to mind.

Biopsy should be avoided unless there are compelling reasons for undertaking it, in which event matched blood must be in readiness and the surgeon must be prepared to ligate one or both external carotid arteries, for hæmorrhage is often profuse and difficult to control.

Treatment.—The fact that this tumour tends to undergo spontaneous involution when sexual maturity has been attained has led some to cherish a belief that the tumour is related ætiologically to a sex endocrine imbalance, for which there is not an iota of evidence. A precipitation of maturity by prolonged testosterone therapy possibly has resulted in a reduction of the vascularity of the tumour, but even this is doubtful.

FIG. 385.—The transmandibular approach to the nasopharynx. The dotted line shows the area of incision for pharyngotomy. *(After A. J. Kreman.)*

Operation.—Excision has been carried out by various routes; probably the best is the transmandibular. An incision is made vertically in front of the ear and carried down the neck along the anterior border of the sterno-mastoid. The carotid artery is exposed and the external carotid artery ligated. The lower border of the parotid gland is elevated and the masseter muscle is transected above its insertion. The periosteum having been incised transversely, it is elevated in an upward direction, carrying with it the masseter muscle and the parotid gland, and thus preserving the facial nerve. The mandible is transected with a Gigli's saw as near the mandibular notch as possible and the resulting segments are retracted apart (fig. 385). The pterygoid muscles are split and retracted as shown in fig. 385. The internal pterygoid muscle is split still further and the nasopharynx is exposed, and entered. Usually the neoplasm will be found to arise from a pedicle attached to the under-surface of the body of the sphenoid, from which it is erased.

Irradiation.—Many methods of irradiation have been employed. Radon seeds have several advantages, the chief of which is that they can be inserted with a minimum amount of bleeding. Seeds, 1 mc. each, are introduced with a specially adapted spinal puncture needle, the left index finger being inserted behind the soft palate so that the tumour can be palpated. The needles are deposited in the tumour through the soft palate and also through the nostril. If they are introduced about 1·5 cm. apart, a total of only 10 seeds being employed, necrosis and secondary hæmorrhage are avoided. Further implantations at intervals of three to six months are usually required.

Malignant :

In China, Japan, and Malaya malignant tumours are more common in the

nasopharynx than in any other part of the body save the cervix uteri, a possible cause being the widespread use of smoky kerosene lamps in these countries.

Type of growth	
Carcinoma	67 per cent.
Lymphosarcoma	15 „ „
Lympho-epithelioma[1]	11 „ „
Other tumours, including mixed salivary tumour	7 „ „

(James Ewing)

Fifty per cent. of these growths arise in the lateral wall of the nasopharynx, mostly in the fossa of Rosenmüller (fig. 386); the remainder are divided equally between the roof and the posterior wall.

FIG. 386.—Papillary carcinoma of the fossa of Rosenmüller, as seen in a laryngeal mirror. (*After W. L. Mattick.*)

Clinical Features.—The *first* symptoms for which advice is sought fall into four groups:

1. *The Nasal Group.*—Slight, intermittent epistaxis and nasal speech are the comparatively early nasal symptoms; other nasal symptoms, viz. a feeling of obstruction to the airway and a post-nasal discharge, usually are delayed.

2. *Aural Group.*—Unilateral deafness, with sometimes pain in the ear, is the usual complaint. Obstruction of the internal orifice of the Eustachian tube by a growth leads to a collection of sero-sanguinous fluid within the middle ear. The deafness that results is relieved by paracentesis of the tympanic membrane and suction, but as a rule a fresh reaccumulation soon occurs. Bleeding on Eustachian catheterisation is a sign of the utmost importance.

3. *Enlarged Cervical Lymph Nodes.*—Although by the time the diagnosis is established about 70 per cent. of patients with a malignant tumour of the nasopharynx have enlarged cervical lymph nodes, 25 per cent. present on account of the cervical swelling. The typical situation of such a swelling is in the upper jugular chain. The nodes are firm, rather than stony hard, and as a consequence frequently they are mistaken for tuberculous cervical adenitis.

Unlike carcinoma of the tongue, metastases more distant than the neck, occur eventually in about a quarter of cases.

4. *Cranial Nerve Involvement.*—In Far Eastern patients this is the most common presenting symptom; in English patients 40 per cent. have some cranial nerve involvement when first seen. The relative frequency of the cranial nerves involved are shown in fig. 387, each and all suffer implication by the growth either at their exit through

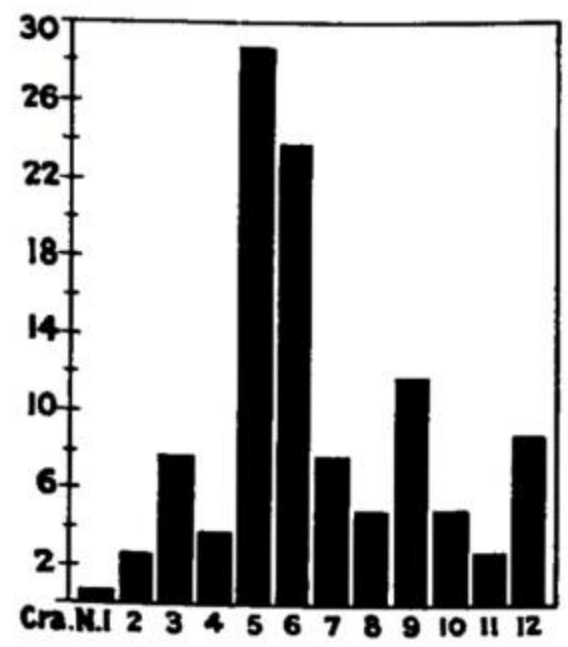


FIG. 387.—The relative frequency of involvement of each cranial nerve in thirty cases. (*G. E. Flatman's statistics.*)

[1] A specific tumour containing many lymphoid elements in addition to carcinomatous elements.

James Ewing, 1866–1943. Professor of Pathology, Cornell University Medical College, New York.

their respective foramina at the base of the skull or, less frequently, by intracranial extension of the growth.

A patient with symptoms belonging to one or more of these groups, in whom a growth of the nasopharynx is not apparent when that region is examined with a laryngeal mirror, should be subjected to digital palpation of the nasopharynx under anæsthesia.

Prognosis.—Owing to their secluded position and consequent late diagnosis, and the inaccessibility of the nasopharynx that prevents thorough extirpation, the prognosis of malignant neoplasms of the nasopharynx is very poor. The five-year survival rate after radium and X-ray therapy is 16 per cent.

Biopsy is most desirable in order that the histological characteristics of the tumour can be ascertained.

Treatment.—Lympho-epithelioma and lymphosarcoma are extremely radio-sensitive ; consequently external radiation alone is effective in these cases. Nevertheless, recurrence is the rule rather than the exception. Carcinomata, especially squamous cell carcinomata, are more radio-resistant and intracavity irradiation, combined with external irradiation, gives better results. In hopeful cases with cervical metastases block dissection of the neck should be carried out in addition. There are two principal methods of giving intracavity irradiation :

Method 1.—Radio-active cobalt in the form of a bead placed in the inflatable bag of a Foley's catheter has been used with fair success. That portion of the nasal septum lying between the middle turbinate bone and the floor of the nasal fossa is resected, so as to give access. Via the enlarged nasal cavity the tumour is coagulated thoroughly with diathermy. The Foley's bag containing the cobalt is then inserted ; the bag is inflated, and retained by packing. The bag is left in position for the time calculated to give the dose desired.

FIG. 388.—Radium applicator in the nasopharynx. (*After N. van Herik.*)

Method 2.—A 25-mg. radium element tube, with a 1-mm. platinum filter with strings attached, is wrapped in cotton-wool, anointed with lubricant jelly, and pulled into the nasopharynx by a catheter passed through the less obstructed side of the nose. The strings issuing from the nose are pulled taut and fixed to the forehead, leaving the applicator in position until the calculated dose has been given. A special box applicator (fig. 388) is available.

NEOPLASMS OF THE OROPHARYNX

Benign:

Diffuse cavernous angioma involving the pharynx, fauces, and often extending into the neck (where it forms a swelling) has been treated successfully by injecting into the bluish mass in the pharynx 0·5 ml. of 1 : 4 solution of ferrous chloride in sterile water. The injected area immediately turns bright red, remains swollen for a few days, and then cicatrizes. Further injections may be required. Later, if necessary, abnormal tissue is removed with a diathermy, with practically no bleeding.

Malignant:

Usually carcinoma of the oropharynx is of the ulcerative type; it can commence on the posterior or lateral wall of the pharynx. When situated on the lateral wall, as the growth enlarges it invades the posterior pillar of the fauces. There is discomfort at the back of the throat, fœtor, and blood-stained sputum. Pain is absent until the growth is far advanced.

Treatment.—Irradiation has proved disappointing, but as a palliative measure radium, in particular, is of great value.

Operation.—Although the long-term results are far from good, when possible, extirpation of the growth and the regional lymph nodes holds out a better prospect of success than irradiation.

Lateral pharyngotomy with partial pharyngectomy is performed as follows. Under intratracheal anæsthesia a block dissection of the cervical and retropharyngeal lymph nodes is carried out. The lateral lobe of the thyroid is then mobilised and displaced forwards. The inferior constrictor muscle is detached from the thyroid and cricoid cartilages. The great cornu of the hyoid bone and the posterior two-thirds of the ala of the thyroid cartilage are removed without opening the mucous lining.

Should the growth be situated on the lateral wall and have invaded the tonsillar region, the cervical operation is halted at this stage, and through the widely open mouth an incision is made at least 1 inch (2·5 cm.) distant from the accessible margins of the neoplasm with a diathermy knife, the internal carotid artery being held aside in the neck (R. Raven). Returning to the neck, the pharynx is opened longitudinally and that portion of the pharyngeal wall containing the growth and a wide margin of healthy tissue is removed in continuity with its lymphatics.

When the loss of the pharyngeal wall is not great the pharynx is closed. A portion of the upper part of the posterior skin flap is anchored by stitches to the prevertebral fascia, thus providing free exit to infected matter should leakage occur. The remainder of the cervical wound is closed with drainage at its lower end.

After-treatment includes transnasal intragastric feeding and antibiotic therapy.

When it is known beforehand that the defect in the pharyngeal wall is likely to be a large one, the operation is performed through a rectangular skin flap (see fig. 392), and after partial pharyngectomy has been performed, the first stage of the plastic procedure is carried out as shown in fig. 389. In the early post-operative period, the patient is fed by a tube passed into the stomach through the fistula.

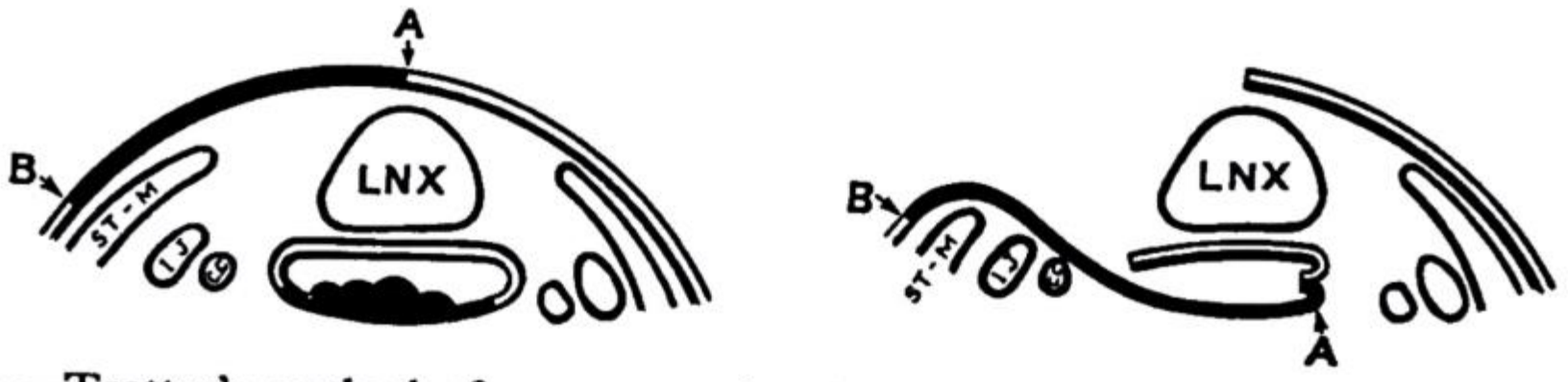


FIG. 389.—Trotter's method of reconstructing the pharynx from a flap of the skin (A–B) of the neck after excision of an extensive pharyngeal carcinoma.

In both the procedures just described the resulting cervical fistula will require closure; this is undertaken after a short convalescence.

Growths situated in the vallecula, unless very advanced, must be treated by pharyngolaryngectomy with, if necessary, excision of a portion of the back of the tongue. For obvious reasons, if the epiglottis has to be sacrificed it is not possible to retain the larynx.

NEOPLASMS OF THE LARYNGOPHARYNX

In accordance with their site or origin, it is customary to subdivide malignant tumours of this part of the pharynx into four groups:

Ronald Raven, Contemporary. Surgeon, The Royal Marsden Hospital, London.
Wilfred Trotter, 1872–1939. Surgeon, University College Hospital, London.

1. Epilaryngeal (20 per cent.).—Nearly always the patient is a man between fifty and sixty years of age. The lesion is situated on an aryepiglottic fold, extending to the epiglottis or the corresponding arytenoid cartilage, and is either of the ulcerative or the papillary type. The earliest symptom is hoarseness. Later there are attacks of dyspnœa associated with the expectoration of blood-stained sputum. The diagnosis is made by indirect laryngoscopy.

2. Sinus Piriformis [1] (40 per cent.).—Again, this group occurs chiefly in men about fifty years of age but, unlike the foregoing, this lesion is notoriously silent, and often its first intimation is an enlarged lymph node behind the angle of the jaw. Frequently this is not heeded in its early stages (fig. 390). Exceptionally, the patient presents himself at an earlier stage, because of slight difficulty in swallowing saliva, as opposed to food. Pain is absent. Carcinomata of the piriform fossa are nearly always of the ulcerative type. The presence of the growth can be shown with a laryngeal mirror, but sometimes its extent cannot be determined without the aid of direct laryngoscopy.

FIG. 390.—Malignant lymph nodes of the neck. Secondary to laryngopharyngeal carcinoma in the 'silent' area. The patient presented himself on account of the lump in the neck.

3. Lateral Wall (12 per cent.).—Once again men are attacked much more often than women. Contrary to the sinus piriformis, the growth is often papillary.

A lateral radiograph of the neck, with air inflation of the pharynx, is often more informative than a barium swallow in the demonstration of a neoplasm in this and nearby situations.

4. Post-cricoid (28 per cent.) occurs on the anterior wall of the hypopharynx at the level of the cricoid cartilage. The patient is nearly always a woman of about forty years of age, who gives a history of increasing dysphagia. Many of these neoplasms are secondary to the Plummer-Vinson syndrome. Indirect laryngoscopy seldom reveals the growth, which lies hidden beneath a pool of mucus. Radiographic examination after a barium swallow is often helpful in determining the site of the lesion. Direct pharyngoscopy is the most informative, and allows a portion of the growth to be removed for biopsy.

Treatment of Carcinoma of the Laryngopharynx.—Because the results of irradiation have been so poor, world opinion now favours laryngopharyngectomy, when feasible.

Laryngopharyngectomy : *Anæsthesia.*—When dyspnœa is not severe endotracheal anæsthesia is employed. An endotracheal tube with an inflatable cuff is passed into the trachea gently, so that the growth is not traumatised. When it is impossible to pass the tube the early stages of the operation are conducted under combined local and thiopentone anæsthesia, the trachea being divided as early as practicable, so that general anæsthesia can be given through the tracheostomy.

Monoblock Dissection.—A quadrilateral skin flap (fig. 391) based on the side with the least lymph node involvement, is raised. Block dissection of the cervical lymph

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[1] Piriformis—Latin, *pirum* = a pear.

Henry S. Plummer, 1874–1936. Physician, Mayo Clinic, Rochester, U.S.A.
Porter P. Vinson, Contemporary. Physician, Mayo Clinic, Rochester, U.S.A.

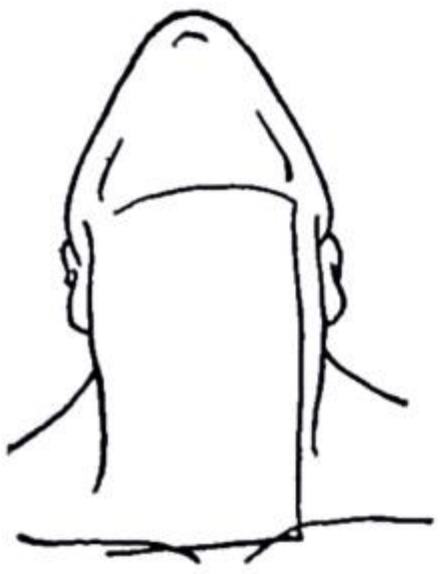


FIG. 391. — Incision for laryngo-pharyngectomy.

nodes is carried out on the more affected side, and a complete dissection of the lymph nodes on the contralateral side is also undertaken, but the sternomastoid muscle and the internal jugular vein are usually spared on the less involved side. In the higher neoplasms the pharynx is divided above the level of the hyoid bone, which then becomes one of the structures to be removed ; the trachea is divided between its second and third rings, after which the pharynx is disconnected at the same level. In lower neoplasms the hyoid bone remains, and the trachea is divided between the third and fourth rings, while the pharynx is divided superiorly well above the growth and inferiorly at the thoracic inlet. In either instance the lower end of the trachea is brought out through a small stab incision in the suprasternal notch. Usually the thyroid gland can be preserved, but if it is involved in the neoplastic process it must be sacrificed, together with the parathyroids, precautions being taken after operation to combat hypoparathyroidism. After the dissection has been completed the larynx and that part of the pharynx containing the neoplasm, together with the bilateral

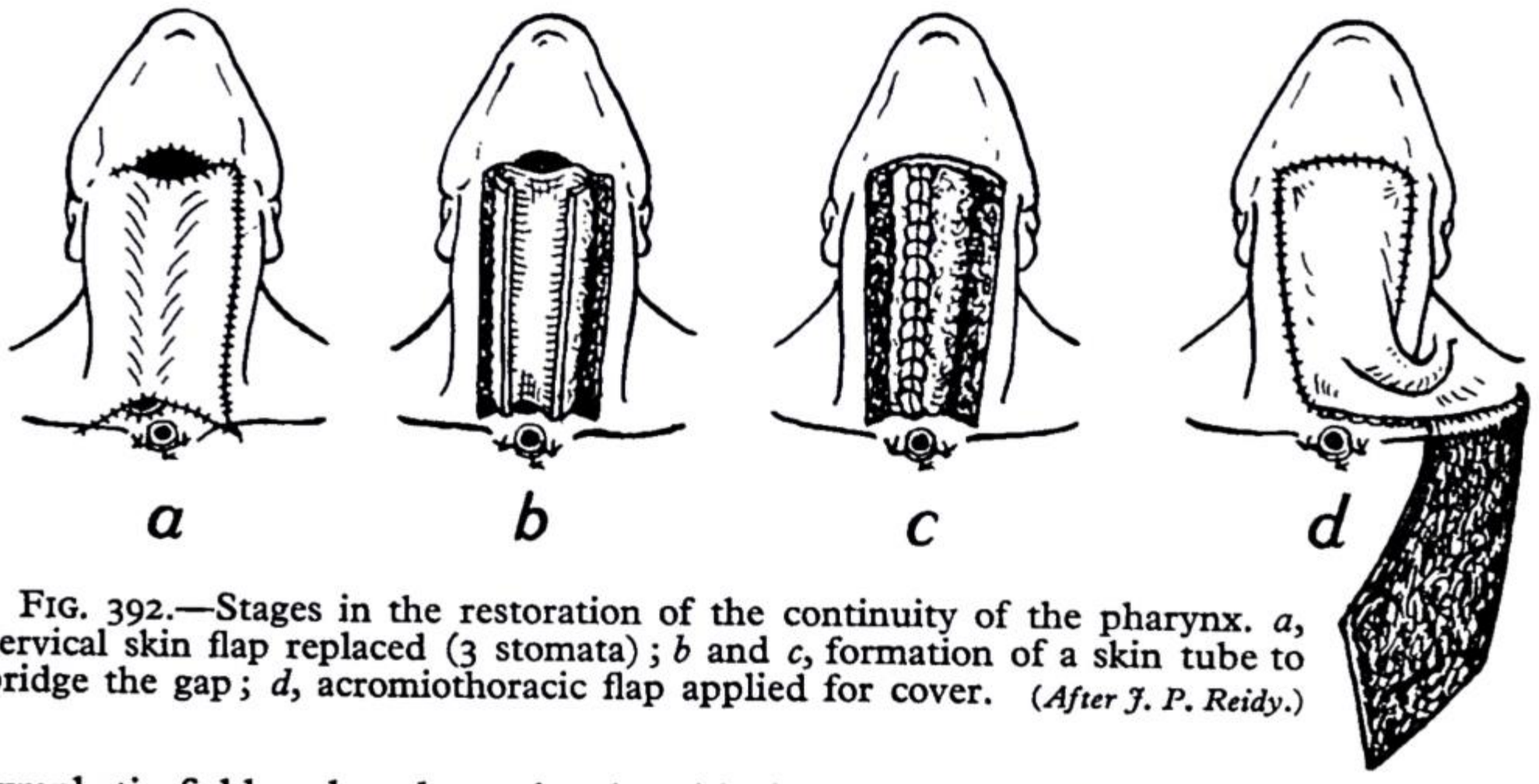


FIG. 392.—Stages in the restoration of the continuity of the pharynx. *a*, cervical skin flap replaced (3 stomata) ; *b* and *c*, formation of a skin tube to bridge the gap ; *d*, acromiothoracic flap applied for cover. (*After J. P. Reidy.*)

lymphatic field and perhaps the thyroid gland, are removed *en bloc*. Hæmostasis being rendered as perfect as possible, the quadrilateral skin flap is replaced.

FIG. 393.—Arrangement of tubes to provide continuous suction of saliva from the upper pharyngostome. A feeding tube passing into the stomach via the lower pharyngostome is also shown. (*Mr. J. P. Reidy, London.*)

Reconstruction : Stage I is carried out at the conclusion of the monoblock dissection. The quadrilateral skin flap is used to create a tube to bridge the pharyngeal defect

in the following manner: The posterior edge of the lower pharyngeal opening is stitched to the lower edge of the flap; the posterior edge of the upper pharyngeal opening is stitched to the upper edge of the flap. The anterior edges of the upper and lower pharyngeal openings are stitched to the corresponding skin edges of the wound (fig. 392*a*). A firm dressing is applied to compress the skin flap on to the prevertebral muscles. Here concludes the formidable operation of laryngopharyngectomy.

After-treatment.—Blood transfusion, which was commenced during the operation, is continued as necessary. Antibiotic therapy is also continued for at least a week. Feeding is carried out by an intragastric drip via the tube passed through the lower pharyngostome, the early diet being the same as that described on p. 277.

A very important matter in the after-treatment is to provide continuous suction to the upper pharyngostome (fig. 393) in order to remove continuously the flow of saliva, which otherwise will excoriate the skin and necessitate two-hourly or more frequent changes of dressings. Furthermore, saliva flowing into the trachea afflicts the patient with repeated attacks of explosive coughing, and engenders a greatly increased liability to bronchopneumonia.

Reconstruction: Stage 2 is undertaken a fortnight or three weeks later. The steps of the operation are shown in figs. 392*b*, *c*, and *d*.

Prognosis.—About 20 per cent. of patients submitted to laryngopharyngectomy survive five years. They are not able to phonate as well as patients with laryngectomy only.

CHAPTER XVI

THE LARYNX

HAMILTON BAILEY

FOREIGN BODY IN THE LARYNX

VARIOUS objects held in the mouth are inhaled accidentally. Occasionally the foreign body is arrested in the larynx.

The first symptoms are those of acute laryngeal obstruction; they are usually transient, and very rarely does death from asphyxia result. These symptoms are succeeded by those of irritation. There is retrosternal pain, persistent cough, and often expectoration of blood-stained mucus. From time to time paroxysms of dyspnœa, with a terrifying sensation of impending death, occur.

Treatment.—Immediate laryngostomy or tracheostomy is the correct treatment in urgent cases with obstructive symptoms. In less urgent cases radiography is indispensable when the foreign body is opaque to X-rays. When possible, direct laryngoscopy should be performed, and by its aid the object can be seized and removed through the natural passages.

ACUTE ŒDEMA OF THE GLOTTIS

Pathology.—There is œdema of the entrance of the larynx, especially of the aryepiglottic folds and the epiglottis. Strictly speaking, the œdema is not of the glottis (the chink between the vocal cords) but of the tissues at a higher level. Nevertheless this ancient and inaccurate term is difficult to displace.

Ætiology.—*Inflammatory*

1. Scalds, corrosives, insect stings.
2. Extension of acute inflammation, especially acute streptococcal tonsillitis, diphtheria, acute parenchymatous glossitis (p. 160), and Ludwig's angina (p. 196).

Non-inflammatory

1. Local dropsy (renal or heart failure).
2. Extension of carcinoma of the base of the tongue, oropharynx, or laryngopharynx.
3. Pressure on cervical veins.
4. Angio-neurotic œdema, including serum sickness.
5. After massive doses of potassium iodide.

The patient complains of pain as though he had a foreign body in the throat. Frequently the œdema is sufficient so to narrow the airway as to cause urgent dyspnœa. If laryngoscopic examination is possible, the entrance

Wilhelm von Ludwig, 1790–1865. Professor of Surgery and Midwifery, University of Tübingen.

to the larynx can be seen presenting an appearance not unlike that of a cervix uteri. In obscure and not very urgent cases, the urine should be examined for albumin and casts.

Treatment.—Inhalation of medicated steam and spraying with a dilute solution of cocaine and adrenaline afford relief in early and mild cases. When dyspnœa is urgent, tracheostomy should be performed forthwith.

THE RELIEF OF URGENT OBSTRUCTIVE DYSPNŒA

In cases of laryngeal obstruction, never give morphine. A patient under the influence of morphine stops fighting for breath, seems peaceful, and not infrequently the nurse returns to find him dead (Chevalier Jackson).

Tracheostomy.—The indications are as follows :

(*a*) *Acute Laryngeal Obstruction :*

1. Laryngeal diphtheria.
2. Œdema of the glottis.
3. Acute pharyngo-tracheo-bronchitis of children not responding quickly to antibiotic therapy.
4. Bilateral abductor paralysis of the vocal cords following injury to the recurrent laryngeal nerves during thyroidectomy.
5. Incised wounds of the larynx or trachea.
6. Foreign bodies in the glottis threatening asphyxia, when facilities for direct per-oral laryngoscopy are not available.
7. Inhaled vomitus.

(*b*) *In Order to rid the Bronchial Tree of Secretions or Inhaled Material :*

1. Inhaled vomitus.
2. Unconsciousness associated with head injuries or facio-maxillary fractures.
3. Coma from other causes likely to persist more than a few hours where there is difficulty in maintaining a free airway.
4. Tetanus. Many of these patients are, of necessity, heavily sedated, have trismus, and are in mortal danger because of inability to expectorate.

(*c*) *Progressive Laryngeal Obstruction :*

1. Laryngeal stenosis following scalds of the glottis.
2. Stenosis following tuberculosis of the rima glottidis.
3. Inoperable neoplasm.

(*d*) *As a Preliminary to certain Operations, particularly Extirpation of the Larynx.*

In groups (*a*) and (*c*) tracheostomy prevents death from impending suffocation ; in group (*b*) it enables aspiration of bronchial secretions that the patient is unable to expectorate, and spares the patient being drowned in his own secretions. To be enabled to carry out suction effectively, the inner tube must be of such a diameter that it will not be occluded by the passage of a No. 3 or 4 rubber catheter ; tracheostomy tubes between the sizes of 28 and 32 French catheter gauge fulfil these requirements.

Chevalier L. Jackson, Contemporary. Professor of Laryngology and Broncho-Œsophagoscopy, Temple University Philadelphia.

Operation.—In cases of dire emergency the operation has been performed successfully with nothing available except a penknife. Fig. 394 shows the usual special instruments required.

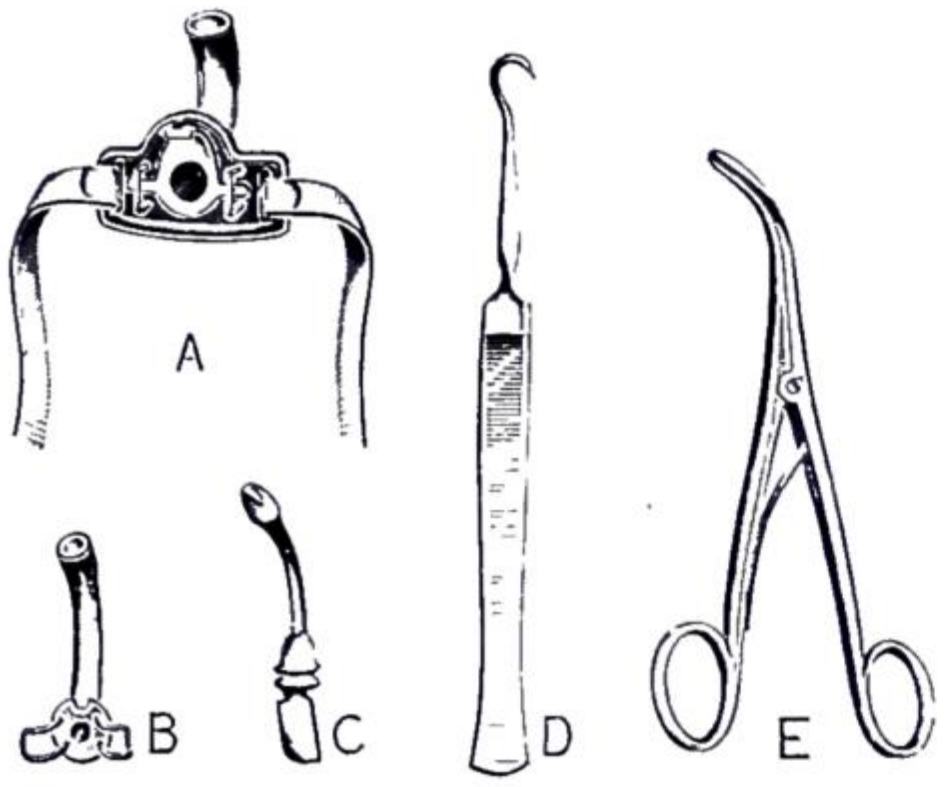


FIG. 394.—Instruments for tracheostomy (excluding scalpel and hæmostats).

A. Outer tube with tapes attached. B. Inner tube. C. Pilot. D. Cricoid hook. E. Tracheal dilator.

Local anæsthesia is employed, because any form of general anæsthetic is liable to cause spasm of the glottis, which, superadded to œdema, may result in complete obstruction. In all cases the child is pinned in a blanket so that a sudden movement of the arms may not embarrass the surgeon. When preparations are complete, a rolled towel or a small sandbag is inserted beneath the shoulders, and an assistant keeps the head strictly in the midline (fig. 395).

The surgeon, standing at the right side of the patient, places his left index finger on the upper border of the cricoid cartilage, with the thumb and the second finger on either side of the trachea, and makes an incision vertically downwards for 1 to 1½ inches (2·5 to 3·75 cm.), dividing skin, fascia, platysma, pretracheal fascia, and passing between the infrahyoid muscles (fig. 396). If seen, the isthmus of the thyroid gland is divided between hæmostats. In an emergency, hæmorrhage is ignored. A cricoid hook (see fig. 394) is then inserted under the cricoid cartilage and grasped in the left hand. The hook steadies the trachea and brings it to the surface of the wound. The trachea is incised with a scalpel, the second, third, and sometimes the fourth rings being divided : the lower the tracheostomy, the less will be liability to laryngeal stenosis. A tracheal dilator is inserted through the tracheostoma, the cricoid hook removed, and the edges of the tracheal wound are separated gently, and in the case of diphtheria the surgeon places a swab over the wound so that the violent expiratory efforts which follow do not spray membrane, infected mucus, and blood over himself and his assistants. When respiratory efforts have become less violent, a tracheostomy tube on a pilot is inserted into the trachea, the dilator is removed, and the surgeon keeps his finger on the tube while the assistant ties the attached tapes around the patient's neck. The inner tube is then fixed in position, and one or two silkworm-gut stitches are introduced if necessary. In cases of diphtheria anti-diphtheritic serum is given.

FIG. 395.—The position for tracheostomy.

FIG. 396.—Exposure of the trachea in the middle line. The first ring of the trachea is always to be avoided, for its division is so likely to be followed by tracheal stenosis.

In the case of a less urgent tracheostomy all bleeding is stopped before the trachea is opened. The injection of a few drops of 2 per cent. cocaine before the trachea is incised prevents the bout of coughing that follows the insertion of the tube. When the operation is performed on an adolescent or an adult, the isthmus of the thyroid gland is divided ; also a small oval window should be cut in the trachea.

After-treatment.—Beside the bed is placed a trolley containing a tracheal dilator, duplicate cannulæ, retractors, a fine rubber catheter with a

well-fitting syringe attached (to remove secretions from the trachea) and dressings. Oxygen and CO_2 is at hand to relieve acapnia [1], which sometimes occurs. For the first few days a special nurse must be in constant attendance in the case of a child ; a bell within easy reach of an adult is an efficient method of summoning aid. As soon as the patient can swallow, he must be encouraged to drink large quantities of fluid in order to render the secretion less viscid ; this is far more effective than nursing the patient in a steam tent. A sucker with a catheter attached should be at hand to keep the tracheobronchial tree free from exudate. When mucus is very tenacious, and consequently difficult to aspirate, a detergent such as alevaire (Bayer Products Ltd.) administered through the tracheostomy by a fine nebuliser will make the secretions less viscid.

The inner tube is removed and washed in sodium bicarbonate solution every four hours, or more often if necessary, and in four to seven days the tracheostomy tube itself can usually be dispensed with, but before this is attempted the patient should be able to sleep with the tube corked completely. First of all, partial corking is used as a method of trial.

Complication:

Mediastinal Emphysema.—The cause is an abnormally low intrapleural tension—air is sucked into the tissue planes during the operation before the trachea is opened. In severe examples the air in the mediastinum causes the mediastinal pleura to rupture, and a pneumothorax results. Should dyspnœa and cyanosis occur *after* tracheostomy has been performed, and the airway is free, one should think of the possibility of mediastinal emphysema, the diagnosis of which can be confirmed by radiography. Mediastinal emphysema is a frequent complication of tracheostomy ; it can occur in the post-operative period if the outer tracheostomy tube is coughed out. Apart from oxygen therapy in high concentration, there is no special treatment. The extravasated air is absorbed slowly.

Endotracheal catheterisation is a substitute for tracheostomy in cases belonging to group 2, but it is usually less desirable, for two reasons :

(*a*) Repeated bronchial tree toilet is performed more easily by a nurse through a tracheostomy.

(*b*) If an endotracheal tube is retained for more than eight hours, ulceration of the vocal cords is probable ; and if it occurs, subsequent stricture is almost certain to follow.

RECURRENT LARYNGEAL NERVE PARALYSIS

The nerves of the larynx, the superior laryngeal and the recurrent laryngeal, are branches of the vagus. The recurrent laryngeal nerve (see fig. 294, p. 211) supplies both the abductor and the adductor muscles of the vocal cords. When the continuity of this nerve is interrupted it is always the abductors that suffer first. The reason for this has not been settled finally. Probably the greater vulnerability of the fibres that supply the abductor muscles is apparent, rather than real ; adduction being effected by the still functioning cricothyroid muscle, which is supplied by the superior laryngeal nerve. Be that as it may, it is fundamental to know that a lesion of the recurrent

[1] Acapnia = diminished CO_2 in the blood.

laryngeal nerve first results in paralysis of the abductors. If the lesion is complete, this is followed later by paralysis of the adductors as well (Semon's law). The end-result of a long-standing complete lesion is *tense* fixation of the cord (due to fibrosis) in a position midway between adduction and abduction ; the free edge of the paralysed cord being somewhat concave and the arytenoid cartilage being a little in front of that of the healthy side. On the other hand, should the patient sustain a complete lesion of the recurrent laryngeal nerve and a complete lesion of the superior laryngeal nerve, the affected cord lies *slackly* in the cadaveric position midway between abduction and adduction which is, in truth, identical with the position and state of the vocal cords soon after death.

Ætiology.—The lesion may be central, cervical, or mediastinal. Of over-riding importance is the relation of a goitre, and especially of thyroidectomy, to recurrent laryngeal paralysis. If routine laryngoscopic examination is made before thyroidectomy, not a few patients with a goitre will be found to have paralysis of one vocal cord, although there were no symptoms pointing to such a lesion. Pre-operative paralysis of a vocal cord with symptoms is highly suggestive that the goitre is carcinomatous. Other causes of recurrent laryngeal paralysis are a central lesion (e.g. tabes), carcinoma of the upper œsophagus, carcinoma of the bronchus, malignant disease of the mediastinal lymph nodes, and aneurysm of the arch of the aorta (always left-sided).

FIG. 397.—Normal larynx on inspiration. Indirect laryngoscopy.

Clinical Features.—The paralysis is much more commonly unilateral than bilateral. When the paralysis follows thyroidectomy, the lesion is frequently incomplete. In those cases showing early recovery (fig. 397) it must be assumed that the nerve was stretched, whereas when recovery takes over six months, crushing of the nerve in a hæmostat or including it in a ligature is likely to have caused the damage.

Unilateral 'abductor'[1] (partial) paralysis of a vocal cord (fig. 398) shows itself by a whispering voice or temporary aphonia. Sometimes slight stridor is present. Owing to failure of the glottis to close during swallowing, paroxysms of coughing may occur while drinking, due to fluid entering the larynx ; such attacks are temporary. Except that excessive bronchial secretions tend to accumulate, unilateral injury to a recurrent laryngeal nerve does not endanger life, and no particular treatment except, perhaps, postural drainage, is required. Although it may take many months, in about 50 per cent. of cases following thyroidectomy the palsy recovers completely (V. Riddell). In the remainder, in process of time, usually compensation is effected by the healthy vocal cord passing over the middle line nearly to meet its permanently paralysed fellow.

FIG. 398. — 'Abductor' paralysis of the left vocal cord (inspiration).

[1] The abductor muscles being paralysed, the vocal cord takes up a position of adduction.

Sir Felix Semon, 1849–1921. Physician to the Throat Hospital, Golden Square, London.
Victor Horsley Riddell, Contemporary. Surgeon, St. George's Hospital, London.

Bilateral 'abductor' paralysis of the vocal cords (fig. 399) that results in spastic paralysis with the vocal cords adducted is an occasional, and very serious, complication of thyroidectomy. Unless urgent tracheostomy or intubation is carried out forthwith, death from asphyxia follows quickly.

FIG. 399.—Bilateral 'abductor' paralysis (inspiration) resulting in stridor.

Bilateral (complete) paralysis of the recurrent laryngeal nerves (fig. 400) results in flaccid paralysis with the vocal cords in the paramedian, cadaveric position. Usually sufficient air can get noisily back and forth through the glottic chink, and as long as the patient does not exert himself unduly, he survives in a state of semi-invalidism. Aphonia persists for weeks; after that, some patients learn to whisper.

FIG. 400.—Bilateral flaccid paralysis of the vocal cords. The cadaveric position.

Treatment.—Tracheostomy should be performed in all cases of bilateral lesions, even when the paralysis is flaccid, for it is far better to provide the patient with a free airway than to permit him to suffer from chronic dyspnœa and its attendant evils, chief of which is the falling of the threatening sword of asphyxia. The use of a flanged tracheostomy tube allows the patient to speak. In those cases following thyroidectomy where the patient is otherwise in good health, the next step is to wait six months or a year in the hope that one or both of the nerves will function once more.

Unilateral extralaryngeal arytenoidectomy (de Graaf Woodman's operation) gives permanent relief of stridor at the expense of speech. The vocal cord is approached through an incision along the anterior border of the sternomastoid. The perichondrium and the underlying thyroid cartilage is incised along its posterior border. After the arytenoid cartilage has been displayed an unabsorbable suture is passed through the submucosa to include the vocal process of the arytenoid; with the exception of this process, the whole of the arytenoid cartilage is excised with nibbling forceps. The long ends of the suture are carried around the inferior corner of the thyroid cartilage and tied. Thus the vocal cord on that side is maintained in an abducted position. The wound is closed with drainage. In favourable cases the tracheostomy tube can be discarded in three weeks.

LARYNGOCELE

A laryngocele is a unilateral (occasionally bilateral) narrow-necked air-containing diverticulum resulting from a herniation of mucous membrane through the gap in the thyrohyoid membrane which gives exit to the superior laryngeal vessels. Once the sac has found its way through this foramen, it enlarges comparatively rapidly, and when distended forms a visible, often resonant, swelling in the neck (fig. 401). Cervical air-pouches are present in many mammals, and can be inflated voluntarily; they are exceptionally well developed in mycetes (South American) monkeys that utilise them for howling (howling pouches). The condition, therefore, can be looked upon as partly atavistic but mainly acquired, for it occurs more frequently in professional trumpet-players, glass-blowers, and in persons with a

FIG. 401. — Laryngocele during an 'attack.'

de Graaf Woodman, Contemporary. Otorhinolaryngologist, Presbyterian Hospital New York.

chronic cough, than in others. The symptoms, due to a recrudescence of infection, come in attacks when the swelling, which often appears when the patient blows his nose, does not abate completely for hours or days; the explanation being that the neck of the sac becomes obstructed by mucopus. The voice is hoarse during an attack, which often terminates with a gurgling noise and discharge of mucus into the pharynx. Shortness of breath accompanies the attack, and sometimes rapid distension of a laryngocele is a cause of sudden death from asphyxia.

Treatment.—For reasons given, the sac should be excised from its fundus to its neck, which is crushed, divided with a diathermy knife, ligated, and invaginated like the stump of a vermiform appendix. The wound is closed with drainage.

TUBERCULOSIS OF THE LARYNX

Rarely is the larynx the seat of primary tuberculosis. Occasionally the first symptoms are laryngeal, but subsequent radiography and the presence of tubercle bacilli in the sputum demonstrate that the primary focus is in the lungs; indeed, it can be taken for granted that in every case the laryngeal mucosa becomes infected by the sputum. During the last twenty-five years the incidence of laryngeal tuberculosis has fallen by 50 per cent.

Stage 1.—The earliest symptoms are frequent attacks of hoarseness, and when this is accompanied by periods of dysphagia, especially for fluids, for which there is no pharyngeal cause, the probability of tuberculosis of the larynx is strong. The earliest laryngoscopic sign is that the mucosa is pallid from œdema; interarytenoid swelling, due to inflammation of the rich network of submucosal lymphatic vessels in this area is particularly characteristic.

Stage 2.—As the disease advances, ulceration of one or both vocal cords occurs, giving a typical 'mouse-nibbled' appearance. Pale superficial ulceration of the epiglottis is also common. Pain on swallowing fluids is increased, and it is often referred to the ears. Cough is now more troublesome, and sometimes painful.

Stage 3.—The terminal phase is characterised by perichondritis and necrosis, particularly of the arytenoid cartilages, but also of the epiglottis and, rarely, of other laryngeal cartilages. The voice becomes weak, coughing is almost incessant, and pain is a distressing feature.

Prognosis.—While the prognosis in advanced cases is hopeless, that of earlier cases is dependent largely on the state of the lungs. Full recovery is possible in about 35 per cent. of cases.

Treatment.—In addition to the usual sanatorium treatment for the pulmonary tuberculosis, for the complete cure of laryngeal tuberculosis there is one outstanding decree—*rest the voice*. The patient should have a pencil and writing-pad always to hand. As in many other forms of tuberculosis, streptomycin, para-amino-salicylic acid (P.A.S.), and isoniazid are most valuable adjuncts. In advanced cases a linctus containing morphine or heroin is given for the cough, and lozenges and insufflations of orthoform or anæsthin to relieve the pain. Alcohol injection of the superior laryngeal nerve alleviates the pain of swallowing, but tube feeding is sometimes necessary. Œdema of the glottis may call for tracheostomy.

LARYNGEAL SYPHILIS

Secondary syphilitic manifestations are sometimes noted in the larynx. The mucous membrane becomes congested and mucous patches form. The voice is husky. Syphilitic laryngitis clears up under anti-syphilitic treatment.

Tertiary Syphilis.—The usual lesion is a gummatous infiltration, which attacks the epiglottis and may implicate all the structures of the larynx. Necrosis of cartilage is liable to follow. Usually the only symptom is hoarseness, the voice during the remissions being particularly raucous. In contradistinction to tuberculosis, pain is singularly absent until the disease is advanced. The pathological process is arrested by anti-syphilitic treatment, but subsequent cicatricial contracture is liable to cause laryngeal stenosis. For severe contractions permanent tracheostomy is the only remedy.

NEOPLASMS OF THE LARYNX

Innocent.—Angiofibroma is always single, and is distinguished from a papilloma by its smooth contour (fig. 402). Except that occasionally it gives rise to haemoptysis, it resembles a papilloma in symptomatology. In appropriate cases the condition must be distinguished from *singer's nodules*, which are nearly always bilateral. The latter condition, which produces a pearly-white nodule on the free edge of the vocal cord, is not a neoplasm, but an epithelial hypertrophy, and should, if possible, always be treated by prolonged rest (which is sometimes successful) before resorting to operation. On the other hand, an angiofibroma should be removed endoscopically with cupped forceps. Great precision is necessary, because if normal tissue is removed the speaking voice will be impaired and the singing voice ruined.

FIG. 402.—Angiofibroma of the left vocal cord. It seldom becomes much larger than depicted here.

Papilloma is the commonest innocent tumour of the larynx.

In an adult a papilloma is usually single, and its pedicle is attached to one of the true or false vocal cords. The symptoms to which it gives rise are similar to those of carcinoma of the larynx, from which it must be distinguished. The diagnosis is made by laryngoscopic examination. Rarely, a papilloma becomes malignant; therefore the papilloma should be removed and a portion of it should be submitted to microscopical examination.

FIG. 403.—Papillomata of the vocal cords of a child.

In a child the growth is relatively common : it is usually more vascular and softer than a papilloma appearing during adult life. Moreover, implantation growths soon appear in the vicinity and tend to obstruct the glottis (fig. 403). The first symptom of laryngeal papillomatosis in children is recurrent attacks of dyspnœa, which sometimes become so urgent as to call for tracheostomy.

Treatment.—Chevalier Jackson's warning is not to be too radical in the

treatment of multiple papillomata for fear of damaging the vocal cords. " Laryngeal papillomata," he said, " is a self-limiting disease and disappears spontaneously in early adult life provided the patient can be carried through until that time." Endoscopic removal with cupped forceps is the usual method of treatment. Painting the papillomata with podophyllin (as for the treatment of warts and condylomata) is employed by some, while others use stilbœstrol paint to speed up keratinisation, as normally occurs in the vagina at puberty. The disadvantage of treatment by irradiation is the vulnerability of the laryngeal cartilages to the rays.

Malignant.—Carcinoma, though rare, is more common than an innocent tumour of the larynx. It usually occurs between forty and sixty years of age, and men are ten times more often attacked than women. There are two varieties of laryngeal carcinoma—carcinoma of a vocal cord, which is relatively common, and subglottic carcinoma, which is rare.

Carcinoma of a vocal cord usually arises from the anterior half of one of the true vocal cords. Most frequently it is of the papillary variety (fig. 404), occasionally it is flattened, rarely it is ulcerative. Due to the paucity or absence of lymphatic vessels of the vocal cords, carcinoma of the larynx remains locally malignant for a long period.

FIG. 404.—Carcinoma of a true vocal cord.

The first symptom is huskiness of the voice. The huskiness is progressive, and the patient can only speak in a low whisper, which finally gives place to aphonia. About this time the growth breaks through its confines, and metastases occur in the cervical lymph nodes and elsewhere.

The diagnosis is made by laryngoscopic examination, and every patient with hoarseness persisting for more than three weeks should be submitted to this form of examination. According to the length of time the growth has been present, three stages of the disease are recognised :

1. The growth is confined to *a still mobile* vocal cord.
2. Subglottic extension with fixation of the cord.
3. Spread to the opposite cord.

Subglottic carcinoma is the less common variety that occurs beneath the vocal cords. In this site the neoplasm grows steadily and silently, until dyspnœa develops. Unlike carcinoma of the vocal cord, metastasis is not long delayed. The first lymph node to be involved is that on the crico-thyroid membrane, the lymph node of Poirier.

Treatment of Carcinoma of the Larynx :

The question of deciding between surgical extirpation and irradiation is a difficult one, the degree of differentiation of the neoplastic cells being one important point, as first shown by Broders. As elsewhere, neoplasms that are highly differentiated are radio-resistant, while those that are anaplastic are radio-sensitive (see Broders' classification, p. 38).

Paul Poirier, 1853–1907. Professor of Anatomy, University of Paris.
Albert C. Broders, Contemporary. Pathologist, The Mayo Clinic, Rochester, Minn., U.S.A.

Laryngo-fissure and Excision of the Growth.—Under local infiltration, a preliminary tracheostomy is performed. The thyroid cartilage is bisected in the middle line and the crico-thyroid membrane opened. The perichondrium in the region of the affected vocal cord is raised by blunt dissection, and the whole vocal cord, with a margin of healthy tissue, is removed. The larynx is repaired and the tracheostomy tube removed after a few days. The patient is left with a useful voice.

Fenestration with interstitial radium is often employed with a high proportion of favourable results.

The larynx is exposed by a J-shaped incision commencing above the level of the hyoid bone, and ending below the lower border of the cricoid cartilage. The flap is raised. The infrahyoid muscles are split, and a large window is cut in the ala of the thyroid cartilage, without opening the underlying mucosa. The object of removing the cartilage is to allow radium needles to come in closer proximity to the growth, and minimise radium necrosis of the cartilage—a great disadvantage of radium. The radium needles are left in place seven to nine days (fig. 405).

FIG. 405.—Alar fenestration and insertion of radium needles.

Total laryngectomy is best performed through a perpendicular incision passing from just *above* the hyoid bone to the upper border of the suprasternal notch, keeping strictly to the middle line (fig. 406).

A small amount of 2 per cent. cocaine is injected into the trachea to anæsthetise its mucosa.

FIG. 406.—Incision for laryngectomy.

The operation is less difficult if it has not been necessary to perform tracheostomy. The sternohyoid muscles are split, and the sternothyroid muscles are divided near their insertion. The isthmus of the thyroid gland is clamped and divided and the lateral lobes of the thyroid gland are stripped from the larynx, a step that is facilitated by ligating and dividing the superior thyroid arteries. The larynx is separated from its muscular attachments on each side, unless there is an extralaryngeal extension of the growth, in which case the involved muscles are excised with the larynx. The larynx is mobilised still further by transecting the superior cornua of the thyroid cartilage. Attention is now directed to separating, by blunt dissection, the trachea and back of the cricoid cartilage from the œsophagus. The trachea is then divided between its first and second rings [1], the distal end of the trachea is brought out through a small stab incision in the suprasternal notch, and fixed in this position, the anæsthetic being continued through a tube passed into the open trachea. The larynx is now hooked forwards, and after still further separating the back of the cricoid cartilage from the commencement of the œsophagus, the hypopharynx is opened. The inferior constrictor muscle is severed from the thyroid cartilage on each side, and the dissection carried as far as the arytenoid cartilages. If the mucosa of the piriform fossæ can be preserved, this is very helpful in subsequent closure. The thyrohyoid membrane is divided completely. The larynx is now free, except for the attachment of

FIG. 407.—Patient after complete laryngectomy. A transverse skin incision was used in this case. (*Jackson and Babcock.*)

[1] If the growth is an early one, it is permissible to transect the windpipe through the middle of the cricoid cartilage.

the epiglottis, which is excised with the larynx. A gastric tube having been introduced through the nose into the open pharynx, it is passed onwards into the stomach. The opening in the pharynx and upper œsophagus is closed accurately by inverting sutures of catgut, reinforced by uniting the overlying muscular layer with unabsorbable sutures. A drainage tube is passed into the lower part of the wound and leaving room for its exit, the infrahyoid muscles are approximated in the middle line. The skin edges are approximated. Antibiotic cover has greatly diminished infection of the wound and mediastinitis.

The lymph nodes can be excised at the time of the laryngectomy or subsequently.

Speech after Laryngectomy.—Many younger patients learn the pharyngeal whisper, belching swallowed air for this purpose. Others require a mechanical larynx which can be fitted to the tracheostomy tube.

Prognosis.—Fifty per cent of patients treated for intrinsic carcinoma of the larynx survive for five years or more.

CHAPTER XVII

THE ŒSOPHAGUS

HAMILTON BAILEY

Surgical Anatomy.—The œsophagus commences at the lower border of the cricopharyngeal sphincter, but there is no certain way of determining exactly where the œsophagus ends, except by identifying the level at which the squamous epithelium of the œsophagus gives place to the columnar epithelium of the stomach (fig. 408). As seen through an œsophagoscope, the normal mucous membrane is bluish-pink.

As will be appreciated by studying fig. 409, the right crus, which is longer,

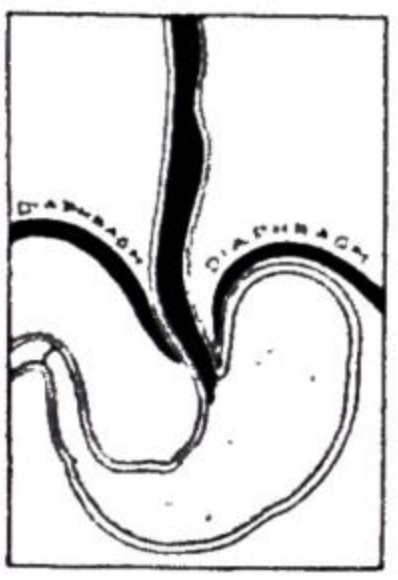


FIG. 408.—The lower part of the œsophagus. The œsophageal squamous mucosa is shown in black, and the gastric mucosa is stippled. (*After N. R. Barrett.*)

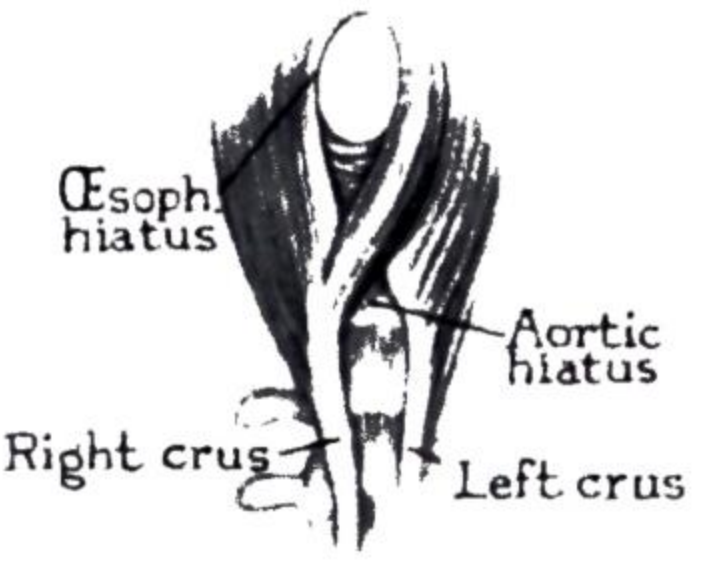


FIG. 409.—The right crus forms the entire musculotendinous diaphragmatic ring around the œsophagus. (*After J. L. Madden.*)

thicker, and more tendinous than the left, is entirely responsible for the constitution of the walls of the œsophageal hiatus of the diaphragm.

To what is Competence of the Cardia due?—As yet this problem has not been elucidated.

It is not due to an Extrinsic Pinch-cock Action of the Right Crus.—S. W. Harrington found that 35 per cent. of patients undergoing upper laparotomy for conditions unrelated to hiatus hernia had a patulous œsophageal hiatus.

There is no Intrinsic Sphincter.—Careful dissection of many specimens has not confirmed the presence of an aggregation of circular musculature in this region, as was described by Helvetius.

The Valvular Mechanism of the Cardia cannot explain Everything.—Demonstrations on the cadaver tend to substantiate the hypothesis that competency is dependent upon a valvular mechanism. As long as the œsophagus joins the stomach at any angle less than a right angle (which appertains normally), intragastric pressure has a tendency to assist closure of the cardia (fig. 410). Nevertheless, this fails to explain how excessive intragastric pressure that produces belching and vomiting renders such a mechanism ineffective.

Obviously, the result of further enquiry must be awaited.

FIG. 410.—The valvular mechanism of the cardia. (*After W. S. Lyons.*)

What prevents the Stomach from Entering the Thorax?—As there is a negative pressure in the thorax and frequently, as in pregnancy and after a full meal, a positive pressure in the abdomen, one might reasonably expect that the stomach or some part of it would

Stuart W. Harrington, Contemporary. Surgeon, The Mayo Clinic, Rochester, Minnisota, U.S.A.
Johannis Claudius Adrian Helvetius, 1685–1755. Physician and Comparative Anatomist of Paris.

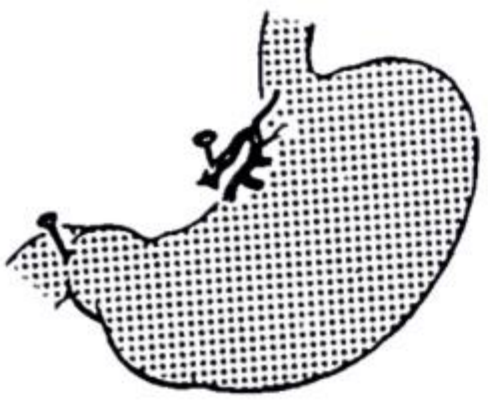


FIG. 411.—How the stomach is pinned within the abdomen. (*After W. S. Lyons.*)

enter the thorax through the œsophageal hiatus more frequently than it does, for the attachments of the stomach to the diaphragm are frail. Contrary to what might be thought, the main anchorage of the stomach to the abdomen is the left gastric artery (Moynihan) and the firm retroperitoneal tethering of the duodenum (fig. 411).

As measured from the incisor teeth in the average adult:

At 7 inches (18 *cm.*)—the pharynx ends and the œsophagus commences.

At 11 *inches* (28 *cm.*)—the œsophagus is crossed by the left bronchus.

At 17 *inches* (43 *cm.*)—the cardiac orifice is situated and the œsophagus ends.

These figures, 7, 11, and 17, are of great importance in the surgery of the œsophagus. They represent the situations of anatomical narrowing, and consequently the points where ingested foreign bodies are likely to be arrested, and the situations where difficulty may be experienced during the passage of instruments. Furthermore, these points are the sites of election for innocent strictures and also for carcinoma of the œsophagus.

INVESTIGATION OF THE DISEASES OF THE ŒSOPHAGUS

The œsophagus being inaccessible, clinical methods of examination are of little avail.

Until the twentieth century one of the chief methods of examining this organ was by inserting bougies blindly down the gullet. Aneurisms were frequent in those days, and it happened occasionally that an aortic aneurism escaped detection until a bougie was passed. The terrifying hæmorrhagic cascade through the victim's mouth clarified the diagnosis but brought 'blind' œsophageal instrumentation into disrepute.

Radiography reveals the presence of a swallowed foreign body opaque to X-rays, and the site of its arrest. Radiography after the ingestion of barium is of the greatest value in the diagnosis of diseases of the œsophagus, and in outlining an impacted foreign body non-opaque to X-rays.

Empty, the normal œsophagus is thrown into longitudinal folds; distended, it is smooth. Abnormalities of the œsophageal wall are detected largely by alteration in the normal rugal pattern. To display this, equal parts of barium sulphate and water are often used. Should this not adhere sufficiently, a slightly thicker mixture is employed.

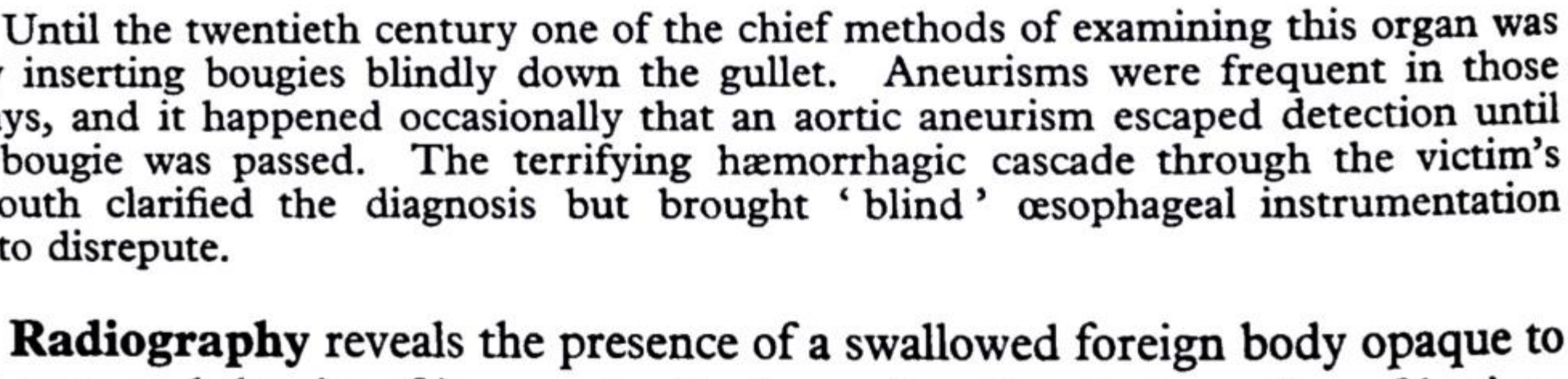


FIG. 412.—Negus' œsophagoscope with proximal twin lighting.

Œsophagoscopy.—Examination with an œsophagoscope (fig. 412) permits visualisation of the interior of the œsophagus. In addition, in the

Lord Moynihan, 1865–1936. Surgeon, The General Infirmary, Leeds.
Sir Victor Ewings Negus, Contemporary. Consulting Surgeon, Ear, Nose and Throat Department, King's College Hospital, London.

case of an impacted foreign body or of an œsophageal stricture, œsophagoscopy is an indispensable means of affording treatment.

In performing œsophagoscopy it is advantageous to adopt Chevalier Jackson's position (fig. 413). The instrument is passed entirely under vision, and once its beak has passed the cricoid cartilage, it can be moved down the œsophagus with comparative ease.

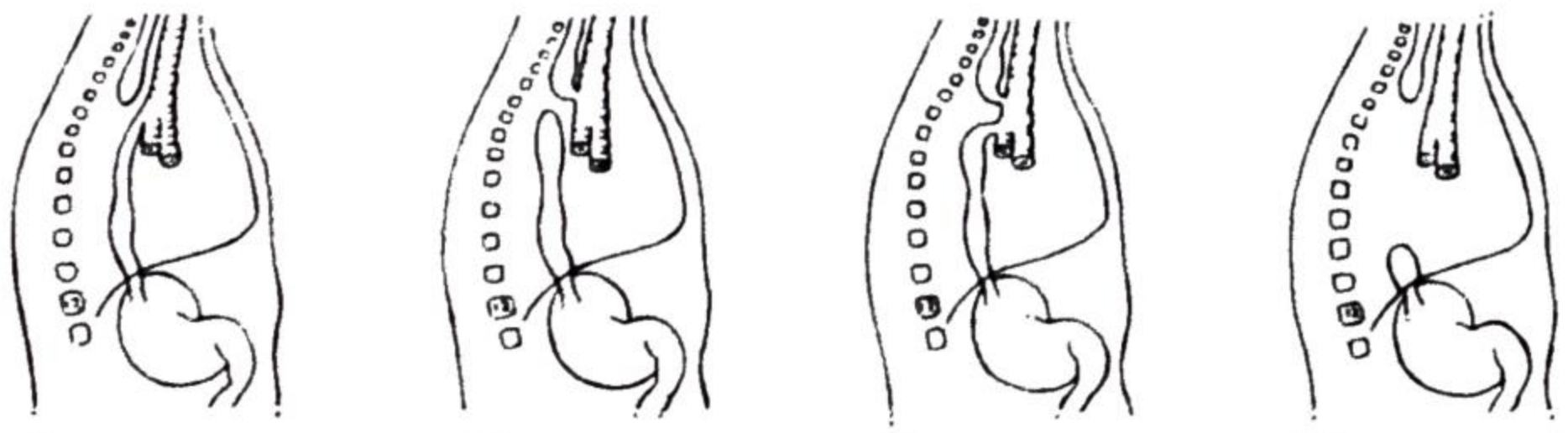
FIG. 413.—Chevalier Jackson's position for œsophagoscopy.

CONGENITAL ABNORMALITIES

Congenital atresia of the œsophagus occurs at least as frequently as a cleft-palate. In the great majority of cases it is associated with a tracheo-œsophageal fistula. Referring to fig. 414, it will be seen that in 90 per cent. of cases it is the *lower* pouch that communicates with the trachea.

It is highly important to be cognisant of the possibility of this abnormality, because its recognition within forty-eight hours of birth, and subsequent surgical rectification, is the only hope of survival.

Clinical Features.—The new-born babe regurgitates all its first, and every feed. Saliva pours, almost continuously, from its mouth. This is *the* sign of œsophageal atresia—to no other condition does this phenomenon appertain. Attacks of coughing [1] and cyanosis are prone to occur (stomach



(*a*) 85 per cent. (*b*) 2 per cent. (*c*) 1 per cent. (*d*) 12 per cent.

FIG. 414.—Congenital œsophageal atresia. (*a*) With lower pouch opening into the trachea. (*b*) With upper pouch opening into the trachea. (*c*) With both pouches opening into the trachea. (*d*) With both pouches ending blindly. Usually the mid œsophagus is missing entirely.

contents regurgitating into the trachea). The abdomen becomes distended (dilatation of the stomach), due to air swallowed from the tracheal fistula (fig. 414 (*a*)).

Clinical Confirmation of the Diagnosis.—A No. 10 soft rubber catheter is introduced into the œsophagus through the nose. Should an obstruction be encountered about 4 inches (10 cm.) from the nostril, the diagnosis is practically certain.

Radiological Confirmation.—On no account should barium emulsion be given in these cases. Injection of 1 ml. of lipiodol down the catheter will demonstrate the septum. During this examination the supine position is

[1] In type (*a*) the patient coughs up frothy mucus, perhaps tinged with bile.

Chevalier Jackson, Contemporary. Emeritus Professor of Broncho-Œsophagoscopy, Temple University, Philadelphia.

advised, because in the rare event of the atresia belonging to categories (*b*) or (*c*), the medium is less likely to enter the trachea. In all cases the lipiodol should be aspirated after the radiograph has been taken. Another radiographic finding of great diagnostic significance is air in the stomach and jejunum, which is indicative of a communication between the lower pouch and the trachea.

Pre-operative Treatment.—It is necessary to spend twelve to twenty-four hours in overcoming the effects of dehydration and combating varying degrees of pneumonitis that is so often present; for this purpose penicillin therapy is commenced. Everything by mouth is forbidden and constant suction of the contents of the blind pouch by means of a No. 8 rubber catheter with a number of holes cut in its distal extremity is essential. The patient is supported by suitable parenteral fluid.

Operation.—The most satisfactory anæsthesia is a small dose of relaxant, together with gas and oxygen administered through an endotracheal tube. During the operation not more than 70 ml. of blood can be transfused with advantage.

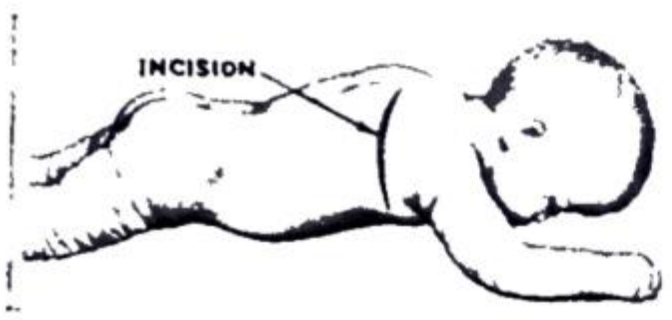


FIG. 415.—Thoracotomy for congenital œsophageal atresia.

The best approach is through a right-sided thoracotomy incision at the level of the fifth intercostal space (fig. 415). The azygos vein having been divided between ligatures, the upper segment of the œsophagus is located by a catheter within it, and freed gently from the surrounding structures. Having been separated from the trachea, the lower segment is transected just sufficiently far from the abnormal communication to permit the opening in the trachea to be closed (fig. 416A) without causing a subsequent stricture, ooooo silk on an eyeless round-bodied needle being used for these, and all subsequent, sutures. An opening is made into the blind upper segment and an anastomosis carried out between this opening and the lower segment. After the first three or four interrupted sutures have been introduced through all layers posteriorly (fig. 416B), a catheter is introduced downwards into the stomach and upwards into the pharynx, where it is grasped and drawn out of the mouth by the anæsthetist. The presence of this catheter greatly facilitates the completion of the anastomosis (fig. 416C). The stomach is emptied of air and the catheter is withdrawn through the mouth before closing the thorax. A drainage tube is inserted through an intercostal space and clipped prior to connecting it to a water-sealed bottle. Should leakage subsequently occur, gastrostomy is performed.

When the case belongs to type (*d*), anastomosis of the two ends being impossible, gastrostomy and bringing the upper pouch out through an incision in the neck, and then opening it, is the best temporary expedient. If all goes well, reconstruction of the œsophagus can be undertaken at a later date.

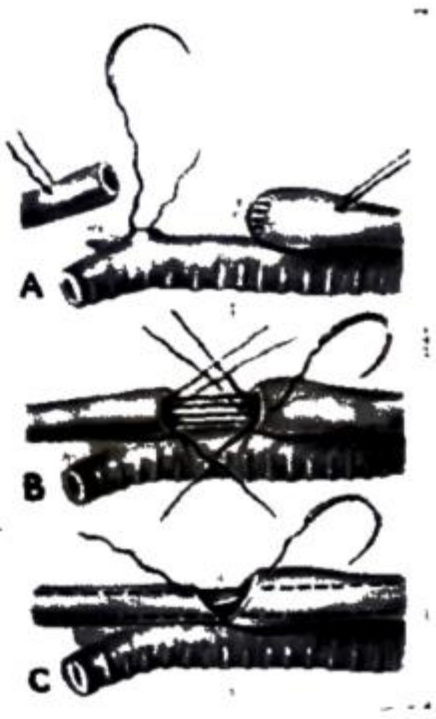


FIG. 416.—Stages in the repair of a tracheo-œsophageal fistula.

Post-operative Care.—A special nurse skilled in aspirating the pharynx, and an oxygen tent-incubator are highly desirable.

Prognosis.—Aspiration pneumonia with acid digestion of the lungs and infection superadded is exceedingly likely to supervene when there has been delay in making the diagnosis. Added to this there is a danger of post-operative leakage from the anastomosis into the pleural cavity, a disaster that is minimised by freeing the distal segment for a considerable distance and

thus minimising tension. These dual complications result in a mortality approximating 40 per cent.

Œsophageal web or diaphragm is a congenital organic narrowing of the lumen of the œsophagus which is a cause of dysphagia. The web can occur at the extreme upper end of the œsophagus when the symptoms it produces and, after a barium swallow, the anteroposterior radiological appearances to which it gives rise are similar to those of a pharyngeal pouch (see p. 275). More frequently the web, which is rare, is situated about 2 inches (5 cm.) cephalad to the œsophago-gastric junction. The web is a leathery-like membrane which reduces considerably the diameter of the œsophagus.

Operation.—The region of the web having been displayed, the œsophagus is incised longitudinally just proximal to the suspected ring, which is identified by passing a finger into the œsophagus. After identification a distal incision is made and the web is intussuscepted through the proximal wound. Wedges of the septum are then removed, always cutting towards the lumen.

Œsophageal Compression by an Abnormal Artery.—Exceptionally, the right subclavian artery arises as a last branch of the arch of the aorta, and passes either behind (fig. 417) or in front of the œsophagus to reach its destination. Another rare abnormality is a double arch of the aorta with the œsophagus and trachea sandwiched between them. Pressure from such abnormal vessels is liable to produce dysphagia. Some cases are remediable by ligation and division of the abnormal artery.

FIG. 417.—Abnormal right subclavian artery compressing the œsophagus.

Congenital Short Œsophagus (see p. 306).

FOREIGN BODIES IN THE ŒSOPHAGUS

All manner of swallowed foreign bodies have become arrested in the œsophagus: coins, pins, and dentures (fig. 418) head the list. When the object contains radio-opaque material, an urgent X-ray examination is called for. The presence of a non-opaque foreign body in the œsophagus can often be confirmed by a barium swallow (fig. 419). Whenever possible the patient should be screened immediately before œsophagoscopy is undertaken.

FIG. 418.—False teeth impacted in œsophagus. *(Dr. James F. Brailsford, Birmingham.)*

FIG. 419.—Damson-stone outlined by barium, indicated by the arrow.

FIG. 420.—A penny in the œsophagus as seen through an œsophagoscope.

The foreign body having been visualised (fig. 420), and, if necessary, manipulated into a favourable position, it is grasped with suitable forceps

introduced through the œsophagoscope. The œsophagoscope, together with the forceps still grasping the foreign body, are then withdrawn steadily.

INJURIES

Perforation of the œsophagus can result from the inexpert use of an œsophagoscope or a gastroscope; usually the beak of the instrument is thrust through the thin posterior wall of the pharynx just above the cricopharyngeal sphincter. Perforation just above an œsophageal stricture can occur from œsophagoscopy or bouginage. It also can result from removal of a piece of growth for biopsy, but probably the most frequent cause of perforation of the œsophagus is a sharp foreign body plus instrumentation to remove it.

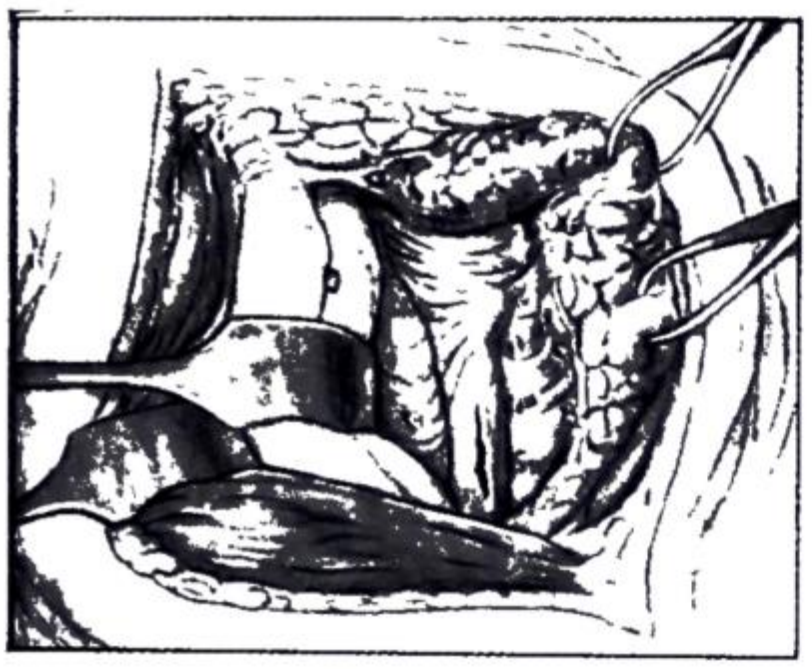


FIG. 421.—Exposure of a tear in the cervical œsophagus. In this case there was surgical emphysema on the right side of the neck.

Often the perforation goes unrecognised by the œsophagoscopist until general distress and great pain on swallowing saliva or fluid, and dyspnœa, become apparent. In such circumstances the possibility of a tear should be considered at once. An X-ray examination is essential; if a perforation has occurred, this frequently discloses the presence of air in the mediastinum, the pleural cavity, or in the neck. In doubtful cases the radiograph should be repeated after the patient has swallowed a small quantity of lipiodol. When the wall of the œsophagus has been perforated, urgent operation under antibiotic cover is indicated. When the cervical œsophagus has been ruptured, an incision along the anterior border of the sternomastoid (usually the left), with lateral retraction of the carotid sheath, gives access to the site of perforation (fig. 421), which can be closed in two layers. When the mid or lower œsophagus is involved, thoracotomy must be performed. In non-malignant cases timely suture is usually followed by recovery.

When the symptoms are much more delayed, and radiography is negative, the perforation is in all probability a very small one. In these circumstances massive antibiotic treatment is usually successful. When the reaction is severe, it is wise to perform temporary gastrostomy, in order to rest the abrasion or small perforation completely.

Burns and scalds of the œsophagus from swallowing corrosive fluid, if not rapidly fatal, are often the precursor of a dense stricture. The surgeon's aim should be to minimise the contracture of the inevitable scar. As soon as the patient's general condition permits, gastrostomy is performed. About a week later it is advisable to ascertain the extent of the damage by œsophagoscopy performed with great gentleness.

From this point there are two schools: one is for early dilatation; this school appears to be losing ground. The other prohibits bouginage for at least three weeks. In an experience of nearly a hundred and fifty cases of corrosive stricture of the œsophagus, L. Fatti found that 70 per cent. were controlled by dilatation. The remainder were treated by œsophagogastrostomy. The enormous improvement in the outcome of burns and scalds of the œsophagus is due chiefly to the introduction of antibiotics and to the development of œsophageal surgery.

SPONTANEOUS RUPTURE OF THE ŒSOPHAGUS

Ætiology.—Instead of the cricopharyngeus relaxing, as is usual during vomiting, it contracts. The pharyngeal and pyloric sphincters being closed, the pressure within the œsophagus rises so steeply that the organ bursts at its weakest point.

Pathology.—The necropsy findings[1] are remarkably consistent. There is a longitudinal tear 1 to 4 cm. in length in the posterior wall of the extreme lower end of the

[1] Spontaneous rupture of the œsophagus has been found at necropsy rather frequently in cases of severe head injury and other cerebral lesions. Possibly it has been brought about by vomiting and retching.

Libero Fatti, Contemporary. Senior Thoracic Surgeon, Johannesburg Hospital, South Africa

œsophagus, nearly always on the left side (fig. 422). Following perforation, the mediastinum becomes filled with air and gastric contents. Usually about six hours later the pleural membrane gives way, and air and gastric contents gush into the pleural cavity.

FIG. 422.—Spontaneous rupture of the œsophagus. (*After S. A. Mackler.*)

Clinical features are also remarkably constant. Following a meal, vomiting occurs. During vomiting, agonising pain is experienced in the thorax, followed by dyspnœa. Board-like rigidity similar to that accompanying perforation of a gastric or duodenal ulcer is often present. Soon surgical emphysema appears in the supra-sternal notch; it spreads up and around the neck. Crepitus is often detected here within one hour after rupture (S. A. Mackler). Hyper-resonance and absence of breath-sounds over one lung strongly suggests pneumothorax, which indeed is present. The pain is so intense that morphine fails to relieve it.

Radiography.—In very early cases nothing is demonstrated; after a few hours mediastinal emphysema is seen; in later cases a hydro-pneumothorax is present.

Paracentesis Thoracis.—Several hours after the perforation, when the extravasated fluid in the mediastinum has ruptured into the pleural cavity, if a hollow needle is inserted into the chest, air and liquid vomitus, acid in reaction, is withdrawn.

Treatment.—In a number of instances recovery has followed immediate thoracotomy, opening widely the mediastinum, suture of the perforation, and closure of the thorax with drainage. Supportive fluid therapy must be given before, during, and after the operation.

ŒSOPHAGEAL DIVERTICULUM

Traction Diverticulum.—The fundus of the diverticulum is adherent to a tuberculous lymphatic node (fig. 423), the commonest site being the anterior wall of the œsophagus in the region of the bifurcation of the trachea. The diverticulum passes upwards. As food is unlikely to enter the open mouth of the diverticulum, it rarely gives rise to symptoms, but occasionally perforation occurs, causing mediastinitis.

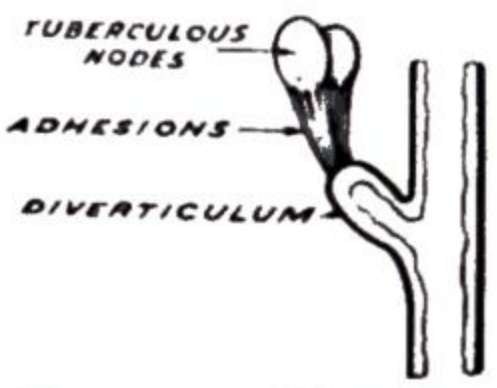


FIG. 423.—Traction diverticulum.

Pulsion diverticulum is rare, and occurs more often in the lower half of the œsophagus. Like pulsion diverticulum of the pharynx (see p. 276) such pouches sometimes cause slight dysphagia and retrosternal discomfort after food.

The diagnosis is made by radiography after a barium meal. Occasionally the symptoms are sufficiently troublesome to warrant thoracotomy and excision of the diverticulum.

ŒSOPHAGEAL VARICES

The lower end of the œsophagus is one of the principal regions where the portal and systemic venous systems anastomose. Dilatation of these anastomotic channels occurs in portal hypertension (pp. 415, 416), and is a cause of hæmatemesis. The treatment of œsophageal varices is considered on p. 417.

PARALYSIS

The passage of food along the gullet is dependent entirely upon involuntary muscular peristalsis. When the neuromuscular mechanism of deglutition is paralysed, as occurs occasionally, notably as a complication of diphtheria, ingested material is regurgitated. In established cases the difficulty has to be overcome by feeding through a stomach tube.

S. Allen Mackler, Contemporary. Thoracic Surgeon, Cook County Hospital, Chicago.

ŒSOPHAGITIS

Apart from acute inflammation produced by burns and scalds, and exceptionally by virulent inflammations, œsophagitis is a chronic condition confined mainly to the lowest few inches of the œsophagus and is due to reflux of gastric contents.

Reflux Œsophagitis.—There is abundant evidence to show that the squamous epithelium lining the œsophagus is inordinately sensitive to the action of digestive juices, and that reflux œsophagitis is brought about by incompetency of the mechanism that prevents unbridled reflux into the lower œsophagus.

The *idée fixe* that reflux œsophagitis is necessarily associated with hiatus hernia should be dispelled ; true, the two frequently go hand in hand, possibly as often as in 80 per cent. of cases, but reflux œsophagitis can occur without such a hernia : for example, repeated vomiting, pylorospasm (e.g. that associated with cholelithiasis), pyloric stenosis from any cause, the long-continued use of an indwelling gastric tube, and the use of the mobilised stomach to bridge the gap after partial œsophagectomy or to short-circuit an obstructing œsophageal carcinoma can all result in reflux œsophagitis. Furthermore, many cases of reflux œsophagitis are associated with the presence of a duodenal ulcer.

It is probable that the reflux œsophagitis so often encountered during pregnancy is due to a temporary sliding hiatus hernia resulting from increased intra-abdominal pressure ; after delivery the hernia reduces itself, but it sometimes recurs apart from pregnancy later in life.

Pathology.—The inflammation is of three types :

Type 1 occurs in the normally lined œsophagus.

Type 2 occurs in gastric epithelium within the œsophagus (*a*) associated with hiatus hernia (see p. 307), (*b*) associated with a short œsophagus (see p. 306), and (*c*) associated with ectopic gastric epithelium (fig. 424). Type 2 is particularly liable to progress to the stage of ulceration (Barrett's ulcer) (see fig. 425).

FIG. 424.—Ectopic islets of gastric epithelium, when they occur are situated in the upper third of the œsophagus. (*After N. R. Barrett.*)

Type 3.—Marginal œsophageal-gastric ulceration in the lowest portion of the œsophagus.

The various pathological stages through which reflux œsophagitis progresses have been studied in the living and recorded with exceptional clarity :

Œsophagoscopy : *Stage* 1.—The mucous membrane of the lower end of the œsophagus is velvety, scarlet, and bleeds readily.

Stage 2.—Additional white areas of desquamating epithelium are seen in the inflamed area.

Stage 3.—One or more ulcers are present (fig. 425).

Stage 4.—Progressive cicatrisation with narrowing of the terminal part of the œsophagus occurs.

Norman Rupert Barrett, Contemporary. Surgeon, St. Thomas's Hospital, London.

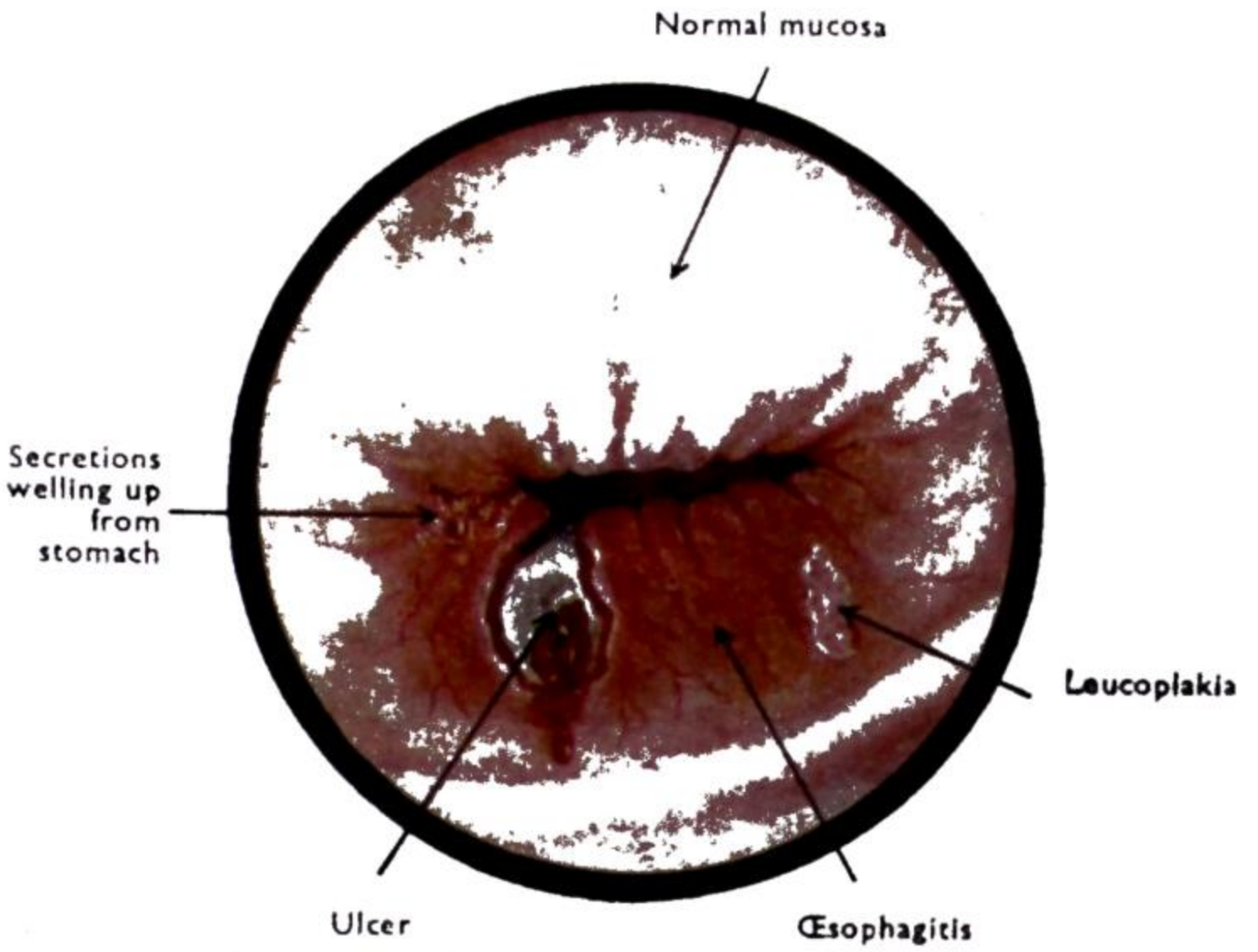


FIG. 425.—Reflux œsophagitis with ulcer.
(*N. R. Barrett.*) (*British Journal of Surgery.*)

Clinical Features.—Reflux œsophagitis is the commonest affection of the œsophagus, but its manifestations are not always clear-cut. The typical sufferer is short, with a tendency to obesity.

Pain.—In the first place, patients are encountered where the condition has progressed to advanced fibro-stenosis, yet no pain has been experienced. In the majority, however, pain is a leading symptom. In the second place, sliding hiatus hernia and reflux œsophagitis are associated so frequently that it is difficult to be sure if the pain experienced is due to one or to the other condition. In general, pain in the back between the shoulders is more constantly related to œsophagitis than to a hiatus hernia : such pain seldom bears a definite relationship to meals, although it is sometimes provoked by taking alcohol, hot fluids, or hot food. It is wont to occur at night about two and a half hours after falling asleep, when it lasts for at least an hour. It is relieved by sitting upright and sometimes by taking alkalis.

Heartburn with regurgitation of small quantities of acid material is very common.

Dysphagia.—A complaint that food sticks in the region of the lower œsophagus is a rather frequent symptom of œsophagitis. It occurs long before any stenosis has developed, and is probably an indication of œdema and early fibroblastic infiltration of the muscle layers of the organ. Later, dysphagia is constant and becomes progressively worse as the stenosis develops.

Occult blood is present in the stools in a high percentage of cases.

Absence of Physical Signs.—A complete absence of tenderness in the epigastrium or the hypochondrium during an attack is helpful in differentiating the condition from an upper abdominal lesion.

Acne Rosacea.—Many female patients with œsophagitis suffer from acne rosacea.

Radiological examination of the œsophagus reveals no characteristic sign until stenosis commences.

The only constant and irrefutable signs are those found on œsophagoscopy.

There is no evidence that reflux œsophagitis is a precarcinomatous condition.

Medical treatment should always be tried in the first instance. In cases without complications such as ulceration or stenosis, it is often successful as long as the patient adheres to the régime.

Six small, non-bulky meals should be taken daily, instead of three ; food should be masticated thoroughly, and eaten slowly. The maintenance of the upright position after meals is sometimes of benefit.

Prescribing aluminium hydroxide or bismuth before meals, or, alternatively, nulacin tablets to suck, and belladonna in full doses, is helpful. Raising the head of the bed 9 inches (22·5 cm.) on blocks is of cardinal importance. Persistent pain and vomiting are usually relieved rapidly by a continuous slow alkaline drip with the distal end of a gastric aspiration tube in the upper part of the œsophagus.

Any benefit that might accrue from bouginage is very transitory, and the method is dangerous, owing to the risk of perforating the normal œsophagus above the stricture.

Operative Treatment.—1. In otherwise healthy, comparatively young patients, repair of a sliding hiatus hernia, if present, will give a prospect of a permanent cure without the need for a lifelong, strict medical régime.

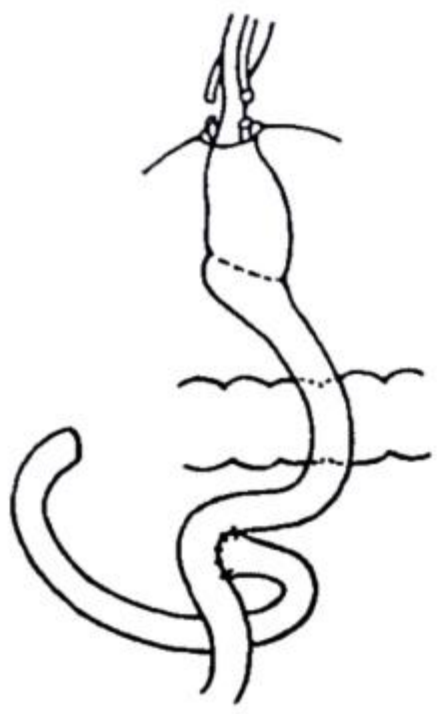


FIG. 426.—Vagotomy, and partial gastrectomy with a Roux-en-Y anastomosis. (*After C. Wells and J. H. Johnstone.*)

2. Patients who suffer from reflux œsophagitis with complications, and those in whom a hiatus hernia has recurred or the repair has failed to cure the condition, are rendered symptom-free by performing vagotomy and partial gastrectomy with an antecolic Roux-en-Y anastomosis (fig. 426) (C. Wells). Following partial gastrectomy O. H. Wangensteen has shown that many of these patients with a strictured œsophagus regain an adequate lumen of the former strictured portion.

3. Patients who have bled violently or in whom there is much stenosis of the œsophagus, are perhaps best subjected to the more severe operation of excision of the affected portion of the œsophagus, closure of the cardiac end of the stomach, and œsophagojejunostomy-en-Y (P. R. Allison).

Short œsophagus is rather an uncommon condition ; its chief claim to a prominent position in the diagnostic arena is that it is one of the causes of reflux œsophagitis with ulceration, fibrosis, and stricture formation at any time of life. Externally the œsophagus is normal in every way—*the 'shortness' of the organ refers to its mucous membrane.* Below a variable level the œsophagus is lined by columnar gastric epithelium (fig. 427). At one time all cases were considered to be congenital ; it is now conceded that some cases are acquired through shortening of the œsophagus resulting from œsophagitis followed by fibrous contraction (R. H. Franklin). Although the condition can be strongly suspected at œsophagoscopy, the only certain way of diagnosing the condition from a sliding hiatus hernia is at operation, when the peritoneal sac of the latter condition is found to be lacking. Occasionally congenital short

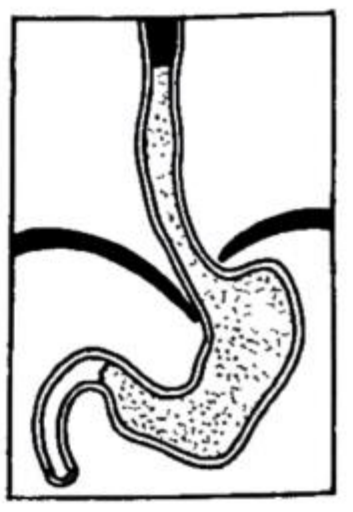


FIG. 427.—Short œsophagus. The gastric epithelium extends above the cardiac orifice. It would be inaccurate to describe this epithelium as ectopic. (*After N. R. Barrett.*)

César Roux, 1857–1934. Professor of Surgery, University of Lausanne, Switzerland.
Charles Wells, Contemporary. Professor of Surgery, University of Liverpool.
Owen Harding Wangensteen, Contemporary. Professor of Surgery, University of Minnesota, Minneapolis, U.S.A.
Philip Rowland Allison, Contemporary. Professor of Surgery, University of Oxford.
Richard Harrington Franklin, Contemporary. Senior Lecturer and Surgeon, Post-Graduate Medical School London.

œsophagus is the cause of regurgitation of feeds during the first week of life, when it must be differentiated from œsophageal and pyloric stenoses by the ingestion of 1 ml. of lipiodol, and radiography.

Treatment.—Medical treatment is highly unsatisfactory. Partial gastrectomy performed in the manner described on p. 306—by preventing regurgitation—usually renders the patient asymptomatic. In advanced cases with ulceration and bleeding, resection of the area involved, followed by œsophagojejunostomy with gastric exclusion, is usually curative.

HERNIA THROUGH THE ŒSOPHAGEAL HIATUS

Sliding	70%
Rolling	20%
Para-œsophageal	10%

Ninety-eight per cent. of diaphragmatic herniæ (see Chapter 43) occur through the œsophageal hiatus. Sir Astley Cooper was the first to insist that œsophageal hiatus hernia was acquired, and not congenital. While probably this is true in the majority of cases, the fact that the condition sometimes occurs in early infancy throws doubt on the validity of this dogmatic statement.

Sliding Hiatus Hernia.—The hernia is small, and remains so. The cardiac orifice and a portion of the stomach immediately adjacent pass into the posterior mediastinum, carrying with them a small peritoneal sac applied to the left side of the stomach. The right side of the hernia is derived from the 'bare area' of the stomach, and consequently is bereft of peritoneum (fig. 428). Branches of the left gastric artery supplying the prolapsed stomach also pass through the hiatus. *The sac is always empty*, and its fundus lies opposite the junction of the prolapsed stomach (lined by columnar epithelium) and the œsophagus (lined by squamous epithelium). It should be noted that the prolapsed stomach, with its columnar-celled epithelium (black) hangs from the œsophagus proper like a supradiaphragmatic bell.

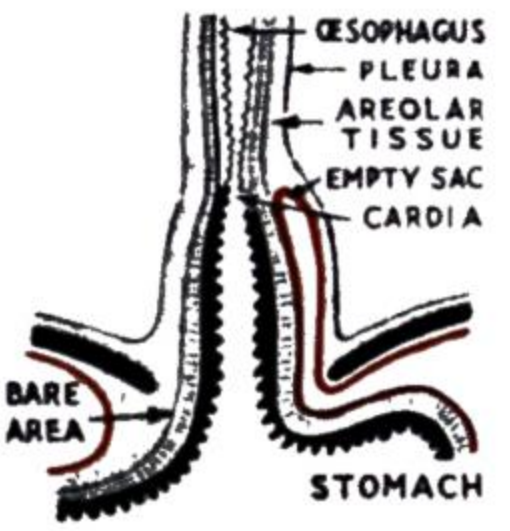


FIG. 428. — Sliding œsophageal hiatus hernia. (*After N. R. Barrett.*)

Clinical Features.—The majority of the patients are over fifty years of age, and men are slightly more often affected than women.

Pain is the dominant symptom; its sites are shown in fig. 429, many patients having pain localised in more than one area. Often the pain is made worse by stooping, and sometimes by lying down. Frequently the most severe pain is experienced by a patient with a hernia uncomplicated by œsophagitis.

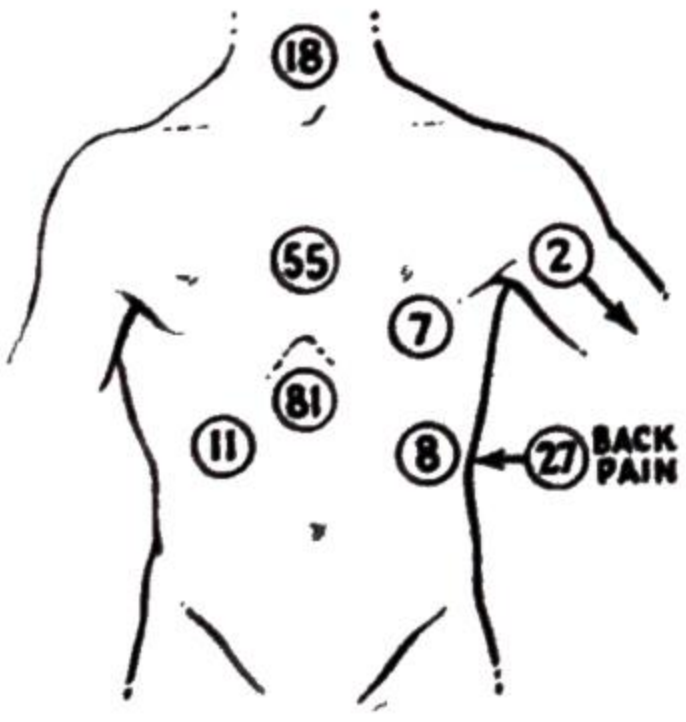


FIG. 429. — Localisation of the pain in 107 cases of hiatus hernia. (*After D. Phear.*)

Pseudo-anginal Attacks.—In a few patients agonising attacks of substernal pain simulating that of angina pectoris sometimes occur and are liable to ensnare even the very elect. The diagnosis is established by negative electrocardiographs and a positive radiological examination for hiatus hernia.

Sir Astley Cooper, 1768–1841. Surgeon, Guy's Hospital, London.

Hæmatemesis.—Serious hæmatemesis or melæna occurs in 10 per cent. of cases, large herniæ having no greater tendency to this complication than small ones. The cause of the bleeding is acute or chronic peptic ulceration within the herniated portion of the stomach, and not œsophagitis.

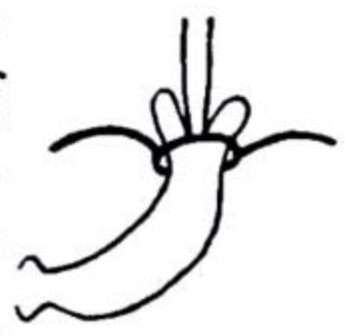
Concomitant Lesions of the Spinal Column.—Kyphoscoliosis and arthritis of the spine are often seen in patients with hiatus hernia. The spinal lesion may have its effect by deformation of the region of the crura of the diaphragm.

Hiatus Hernia in Children and Infants.—Twenty per cent. of patients with a hiatus hernia are under ten years of age (R. Belsey), and hiatus hernia with œsophagitis is less rare in infants than has been supposed. The outstanding clinical features in them is effortless vomiting, often blood-tinged, dating from shortly after birth.

Radiography.—In order to demonstrate a sliding hiatus hernia radiologically, technique is important. The patient should lie semi-prone on the right side with a rolled-up radio-translucent mat beneath the abdomen. The table is then placed in Trendelenburg's position. During the exposure of the films barium is imbibed through a tube continuously, and as rapidly as possible. Compression of the abdomen will demonstrate reflux (fig. 430).

FIG. 430.—Radiograph showing a sliding hiatus hernia. (*Dr. Oliver Smith, Birmingham.*)

Klinefelter's Sign.—Patients with a sliding hiatus hernia who complain of dysphagia are very likely to have intermittent invagination of the œsophagus, viz.: ——→



Œsophagoscopy reveals varying degrees of inflammation of the lower end of the œsophagus. *The* sign of a sliding hernia is, that as the œsophagoscope is withdrawn, gastric mucosa follows it upwards for a variable distance from the level at which it was first encountered.

Differential Diagnosis.—Hiatus hernia has become a fashionable diagnosis, and with improved radiological technique such a hernia is demonstrated in about 10 per cent. of patients submitted to a barium meal. One must therefore be vigilant lest cholelithiasis, cholecystitis, peptic ulcer, or appendicular dyspepsia be overlooked in a patient with an incidental hiatus hernia.

Medical Treatment.—In patients with abdominal obesity—the fat are more frequently affected than the lean—the beneficial effects of reduction of weight are noteworthy. Quite often the abandonment of a tight belt or corset brings about a remarkable change for the better (P. Marchand). Frequently the avoidance of stooping is no great hardship; other factors that cause increased intra-abdominal pressure, viz. constipation and heavy lifting, must be avoided studiously. Sleeping with the shoulders raised on pillows or blocking the bed should be insisted upon. Other details of the medical treatment of reflux œsophagitis are invoked, if this condition is present.

Ronald Herbert Robert Belsey, Contemporary. Thoracic eon, Frenchay Hospital, Bristol.
Friedrich Trendelenburg, 1844-1924. Professor of Sur zig.
Edmund William Klinefelter, Contemporary. Radiolo ennsylvania, U.S.A.
Paul Edmond Marchand, Contemporary. Surgeon, Jo ospital, South Africa.

Especially when the patient is old, or one who leads a sheltered life, or at any rate follows a sedentary occupation, not infrequently these simple measures bring about and maintain such a remarkable improvement that the question of operation can be postponed indefinitely. In other circumstances operation should be advised.

Medical Treatment in Infancy.—The first injunction is to nurse the baby in an upright position, and the second is to thicken feeds, giving semi-solid diet as soon as possible. The most practical method of maintaining the sitting position is by an almost legless chair made of plaster of Paris, which can be used both in the cot and the perambulator. Many children lose all symptoms when they start to walk; most of the remainder will require hiatus herniorrhaphy (J. M. Smellie).

Operative Treatment.—When a patient has a hiatus hernia and some other abdominal lesion requiring operation, the two operations should not be performed at the same time. In the case of gall-stones the cholecystectomy should be performed first, lest an attack of vomiting provokes recurrence of the hernia.

With the patient lying on the right side, an incision is made along the eighth rib (fig. 431) which is resected. The pleural cavity is opened, a rib spreader inserted, and the lung retracted upwards. The visceral pleura over the lower end of the œsophagus is incised, and the distal 4 inches (10 cm.) of the œsophagus is mobilised by ligating the supplying vessels and sectioning the vagus nerves, if necessary. A piece of rubber tubing is passed around the œsophagus to act as a retractor, and with its assistance the musculature surrounding the hernial orifice is displayed by careful dissection. This completed, the peritoneal sac is opened along the margin of the hiatus. The left phrenic nerve having been crushed, an incision is made into the left dome of the diaphragm. After bleeding vessels have been ligated by transfixion, the left hand is passed into the abdomen to explore the œsophageal hiatus from below. Following this, the ends of the rubber tubing are passed through the hiatus and back again through the diaphragmatic incision (fig. 432(*a*)) and by exerting traction on the rubber tubing, the cardia is drawn into pristine

FIG. 431. — Thoracotomy incision for the repair of a hiatus hernia.

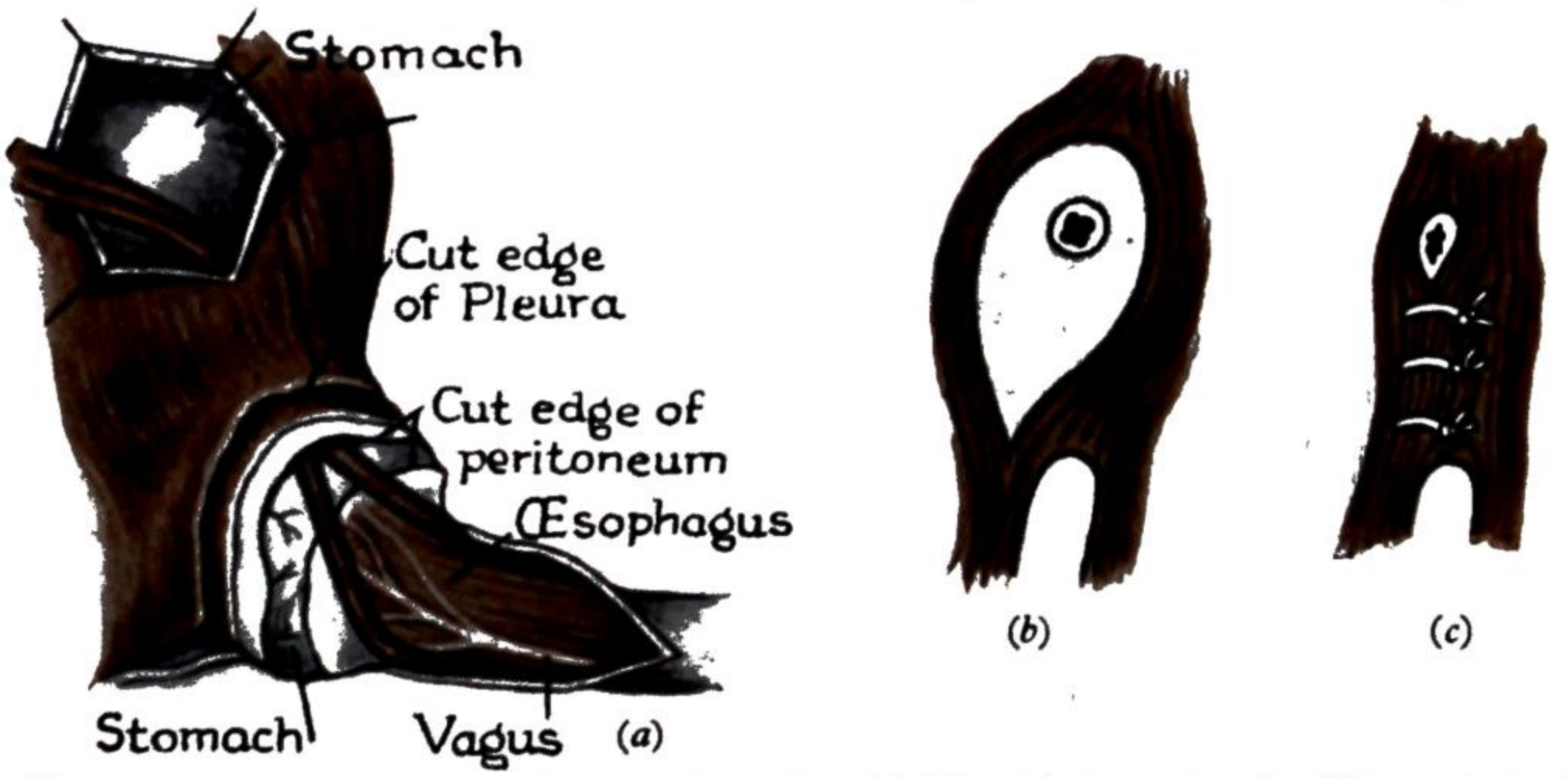


FIG. 432.—Œsophageal hiatus herniorrhaphy. (*a*) Hernial sac opened. The prolapsed cardia is about to be drawn into the abdomen by the encircling tube; (*b*) the enlarged hiatus from above; (*c*) the same reduced to normal dimensions by repairing the diaphragm. (*After Martin Kirschner.*)

James Maclure Smellie, Contemporary. Professor of Pædiatrics and Child Health, University of Birmingham

position below the diaphragm. The anæsthetist passes a moderate-sized stomach tube. Three silk sutures are inserted to approximate the edges of the enlarged hiatus snugly around the œsophagus (fig. 432(*c*)), the stomach tube ensuring that the opening is not over-narrowed. From above, the fascia of the œsophagus is stitched to the fascia of the diaphragm, while the collar of peritoneum attached to the stomach can be stitched to the under-surface of the diaphragm. The tape is withdrawn, and the incision in the diaphragm sutured. The lungs are then inflated and, all blood having been aspirated from the pleural cavity, the thorax is closed with water-sealed drainage.

Rolling Hiatus Hernia.—The main difference between the sliding and the rolling hiatus hernia lies in the oblique entry of the œsophagus into the stomach in the latter (fig. 433), and the possibility of valvular mechanism preventing reflux. Also the greater bulk of the herniated segment of stomach, as shown radiographically, tends to compress the lower end of the œsophagus, thereby helping to prevent reflux. For these reasons a rolling hiatus hernia rarely gives rise to reflux œsophagitis.

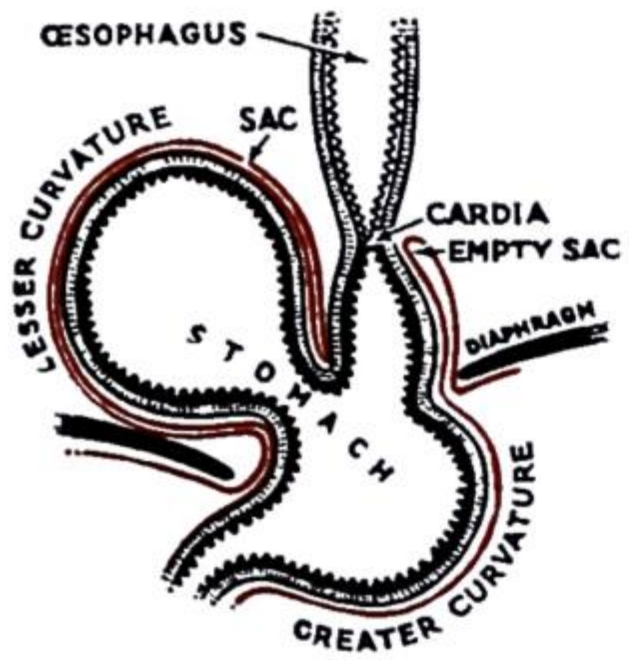


FIG. 433.—Rolling hiatus hernia. (*After N. R. Barrett.*)

Clinical Features.—The symptoms engendered by a rolling hiatus hernia are relatively mild, but the dangers of harbouring this type of hernia are stupendous. Of twenty-two cases treated conservatively on account of the mildness of the patient's symptoms, five died as a result of the sudden development of hæmorrhage, perforation, or strangulation (R. Belsey).

Treatment.—Operative treatment is therefore indicated strongly. For the repair of the hernia some prefer the transthoracic route, and others the abdominal route as described under ' Para-œsophageal hernia.'

Para-œsophageal hernia is a true hernia into which the greater curvature of the stomach (figs. 434 and 435) or, very rarely, the whole stomach (fig. 436) ascends into a preformed sac lying in the mediastinum (fig. 434). As a rule adhesions form between the sac and its contents, preventing the stomach escaping.

Clinical Features.—Symptoms rarely appear until the hernia is large

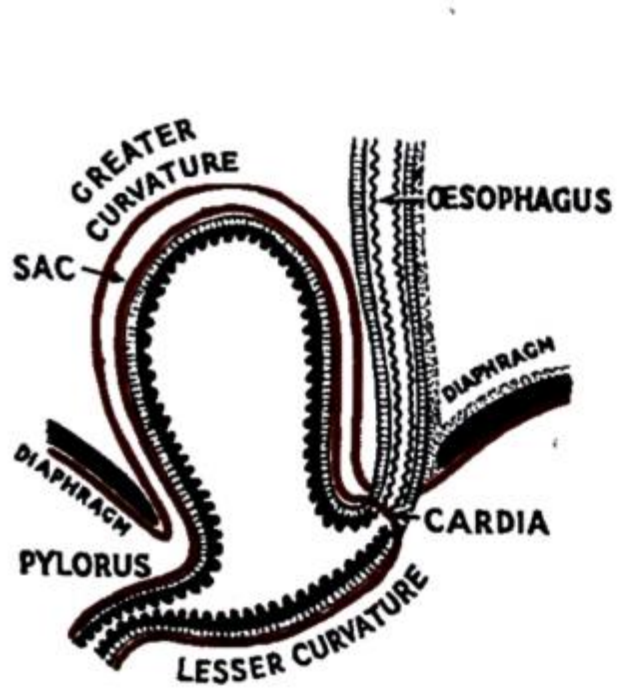


FIG. 434.—Para-œsophageal hernia. (*After N. R. Barrett.*)

FIG. 435.—Radiograph showing para-œsophageal hernia. (*Dr. Oliver Smith, Birmingham.*)

FIG. 436.—Inverted stomach in the thorax. Case of para-œsophageal hernia.

(fig. 436), and they are variable: (*a*) intermittent dysphagia; (*b*) cardiac symptoms due to pressure on the heart; (*c*) serious melæna from gastric erosions and consequent anæmia; (*d*) occasionally bouts of hiccough from irritation of a phrenic nerve.

Operation.—The muscular fibres of the crus are so attenuated by stretching that the operation described for sliding hernia is usually inapplicable. S. W. Harrington, who has had an immense experience of this condition, proceeds as follows:

1. Crushing of the phrenic nerve on the side of the lesion, under local anæsthesia, through a cervical approach is carried out about a week before the repair of the hernia. This puts the corresponding half of the diaphragm at rest for three to five months.

2. For a right-sided hernia the thoracic approach is chosen, because the liver mitigates a satisfactory abdominal exposure of the hernial site. In the case of the left side (much more common) the abdominal approach is chosen.

3. The upper abdomen having been opened, a stomach tube is passed by the anæsthetist and all gaseous and fluid stomach contents are aspirated before reduction of the hernia is undertaken.

4. Reduction having been effected, usually the hernial sac is excised. A very large adherent sac is detached from the stomach, but the intrathoracic portion is left after penetrating its wall in several places to prevent accumulation of serum.

5. The hernial orifice is repaired by overlapping. The first layer of sutures is of thread (fig. 437(*a*)); the second and third layers are of fascia lata (fig. 437(*b*)).

FIG. 437.—(*a*) Repair of a para-œsophageal hernia. First layer of sutures. (*b*) The second and third layers of sutures of fascia lata, so placed as to imbricate the pillars of the hernial orifice. (*After S. W. Harrington.*)

CHRONIC ŒSOPHAGEAL OBSTRUCTION

The causes of chronic œsophageal obstruction can be classified as follows:

- **Pressure from without**
  - Aortic aneurism, abnormal artery.
  - Pharyngeal pouch (see p. 275).
  - Mediastinal
    - Neoplasm.
    - Abscess.
- **Localised muscular spasm**
  - Plummer-Vinson syndrome.
  - Achalasia of the œsophagus.
  - Multiple ring contractions.
- **Stricture**
  - Congenital.
  - Cicatricial
    - Secondary to reflux œsophagitis and peptic ulcer of the œsophagus.
    - Secondary to the Plummer-Vinson syndrome.
    - Following swallowed corrosive poisons.
    - Tuberculous (rare).
    - Syphilitic (now almost extinct).
  - Carcinomatous.

LOCALISED MUSCULAR SPASM

There are two important clinical entities associated with muscular conditions of the œsophagus. One affects the pharyngo-œsophageal junction and is known as the Plummer-Vinson syndrome. The other affects the extreme lower end of the œsophagus and is called cardiospasm, or achalasia.

THE PLUMMER-VINSON SYNDROME

The patient is nearly always a middle-aged woman who comes complaining of difficulty or inability to swallow. Severe retching spells are wont to occur and classically the patient fears choking. Provided the clinician is aware of the existence of the syndrome, close examination nearly always provides clues to the diagnosis, but not all the following are necessarily in evidence in a given case.

The tongue is usually devoid of papillæ, smooth and pale, but rarely inflamed or sore.

The lips and corners of the mouth are often cracked, giving the mouth a pursed appearance.

FIG. 438.—Spoon-shaped finger-nail.

The finger-nails are brittle, and tend to be spoon-shaped (koilonychia) (fig. 438).

The spleen is enlarged in the same ratio as in other iron-deficiency anæmias.

The bone marrow is devoid of stainable iron stores.

The Blood.—Hypochromic[1] anæmia is always present, the serum iron levels being particularly low. It seems probable that the dysphagia precedes the anæmia, which is due to lack of iron and other necessary ingredients of a balanced diet.

Achlorhydria is often present, as is usually the case in iron-deficient anæmia.

The Commencement of the Œsophagus.—The dysphagia is due to spasm of the circular muscle fibres of the extreme upper portion of the œsophagus. The mucous membrane is hyperkeratotic in places, and desquamated in others; it is extremely friable and easily traumatised by the passage of an œsophagoscope. In long-standing cases the orifice looks like a mere pin-hole. What is highly important to realise is that this lesion is definitely a pre-carcinomatous condition.

Treatment.—The dysphagia yields readily to dilatation of the stricture through an œsophagoscope. As always, gentleness must be used; even so, in cases of some standing bleeding will occur. The administration of tab. ferrous sulphate, 3 grains (0·2 G.) t.d.s., together with vitamins, is indicated. In refractory cases intravenous saccharinated iron, 100 mg. daily for ten days, rapidly improves the condition. Sometimes blood transfusion is necessary. Hyperalimentation with a liquid diet through a gastric aspiration tube helps to bring about regeneration of the desquamated epithelium of the mucous membrane of the œsophagus. Once the anæmia is under control and the patient

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[1] Hypochromic anæmia is so-called because the red blood-corpuscles contain less hæmoglobin than normal.

Henry S. Plummer, 1874–1936. Physician, Mayo Clinic, Rochester, U.S.A.
Porter P. Vinson, Contemporary. Physician, Mayo Clinic, Rochester, U.S.A.

can swallow an adequate diet, rapid improvement occurs and usually is maintained.

ACHALASIA OF THE ŒSOPHAGUS (*syn.* 'CARDIOSPASM')

Ætiology.—Achalasia is a disease of the œsophagus, the exact cause of which remains unknown. The diseased portion lies above the cardiac sphincter, which plays little part in its development. The œsophagus consists of a dilated sac above and a narrow neck below. In both segments there is an absence of Auerbach's plexus (A. Stokes), which accounts for the dilatation, but not for the narrow neck. There is no evidence of inflammation except that which can be accounted for by stasis. The cardia is normal[1] and so is the stomach. Œsophagitis and reflux play no part in the cause of this condition.

Pathology.—When slit up longitudinally it will be seen that not only is the œsophagus enormously dilated (fig. 439), but it is also lengthened. Its circumference at the distal end sometimes measures as much as 7 inches (18 cm.). As a rule there is no hypertrophy of the muscle at the lower end ('neck') of the œsophagus—merely narrowing.

Clinical Features.—Usually achalasia of the œsophagus occurs in women about forty years of age, but it can occur at any time of life and in both sexes. The history is one of progressive dysphagia, but there are several special features.

The onset is insidious and, more often than not, the patient seeks relief only after the symptoms have been present for many years. Curiously, not a few sufferers complain that the dysphagia is more in evidence when taking fluids. Although the patient says she vomits, on closer interrogation it becomes apparent that there is regurgitation of food, often several hours after the meal. In advanced cases mucus and froth are brought up in considerable quantities. There may be retrosternal discomfort, rarely amounting to pain.

FIG. 439. — Achalasia of the œsophagus. Necropsy specimen showing the typical flask-shaped dilatation. (*British Journal of Surgery.*)

FIG. 440. — Typical X-ray appearance after the ingestion of a barium meal in a case of achalasia of the œsophagus.

As a result of the obstruction the patient fails to obtain sufficient nourishment, and consequently remains in a state of continual ill-health, rendering normal activities impossible.

Radiography.—Radiological appearances are characteristic; the enormous dilatation of the œsophagus is seen in no other condition (fig. 440).

[1] The widely employed term 'cardiospasm' is, therefore, inaccurate.

Leopold Auerbach, 1828–1897. Professor of Neuropathology, Breslau.
Adrian Stokes, 1887–1927. Pathologist, Guy's Hospital, London.

Œsophagoscopy.—Once the instrument has passed the cricoid cartilage it appears to enter a gaping cave partially filled with dirty water, which laps to and fro with respiratory movement. When the fluid has been aspirated the cardiac orifice is located with difficulty, owing to its contracted state.

Treatment

Plummer's Hydrostatic Bag.—A silk thread with a shot on the end is swallowed, and when the shot has entered the stomach, suitable bougies are passed by the 'railroad' method. Once the narrow neck has been dilated sufficiently, the hydrostatic bag (fig. 441) is inserted. Plummer's bag often succeeds where dilatation fails, because the hydrostatic bag can be distended to a transverse diameter of 5 cm. This ruptures the circular muscle fibres of 'the neck.'

FIG. 441.—Plummer's hydrostatic bag *in situ*.

Operative treatment becomes necessary in at least 20 per cent. of cases.

Heller's Operation (*Œsophagocardiomyotomy*).—Aspiration of the dilated œsophagus is commenced before operation and continued during the operation. The abdomen is opened by a long left paramedian incision[1]. The left lobe of the liver is retracted to the right and the triangular ligament, thus rendered taut, is severed. This permits further displacement of the liver. The stomach is retracted downwards so as to display the abdominal portion of the œsophagus, the peritoneum overlying which is incised, permitting the lower end of the œsophagus to be liberated circumferentially. A piece of gauze is passed around the cardia to facilitate retraction. When the lower end of the œsophagus has been mobilised sufficiently, a longitudinal incision is made extending 2 inches (5 cm.) proximal and 2 inches distal to the constricted portion. The incision is deepened to the mucosa throughout the length of the incision (fig. 442). After its completion the mucous membrane bulges, as occurs in Rammstedt's operation (see p. 363). A few small blood-vessels require ligation. The gauze sling is removed. It is unnecessary to resuture the divided triangular ligament. The abdomen is closed.

In 80 per cent. of cases the results of Heller's operation are most satisfactory; in the remainder the symptoms due to reflux œsophagitis mar the benefits conferred by the operation. The addition of pyloromyotomy (Rammstedt's operation) helps to reduce the incidence of this complication, but the presence of a concomitant duodenal ulcer affects the result so adversely that subsequent partial gastrectomy will be required.

FIG. 442.—Heller's operation, showing the length and position of the incision dividing the muscular coats. (*After P. Thorek.*)

ABNORMAL RING CONTRACTIONS OF THE THORACIC ŒSOPHAGUS

Multiple segmental ring-like spasms of the smooth muscle leading to alternate contractions and dilations (ripple œsophagus) sometimes occur, usually in middle life. They are responsible for mild dysphagia and regurgitation and are discovered on radiological examination. The condition, which is sometimes familial, is presumably the result of autonomic dyskinesia. Antispasmodics, e.g. pentamethonium bromide or very small doses of curare, can be tried in early cases. Later cases need regular dilatation with bougies.

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[1] The operation can also be carried out through a left transthoracic incision.

Ernst Heller, Contemporary. Professor of Surgery, Leipzig.
Conrad Rammstedt, Contemporary. Consulting Surgeon, Rafael Clinic, Münster. This venerable surgeon is now 91 years of age.

BENIGN STRICTURE

Compared with obstruction due to carcinoma, simple stricture is rare. As set out in the table on p. 311, the causes of benign stricture are various. When consequent upon swallowing corrosive poisons, the strictures are usually multiple, the densest being at the level of the crossing of the left bronchus. The sole symptom is increasing dysphagia, and the diagnosis is established by an X-ray examination after swallowing barium emulsion, and by œsophagoscopy.

Treatment consists in dilatation with bougies (fig. 443). In the first instance this

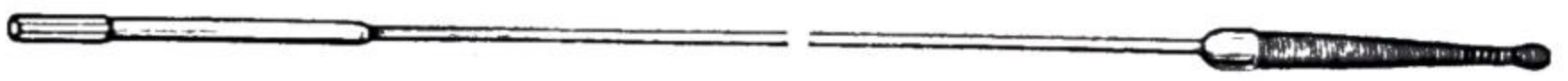

FIG. 443.—Chevalier Jackson's carrot-shaped œsophageal bougie.

should always be carried out under vision; in most cases it is advisable to continue to dilate the stricture at regular intervals under the vision afforded by an œsophagoscope. When the stricture has a very small lumen a special guide is passed, to the end of which a larger bougie is attached by a screw. By these means nearly all simple strictures can be dilated sufficiently to permit bougies to be passed in the usual manner, but treatment must be continued at regular intervals suited to the individual case for the remainder of the patient's life.

In cases where a bougie cannot be passed from above or threaded along a swallowed string weighted by a small shot, retrograde bouginage can be attempted through a gastrotomy. If this measure is successful, bougies can be passed afterwards in the usual way. In extreme cases, where dilatation of a dense stricture is impossible, the choice lies between a permanent gastrostomy or excision of the strictured segment with reconstruction of the œsophagus, similar to that used for malignant disease (p. 318).

BENIGN TUMOURS

Simple tumours of the œsophagus are exceedingly rare. Usually they are discovered as a space-occupying lesion in a radiograph following a barium swallow, ordered on account of dysphagia. The diagnosis is confirmed by œsophagoscopy with, perhaps, biopsy. Papilloma of the œsophagus is usually solitary, and occurs in the upper third of the organ. Diathermy excision through an œsophagoscope is a satisfactory method of treatment. A polyp with a narrow stalk can be removed with a snare. On a number of occasions a leiomyoma or a submucous lipoma causing symptoms of dysphagia has been removed successfully by the transthoracic approach. The most difficult benign neoplasm of the œsophagus to treat is a cavernous hæmangioma which, as might be expected, usually gives rise to hæmatemesis. Injection of a sclerosing agent is sometimes successful; in others, partial œsophagectomy is required

CARCINOMA OF THE ŒSOPHAGUS

Carcinoma of the œsophagus presents a disturbing problem. Most cases are diagnosed only after œsophageal obstruction has developed and the tumour has progressed beyond the anatomical limits of the organ and has involved the regional, if not distant, lymph nodes. In spite of modern methods of treatment, only 2 or 3 per cent. of patients with this disease survive for five years after the diagnosis has been made.

The œsophagus is the fourth most common site for a carcinoma in men, being exceeded only by the prostate, the stomach, and the large intestine, including the rectum. In Japan, carcinoma of the œsophagus occurs even more frequently, and at a younger age, than in Western races.

Site.—Fig. 444 shows the relative number of neoplasms occurring in each division of the œsophagus. The boundaries between the three divisions are

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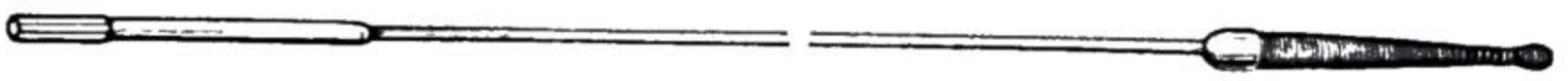

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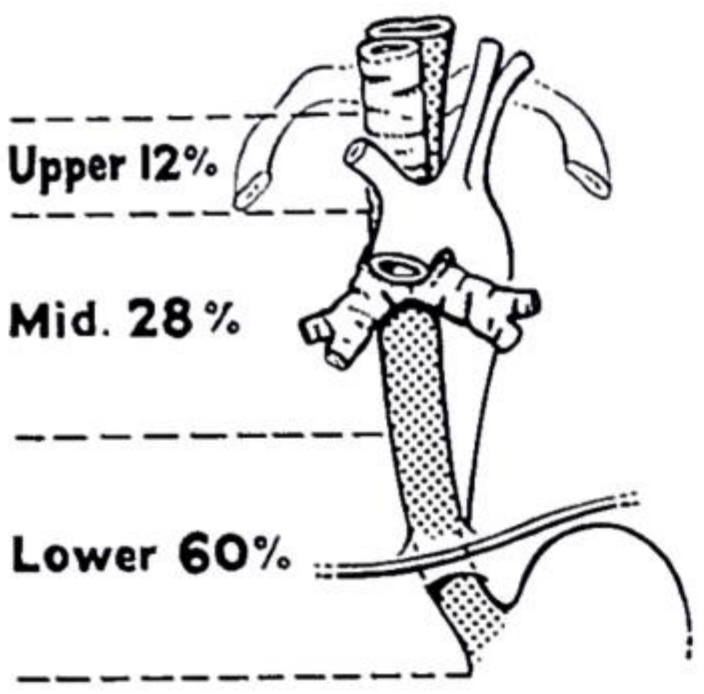


FIG. 444.—The relative frequency of carcinoma in various portions of the œsophagus. (*R. H. Franklin's figures.*)

arbitrary, and refer to surgical approach rather than to anatomical landmarks.

Pathology.—As pointed out already, the neoplasm often commences at one of the zones of anatomical narrowing, but any portion of the œsophagus may be attacked.

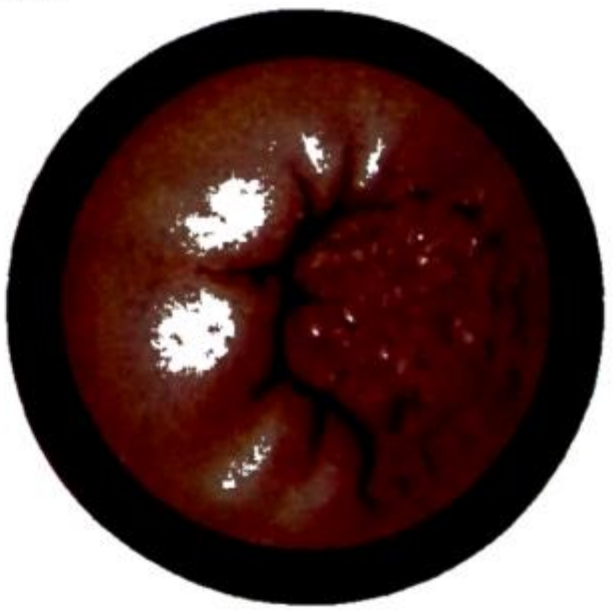


FIG. 445.—Carcinoma of the œsophagus as seen through an œsophagoscope. (*Mr. A. Lawrence Abel, London.*)

Macroscopically three types can be recognised:

1. An annular constriction.
2. A papilliferous mass (fig. 445).
3. A carcinomatous ulcer.

The first variety is usually found at the cardia.

Microscopically, over 85 per cent. of carcinomata of the œsophagus are squamous-celled; of the remainder, more than half are undifferentiated spheroidal-celled, while the minority are adenocarcinomata. The last have their origin in gastric mucosa in the region of the cardia, or in an island of aberrant columnar epithelium.

Spread: (*a*) *Direct.*—The neoplasm tends to encircle the œsophagus, but spread occurs also in a longitudinal direction with outcroppings some distance from the palpable margin of the tumour. When the muscular coat becomes involved, peri-œsophagitis causes fixity to neighbouring structures, but it is only a matter of a few months before the inflammatory adherence gives place to neoplastic infiltration.

(*b*) *Lymphatic.*—From the cervical œsophagus the spread is to the lymph nodes of the supraclavicular triangles. From the thoracic œsophagus metastases pass to the para-œsophageal and tracheo-bronchial lymph nodes, with downward extension to the subdiaphragmatic nodes.

In the case of the abdominal œsophagus, spread is to the lymph nodes along the lesser curvature of the stomach, and from thence to those around the cœliac axis.

It should be noted that, in the main, lymphatic metastases occur in a *downward* direction.

(*c*) *By the blood-stream* is exceptional; occasionally metastases occur in the liver or the lungs.

Clinical Features.—Men between forty-five and eighty are the usual victims; their average age being sixty-three. About 28 per cent. of the patients are women, and in them the neoplasm is situated most frequently in the upper third of the œsophagus; their average age is in the late fifties.

The leading symptom—indeed, often the only symptom—of this fell disease is dysphagia. Sometimes, owing to sloughing of a portion of the growth, for a time swallowing becomes easier, but as a rule the difficulty is steadily progressive. Only 40 per cent. of patients report within three

months ; too often the patient procrastinates seeking advice until he can no longer swallow milk pudding. By this time the growth must have encircled at least three-quarters of the lumen of the œsophagus and, as might be expected, loss of weight is obvious. Regurgitation (œsophageal pseudo-vomiting) is a fairly common symptom. The regurgitated material is alkaline, mixed with saliva, and possibly streaked with blood. In growths situated in the lower part of the œsophagus, anorexia is sometimes a feature. Pain, if it occurs, is usually a late manifestation, but it is not in itself a contraindication to an exploratory operation.

Radiography after barium emulsion has been swallowed should be carried out in every case of dysphagia. By this investigation the presence of a carcinoma of the œsophagus (fig. 446), or, more usually, the stenosis produced by the neoplasm, is displayed. Nevertheless, complete reliance must not be placed on the radiological findings, particularly if the examination is negative.

FIG. 446. — Comparatively early carcinoma of the œsophagus. (*The late Dr. G. R. Mather Cordiner, London.*)

FIG. 447.—Advanced carcinoma of the œsophagus, D.8 level, with a fistula leading towards extrapleural fluid and metastases. (*Dr. Oliver Smith, Birmingham.*)

Œsophagoscopy is absolutely reliable. Should there be any doubt about the nature of the pathological process a portion can be removed with biopsy forceps for microscopical examination.

Bronchoscopy should be undertaken when there is a cough with expectoration of large quantities of purulent sputum which suggests involvement of the bronchial tree, and possibly the presence of a fistula.

Treatment : *Contraindications to exploratory thoracotomy* are involvement of the air passages or the presence of distantmetastases. Often a patient, seemingly too old and debilitated for a major procedure, improves greatly as a result of :

Pre-operative Treatment.—Hourly feeds, as much as the patient can take, of fortified milk (2 eggs, 2 ounces (60 G.) sugar, 1 teaspoonful salt, 2 ounces dried milk, and 1 ounce of butter to 2 pints (1·14 l.) of milk) are given. In exceptional cases when the patient cannot swallow this, a temporary gastrostomy is performed and the nourishment is given by the drip method. Breathing exercises and, when necessary, postural drainage are carried out. The patient's teeth, if present, are cleansed ; the hygiene of the mouth is most important. Ferrous sulphate and vitamins are prescribed separately. Antibiotic therapy is commenced three days before the operation.

Operation.—It is only after the region of the growth has been displayed and the extent of its fixity to surrounding structures ascertained that it is possible to tell if partial œsophagectomy is practicable. As a result of

exploration, a high percentage (about 50 per cent.) of growths will be found to be irremovable, in which case a short-circuiting operation is performed.

FIG. 448. — Usually the eighth rib is resected subperiosteally, and its intercostal vessels are ligated. If more room is required, the posterior ends of the seventh, sixth, and fifth ribs are sectioned.

Assuming the growth is operable, the method of procedure is as follows :

(*a*) **When the Growth is at the Cardiac Orifice.**—Through a thoraco-abdominal approach (fig. 448) a block dissection of the stomach, together with the spleen, omenta, and tail of the pancreas, is undertaken. Restoration of the continuity is effected by œsophago-jejunostomy, employing a Roux-en-Y anastomosis (see p. 356).

(*b*) **When the Growth is situated in the Lower Half of the Thoracic Œsophagus.**—Again a thoraco-abdominal incision is made, but at a slightly higher level. Because of the danger of hæmorrhage from branches of the thoracic aorta, Allison frees the aorta as a first step by dividing between ligatures the upper six left, and then the corresponding right intercostal arteries. The thoracic aorta can then be lifted up with tapes while the dissection of the œsophagus from its bed is carried out. Once the tumour-bearing area of the œsophagus has been mobilised, the phrenic nerve is crushed and the diaphragm is incised from the œsophageal hiatus to the lateral thoracic wall. Resection and restoration of the continuity of the alimentary canal are effected by mobilising the stomach (fig. 449), division of the termination of the œsophagus with closure and invagination of its distal end, followed by attaching the fundus of the stomach to the œsophagus just above the proposed line of section. Resection having been completed, the proximal end of the œsophagus is joined to the fundus of the stomach, a circular area of about 3 cm. in diameter being removed from the stomach for that purpose (fig. 450). The diaphragm is repaired around the stomach. The lung is re-expanded, and the incision in the thoracic wall closed in layers with dependent stab drainage.

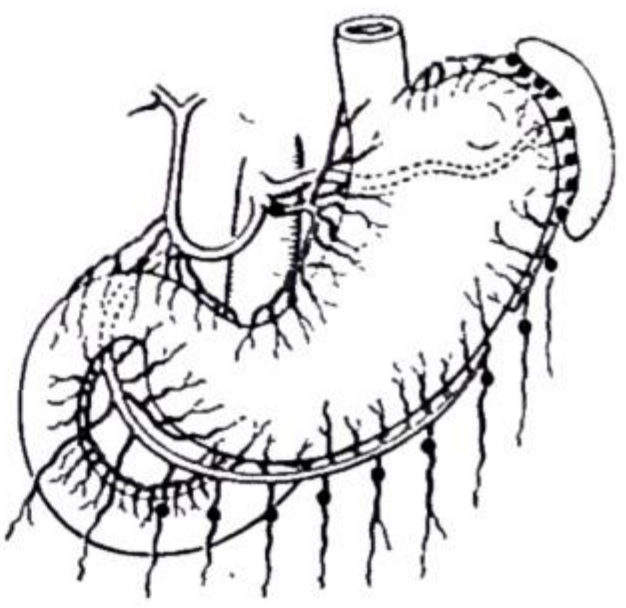


FIG. 449.—Sites of vascular ligation and division to mobilise the stomach with a vascular supply. The left gastric artery is ligated and divided near its origin.

(*c*) **When the Growth is Nearer the Arch of the Aorta.**—After the œsophagus has been freed by dissection, if it is found that the proposed line of anastomosis will lie in the shadow of the arch of the aorta, although it increases the severity of the operation, it is better to mobilise the œsophagus still further and perform the anastomosis in front of the aorta, rather than risk a faulty junction made under the arch.

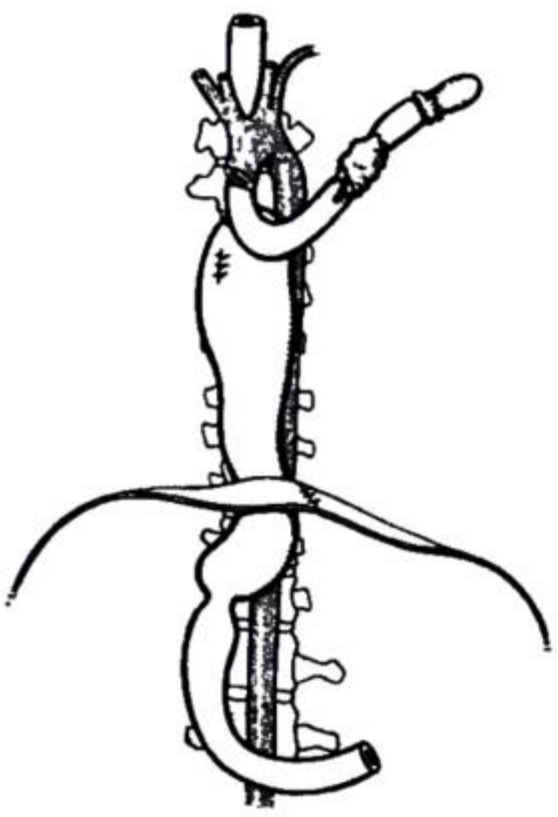


FIG. 450. — Resection of the œsophagus for a growth in its middle third, utilising the mobilised stomach for restoring the continuity of the alimentary tract (semi-diagrammatic).

(*d*) **When the Growth lies in the Thorax above the Arch of the Aorta.** See **Radiotherapy**, p. 319.

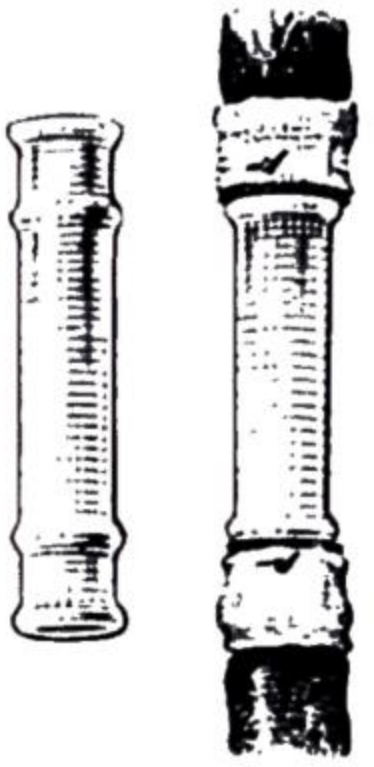
* * *

Other Methods of bridging the Defect.—The great disadvantage of utilising the stomach as a substitute for the œsophagus is reflux œsophagitis above the anastomotic line. For this reason other methods are likely to supplant it. 1. Instead of the stomach, a length of jejunum can be substituted. 2. An isolated segment of the transverse or the right colon, with its blood supply intact, can be utilised

Franz Torek, 1861–1939, Surgeon, Lenox Hill Hospital, New York, performed the first successful excision of the œsophagus in 1914.

to connect the stump of the œsophagus to the stomach. The advantage claimed over (1) is that the patient does not suffer from post-gastrectomy syndromes (see p. 346).

3. **An Intrathoracic Polythene Prosthesis.**—The plastic-tube technique is the simplest and the least time-consuming of any procedure devised to maintain the continuity of the œsophagus. Only one body cavity, viz. the thorax, is entered (low lesions involving the cardia are treated by conventional technique). Another great advantage is that a prosthesis within the mediastinum is without the disabling symptoms inseparable from the stomach being housed in the pleural cavity. A margin of at least 2 cm. to cover the ends of the tube is essential. The polythene tube (fig. 451*a*) is anchored to each cut end of the œsophagus by a loose purse-string suture reinforced by a cuff of elastic nylon mesh (fig. 451*b*). After both anastomoses are complete, sheets of gelfoam are placed completely around the tube, the object being to form a scaffold for fibrous tissue, which indeed grows into this meshwork. In most cases it is possible to approximate the cut edges of the mediastinal pleura over the anastomosis. The thorax having been closed, a gastric tube is passed into the stomach, where it remains for at least six days with suction. For two more days it is used for feeding, and then removed. Cases have been reported where the tube has functioned admirably for up to two years (E. F. Berman).



(*a*) (*b*)

FIG. 451.—(*a*) Polythene prosthesis. It is made in six different lengths. (*b*) Method of joining the tube to the cut ends of the œsophagus with cuffs of nylon mesh. (*After E. F. Berman.*)

Radiotherapy.—In carcinoma of the upper and mid-œsophagus treatment by radiation frequently restores the ability to swallow, although this benefit lasts only a few months.

Growths of the Upper Third.—In the world's literature thirty-three five-year survivals following this form of therapy have been reported (D. W. Smithers). The magnitude and severity of extirpation of the œsophagus in this region, and the radio-sensitivity of most of the neoplasms, renders radiotherapy the method of choice.

Growths of the Mid Third.—The ^{60}cobalt teletherapy unit emits gamma radiation equivalent to the most powerful super-voltage X-ray machine, and a rotational device has enabled a more uniform dose to be delivered to the growth. In a number of instances, as a result of this treatment, the tumour disappears; however, in spite of improvement in swallowing, the majority of patients soon die of metastases.

Growths of the Lower Third.—Radiotherapy should not be employed. Frequently the neoplasm is columnar-celled and radio-resistant. Irradiation of the liver cannot be avoided, and this makes the treatment distinctly dangerous.

The results of radiotherapy plus operation appear to be little better than either alone.

PALLIATIVE PROCEDURES

When Thoracotomy reveals that the Growth is Irremovable.—If the neoplasm is situated at the cardia, the œsophagus can be divided above the growth, the lower end closed, and œsophago-jejunostomy-en-Y (Roux) performed above the obstruction. When the neoplasm is higher in the thoracic œsophagus, after similar exclusion, the previously mobilised stomach can be anastomosed to the upper end of the œsophagus.

When Inoperability is decided upon at a Clinical Examination.—The introduction of a Souttar's tube often permits the patient to take sufficient nourishment by mouth.

Edgar F. Berman, Contemporary. Assistant Surgeon, Sinai Hospital, Baltimore, Maryland, U.S.A.
David Waldron Smithers, Contemporary. Director of the Radiotherapeutic Department, The Royal Marsden Hospital, London.
Sir Henry Souttar, Contemporary. Consulting Surgeon, The London Hospital.

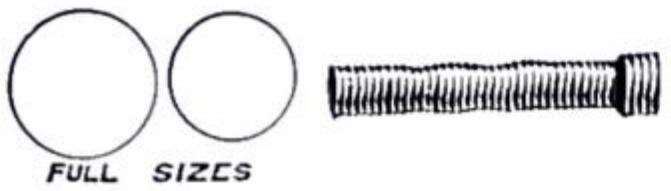


FIG. 452.—Souttar's tube.

The Souttar tube (fig. 452) is made of German silver wire with an expanded upper end, oval in section, and twisted in such a manner as to minimise upward displacement. The tube is introduced after dilatation under vision, with a special introducer. Each meal should be followed by a drink, and several times a day the patient should sip a dilute solution of hydrogen peroxide.

A polythene funnel (fig. 452a) has the advantage in that decaying food débris does not adhere to the smooth surface, as it is prone to do in the meshes of the wire of the Souttar tube. The metallic construction of the Souttar tube encourages ulceration of the tumour, with the result that the tube passes through the stricture. When the stricture is tortuous, the polythene tube can be softened in hot water to facilitate introduction. Sometimes this tube can be worn for as long as three months before requiring attention.

The funnel is the polythene counterpart of Symonds' tube (made of gum elastic), which was much in vogue at the beginning of the century.

FIG. 452a.—Polythene funnel to be worn in cases of inoperable stricture of the œsophagus. (*After J. K. B. Waddington.*)

Alternatively, gastrostomy or jejunostomy can be performed. Deep X-ray therapy is sometimes effective for growths in the upper half of the œsophagus, but is of little avail for those situated more distally. Implantation of radon seeds has been employed with occasional temporary improvement.

Terminal Complications.—Unresected, the growth causes death in one of the following ways :

1. Progressive cachexia and dehydration.
2. Pneumonia from perforation into some part of the bronchial tree.
3. Mediastinitis from perforation into the posterior mediastinum.
4. Erosion of the aorta (very rare).

Sir Charters Symonds, 1852–1932. Surgeon, Guy's Hospital, London.

CHAPTER XVIII

THE STOMACH AND DUODENUM

HAMILTON BAILEY

Surgical Anatomy and Physiology.—John Hunter described the stomach as "a gland with a cavity," and it is conventional to subdivide the organ into various parts (fig. 453). The mucous membrane is composed of some 35,000,000 branched tubular secreting glands packed closely perpendicular to the surface. The oxyntic and pepsin-secreting cells are confined mainly to the body of the organ.

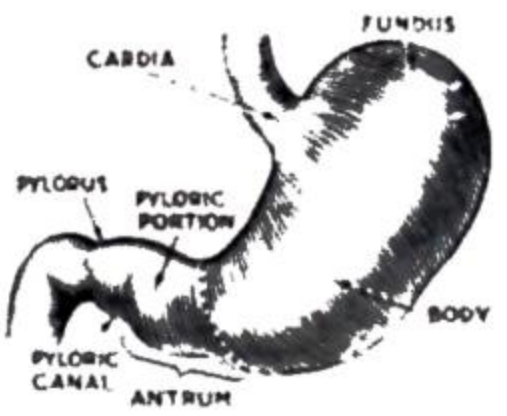


FIG. 453.—The subdivisions of the stomach.

Secretion of Gastric Juice.—Two distinct mechanisms are involved. The first to come into action is the nervous mechanism, via the vagi, from thought, sight, smell, and taste of food. The second is hormonal, the hormone gastrin being secreted by the mucous membrane of the pyloric canal (fig. 454), and absorbed into the blood-stream. Gastrin excites the secretory cells of the body and fundus of the stomach to activity.

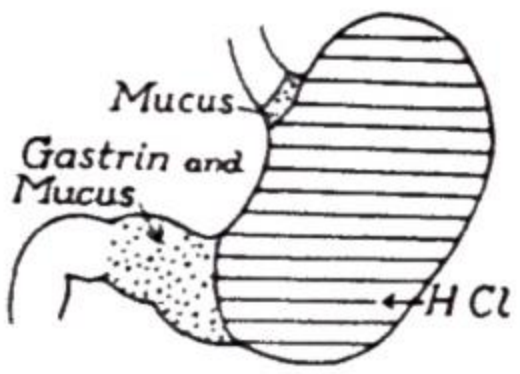


FIG. 454.—The location of the origin of the various gastric secretions. *(After Charles Wells.)*

Innervation.—Apart from peristaltic waves, the stomach possesses muscular tone, controlled by the intrinsic nerve plexuses in the walls of the viscus. The *vagus nerves* are the motor nerves of the stomach. The vagus nerves emerge from the œsophageal plexus and reach the stomach by passing through the œsophageal opening in the diaphragm, the left anteriorly, and the right posteriorly. The left vagus nerve supplies the anterior wall of the stomach and sends branches to the liver. The right vagus supplies the posterior wall and a large branch to the cœliac axis. The large number of vagotomies that have been performed have revealed that in 25 per cent. of cases the disposition of the nerves at the œsophageal hiatus is atypical—in 20 per cent. of cases the nerves are found as three trunks, and in 5 per cent. as four trunks.

The sympathetic innervation of the organ is, presumably, inhibitory.

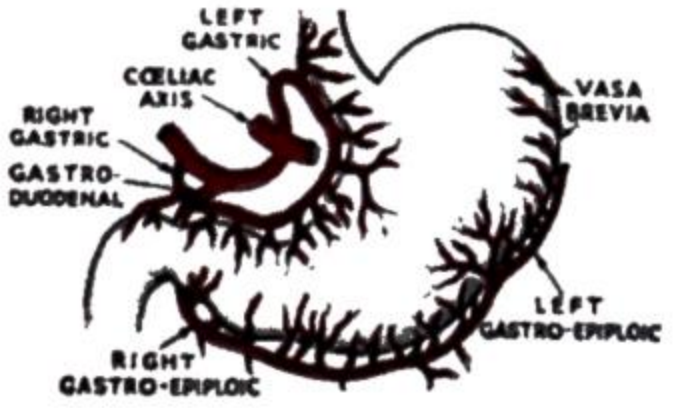


FIG. 455.—The arteries of the stomach. Frequently the right gastric artery is represented by a leash of vessels.

Arterial Supply (fig. 455).—(*a*) The left gastric artery, the smallest branch of the cœliac axis, runs towards the cardiac orifice and thence along the lesser curvature, from left to right, to join (*b*), the right gastric artery, which arises from the hepatic artery and pursues a course from right to left along the lesser curvature. (*c*) The gastro-duodenal artery is the largest branch of the hepatic artery. It passes behind the first part of the duodenum, where it bifurcates into the superior pancreatico-duodenal artery and (*d*) the right gastro-epiploic artery. (*e*) The left gastro-epiploic artery is the largest branch of the splenic artery. (*f*) Vasa brevia are five to seven small vessels that spring from the splenic artery towards its termination, and are distributed to the fundus of the stomach.

Veins.—Those corresponding with the right and left gastric arteries terminate in the portal vein. Those corresponding with the left gastro-epiploic artery and vasa brevia join the splenic vein, while the right gastro-epiploic vein empties into the

John Hunter, 1728–1793. Surgeon, St. George's Hospital, London.

increase in the incidence of Curling's ulcer. Such an ulcer is a menace to life from massive gastro-intestinal hæmorrhage or perforation.

CHRONIC PEPTIC ULCER

Ætiology.—The cause of chronic peptic ulcer is bound up with that of acute peptic ulceration, and has long been a matter for controversy. The following are the main theories which have been put forward. None is a satisfactory explanation for all the various forms of the lesion.

(*a*) *The Infective Theory.*—Bacteria, especially streptococci, from a distant focus are arrested in the gastric lymphoid follicles, which break down, forming an acute ulcer, which in turn becomes chronic.

(*b*) *Neurogenic Theory.*—That the ulcer is due to undue stimulation of the vagus nerves, which in turn results in hypersecretion and hypermotility of the stomach. Stress and anxiety are undoubtedly a leading cause of duodenal ulcer. It is more than probable that emotional, as well as physical stress, is hormonally transmitted to the stomach via the pituitary-adreno-cortical axis (see fig. 356).

(*c*) *Vascular Theory.*—Local embolism or thrombosis causes a devitalisation of an area of mucosa which is subsequently digested by gastric juice.

(*d*) *Accessory Causes.*—Inadequate mastication, indigestible food, irregular meals, excessive smoking, and vitamin deficiency have at one time or another been blamed, and unquestionably are, to some extent, predisposing factors to the formation of a chronic peptic ulcer.

(*e*) *Greater Frequency in Persons of Blood Group O.*—Persons of blood group O are about three times more likely to develop a peptic ulcer than are persons in other blood groups. It seems possible that the ABO genes may, in some way, modify the amount of hydrochloric acid that an individual can secrete.

(*f*) *Selective Liability to Duodenal Ulcer.*—Some members of the community have a liability to duodenal ulcer, possibly by virtue of their especially generous endowment of parietal cells or because of their blood group.

(*g*) Persistent and recurrent peptic ulceration occasionally is due to a non-insulin secreting islet cell tumour of the pancreas (see p. 474).

Pathology.—The ulcer-bearing area is shown in fig. 457. Outside this area ulcers are comparatively rare. A chronic peptic ulcer invades the muscular coats, which it tends to penetrate. Alternatively, the ulcer tends to heal, only to break down again, with further loss of tissue. Repetition of this cycle produces deformities, including pyloric stenosis and hour-glass contracture.

FIG. 457. — The ulcer-bearing area of the stomach and duodenum.

Chronic gastric ulcer is usually larger than a chronic duodenal ulcer. It varies in size, but in a well-established case it will admit the tip of a finger. The floor of a chronic gastric ulcer is situated in the muscular coats of the stomach, and as time goes on the ulcer occupying the posterior wall becomes adherent to, and later invades (chronic perforation), the pancreas. In the same way a chronic ulcer situated on the antero-superior aspect of the stomach can penetrate the liver, while a saddle-shaped ulcer situated on the lesser curvature can, and often does, penetrate both the liver and the pancreas.

Chronic Duodenal Ulcer.—The ulcer is always situated in the supra-ampullary portion of the duodenum, and sometimes two ulcers are present: one on the anterior surface and one on the posterior surface of the first inch of the duodenum. The anterior ulcer tends to perforate, the posterior one is prone to penetrate into the pancreas and in so doing it often erodes an artery.

Microscopical Examination.—There is nearly always greater destruction of the muscular coat than of the mucosa. The base of the ulcer is filled with sloughing granulation tissue; around this there is a zone of living granulation tissue. The arteries in the neighbourhood show evidence of endarteritis obliterans. Often there are no nerves in the floor of the ulcer but always many in the edge. The terminations of these nerves are bulbous, akin to those in an amputation stump (V. J. Kinsella). At the margin of the ulcer there may be epithelial proliferation, and downgrowths of glandular tissue are apt to be found beneath the muscularis mucosæ. These downgrowths are sometimes interpreted wrongly as indicating a carcinomatous change (W. Boyd).

A chronic duodenal ulcer rarely, if ever, becomes carcinomatous. On the other hand, there is ample proof that a long-standing chronic gastric ulcer sometimes becomes malignant, but how frequently this change takes place is a matter of great difference of opinion. While a much higher figure has been given in many series, it would seem probable that it does not exceed 5 per cent., and, in the opinion of many, this estimate is too high. Even **giant ulcers** (those with a crater of more than an inch (2·5 cm.)) are seldom carcinomatous.

Pathology of the Living.—At operation the presence of a chronic peptic ulcer may be evident as a white scar under the peritoneal coat. Delicate vascular adhesions, salmon pink and fluffy in appearance, can often be observed in the immediate neighbourhood of the peritoneal aspect of the ulcer. At other times the ulcer must be sought for by palpation; induration, frequently extensive in the case of a gastric ulcer, is centred over the mucosal lesion. When the ulcer is situated in the duodenum, the surrounding induration is not so evident, but if the ulcer is situated on the posterior wall it may be possible to feel the crater with the tip of the finger. A useful method of confirming the presence of a peptic ulcer, particularly one situated on the anterior wall of the duodenum, is to rub the peritoneal surface gently with a swab; the peritoneum overlying the ulcer becomes speckled, as though sprinkled with cayenne pepper (fig. 458), a characteristic phenomenon due to minute petechial hæmorrhages.

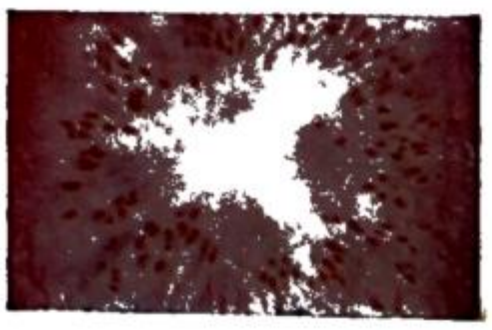


FIG. 458.—Petechial hæmorrhages around the peritoneal aspect of a chronic peptic ulcer. These become very noticeable after rubbing the surface gently with gauze.

It is sometimes difficult to be certain whether a given ulcer is gastric or duodenal. The veins of Mayo (see fig. 456) are a helpful landmark; an ulcer situated to the right of these veins must be a duodenal ulcer.

When at operation there is doubt concerning the presence of a gastric ulcer; if a careful search reveals that the related lymph nodes are enlarged, an ulcer is present (W. W. Davey). Further details of the pathology of the living as seen by gastroscopy appear on page 329.

Incidence.—Peptic ulcer, rare before the age of sixteen, becomes more frequent as middle age approaches, and in England nearly 10 per cent. of men aged forty-five to fifty-four years are thus afflicted. Occupation has some bearing on the condition; thus significantly high incidences are found among doctors, foremen, and business executives, while significantly low incidences occur among agricultural workers and sedentary workers, e.g. clerks, civil servants, and draughtsmen (R. Doll). The popular belief that bus-drivers are especially liable to this condition has not been

Victor John Kinsella, Contemporary. Surgeon, St. Vincent's Hospital, Sydney, Australia.
William Boyd, Contemporary. Professor of Pathology and Bacteriology, University of Toronto
William Wilkin Davey, Contemporary. Professor of Surgery, University College Hosiptal, Ibadan, Nigeria.
Richard Doll, Contemporary. Associate Physician, Central Middlesex Hospital, London.

substantiated. In many parts of the world, e.g. U.S.A., Scandinavia, this disease is as rife as it is in Great Britain. Conversely, the incidence among Africans and Asiatics living in their native lands is comparatively low. Duodenal ulcer is found four times more commonly than gastric ulcer in patients under the age of thirty-five years, but after forty-five years of age it is only one to two times more common. In Scotland the ratio of duodenal to gastric ulcer is higher than in England, while in India (where peptic ulcer is common) the ratio of duodenal to gastric ulcers is 30 : 1.

All over the world the incidence of peptic ulcer in women is about 1·7 per cent., much lower than in men, and in women the two types of ulcer are about equal. Chronic gastric and duodenal ulcers can co-exist, but such dual lesions are infrequent.

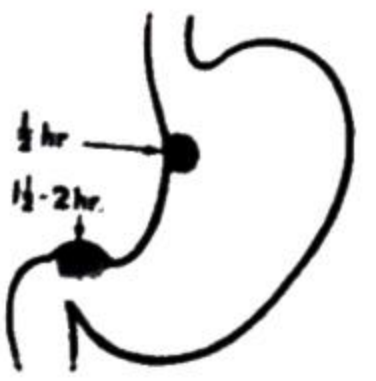
THE CLINICAL FEATURES OF GASTRIC AND DUODENAL ULCERS CONTRASTED

It is an excellent practice to record the patient's history under seven headings, preferably in tabular form.

Chronic Gastric Ulcer.—The patient is usually beyond middle age, and by reason of a restricted diet, is often thin. In many instances the patient appears anæmic, and this is often confirmed by a hæmoglobin estimation. On careful enquiry certain features of the dyspepsia become manifest. Typically there is :

1. *Periodicity*.—The attacks last from two to six weeks, and are followed by intervals of freedom from two to six months. The attacks are more in evidence in the spring and autumn.

2. *Pain* is epigastric, and occurs half to one and a half or two hours after food. This variation often bears a direct relation to the position of the ulcer, viz. :——→ The longer the ulcer has existed the more does the pain radiate.



3. *Vomiting*.—In over 50 per cent. of cases vomiting is a notable symptom. It relieves the pain, and may be self-induced.

4. *Hæmatemesis and Melæna*.—Approximately 30 per cent. of patients have suffered bleeding from the ulcer. The ratio of hæmatemesis to melæna is about 60 : 40.

5. *Appetite* is good, but the sufferer is afraid to eat.

6. *Diet*.—The patient learns to avoid meat and certain other foods, which vary with the individual. Milk, eggs, and fish are the staple diet.

7. *Weight*.—Usually by the time the surgeon is consulted there has been some loss of weight.

On examination there is frequently deep tenderness in the epigastrium, especially during seasonal exacerbations of the disease.

Chronic duodenal ulcer can occur at any time during adult life, but is commonest between the ages of twenty-five and fifty. As has been pointed out already, it is more common in men. The usual history is as follows :

1. *Periodicity* is usually well marked, and classically the attacks come on in the spring and in the autumn and are precipitated by 'work, worry, or weather.' These attacks usually last from two to six weeks, with intervals of freedom from one to six months.

2. *Pain* is severe, and may double the patient up. It usually occurs two to two and a half hours after food. As it is often relieved by food, the pain

is known as 'hunger pain,' and, classically, the patient carries biscuits, which he eats at frequent intervals to prevent this gastric torment. The pain, which is also relieved by alkalis, often awakens the patient in the early hours of the morning.

3. *Vomiting is very rare* in duodenal ulceration unless it is self-induced or stenosis has occurred. Regurgitation of burning fluid into the mouth ('water-brash'; 'heart-burn') is an extremely common complaint.

4. *Hæmatemesis and melæna*, which occur in the ratio of 40 : 60, but sometimes together, are rather more frequent than in the case of gastric ulcer.

5. *Appetite* is exceptionally good, but the patient sometimes refrains from eating solid food during the attacks.

6. *Diet.*—In contradistinction to patients with a chronic gastric ulcer, those suffering from duodenal ulcer who have not been ordered a special diet seldom display much dietetic discrimination, although some of the more intelligent find it advisable to avoid red meat and fried food.

7. *Weight.*—Usually there is no loss of weight; indeed, the patient often tends to become plump.

On examination it is not unusual to find localised deep tenderness in the right hypochondrium.

SUMMARY

	Gastric Ulcer	*Duodenal Ulcer*
Periodicity .	Present	Well marked
Pain . .	Half an hour after food	Two hours after food
Vomiting .	Considerable vomiting	No vomiting
Hæmorrhage .	Hæmatemesis more frequent than melæna.	Melæna more frequent than hæmatemesis.
Appetite . .	Afraid to eat	Good
Diet . .	Lives on milk and fish	Eats almost anything
Weight . .	Loses weight	No loss in weight

SPECIAL METHODS OF INVESTIGATION

Barium Meal.—The radiological findings are often conclusive. When a deep ulcer is present, there will be a niche seen throughout the examination (figs. 459 and 460), and a flake of barium persisting in the crater after the stomach has emptied.

FIG. 459.—Large penetrating ulcer on the lesser curvature. *(The late Dr. Mather Cordiner, London.)*

FIG. 460.—Duodenal ulcer showing typical trefoil or shamrock deformity. *(Dr. G. Stachurko, London.)*

Lord Moynihan 1865–1936, Surgeon, The General Infirmary, Leeds, first described 'hunger pain.'

In the case of an uncomplicated *gastric* ulcer, unless there is pylorospasm the rate of emptying is usually rapid, and there is no residue after six hours.

In cases of uncomplicated chronic *duodenal* ulcer the usual characteristic finding is initial rapid emptying of the major part of the meal, followed by delay of the remainder. In cases of longer standing, a deformity of the duodenal cap is often found, and sometimes an ulcer niche can be demonstrated (see fig. 460) with persistence of a flake of barium in the ulcer crater after the stomach and duodenum have emptied.

Referring particularly to chronic duodenal ulcer, the appearance of an ulcer crater seen on the radiograph varies in accordance with its position in the duodenum and, in the case of a trefoil ulcer, with the contour of the crater (fig. 461). In the case of inferior and superior ulcers the bulge (prestenotic diverticulum) occurs opposite the ulcer.

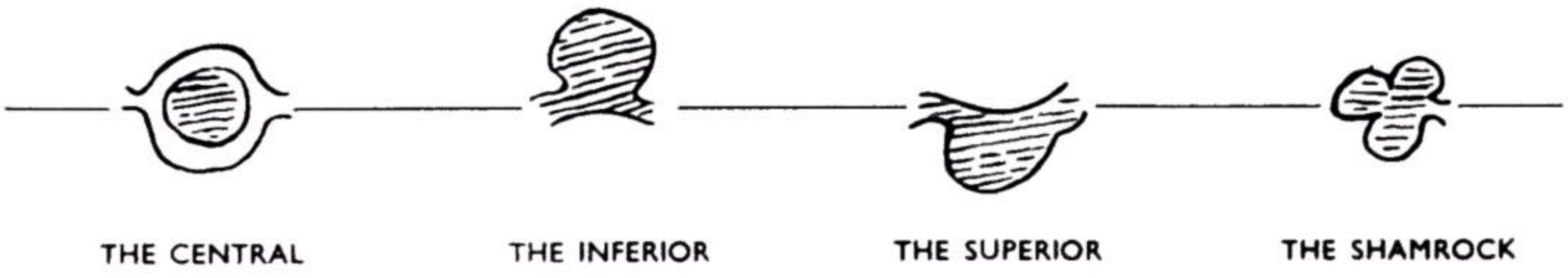


FIG. 461.—Common types of peptic ulcer craters as seen radiologically. (*After W. W. Davey.*)

A 'central' duodenal ulcer is nearly always situated on the posterior wall, for if an ulcer on the anterior wall penetrates, it soon perforates into the general peritoneal cavity.

Unless it is sufficiently deep to remain filled after the duodenum has emptied, an ulcer on the posterior wall of the bulb of the duodenum is the most difficult peptic ulcer of all to demonstrate radiologically. When the bulb is full of barium, the ulcer is totally obscured. Even at operation, it cannot be demonstrated unless the duodenum is opened.

The X-ray appearances of chronic peptic ulcer complicated by pyloric stenosis or hour-glass stomach are extremely characteristic (see pp. 340 and 342).

A hæmoglobin estimation is performed, and the vomitus, if any, and the stools should be examined for occult blood. Provided the patient has not eaten liver, or other food containing animal blood, for several days the finding of occult blood in the stools is of considerable diagnostic significance.

The Amount of Gastric Juice Collected at Night.—If the night secretion of gastric juice, collected by suction via a gastric aspiration tube, exceeds 500 ml. in twelve hours, it is confirmatory evidence of over-stimulation of the vagus nerves.

Fractional Test-meal.—To obtain representative samples of gastric juice the tip of the tube must lie within the body of the stomach, and the only way of being certain that it occupies this position is to have a radiograph taken after the tube has been passed. In the case of a chronic *gastric* ulcer the acid curve is not characteristic; it may be slightly raised, but often it is

normal (fig. 462). Of more diagnostic value is the presence of excess of mucus. The presence of blood in a fractional test-meal is a very unreliable sign; so often it is due to trauma produced by too much suction on the gastric aspiration tube.

In the case of an uncomplicated chronic *duodenal* ulcer, the acid curve rises

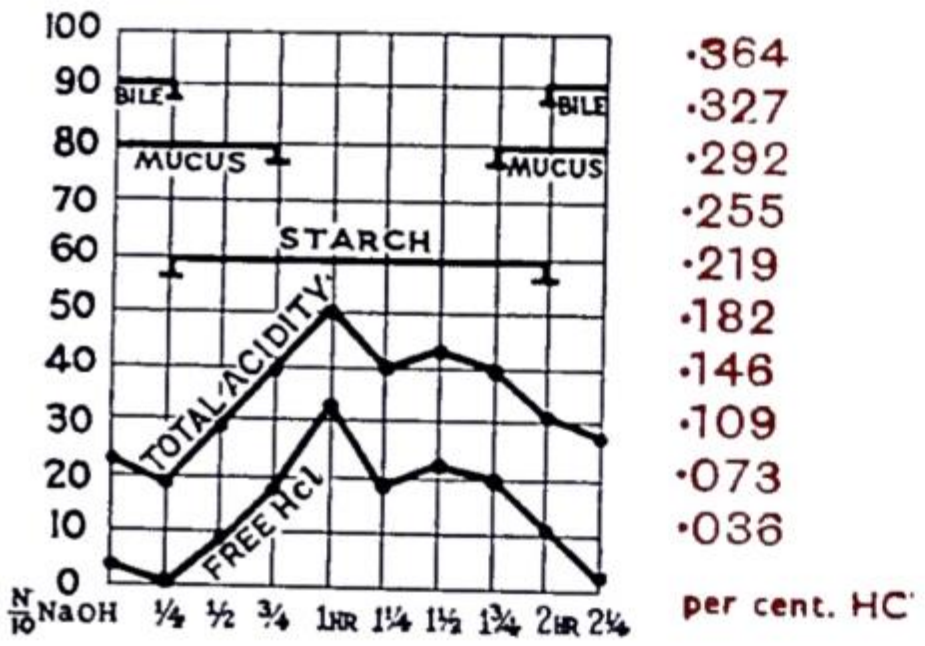


FIG. 462.—Normal fractional test-meal.

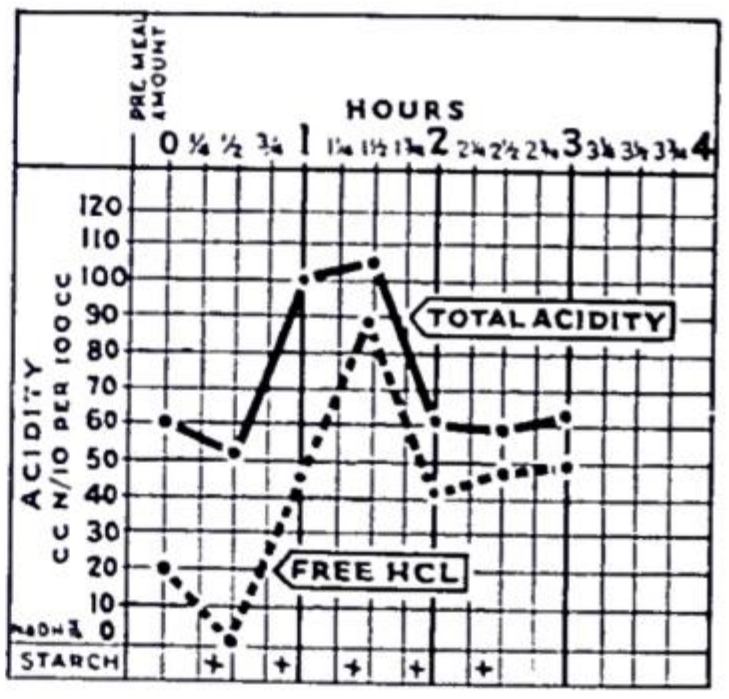


FIG. 463.—Typical steep curve of duodenal ulcer.

precipitously (fig. 463), reaching a maximum about two hours after a meal. This is caused by spasm of the pylorus preventing reflux of alkaline duodenal content.

Insulin Test-meal.—Insulin produces hypoglycæmia, a state that induces vagal stimulation: this causes an increased secretion of gastric juice. Fourteen units of insulin are given intravenously; the hypoglycæmia thus induced is measured by a blood-sugar reading forty-five minutes later. A fractional test-meal taken during the period of hypoglycæmia shows an increase in the total and free acidity over and above that of the usual fractional test-meal of that patient. After vagotomy, this test is negative.

Kay's augmented histamine test is the best method of estimating the maximum secretion of HCl by the parietal cells of the gastric mucosa. The cells are stimulated to activity by injections of histamine preparations before aspirating the samples of juice to be analysed. The technique of the test is beyond the scope of this work.

Gastroscopy, which is a method of examination that requires special training and considerable experience, affords valuable information. By its employment, with the exception of the areas shown in fig. 464, the whole of the interior of the stomach can be scrutinised by the eye of the gastroscopist.

FIG. 464.—The blind areas of gastroscopy.

Contraindications.—The passage of a gastroscope is contraindicated in the presence of inflammatory lesions of the mouth and pharynx, disease of the œsophagus, and in patients with an aortic aneurysm or an obvious spinal deformity. On account of dorsal kyphosis, the passage of the instrument down the œsophagus and the necessary manœuvres of it within the stomach are rendered difficult, and sometimes impossible, in persons over seventy years of age. The same difficulties are encountered in younger patients with osteoarthritis of the cervical spine, and those possessed of all, or nearly all, their teeth.

Indications.—Gastroscopy is valuable in the diagnosis of shallow gastric ulcers that do not show on radiography, in checking the results of medical

Andrew Watt Kay, Contemporary. Surgeon and Assistant, Peptic Ulcer Clinic, Glasgow Western Infirmary.
Georg Wolf, Contemporary, Optical-instrument Maker, Berlin, and Rudolph Schindler, Contemporary, Associate Professor of Medicine, University of Chicago (formerly of Munich), invented the gastroscope in 1932.

treatment in cases of chronic gastric ulcer, in the differential diagnosis between a chronic peptic ulcer (fig. 465) and a carcinoma (fig. 466), in the diagnosis

FIG. 465.—Gastroscopic view of the lesser curvature showing a gastric ulcer above the entrance to the antrum. (*Mr. W. W. Davey, London.*)

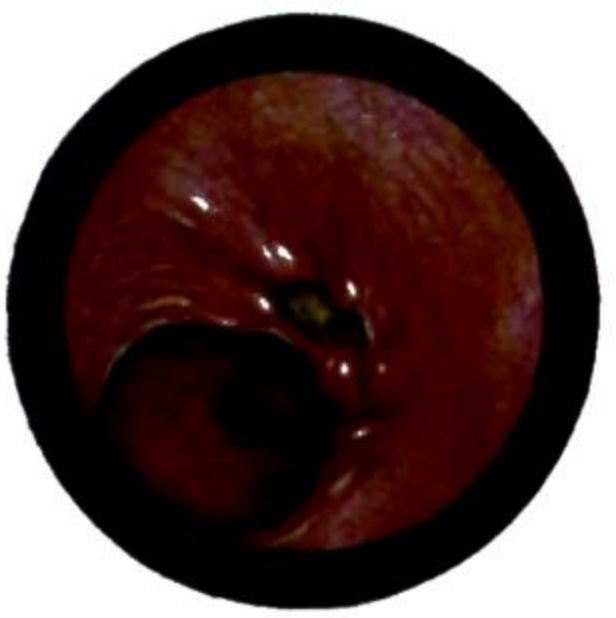


FIG. 466. — Early carcinomatous change in a chronic gastric ulcer seen by gastroscopy in a patient undergoing medical treatment for gastric ulcer. (*Mr. Hermon Taylor London.*

of a small gastric neoplasm, in the detection of certain forms of gastritis, and for the direct examination of the stoma in cases of suspected gastrojejunal ulcer.

Preparation and Anæsthesia.—After at least twelve hours' starvation, a suitable injection of morphine is administered. The patient is then asked to gargle 2 ml. of 4 per cent. xylocaine, and to continue to gargle for as long as he can manage it. Next the gastric aspiration tube is passed and the contents of the stomach are aspirated. The patient is sent to the operating theatre with the tube in place. After further aspiration the tube is removed. Although the examination can be undertaken without further anæsthesia, it is usual to administer pethidine intravenously (average dose 70 mg.), which renders the patient barely conscious.

Technique.—The gastroscope is passed and the stomach inflated with air. The flexible extremity of Hermon Taylor's instrument (fig. 467) can be

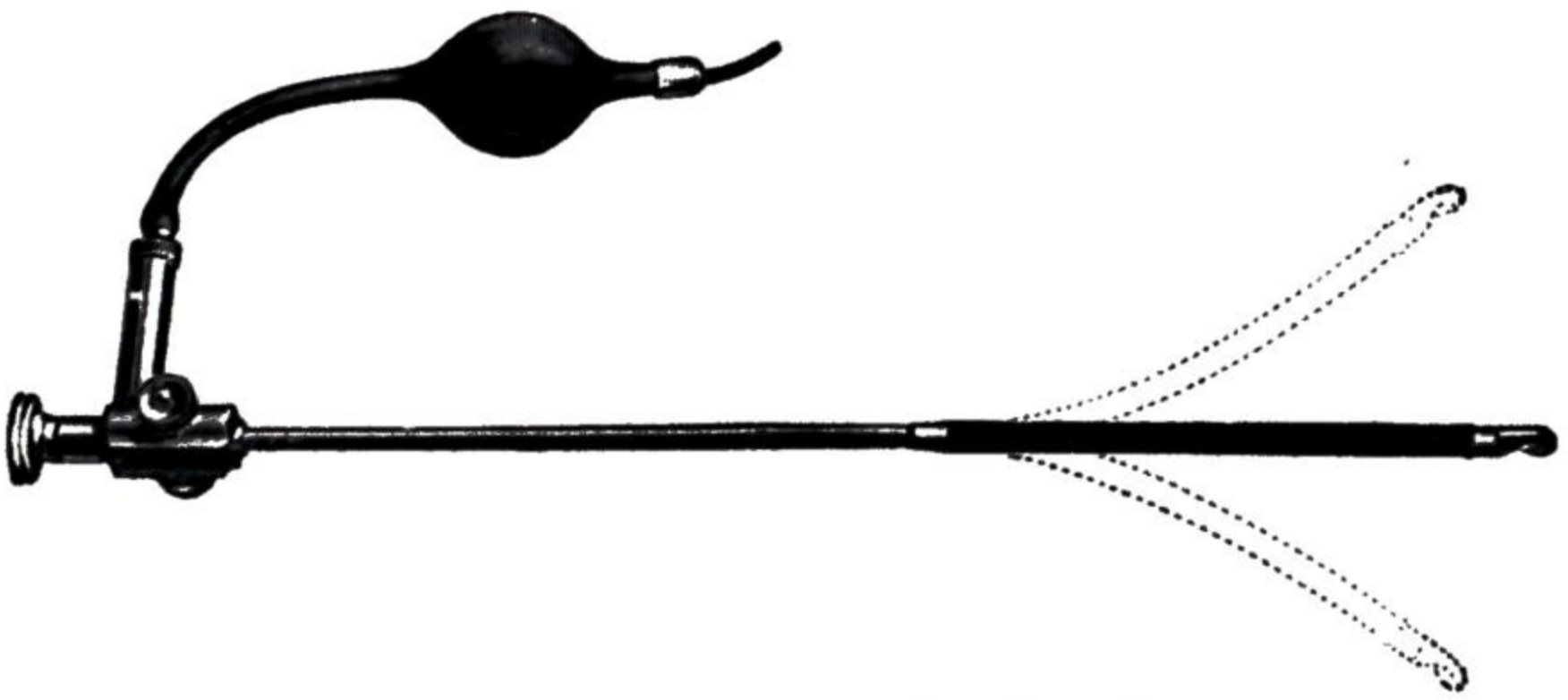


FIG. 467.—Hermon Taylor's flexible gastroscope.

moved into different parts of the stomach by means of a controlling wheel near the eyepiece, and with this instrument, with the exception of the blind spots referred to, all parts of the ulcer-bearing area can be examined, but

Hermon Taylor, Contemporary. Surgeon, The London Hospital.

positive radiographic evidence is more reliable than negative gastroscopic findings.

TREATMENT OF CHRONIC PEPTIC ULCER

All are agreed that in the absence of complications threatening life, in the first instance the treatment of a chronic peptic ulcer should be medical. When necessary, dental attention should be insisted upon, and as far as possible any other source of focal infection eliminated.

Medical Treatment.—The most important single factor in medical treatment is rest in bed in peaceful surroundings with the patient in the horizontal position with one pillow beneath his head. The doctor and the sister-in-charge must have ample time to talk to the patient, and thereby unfold any factor or factors that are causing stress, and strive to eliminate them. At least six weeks of rest in bed is essential for the healing of a peptic ulcer with a resulting supple scar. To afford the maximum rest to the ulcer-bearing area an intragastric milk drip delivered through fine polythene tubing, which patients will tolerate through the nose for a long time, has much to recommend it.

In patients with hyperchlorhydria, to administer an alkali such as magnesium trisilicate, magnesium carbonate, or aluminium hydroxide at frequent intervals is also of considerable value. Belladonna is prescribed if the patient complains of post-prandial pain. Ascorbic acid, 500 mg. daily, helps to expedite healing of the ulcer, while phenobarbitone, or cannabis indica (A. H. Douthwaite), are suitable drugs for promoting restfulness and mental tranquillity in highly-strung individuals. It should be noted that patients with a gastric ulcer and (almost) achlorhydria are benefited by giving weak HCl to drink with their meals (N. C. Tanner).

Probanthine is a ganglion-blocking agent that inhibits secreting activity. Its effect is that of a ' medical vagotomy,' and it powerfully inhibits acid secretion and motility of the stomach. Probanthine is given in conjunction with routine antacid and dietary treatment, in doses of 15 to 60 mg. (1 to 4 tablets) between meals and at night, and often it effectively relieves pain, especially in cases of duodenal ulcer.

The side-effects include dryness of the mouth, blurring of vision, dysuria, and tachycardia, and they are due to general parasympathetic inhibition. Usually after a few days with continuation of the drug these unpleasant sequelæ gradually cease. Although gratifying relief of pain is obtained, the final outcome of the ulceration and the indications for operation seem to be little affected by the use of this latest addition to the medical armamentarium.

The effects of medical treatment on the ulcer should, if possible, be viewed by gastroscopy as well as visualised by radiography.

As soon as healing of the ulcer bids fair, transnasal gastric drip feeding is abandoned in favour of one of the well-known ulcer diets.

When the patient resumes his occupation, irregular and unsuitable meals must be avoided. If the pre-operative free HCl was high, treatment with alkalis is continued for six months or more.

Indications for Operation.—In an age when every week millions spend uncountable man and woman hours in forecasting, listening to, and watching points being scored, it is perhaps forgivable to endeavour to set out a method

Arthur Henry Douthwaite, Contemporary. Senior Physician, Guy's Hospital, London.

of deciding whether to continue with medical treatment or to recommend elective operation by the scoring of points. The points system devised by W. W. Davey has been in operation at the Whittington Hospital, London, for some years. Points are allocated as follows, and two or more points weigh the scales in favour of operation :

1. Five year's history . .	1 point
2. Previous medical treatment, including six weeks' rest in bed . . .	1 point
3. One previous hæmorrhage . .	1 point (2 previous hæmorrhages, 2 points).
4. One previous perforation . .	1 point (2 previous perforations, 2 points).
5. *Sustained* evidence of pyloric stenosis	2 points (Stenosis due to œdema often responds to medical treatment).
6. Hour-glass contracture of the stomach	2 points
7. Suspicion of malignancy . .	2 points

It should be noted that given full facilities for repeated investigations, giant gastric ulcer (see p. 324) does not necessarily score even one point. This lesion often heals with three or more months of medical treatment, and it is (or becomes) malignant in only 2 per cent. of cases.

The pros and cons of urgent operation in cases of acute perforation and hæmorrhage threatening life are problems apart that are discussed on pp. 334 and 338 respectively.

OPERATIVE TREATMENT

Partial gastrectomy (with, in the case of a duodenal ulcer, resection of the first part of the duodenum) is the most reliable and, in many cases, the only operation that is likely to cure the condition.

FIG. 469.—Partial gastrectomy in progress. An ulcer penetrating the pancreas has been separated.

There are several methods of performing partial gastrectomy; in all, the initial steps are similar :

FIG. 468.—The main arteries supplying the stomach. Arrows and circles denote where these vessels are divided and ligated. The dotted lines show where the stomach and duodenum are divided.

The upper abdomen is opened by a right paramedian incision. Having verified the diagnosis, the first step is to open the lesser sac between the stomach and the transverse colon. The gastro-colic omentum is freed from the greater curvature and the first part of the duodenum by clamping and dividing this omental attachment and its contained blood-vessels as far as the duodenum on the right and to the level of the desired resection on the left, the gastro-epiploic vessels being ligated as shown in fig. 468. In a similar manner, the gastro-hepatic omentum is freed from the lesser curvature of the stomach and the superior surface of the first part of the duodenum, its main blood-vessels being ligated as illustrated. The duodenum is then divided between clamps, and in the Polya operation the duodenal stump is closed and invaginated, the suture line being reinforced by a covering of omentum. The stomach is turned over to the left (fig. 469), and is further

cleared of omental attachment, as necessary. The subsequent steps of the two principal forms of gastrectomy are described below.

The Billroth I operation can be described as a sleeve resection, and it is employed extensively for the treatment of *gastric* ulcer. As will be seen in fig. 470, after the resection has been effected the cut edges of the stomach are united and enfolded from the lesser curvature to within 2 inches (5 cm.) of the greater curvature. The small opening in the inferior part of the gastric stump is then anastomosed to the cut surface of the mobilised duodenum. The dotted outline shows how the gastric stump can be displaced to the right and how the mobilised duodenum can be drawn to the left—factors that are so important in minimising tension on the suture line.

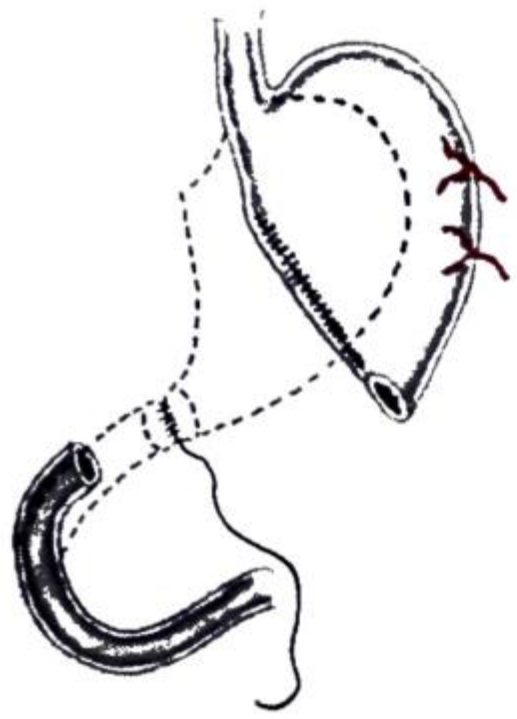


FIG. 470.—Billroth I operation. Dotted lines show rotation of the stomach, mobilisation of the duodenum, and the anastomosis in progress.

The Polya operation is the form of gastrectomy employed most often in the treatment of dual gastric and duodenal ulcers and cases of duodenal ulcer of long standing. The stomach and the first part of the duodenum having been devascularised as described already, the supra-ampullary portion of the duodenum is mobilised as far as possible, and when feasible the duodenum is divided beyond the ulcer. The distal end of the duodenum is then closed by two layers of sutures—a most onerous step. Should the tissues prove friable, rendering leakage possible, there should be no hesitation in providing drainage down to the site of the closure. The resection of the ulcer-bearing area of the stomach is carried out as described for the Billroth I operation, and in the same way the cut edges of the stomach are united to within 2 inches of the greater curvature. The anastomosis is effected by an end-to-side union of the stomach to the jejunum, care being taken to rotate the loop of jejunum so that isoperistalsis (see arrows in fig. 471) will occur. In order to minimise kinking, the afferent loop is anchored along the whole width of the stomach, the anterior and posterior surfaces of the jejunum being stitched to the corresponding surfaces of the stomach near its distal extremity. This results in the creation of a valve (the Hofmeister-Finsterer valve) between the greater parts of the lumina of the stomach and the jejunum. This valve (fig. 471) helps to prevent stomach contents entering the blind afferent loop and, to some extent, minimises too rapid emptying of the stomach. The operation described by Polya was retrocolic; many surgeons modify the original technique, and bring the coil of jejunum in front of the transverse colon.

FIG. 471.—Polya gastrectomy with a Hofmeister - Finsterer valve.

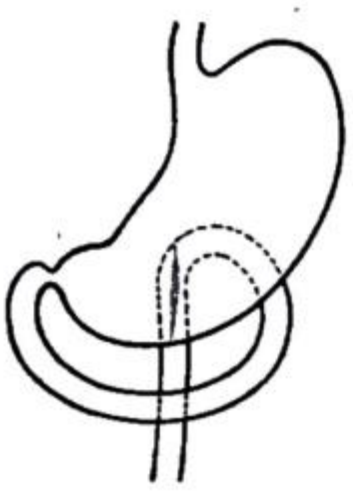


FIG. 472.—The posterior, vertical, short-loop retrocolic gastro-jejunostomy of Mayo.

Gastro-jejunostomy.—When performed in selected cases (*a*) for cicatricial pyloric stenosis; (*b*) in cases of duodenal ulcer occurring in patients over forty-five who can be shown to have relatively low acidity and slow emptying of the stomach; and (*c*) in most cases of duodenal ulcer in women (women are not prone to develop an anastomotic ulcer but they are very susceptible to post-gastrectomy syndromes); this operation gives good results and carries a very low mortality. A short-loop posterior operation with a vertical stoma extending to the greater curvature (fig. 472), is the type of this operation that gives the best results.

Theodor Billroth, 1829–1894. Professor of Surgery, Vienna.
Eugers Polya, 1876–1944. Surgeon, St. Stephen's Hospital, Budapest.
Franz von Hofmeister, 1867–1926. Professor of Surgery, Stuttgart.
Hans Finsterer, 1877–1955. Professor of Surgery, Vienna.
On September 27th, 1881, Anton Wolfler, of Vienna, first performed gastro-jejunostomy, the operation being suggested by Nicoladoni, his assistant.

In recent years it has become fashionable to disparage gastro-jejunostomy. Some examiners in surgery look askance at the very mention of the operation; others patronisingly concede that for the unskilled surgeon operating upon an unfit patient it has much to recommend it! What brought gastro-jejunostomy into disrepute was the development of a gastro-jejunal ulcer which, in point of fact, in collected published results of 5,000 cases from well-known clinics occurred in only 3 or 4 per cent. of cases. As E. L. Farquharson points out, gastro-jejunal ulcer following gastro-jejunostomy can be remedied comparatively easily by partial gastrectomy, whereas gastro-jejunal ulcer following partial gastrectomy often can be eradicated only by dismantling the anastomosis, resecting more of the stomach, followed by reanastomosis—an extremely difficult and dangerous undertaking.

Vagotomy (Vagus Nerve Section).—Both hypermotility and hypersecretion of the stomach are diminished by complete section of the vagus nerves (L. R. Dragstedt).

Vagotomy with gastro-jejunostomy is on trial, especially for duodenal ulcer [1] in young subjects. Some surgeons also advocate this combined operation when a duodenal ulcer is situated so far to the right that resection would endanger the common bile duct, and in cases of duodenal ulcer encased in adhesion (N. Blixenkrone-Møller). The operative mortality is lower than that of partial gastrectomy, and in the main a five-year follow-up of various series shows satisfactory results. There is a recurrence rate (comprising duodenal, gastric, or gastro-jejunal ulcer) of about 6 per cent., but these recurrences, as in the case of gastro-jejunostomy *per se* (which is never to be recommended in young subjects with duodenal ulcer), can be remedied relatively easily by partial gastrectomy. Now that the varying anomalous conformations of the vagus trunks (see p. 321) are better understood, it is possible that future section of all nerve fibres in every case will render recurrences less common. Vagotomy is also of great service as an additional measure in the treatment of gastro-jejunal ulcer.

The commonest complication following vagotomy is diarrhœa, which occurs in about 50 per cent. of cases. It seldom lasts more than a matter of a few weeks, and clears up either spontaneously, or with the administration of sulphasuccidine. Eructations are also common, but they, too, cease to trouble the patient after a varying time.

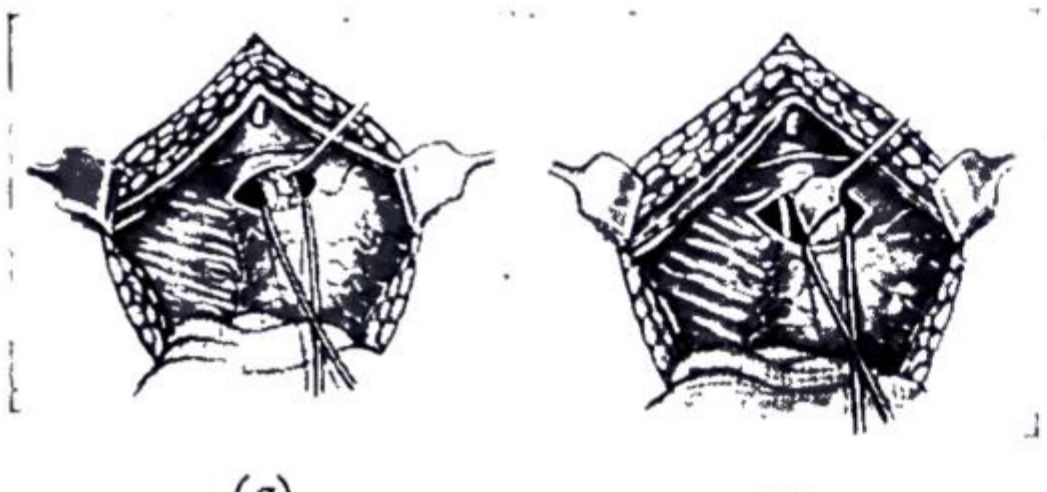
Operation.—A mid-line upper abdominal incision is made, and prolonged upwards to display the xiphoid process which, if necessary, can be excised. The left triangular ligament of the liver is exposed and made taut. This is divided close to its hepatic attachment and the left lobe is retracted to the right. Thus the region of the œsophageal hiatus is exposed, and a gastric aspiration tube, left in place, can be palpated within. The stomach is retracted downwards and the comparatively large inferior phrenic vein will be seen coursing across the under-surface of the diaphragm just anterior to the œsophageal hiatus. The peritoneum overlying the œsophagus is incised transversely below this vein. The terminal 3 inches (7·5 cm.) of the œsophagus is mobilised by digital dissection. During this procedure the vagus nerves can be felt as taut cords and thus they can be differentiated from the more yielding muscle of the œsophagus. At the conclusion of this manœuvre a length of ½-inch (1·3 cm.) rubber tubing is passed around the œsophagus to serve as a retractor (fig. 473).

The left vagus nerve usually lies on the anterior aspect of the œsophagus; it is mobilised for a distance of 3 inches (7·5 cm.) and this segment is resected. In 90 per cent. of

[1] "If a surgeon threatened me with partial gastrectomy for a small duodenal ulcer, he would have to run faster than I." (C. H. Mayo.)

Eric Leslie Farquharson, Contemporary. *Surgeon, Royal Infirmary, Edinburgh.*
Lester Reynold Dragstedt, Contemporary. *Professor of Surgery, University of Chicago.*
Niels Blixenkrone-Møller, Contemporary. *Professor of Surgery, Aarhus, Denmark.*

cases the left vagus nerve is mobilised with the œsophagus, but sometimes it bears a relation other than the typical anterior disposition, and frequently two or more additional nerve fibres exist. These can be felt better than they can be seen, and they must always be resected.



(*a*) (*b*)

FIG. 473.—(*a*) Left vagus nerve, usual disposition. (*b*) Right vagus nerve. Note that it does not cling to the œsophagus. (*After C. G. Rob.*)

The right vagus nerve (fig. 473(*b*)) differs from the left in that it is rarely mobilised with the œsophagus; it remains behind on the right side, often covered by the right crus of the diaphragm. Failure to find this nerve, which is the larger of the two vagi, accounts for many unsuccessful vagotomies. Again, the nerve is felt better than it can be seen, and when found, is mobilised sufficiently to permit resection of about 3 inches (7·5 cm.). A careful search must always be made for extra fibres, the finding of which, together with their division, will reduce the number of unsuccessful operations.

The incision in the peritoneum overlying the œsophageal hiatus is sutured, and the abdomen is closed.

When adhesions from a previous abdominal operation are likely to prove formidable, vagotomy can be performed through a thoracic incision.

The results obtained by performing vagotomy alone are seldom of lasting benefit.

COMPLICATIONS OF CHRONIC PEPTIC ULCER

Acute — Perforation.
Severe hæmatemesis and/or melæna.

Intermediate.—Perigastric abscess.

Chronic — Stenosis — Pyloric stenosis.
'Tea-pot' deformity.
Hour-glass contracture.
Penetration into neighbouring viscera, notably the pancreas.
Neoplastic change.

PERFORATED PEPTIC ULCER

Sex.—The ratio is 19 men to 1 woman (C. F. Illingworth).

Age.—The highest incidence is between forty-five and fifty-five years of age (fig. 474).

Most often a peptic ulcer that perforates is situated on the anterior surface of the duodenum; much less frequently it is situated on the anterior surface of the stomach, usually near the lesser curvature or the pyloric antrum. Rarely an ulcer on the posterior wall of the stomach perforates into the lesser sac. In 80 per cent. of cases there is a history—often a long history—of peptic ulceration. In 20 per cent. there is no such history; it is a 'silent' chronic ulcer that perforates.

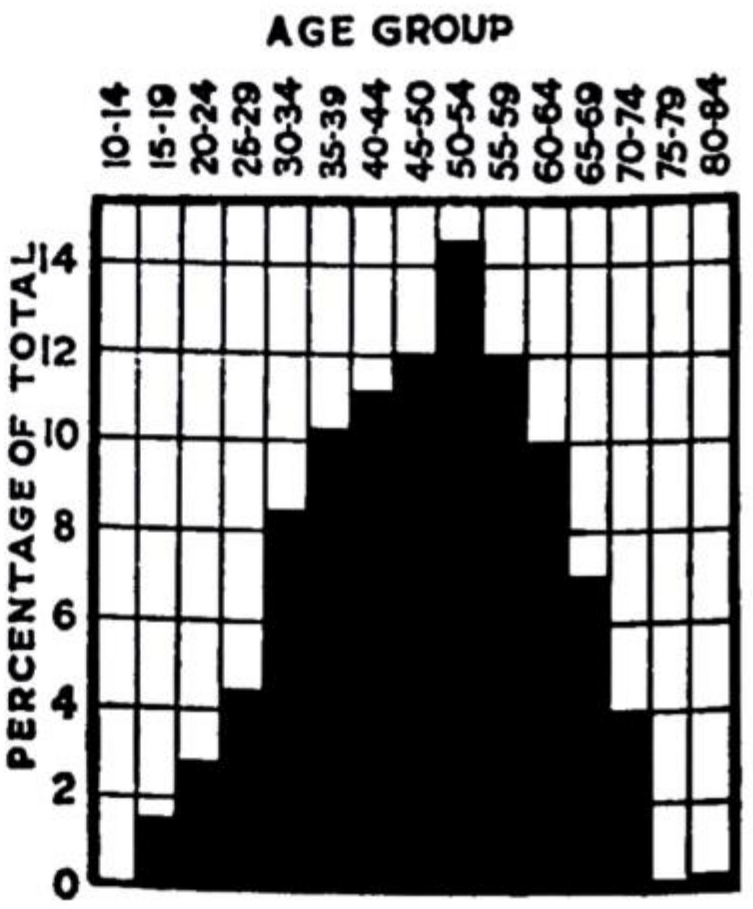


FIG. 474.—Age incidence of perforated peptic ulcer compiled[1] from 1,055 cases of perforation collected from sixteen London hospitals. (*D. N. Stewart and D. M. de R. Winser.*)

[1] D. N. Stewart and D. M. de R. Winser compiled these statistics while they were medical students at Charing Cross Hospital, London.

Usually the symptoms of perforation come on with dramatic suddenness.

The gastric or duodenal contents escape through the perforation into the general peritoneal cavity, provoking widespread peritoneal irritation (peritonism). At that moment the victim cries out in agony, and, at any rate if the perforation is a large one and the stomach is full, he is riveted temporarily to the spot where the perforation felled him. The peritoneum reacts to this chemical irritation by secreting peritoneal fluid copiously. For a short time this outpouring relieves the pain, and the stage of reaction is at hand. This stage of reaction lasts from three to six hours, and is followed by diffuse bacterial peritonitis.

Clinical Features.—1. *Stage of Peritonism.*—Examination reveals a pale, anxious individual obviously in great pain. The temperature is usually subnormal, and *the pulse-rate frequently in the neighbourhood of* 80 *or* 90, and remains so during the first six hours. The upper abdomen of a thin subject will be seen to be scaphoid, and it moves little or not at all with respiration (fig. 475). The palpating hand at once recognises an abdominal rigidity which is general and board-like. The whole abdomen is tender and inclined to be dull to percussion. In a small percentage of cases, sufficient gas escapes to cause a diminution of the normal liver dullness in the mid-axillary line. A rectal examination sometimes reveals tenderness in the recto-vesical pouch. When a comparatively small perforation is situated in the duodenum, the escaping fluid is sometimes directed down the right paracolic gutter to the right iliac fossa. The symptoms then simulate closely those of acute perforated appendicitis.

FIG. 475.—Watching for abdominal movement on respiration. In cases of perforated peptic ulcer abdominal movement is restricted or absent.

FIG. 476.—Showing gas beneath the diaphragm. Plain radiograph of a patient with a perforated duodenal ulcer.

2. *The Stage of Reaction.*—The severe abdominal pain lessens, and the patient says he feels better. The temperature becomes normal or elevated 1 degree, but the pulse-rate is usually still in the neighbourhood of 90. This temporary improvement in the general condition has been termed the 'period of illusion,' and it occurs between the third and sixth hours after the perforation. On examination there is a varying amount of rigidity, but it is not board-like; there is tenderness, and because of the considerable quantity

of free fluid present, shifting dullness can often be elicited. Because of paresis consequent upon chemical peritonitis, bowel sounds are infrequent, or absent.

Radiography.—When a perforation is present, in about 70 per cent. of cases a plain radiograph will reveal a crescent-shaped translucent area beneath the right cupola of the diaphragm (fig. 476). In cases of clinical doubt (for instance, if the patient has been given morphine) when the gastric contents have been aspirated, 20 to 30 ml. of air are injected into the stomach. After the patient has lain on his left side for a few minutes a radiograph is taken in the sitting posture, and if a perforation is present, the crescent-shaped translucent area will be seen in every case.

3. *The Stage of Diffuse Peritonitis.*—After six or eight hours the signs gradually change to those of diffuse peritonitis. The abdomen slowly becomes distended and the intense rigidity tends to pass off. By this time enough free fluid may have collected in the peritoneal cavity for shifting dullness to be elicited.

After the sixth hour the pulse-rate increases gradually, and with each passing hour, in the absence of operative treatment, the general condition of the patient gradually deteriorates. (See Chapter 24, The Peritoneum.)

FIG. 477.—Perforated gastric ulcer exposed by laparotomy.

Treatment.—Morphine should not be given until written permission for operation has been obtained. Operation, as soon as the general condition permits, is usually the best course. Laparotomy is performed (fig. 477) and the perforation is closed with interrupted sutures. In large perforations it is advisable to reinforce the suture line with a patch of omentum. With a mechanical sucker or swabs, free fluid and food débris is removed from the peritoneal cavity. Suprapubic drainage of the peritoneal cavity is employed in late cases, or when the leaking contents are foul, e.g. pyloric stenosis is present. The laparotomy incision is then closed. The immediate after-treatment consists in giving continuous intravenous dextrose-saline solution, and as soon as the patient awakens from anæsthesia he should be placed gradually in modified Fowler's position. Antibiotic therapy has contributed to the improvement of results.

Partial gastrectomy is indicated occasionally as an emergency procedure: (*a*) when the perforation is deemed to have occurred in a carcinomatous ulcer; (*b*) when perforation is accompanied by severe hæmorrhage (hæmatemesis and/or melæna); (*c*) in a case of recurrent perforation. But in each instance the patient must be in exceptionally good general condition.

Conservative (Aspiration) Treatment.—Hermon Taylor advises non-operative treatment. His instructions are as follows:

The patient is placed in low Fowler's position and receives not more than one dose of ¼ grain (15 mg.) of morphine subcutaneously. If after six hours of gastric aspiration he does not experience considerable relief of pain, a radiograph is taken with a portable machine (this must be available) and the diagnosis is reviewed. Repeated radiographs are an integral part of the régime. If the perforation becomes sealed with fibrinous lymph, the subdiaphragmatic shadow of air diminishes in size slowly.

First twenty-four hours: Aspiration every half-hour. Three pints (1·7 l.) of fluid parenterally plus the amount of fluid aspirated.

George Ryerson Fowler, 1848–1906. Surgeon, Brooklyn Hospital, New York.
Ludwig Heusner, 1846–1916, Surgeon, Barmen, Germany, performed the first successful operation for perforated peptic ulcer in 1892.

Second twenty-four hours : Aspiration every hour, followed by drinks of 1 ounce (30 ml.) water.

Third twenty-four hours : The same as the second twenty-four hours, but a mixture of milk and water instead of water only.

On the fourth day the tube is removed if the fluid chart proves that all the fluid taken by mouth is indubitably passing onwards.

As yet there is no conclusive evidence that treatment by aspiration, which is practised much less frequently than operative treatment, has effected a lowering of the mortality, even when the desirable nursing facilities are of a high order. It is more than probable that the incidence of intraperitoneal and subdiaphragmatic abscesses is higher than after operative treatment. The method is contraindicated in the presence of bleeding or pyloric stenosis, after a heavy meal and in air swallowers. Provided the diagnosis of perforated peptic ulcer can be made with assurance, conservative (aspiration) treatment is the method of choice in patients with a cardiac lesion, emphysema, or some other condition which renders operation dangerous. At all times the chief danger of conservative treatment lies in the assumption that a correct diagnosis has been made : not a few deaths following its use are attributable to the incorrectness of that assumption. Another drawback is that if a carcinomatous ulcer has perforated, the fact that it is a carcinoma is missed.

Follow-up of Patients who Survive Perforation.—As might be expected, there is a transient remission of symptoms due to the rest in bed and the careful dietetic supervision during convalescence. Elderly patients and those of any age with a short dyspeptic history are the ones who are likely to remain symptom-free after successful treatment of a perforation (C. F. Illingworth). Nevertheless, within one year 40 per cent. of patients relapse, and within five years 70 per cent. On this account, those who have been fortunate enough to survive perforation should be followed up as out-patients, so that if symptoms suggesting renewed activity of the ulcer occur, timely treatment can be instituted.

'Dry' Perforated Peptic Ulcer.—By this is meant that a perforation of the stomach or the duodenum occurred while the stomach was empty or, what is more usual, the perforation becomes sealed by a tag of omentum, the fundus of the gall-bladder, or, most frequently of all, an anterior perforation of the duodenum becomes sealed by the inferior surface of the right lobe of the liver. The onset does not differ from that of the more usual perforation, but in a matter of a few hours the pain diminishes and rigidity and tenderness become localised to the right upper quadrant of the abdomen. The condition is sufficiently common for a diagnosis of dry perforation to be made with some confidence, in which case the advisability of aspiration treatment can be considered.

Perigastric abscess is an uncommon condition that arises in one of two ways : (1) the amount of fluid escaping from a leaking duodenal ulcer due to a minute perforation may be small enough to be confined to Morison's right kidney pouch, and there become shut off from the rest of the peritoneal cavity by adhesions ; (2) an ulcer on the posterior wall of the stomach perforates into the lesser sac, the foramen of Winslow being occluded by adhesions.

Some days after an acute attack of upper abdominal pain a tender swelling appears in the epigastrium or right hypochondrium. Usually the temperature is elevated.

Treatment.—If on laparotomy an abscess of the first variety is found, it is best to drain it through a counter-incision in the flank. An abscess of the lesser sac can be drained conveniently through the gastro-hepatic omentum. A gastric or duodenal fistula may result from the drainage of a perigastric abscess.

Subphrenic Abscess, see p. 489.

Rutherford Morison, 1853–1939. Professor of Surgery, University of Durham.
Jacob Winslow, 1669–1760. A Dane who migrated to Paris, and there established a School of Anatomy.

HÆMATEMESIS AND MELÆNA

Ætiology.—Chronic peptic ulcer	. . . . .	65% of cases.
Acute peptic ulcer (p. 322)	. . . . .	30% „ „
Œsophageal varices (p. 303) Carcinoma of the stomach (p. 349) Peptic ulcer in a Meckel's diverticulum (p. 521) Purpura (p. 88) Hæmophilia Pernicious and other anæmias	. . . .	5% „ „

(Compiled mainly from statistics by Avery Jones.)

Pathology.—*Chronic Peptic Ulcer.*—Slight bleeding due to trauma from solid food occurs frequently from all chronic peptic ulcers; such bleeding is demonstrated by finding traces of blood in a fractional test-meal and occult blood in the stools. In about 20 per cent. of cases of chronic peptic ulcer, sooner or later a sudden and serious hæmorrhage occurs, due to erosion of an artery in the floor of the ulcer. Occasionally the artery thus implicated is of considerable size, such as the splenic or the gastro-duodenal artery; more usually it is a branch of one of these vessels. Past the meridian of life arteries are liable to become sclerotic; once a sclerotic artery has been eroded, even if it is sealed by clot, it is liable to bleed again (fig. 478). Even when a large vessel is eroded, death from hæmorrhage seldom results from the initial hæmorrhage. Far more frequently a large hæmorrhage is heralded by two or three smaller ones on consecutive days, as in other cases of secondary hæmorrhage.

FIG. 478.—Fatal hæmatemesis. Sketch made in the post-mortem room, showing an open arterio-sclerotic vessel in the floor of a chronic gastric ulcer.

Acute Peptic Ulcer.—In addition to acute gastric ulcers, a few of which are due to drug reactions (see p. 322), this group includes acute peptic ulceration associated with œsophageal hiatus hernia (see p. 307) and cases of traumatic longitudinal tearing of the mucosa of the lower œsophagus resulting from violent vomiting—a lesion that has been described only comparatively recently.

Clinical Features.—Serious hæmorrhage from a peptic ulcer is ushered in by the patient saying he feels faint, and by pallor; occasionally he collapses. Soon afterwards there is hæmatemesis, which is effortless vomiting of coffee-ground material, sometimes followed by bright-red blood and/or the passage of a melæna stool. So great may be the bleeding that bright-red clotted blood is passed per rectum.

The pulse becomes rapid and the blood pressure low.

Treatment.—*On admission* the collapsed patient is laid flat, with one pillow under the head, and the foot of the bed is raised. He is accorded the usual number of blankets for the time of year, and not heated artificially in any way. If restlessness is in evidence, morphine grain $\frac{1}{6}$ (10 mg.) is given intravenously and repeated in four hours if necessary. While arrangements

Francis Avery Jones, Contemporary. Physician, Central Middlesex Hospital, London.

(including cross-matching) are being made for blood transfusion, if the blood pressure is very low a plasma or dextran infusion is given. The important consideration is to replenish the circulation without overloading it, and a drip blood transfusion proportional to the estimated blood loss should be given. A pulse chart, if necessary half-hourly, is compiled, and a careful watch is kept on the blood pressure.

Very soon after a severe hæmorrhage the value of the hæmoglobin estimation is often unchanged, and therefore no reliance should be placed upon it at this critical time. After three hours, estimations, repeated at frequent intervals, provide helpful information.

The patient should be revisited in one hour. As a result of replenishing the circulation, improvement often occurs. Conversely, signs that bleeding has very seriously depleted the blood volume and is probably progressing are increasing pallor, increasing pulse-rate, beads of sweat on the forehead, and clammy palms of the hands.

In the treatment of acute gastro-intestinal bleeding due to peptic ulceration, co-operation between the physician and the surgeon is of cardinal importance. In deciding whether conservative or operative treatment is the best course they will take into consideration the following factors :

History.—Sometimes, on account of the anæmia, the patient's history is unreliable, in which event it is necessary to obtain all possible information from the relatives. Should it transpire that the patient has been treated for gastric trouble at another hospital, no time should be lost in telephoning to that hospital, because all-important radiographic evidence may be forthcoming. In general, the patient with a short history is more likely to respond to medical treatment than one whose history suggests a deep penetrating ulcer. However, this generality must be tempered by taking into consideration the patient's age, his build, and the character of the bleeding.

The Age of the Patient.—When under forty-five years of age, in the majority of instances medical treatment has a successful outcome. Over the age of forty-five the mortality rate from hæmorrhage rises *pari passu* with advancing years.

The Character of the Bleeding.—A sudden fall in blood pressure or collapse favours bleeding from a vessel of considerable size such as the gastro-duodenal or the splenic artery, in which event urgent operation is the only course likely to save the patient's life.

The Build of the Patient.—In the very fat the difficulties of the operation are increased greatly ; when the patient is thin, partial gastrectomy often proves straightforward.

Bleeding in Spite of Medical Treatment.—When a patient under a proper medical régime at rest in bed bleeds from a peptic ulcer, or bleeding that had ceased recommences, the call for operation is compelling.

Medical Treatment.—The essentials of medical treatment are :

Blood Transfusion.—When the estimated blood loss has been replenished, a drip transfusion is continued at the rate of 30 drops a minute for as long as is deemed necessary. The aim always is to render and maintain the reading of

the hæmoglobin level at least 5 points above that of the patient's age, i.e. if he is sixty, the hæmoglobin should be at least 65 per cent. In addition, frequent pulse-rate and blood-pressure readings are continued for at least three days after the apparent cessation of hæmorrhage.

Morphine.—Sufficient morphine is prescribed to keep the patient just drowsy. When it is considered that the hæmorrhage has ceased, the dose is reduced very gradually over forty-eight hours.

Diet.—Within two hours of admission feeding by mouth[1] is commenced. Two-hourly 7-ounce (200-ml.) feeds of milk, egg and milk, alternating with Benger's Food or Ovaltine, are given. After three days milky porridge is allowed. It is essential that the patient should drink at least $3\frac{1}{2}$ pints (2 l.) of one-third normal saline flavoured with orange juice each twenty-four hours and that an accurate balance-sheet be kept.

Prevention of Pulmonary Complications.—These patients are prone to develop respiratory infection, and not a few of them have bronchitis, with or without emphysema. The patient can be propped up gradually into the sitting position. Breathing exercises are valuable. Patients with chronic bronchitis are given a suitable prophylactic antibiotic.

Operative Treatment.—Should operation be deemed advisable, the aim must be to make the decision within seventy-two hours of admission. Experience has shown that when operation is delayed beyond that time the mortality rises steeply. Before the patient is anæsthetised it is essential to ascertain that the blood transfusion is capable of rapid acceleration. In this connection, sometimes it is advisable, in order to provide a stream of blood equivalent to that of the splenic or the gastro-duodenal artery, to set up a second transfusion into another vein. The aim of the operation is to stop the bleeding. This usually entails carrying out partial gastrectomy, including the bleeding ulcer. Other procedures have proved unreliable.

When no ulcer is found, if the rate of hæmorrhage is computed to be faster than that of the standard rate for prolonged transfusion (30 drops per minute), partial gastrectomy is still the best course. In other circumstances the abdomen should be closed, and the transfusion continued. In these cases, after irrigating the stomach through a gastric aspiration tube with 1 pint (568 ml.) of sterile water, 20 ml. adrenaline hydrochloride (1 : 1,000 solution) injected down the tube and, twenty minutes later (after the lavage has been repeated), a further 20 ml. of adrenaline is injected, followed a few minutes later by 5 ml. of stypven.[2] In order to ensure that none of the stypven remains in the tube, 5 ml. of sterile water is injected. Often in this type of case such treatment is rewarding.

CHRONIC COMPLICATIONS

1. **Pyloric stenosis** is usually the result of cicatrisation of a duodenal ulcer; therefore in this instance the term *pyloric* stenosis is inaccurate—it

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[1] Einar Meulengracht, Emeritus Professor of Medicine, Copenhagen, introduced in 1935 early liberal purée feeding in these cases. Before that time absolute starvation by mouth for several days was the unwavering rule.

[2] Russell's viper venom (Burroughs Wellcome).

should be called duodenal stenosis. Occasionally fibrotic stenosis follows a prepyloric ulcer. Attention has been directed already to temporary pyloric stenosis due to œdema associated with an active prepyloric ulcer. Not infrequently pyloric stenosis is due to a carcinoma situated at or near the pylorus.

FIG. 479.—Pyloric stenosis. Wave of peristalsis passing from left to right.

When secondary to an ulcer, there is a history of a long-standing peptic ulcer, with the following modifications :

Periodicity is lost, and pain becomes constant.

Pain comes on immediately after food, and remains as a constant heavy discomfort with attacks of colic due to excessive peristalsis.

Vomiting.—Very large foul and frothy vomits are characteristic. They usually occur once a day, commonly in the evening. Classically, the patient recognises currants or other undigested particulate matter eaten one or more days previously. Vomiting does not entirely relieve the discomfort.

FIG. 480.—Typical X-ray appearance of pyloric stenosis. The barium meal lies as at the bottom of a bowl. (*Professor Carl Krebs, Aarhus, Denmark.*)

On Examination.—In thin subjects with considerable stenosis of the duodenum or the pylorus, the outline of the full, dilated stomach can sometimes be observed. Visible peristaltic waves passing from left to right (fig. 479) are characteristic. These patients may be mentally confused as a result of vitamin B deficiency or of alkalosis.

Barium Meal.—The stomach is large and low (fig. 480), and often takes more than six hours to empty.

Fractional test-meal registers a high *total* acidity, partly due to fermentation and partly due to union of free acid with food débris and mucus. The latter may result in lowering of the free HCl. The contour of the fractional test-meal curve tends to be raised, but flat—the so-called plateau curve (fig. 481). As shown in the chart, the starch content is high in all specimens.

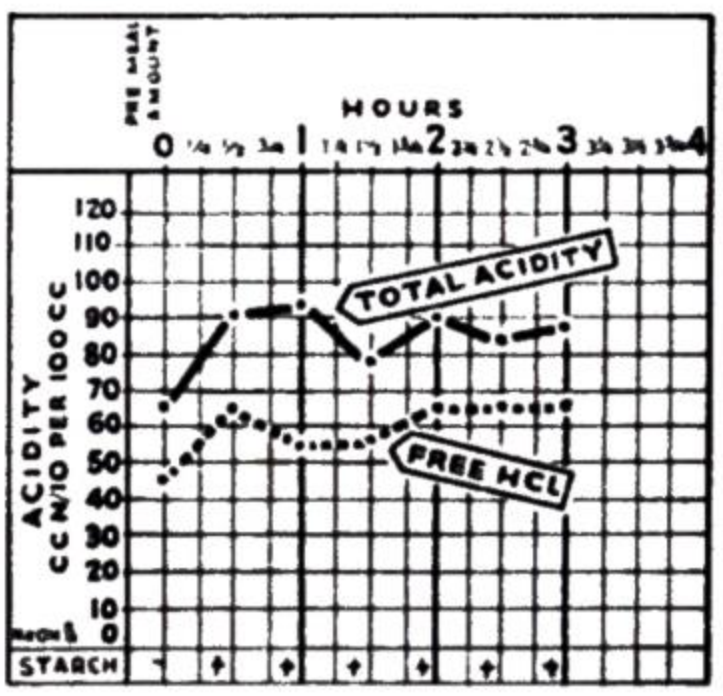

FIG. 481.—Plateau curve of pyloric stenosis.

Treatment.—Preliminary treatment with gastric lavage, a high-protein diet, and correction of chloride and vitamin (particularly B and C) deficiencies is necessary. In cases with a persistently low free HCl content, gastro-jejunostomy gives satisfactory results. If, however, the ulcer is active, partial gastrectomy is indicated; should the condition be due to carcinoma, radical gastrectomy will be required.

2. **'Tea-pot' Stomach.**—Cicatrisation around a long-standing ulcer of the lesser curvature often causes shortening of the lesser curvature, thus producing the 'tea-pot' deformity of the stomach, viz.⟶

'Tea-pot' stomach (W. W. Davey), called in the U.S.A. 'handbag' stomach, is fairly common. Unless the deformity is known to the radiologist it is likely to be diagnosed as a congenital abnormality or as

the result of a carcinoma. The pylorus being no longer in an advantageous position for complete emptying of the stomach, not infrequently these patients present with symptoms and signs of pyloric stenosis. For the cure of the condition usually partial gastrectomy is required.

FIG. 482.—Hour-glass stomach.

3. **Hour-glass stomach** occurs almost exclusively in women, and is due to cicatricial contracture around a saddle-shaped lesser-curve ulcer. In extreme cases the stomach is divided into two compartments, united by a channel which barely admits a pencil (fig. 482). The condition is sometimes associated with pyloric stenosis.

History.—*Periodicity* is lost. The symptoms have become practically constant.
Vomiting is more frequent, and gives no relief to the discomfort.
The *appetite* becomes poor.
Weight.—Loss may be so great that carcinoma is suspected.

Barium meal is often characteristic. We have known of cases of hour-glass stomach being reported as having pyloric stenosis, owing to failure of the second pouch to fill. True hour-glass stomach (fig. 483) must be distinguished from gastric spasm of the hour-glass type, which is sometimes associated with an uncomplicated ulcer on the lesser curvature.

Fractional test-meal shows a very low acidity.

Gastroscopy.—The gastroscope enters the upper compartment of the stomach, and the narrow, scarred channel leading to the lower compartment and the causative ulcer is usually seen.

Treatment.—Usually partial gastrectomy, with removal of the second pouch and the isthmus, is the best treatment. When the ulcer has healed and the stenosed area consists entirely of scar tissue, union of the pouches by gastro-gastrostomy with a wide stoma is followed by complete amelioration of all symptoms. In some cases with a fairly adequate stoma an elderly patient, not seriously inconvenienced, can be treated medically, provided regular re-examination by barium meal is made.

FIG. 483.—Hour-glass contracture of the stomach. (*The late Dr. G. Mather Cordiner, London.*)

4. **Adherence of the ulcer to the pancreas and penetration into it (chronic perforation)** is a common complication of chronic gastric and duodenal ulcers situated on the posterior wall of the duodenum and the body of the stomach.

History is one of chronic gastric ulcer with the following modifications:
Periodicity tends to be less definite, in that the intervals of freedom are short or absent.
Pain becomes more severe, constant, and passes to the back or the left shoulder. Such pain is often worse on standing (dragging by the dependent stomach on the adhesion) and relieved by lying down.

Barium Meal.—If there is a definite crater in this region, the diagnosis is certain.

Treatment.—In deep, penetrating ulcers, and when medical treatment has failed, partial gastrectomy is indicated.

5. **Neoplastic Change in the Ulcer.**—The possibility of a malignant change occurring in a peptic ulcer is limited to a gastric ulcer.

History.—*Periodicity*.—The last attack continued much longer than usual, and there was no remission.

Pain is constant, but not as severe as formerly, and it is usually unrelieved by medical treatment.

Vomiting does not relieve the pain, and sometimes takes the form of regurgitation of foul material, or ' coffee grounds.'

Appetite is lost ; in the early stages, especially for meat.

Weight.—The patient tends to lose weight rapidly.

Barium meal may show nothing characteristic in the early stages, but an ulcer crater which exceeds 1 inch (2·5 cm.) in diameter should be assumed to be malignant until it has been proved otherwise.

Fractional test-meal tends to have a low free hydrochloric acid content. Absence of free hydrochloric acid is a frequent finding in advanced cases. Owing to fermentation the total acidity may be increased.

Gastroscopy is the most certain method of making an early diagnosis. Nodular changes of one part of the ulcer edge and infiltration of the adjacent stomach wall may be seen (see fig. 466, p. 329).

Carcinoma of the stomach and its treatment are discussed on p. 349.

COMPLICATIONS AFTER GASTRIC OPERATIONS

Early
- Pulmonary complications.
- Post-operative hæmatemesis or melæna.
- Stomal hold-up.
- Small bowel obstruction following Polya partial gastrectomy.
- Gastric fistula.
- Duodenal blow-out.
- Acute post-operative pancreatitis.

More Remote
- Gastro-jejunal ulcer.
- Jejunal ulcer.
- Gastro-jejuno-colic fistula.
- Post-gastrectomy syndromes.
- Jejuno-gastric intussusception.
- Pulmonary tuberculosis.

EARLY COMPLICATIONS

1. **Pulmonary complications** are by far the most frequent. Nearly always the original lesion is an area of atelectasis, and males who smoke heavily are considerably more liable to pulmonary complications than non-smokers and women.

2. **Post-operative Hæmatemesis and/or Melæna.**—Although sometimes it emanates from the duodenal stump, bleeding usually comes from a vessel in the posterior line of suture. This complication has been largely circumvented by loosening the clamp, and observing the posterior suture line before completing the anastomosis. As a rule with gastric aspiration,[1] blood transfusion and morphine, the hæmorrhage ceases. Occasionally it is necessary to reopen the abdomen, open the stomach or the stump of the stomach, as the case may be, and unless a spurting vessel can be located (a rare event) to reinforce the posterior anastomotic line with a hæmostatic suture. Manual evacuation of clots from the gastric stump may permit the stomach to contract sufficiently to arrest the bleeding.

3. **Stomal Hold-up.**—Usually this occurs after a Billroth I gastrectomy. Fortunately, as a rule it responds to gastric aspiration and intravenous fluid therapy. The cause is uncertain, but most probably it is due to œdema of the stoma.

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[1] Bile is a potent anticoagulant, and its continuous removal from the bleeding area sometimes results in the control of hæmorrhage.

4. **Small bowel obstruction following partial gastrectomy** is not as rare as reported cases would seem to indicate (F. A. R. Stammers). The condition is more liable to occur in cases of a Polya gastrectomy with an antecolic anastomosis. Small intestine herniates through a gap between the anastomosis and the transverse mesocolon, either from right to left (fig. 484) or from left to right. The amount of intestine so herniated is sometimes as little as 9 inches (22·5 cm.) and sometimes as great as 19 feet (5·7 m.).

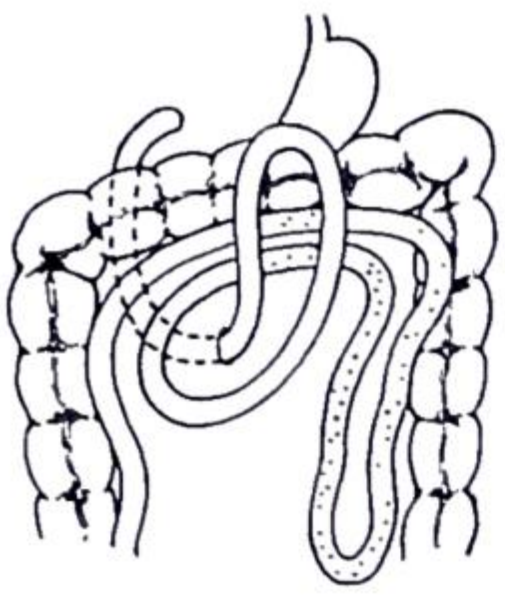

FIG. 484.—Small bowel obstruction following partial gastrectomy. (*After F. A. R. Stammers.*)

Clinical Features.—Usually symptoms of high intestinal obstruction commence between the third and eighteenth post-operative days, but often these symptoms soon become atypical because gastric aspiration is instituted after the first or second vomit. For the same reason colicky pains, so typical of intestinal obstruction, are often lacking; in most cases the pain is continuous, and increases in severity.

Treatment.—Even if the condition is only suspected, the abdomen should be reopened. The hernia is usually reducible, but in 30 per cent. of cases gangrene has occurred from long delay. The mortality is also 30 per cent., but the fatalities are not limited to cases of gangrene.

Much more rarely, similar strangulation of small intestine occurs around a gastro-jejunostomy stoma.

5. **Gastric fistula** can occur as the result of a leak in the suture line after partial or total gastrectomy. This serious complication is more liable to occur after an operation performed for an ulcer that had penetrated the pancreas extensively, or when the subject is debilitated. It can occur also after suture of a large perforated gastric ulcer. If the patient's condition can be rendered satisfactory, re-operation with closure of the fistula is the best course. Should the patient's condition not warrant a major operation, jejunostomy under local anæsthesia, combined with sump suction drainage of the fistula, sometimes proves effective.

6. **Duodenal 'blow-out'** is an infrequent, but a very serious, complication of Polya partial gastrectomy. It may occur in cases where there has been difficulty in closing the duodenum, but the more usual cause is raised tension within the afferent jejunal loop, due to temporary obstruction at the site where that loop has been joined to the stomach: as a rule the point of obstruction is at A (fig. 485).

FIG. 485. — Obstruction to the afferent loop. A Polya operation with a Hofmeister-Finsterer valve has been performed.

Prevention.—A transnasal tube into the duodenum just before completing the anastomosis enables the duodenum to be kept empty by aspiration. It is also necessary to aspirate the contents of what remains of the stomach. If the use of two gastric aspiration tubes is to be avoided, one double-lumen tube with an unequal Y-end, the longer stem of which is passed into the duodenum, is ideal. This tube is retained until reduced quantities of aspirate from both the duodenum and the stomach show that there is no stasis in the former, and that the gastro-jejunal stoma is functioning satisfactorily.

When a blow-out occurs the duodenal sutures give way, and if drainage was not provided at the time of the operation, there is intense thoraco-abdominal pain, which is not infrequently mistaken for acute basal pneumonia with pleurisy. Unless prompt action is taken, diffuse peritonitis ensues, and death is the usual sequel.

Treatment consists in providing free drainage down to the duodenum and suprapubic peritoneal drainage if the peritonitis is widespread. When drainage of the periduodenal tissues was not provided at the time of the

Francis Alan Roland Stammers, Contemporary. Professor of Surgery, University of Birmingham.

gastrectomy a small subcostal incision is made down to the duodenum. In either event sump suction drainage is instituted until, and even after, the track of an external duodenal fistula has become defined.

Duodenal Fistula (see p. 366).

7. **Acute post-operative pancreatitis** is always a serious, and often a fatal, complication of gastro-duodenal resection which necessitated a difficult dissection about the head of the pancreas. Usually the symptoms (see p. 464), which appear twenty-four hours after the operation, are difficult to distinguish from those of a leaking duodenal stump. Careful consideration of the details of the operation, a theoretical knowledge that acute pancreatitis is a complication to be reckoned with in these circumstances, and a considerable elevation of the serum amylase estimation provide the only keys to unlock the diagnostic door. Acute post-operative pancreatitis is produced by injury to the duct of Santorini, by interference with the blood supply of the pancreas, or by considerable traumatic manipulations of that organ.

For treatment of acute pancreatitis, see p. 466.

MORE REMOTE COMPLICATIONS

1. **Gastro-jejunal ulcer** (*syn.* anastomotic ulcer) and jejunal ulcer follow operations for duodenal ulcer with high acidity in possibly 20 per cent. of cases of gastro-jejunostomy alone (fig. 486), in about 7 per cent. of cases of gastro-jejunostomy with vagotomy, and in about 4 per cent. of cases of Polya partial gastrectomy.

FIG. 486. — Gastro-jejunal ulcer following gastro-jejunostomy. (*Dr. K. J. Yeo, London.*)

The symptoms, which appear months or sometimes years after the operation, are almost identical with those of duodenal ulcer, except that the patient vomits frequently and pain is referred to the left side. These ulcers sometimes perforate, and indeed are liable to all the complications of a primary peptic ulcer, including carcinoma. When hæmatemesis occurs it is likely to be most serious, for the middle colic artery is liable to be involved.

Treatment.—Relapses are usual after medical treatment, and re-operation becomes necessary. Provided the pyloric antrum (which secretes gastrin) has been removed completely, vagotomy is sometimes successful. When vagotomy with gastro-jejunostomy has been performed already, conversion to partial gastrectomy is the obvious choice. In cases where partial gastrectomy and vagotomy have failed, either a higher gastrectomy or a local resection is usually undertaken, but non-insulin-producing islet-cell tumour must be eliminated first (see p. 474).

If the previous operation was partial gastrectomy, a more radical gastrectomy is the only curative measure. When severe hæmatemesis necessitates further operation, and it is found that the hæmorrhage is coming from the middle colic artery, in addition to measures to remedy the gastro-jejunal ulcer, ligation of the middle colic artery may so endanger the vascular supply of the transverse colon that this, too, must be resected.

2. **Gastro-jejunal-colic fistula** is a complication of gastro-jejunal ulcer. The ulcer penetrates and erodes the transverse colon. Usually the symptoms of anastomotic ulcer disappear soon after the fistula develops, but in their place the unfortunate patient is troubled with diarrhœa containing semi-digested food after every meal, and eructates foul gas. Exceptionally the patient vomits fragments of formed fæces. Loss of weight and strength, dehydration, and anæmia complete the picture.

Giovanni Domenico Santorini, 1681–1737. Professor of Anatomy, Venice.

Treatment.—When the patient is in poor condition the first step is to perform lower laparotomy, divide the ileum near the ileo-cæcal valve, close the distal end, and anastomose the proximal end to the pelvic colon (W. M. Capper). The purpose of this is to minimise the contents of the colon entering the jejunum and causing jejunitis, which is the main cause of the patient's symptoms. When the patient is in good condition initially, or when his condition has improved as a result of the colostomy, the operation of 'triple resection' is carried out. This involves resection of portions of the stomach, jejunum, and the transverse colon. The alimentary canal is restored by anastomosing the gastric remnant to the jejunum (Polya gastrectomy). The jejunum is anastomosed to the jejunum, and the colon is anastomosed to the colon, or repaired.

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During the present century gastro-jejunal ulcer has undermined successively the popularity of gastro-jejunostomy and low partial gastrectomy. Thanks to more extensive partial gastrectomy, gastro-jejunal ulcer is becoming less frequent, but in its stead the higher partial gastrectomy has created another aftermath that is difficult to treat—the post-gastrectomy syndromes.

To summarise: If a low partial gastrectomy is performed in cases of duodenal ulcer, there is a high incidence of anastomotic ulceration, but if a high partial gastrectomy is performed, anastomotic ulceration is uncommon, but post-gastrectomy symptoms are frequent. At the present time most surgeons carry out a moderately high gastrectomy in the hope that if they do occur the patient will suffer only mild post-gastrectomy symptoms.

The operator must be prepared to accept an anastomotic ulcer rate of about 4 per cent., and treat those who relapse in the manner that has been described.

3. **Post-Gastrectomy Syndrome** { Early / Late } after meals.

After partial, and especially after complete, gastrectomy many patients experience a certain amount of post-prandial discomfort—a sense of fullness after taking solid food, referred to the umbilical region. As time passes it usually becomes less, but it takes one to two years to disappear completely. Up to 7 per cent. of these patients develop more severe symptoms, known collectively as the post-gastrectomy syndrome, which is divided essentially into two varieties:

1. Early post-gastrectomy syndrome, called colloquially the 'dumping'[1] syndrome.

2. Late post-gastrectomy syndrome.

The early post-gastrectomy syndrome is much more common than the late. It can occur with or without bilious vomiting, and the following description is based on the teaching of Charles Wells.

(*a*) *Early post-prandial syndrome with bilious vomiting* (*syn.* the afferent loop syndrome) occurs exclusively after the Polya type partial gastrectomy. Bile and pancreatic juice accumulate in the afferent loop, causing discomfort. There is immediate relief and a desire for more food as soon as the distended loop has discharged its contents into the empty stomach, which ejects it as

[1] Radiologically the barium meal is dumped hurriedly from the gastric remnant into the jejunum.

William Melville Capper, Contemporary. Surgeon, Bristol Royal Hospital, Bristol.
Charles Wells, Contemporary. Professor of Surgery, University of Liverpool.

vomit (fig. 487 (1)). The vomit consists of 'bile only,' because the meal has passed onwards down the efferent loop (fig. 487 (2)) before the contents of the afferent loop are ejected.

(*b*) *Early post-prandial syndrome without bilious vomiting* differs from the above in that when the 'bile' is discharged into the stomach it follows the food into the efferent loop and down the jejunum. However, in typical cases this variety of the syndrome produces symptoms that are more severe, more varied, and more incapacitating than the prodromal symptoms of those who vomit bile. There is profound lassitude, often with tachycardia and sweating, rendering the patient so unwell that he feels compelled to lie down. Intestinal hurry results in an increase in the number of bowel actions, sometimes amounting to diarrhœa which occasionally, though very rarely, is accompanied by considerable abdominal pain. Steatorrhœa is not unusual. Severe symptoms are in evidence particularly after the ingestion of sweets, puddings, sugar-containing foods of all kinds, and tea.

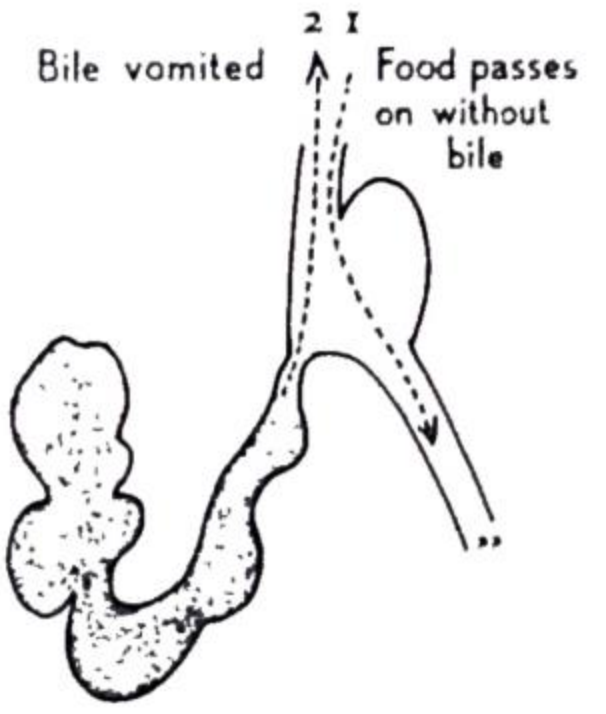


FIG. 487 — The afferent loop syndrome. The food (1) passes out of the gastric remnant before the bile (2) is ejected. (*After Charles Wells.*)

Seeing that post-prandial symptoms (*b*) have occurred in patients on whom a Billroth I operation has been performed, and even in individuals who have had no operation upon their stomach, a blind obstructed afferent loop (see fig. 487) cannot be the cause of such symptoms. A probable explanation is that concentrated food of high osmotic properties passing rapidly into the jejunum causes such an outpouring of intestinal secretions that a severe loss from the circulation into the alimentary canal of fluid and electrolytes, notably potassium, occurs. Sudden fluid and electrolytic imbalance would explain the aforesaid symptoms.

(*c*) *Regurgitation of bile or food* is the third variety of the early syndrome. If incompetence of the cardio-œsophageal mechanism is present either before the operation (see p. 304), or occurs as the result of vagotomy, food and bile, either alone or together, are vomited in varying quantities at irregular intervals. The diagnosis is confirmed by careful X-ray study after a barium meal.

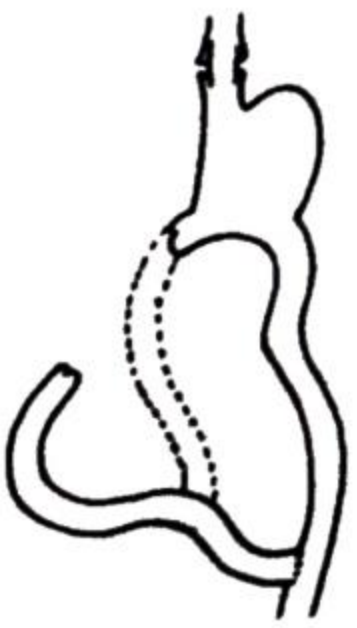


FIG. 488.— Conversion of a Polya partial gastrectomy to a Roux-en-Y plus vagotomy.

Treatment of the Early Post-gastrectomy Syndrome.—Apart from the suggestions made already, experiments with different diets are worth a trial, together with the exhibition of a drug that diminishes the flow of intestinal juice, e.g. probanthine (see p. 330). Bilious vomiting can be relieved by performing an operation that abolishes the afferent loop, viz. conversion from a Polya to a Billroth I or a Roux-en-Y (fig. 488). In either case vagotomy is essential to prevent anastomotic ulceration. If there is any evidence of cardio-œsophageal incompetence, even if the Billroth I operation is feasible, the Roux-en-Y procedure should be chosen. Indeed, for no very obvious reason conversion to a Roux-en-Y with vagotomy (see fig. 488) sometimes relieves even severe

César Roux, 1857–1934. Professor of Surgery, University of Lausanne, Switzerland.

symptoms of the early post-prandial syndrome without bilious vomiting. It would, however, be not only an over-simplification, but highly misleading, to suggest that the Roux-en-Y operation is the end-all and cure-all of all the manifestations of the early post-gastrectomy syndrome.

Remote Effects of the Early Post-prandial Syndrome

(*a*) **Loss of Weight** results from reluctance to take adequate meals, vomiting, intestinal hurry, and failure of the passage of food into the intestine to coincide with that of the bile and pancreatic juice, with consequent diminished digestion and absorption.

(*b*) **Microcytic anæmia** is very common, especially in women of child-bearing age who have menstrual loss. The cause is impaired absorption of iron due to achlorhydria. The remedy is occasional replenishment by the intravenous route, if there is no response to ferrous sulphate 6 grains (0·4 gm.) t.d.s.

(*c*) **Macrocytic (pernicious) anæmia** does not occur with greater frequency than the normal incidence except after *total* gastrectomy, when it follows invariably in from one to two years, depending upon the time that the body's reserve of vitamin B_{12} becomes exhausted.

(*d*) **Vitamin B deficiency** is less common than formerly, but is encountered occasionally as angular stomatitis (see fig. 183, p. 154), superficial glossitis (ariboflavinosis) or, more rarely, as peripheral neuritis, Wernicke's encephalopathy (aneurin deficiency) or even pellagra (multiple B group deficiency). All but the most severe cases respond to vitamin reinforcement.

The late post-gastrectomy syndrome is much less common and remedied more easily than the early variety. One of the penalties of rapid emptying of the remnant of the stomach into the jejunum is that sugars absorbed in the jejunum are wont to reach the systemic circulation sooner, and in greater quantities, than normal, because during their sojourn in the portal system, insufficient insulin can be secreted in time for them to be converted into glycogen. Hyperglycæmia causes no symptoms; it may result in glycosuria, which is also symptomless, and not of serious consequence. Conversely, this hyperglycæmia tends to stimulate an over-production of insulin which causes the blood-sugar to fall to hypoglycæmic levels later. Such blood-sugar curves occur in about one-third of patients subjected to high partial or total gastrectomy, but only in 15 per cent. does the hypoglycæmia give rise to symptoms, viz. attacks lasting thirty to forty minutes, occurring two to three hours after meals (especially meals composed mainly of carbohydrates), of giddiness, tremor, nausea, and a feeling of emptiness in the epigastrium. These symptoms are aggravated by taking exercise, but are relieved by taking more food. The symptoms are largely or entirely prevented by sucking glucose sweets frequently between meals.

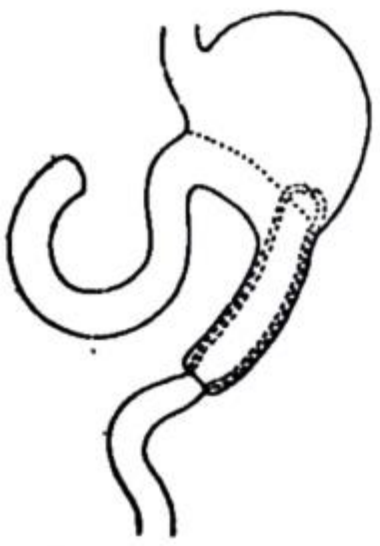


FIG. 489.—Jejuno-gastric intussusception following Polya gastrectomy. (*After P. F. Early.*)

4. Jejuno-gastric Intussusception

Retrograde intussusception of the jejunum into the stomach (fig. 489) is a well-recognised, but rare, complication of the operations of Polya partial gastrectomy and gastro-jejunostomy. It has occurred at times varying from a few weeks to many years after one of these operations on the stomach. Considering that retrograde pouching of the jejunal mucosa through the stoma is a very common finding at gastroscopy, it is somewhat remarkable that this complication is so infrequent, and it is probable that cases of a more chronic type occur with some degree of frequency and reduce themselves spontaneously. In acute cases the symptoms are those of high intestinal obstruction.

Carl Wernicke, 1848–1905. Professor of Psychiatry and Neurology, Berlin.

Hæmatemesis is a late symptom. Sometimes a lump can be detected in the epigastrium. The diagnosis has been confirmed before operation by radiography following a barium meal, but such a step is not permissible except in chronic cases.

Treatment.—Left upper paramedian laparotomy reveals a semi-solid mass within the stomach and invagination of the efferent loop into the stomach through the stoma. In this instance the rule for reducing an intussusception—always push, and never pull—can be broken and the intussuscepted jejunum is withdrawn by traction, aided, if possible, by pressure from above. If the operation is performed within forty-eight hours of the onset of symptoms, recovery usually follows; after that time resection of gangrenous intestine is frequently required and the mortality is high. There is no tendency for the intussusception to recur.

5. Pulmonary Tuberculosis

Gastrectomised persons show a slight, but definite, increased susceptibility to pulmonary tuberculosis.

GASTRIC NEOPLASMS

Benign Tumours.—Although they constitute 3 per cent. of all gastric neoplasms, benign tumours of the stomach are so over-shadowed by the frequency and gravity of gastric carcinoma that they tend to be forgotten.

Leiomyoma is the most common benign neoplasm of the stomach. Sometimes it grows mainly towards the serosal coat, in which case it is symptomless, and only attracts notice when it is large enough to constitute a painless, smooth lump in the epigastrium. More usually a leiomyoma protrudes towards the lumen of the stomach, and gives rise to melæna, mild indigestion, and epigastric pain, in that order. Hæmatemesis is, however, the most common symptom, and results from deep central ulceration of the tumour. Radiography after a barium meal reveals a space-filling lesion. Necrobiosis of the tumour has led to perforation of the serosal surface with intraperitoneal bleeding, and even to perforation of the stomach. How often a leiomyoma becomes a leiomyosarcoma is not known.

Local excision is curative.

Neurofibroma.—A tumour arising from a nerve sheath gives rise to exactly the same symptoms as a leiomyoma from which, macroscopically, it is indistinguishable. Microscopically it requires an expert to distinguish the two conditions.

Adenomatous polyp, sometimes single but more often multiple, is, as a rule, situated in the lower half of the stomach. Usually the symptoms are bleeding and abdominal pain. Achlorhydria is present in nearly all cases. Rarely a pedunculated adenomatous polyp of the pyloric antrum is carried into the pyloric canal, there to cause pyloric obstruction. The diagnosis rests on gastroscopy and/or X-ray. Chymotrypsin lavage, followed by exfoliate cytology, has been recommended to distinguish multiple polyps from carcinoma, but it is not an absolutely reliable method. It is safer to regard multiple polyps as premalignant, and accordingly perform partial gastrectomy in such a way as to include all the polyps; a definitely solitary polyp can be excised locally.

Adenomatous Polyps and Pernicious Anæmia.—In pernicious anæmia there is severe atrophy of that portion of the gastric mucosa containing the fundal glands, and this provides a fertile bed for precarcinomatous adenomatous polyps to flourish. In about one in five cases of pernicious anæmia gastroscopy reveals adenomatous polypi; consequently, in addition to a six-monthly barium meal, patients suffering from pernicious anæmia should undergo annual gastroscopy.

An aberrant pancreas has been found arising in the wall of the stomach from time to time. Because the nature of the lump was uncertain, usually partial gastrectomy has been performed.

Other benign tumours of the stomach are pathological curiosities.

CARCINOMA OF THE STOMACH

Carcinoma of the stomach is one of the 'captains of the men of death.' In 1955, 14,155 persons died from this cause in England and Wales. While from early adult life to senility no age is exempt, it will be seen from the

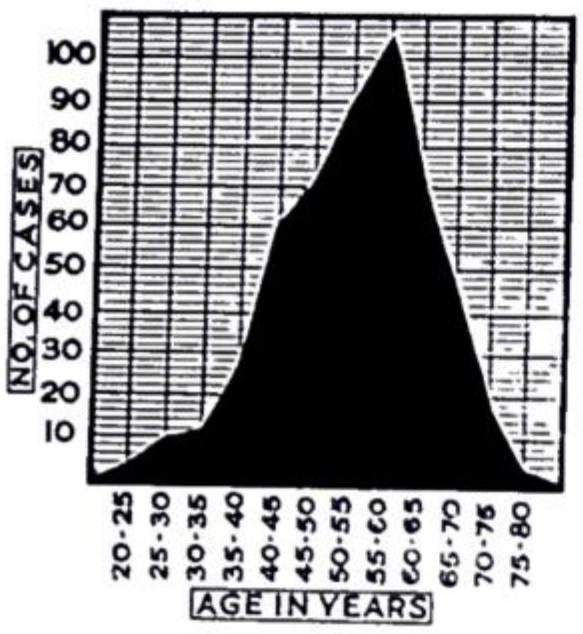


FIG. 490. — Age-incidence of cancer of the stomach. Compiled by R. T. Payne from 506 cases admitted to St. Bartholomew's Hospital, London.

graph (fig. 490) that the highest incidence is between forty and sixty years of age. Three times as many males as females fall victims to this disease.

Ætiology.—Certain clinical facts throw some light upon the frequency with which the stomach is attacked. As gastric cancer does not occur in animals, and as primitive peoples are almost exempt, it is reasonable to argue that highly-civilised man, by pouring hot, semi-solid, and fluid nourishment into the stomach, is subjecting his gastric mucosa to a form of repeated irritation that predisposes to malignancy.

Other possible factors in the production of this fell disease are the regular consumption of curries and other highly-spiced foods in the East, the swallowing of tobacco juice or infected material from oral and nasal sepsis, the entrance into food during cooking of certain hydrocarbons, and the consumption of neat spirits. In this connection it is noteworthy that the highest incidence of carcinoma in Europe is in Scandinavia, Holland, and Czechoslovakia, where spirit drinking is common.

Greater Frequency in Persons of Blood Group A.—There is a definite relationship of the disease to blood groups, there being a higher proportion of group A and a lower proportion of group O in those afflicted (I. Aird). The preponderance of group A sufferers seems to be confined to carcinoma. As a result of investigations in other parts of the world, in many instances the blood group A was found to be moderately dominant, and in some instances the dominance varied with the frequency of carcinoma of the pylorus. In the Department of Animal Genetics in the University of Edinburgh it was computed that blood group A increases the risk of carcinoma of the stomach by as much as 39 per cent. On the other hand, in Australia no dominance of any blood group was found in these cases. At present, as far as can be judged, this question of blood groups in carcinoma of the stomach is one of purely academic interest, and there are medical statisticians who doubt its validity, some of whom warn us not to forget that the hardest things to explain are those that are not true.

Pathology.—*Macroscopically* five types can be recognised :

Type 1.—A cauliflower-like growth with sharply defined edges. Its surface is indurated. Later it ulcerates.

Type 2.—An ulcer with an irregular indurated edge. Sometimes small superficial ulcers are present in the immediate vicinity.

Type 3.—Colloid carcinoma.

Type 4.—Leather-bottle stomach.

Type 5.—Carcinoma secondary to a chronic gastric ulcer. Some pathologists deny the existence of this transformation, but most agree that about 5 per cent. of carcinomata of the stomach arise in this way.

Microscopically.—The growth is usually columnar-celled, but cubical, and even squamous-celled neoplasms arise near the œsophageal orifice. The last type probably arises within the œsophagus.

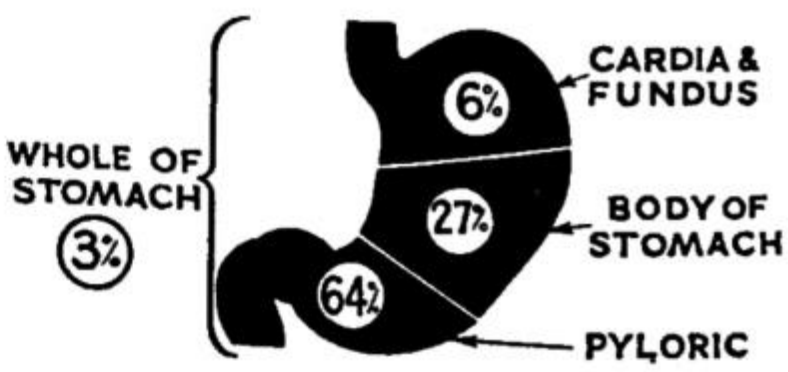


FIG. 491.—Incidence of carcinoma in various portions of the stomach.

The most common site for the neoplasm is in the prepyloric region ; the least common in the fundus of the stomach (fig. 491).

Ian Aird, Contemporary. Professor of Surgery, Post-Graduate Medical School, London.

The Spread of Carcinoma of the Stomach.—No better example of the various modes by which carcinoma spreads can be taken than the case of the stomach.

1. *Direct Spread.*—As the growth enlarges, it tends to invade neighbouring structures. The pancreas, transverse colon, mesocolon, œsophagus, or liver may be involved.

2. *Lymphatic Spread* (see fig. 498):

(*a*) *By Emboli.*—Small clumps of carcinoma cells are carried by the lymph to neighbouring lymph nodes.

(*b*) *By Permeation.*—Carcinoma cells grow along the lumina of the lymphatic vessels. At operation lymphatic vessels, enlarged and white from contained neoplasm, can sometimes be demonstrated.

3. *Spread by the Blood-stream.*—Minute portions of the growth are carried by the venous blood-stream to the liver and more distant sites.

4. *Transcœlomic Implantation.*—Carcinoma cells sometimes fall from the stomach into the peritoneal cavity. They gravitate to the pelvis, where secondary tumours palpable on rectal examination sometimes develop. On occasions, in the female, they alight upon the ovaries, giving rise to **Krukenberg's tumours** (fig. 492), which are liable to cause diagnostic confusion. These tumours are premenopausal, because after the climacteric the ovaries atrophy and thus are less likely to give sustenance to tumour cells. In some cases Krukenberg's tumours are not the result of transcœlomic implantation, but are due to retrograde lymphatic permeation, especially from a carcinoma of the colon.

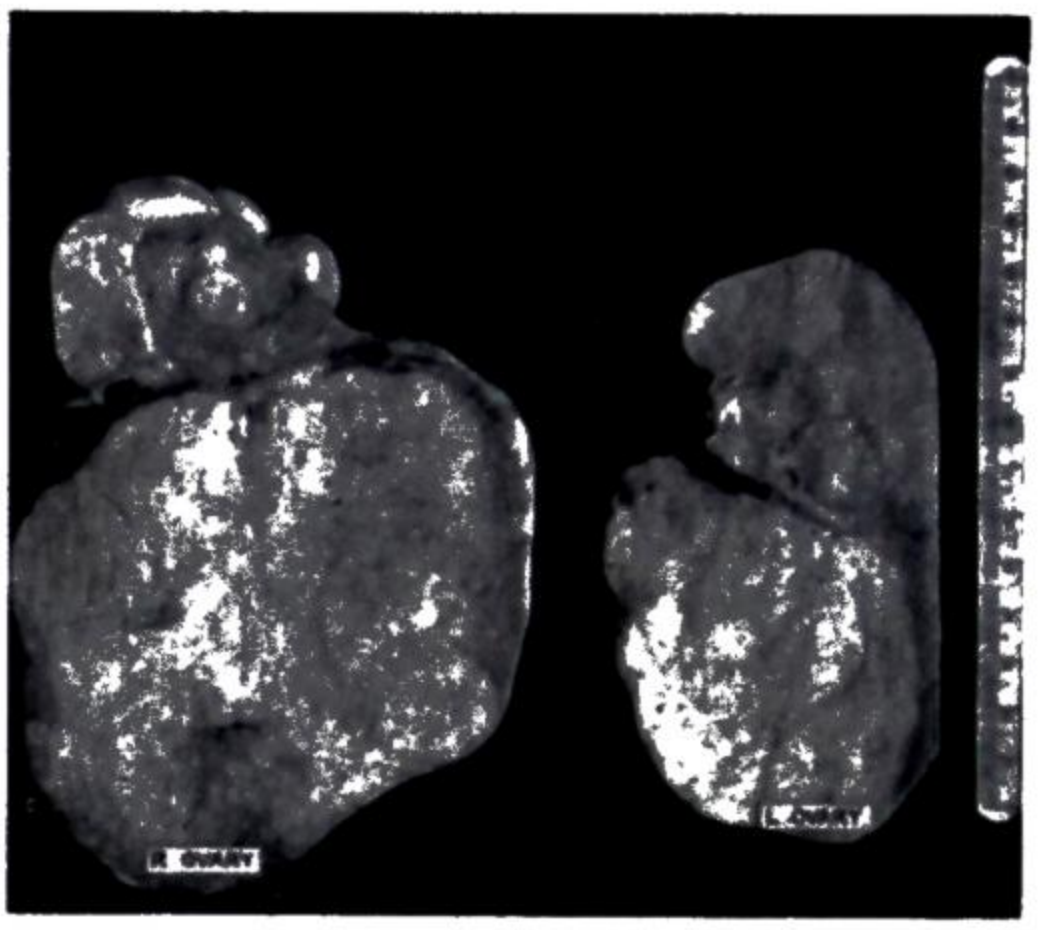


FIG. 492.—Krukenberg's tumours from a woman of thirty-seven.

Clinical Features.—Seven clinical types are met with in practice:

1. '*Indigestion,*' *often vague, but persistent,* occurring for the first time in a patient over forty should be assumed to be due to carcinoma of the stomach unless proved to the contrary. If before prescribing the practitioner would do (they are all simple tests) (*a*) a hæmoglobin estimation, (*b*) test the stools for occult blood, (*c*) pass a gastric aspiration tube in order to withdraw some gastric juice and test it for HCl, and if any one of these tests is abnormal, arrange for the patient to be radiographed after a barium meal, the vast concord of inoperable cases would be reduced in number.

2. *Insidious Onset.*—The patient feels tired and weak. Often the three A's —*A*næmia, *A*norexia (especially for meat), and *A*sthenia are in evidence. This type simulates closely (*a*) pernicious anæmia (see p. 349) and (*b*) oncoming uræmia such as might be occasioned by prostatic obstruction.

3. *Carcinoma of the cardiac end of the stomach* often simulates œsophageal obstruction, from which it must be differentiated.

4. *Carcinoma of the Pylorus.*—The symptoms are identical with those of simple pyloric stenosis. The feature favouring a malignant origin of the stenosis is a comparatively short history in a patient past the meridian of life.

5. *Latent Type.*—The symptoms and signs are extragastric, i.e. they are not at first sight referable to the stomach. Such manifestations as painless

Friedrich Krukenberg, 1872–1946, Ophthalmologist, of Halle, wrote a classical thesis on malignant tumours of the ovary at the age of twenty-four.

jaundice due to secondary deposits at the hilum of the liver, ascites from carcinomatosis peritonei, Krukenberg's tumours (see p. 351), Troisier's sign (enlarged carcinomatous deposits in the left supraclavicular lymph nodes) (fig. 493), and Trousseau's sign (see p. 99), are examples of the diverse extragastric manifestations of gastric carcinoma.

FIG. 493.—Troisier's sign found in the course of a routine examination for vague dyspepsia of recent origin. In this case there was a visible as well as a palpable mass of lymph nodes in the left supraclavicular fossa.

6. *Secondary to a Chronic Gastric Ulcer.*—After years of typical attacks of symptoms of chronic gastric ulcer the symptoms change. The clinical features of this variety have been discussed on p. 342.

7. *Lump.*—The incidental discovery of an intra-abdominal lump, no other symptoms being present, is sometimes the cause of the patient seeking advice.

In about 40 per cent. of all cases of carcinoma of the stomach a lump can be palpated in the epigastrium.

One of the main obstacles to early diagnosis is that on an average it is between three and six months after the onset of symptoms that the patient visits his doctor. Even so, at the present time a further three to six months sometimes elapses before the doctor sends the patient to hospital for gastric investigation.[1]

COMPLETE INVESTIGATION OF A SUSPECTED CASE

Hæmoglobin Estimation.—Anæmia is present in 45 per cent. of patients with carcinoma of the stomach.

Occult Blood.—Eighty-three per cent. of patients with carcinoma of the stomach give a positive reaction to the occult blood test. Only results with the guaiac test are reliable; the benzidine test, because of its extreme sensitivity, leads to many false positive readings. It is, however, a fallacy to suppose that carcinoma of the stomach invariably bleeds into the lumen, and it is important to recognise that a negative result of the test has no significance in the search for this neoplasm (C. F. W. Illingworth).

Fractional Test-meal.—As emphasised on p. 328, the findings of blood in the specimen is of no diagnostic significance. Achlorhydria (fig. 494) is present in about two-thirds of patients with carcinoma of the stomach, and either achlorhydria or an acidity below normal in 88 per cent. None the less the finding of normal or hyperchlorhydric gastric secretion is not a bar to the

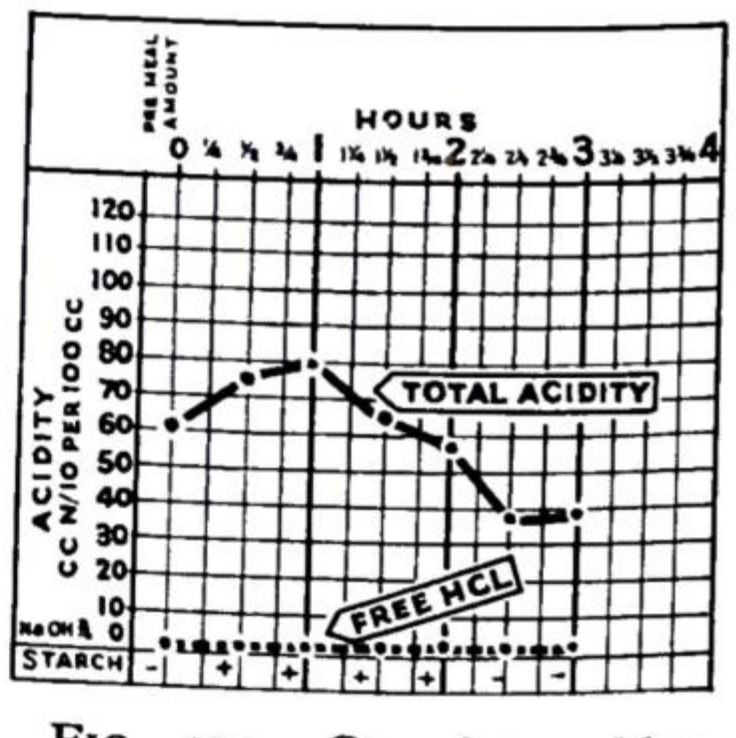


FIG. 494.—Complete achlorhydria in a case of carcinoma of the stomach.

[1] Especially to be deplored is the increasing practice of referring patients with 'neuropathic dyspepsia' for psychiatric treatment without first excluding carcinoma of the stomach by every means known to medical science.

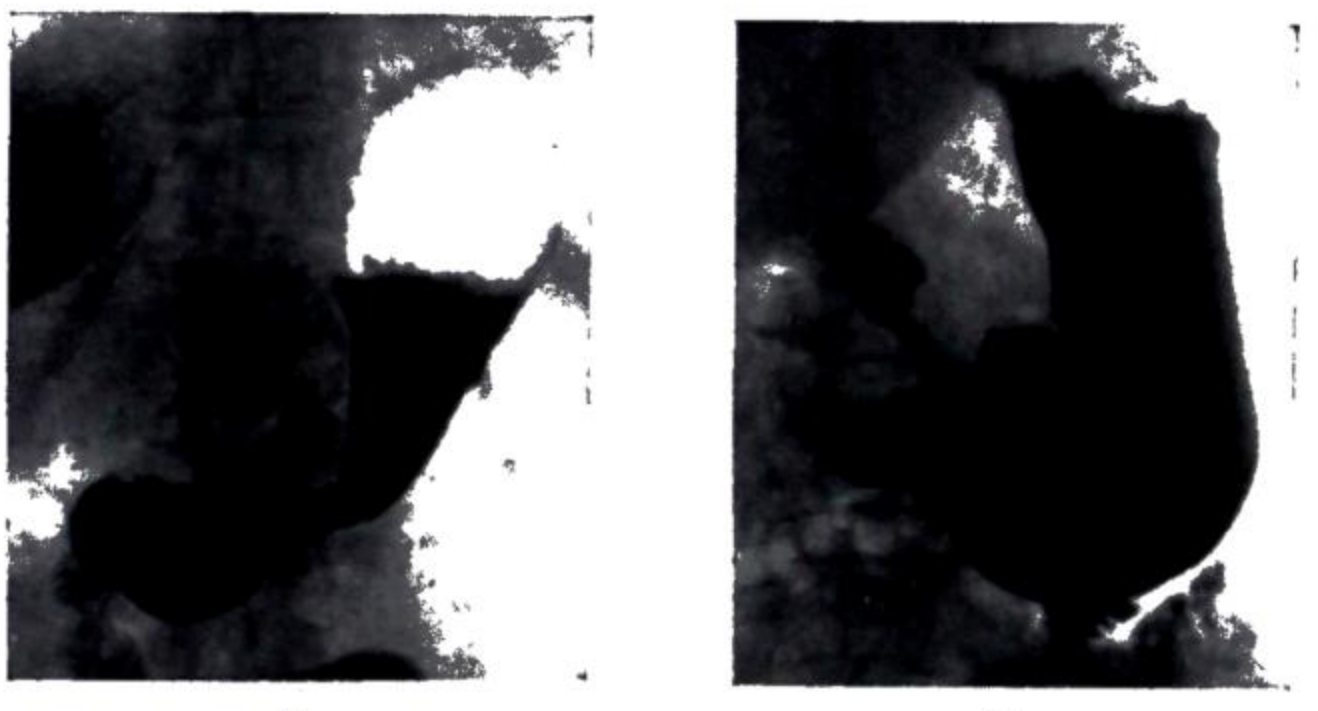
Charles E. Troisier, 1844–1919. Professor of Pathology, Paris.
Armand Trousseau, 1801–1867. Physician, Hôtel-Dieu, Paris.

diagnosis of carcinoma ventriculi (S. C. Truelove). On this account less reliance is being placed on the result of the fractional test-meal than formerly.

Exfoliate Cytology.—Examination of cells found in the washings after gastric lavage has, according to a number of reports, proved sufficiently reliable to confirm a diagnosis of carcinoma of the stomach in doubtful cases in about three out of five instances where a growth is present. Negative results are of no moment. Chymotrypsin lavage to soften the mucous lining has aided this method of investigation.

Erythrocyte sedimentation rate is raised in cases of carcinoma of the stomach; in all patients with a gastric ulcer who have a raised E.S.R., carcinoma should be suspected.

Radiology.—X-ray examination of the stomach with barium meal is still the best single means of detecting carcinoma of the stomach. While a skilled radiologist attains a high degree of accuracy in the interpretation of a barium meal, small lesions are liable to escape notice, particularly if too much barium is given initially. Irregularities of the cardia or fundus are inclined to be overlooked unless the technique includes an examination in the inverted position. Flat growths are prone to remain undetected or to be attributed to gastritis.



A B

FIG. 495.—Typical radiographic appearances in carcinoma of the stomach, (A) of the body of the stomach, (B) of the pyloric antrum. (*Professor Carl Krebs, Aarhus, Denmark.*)

Radio-diagnosis is accurate in 90 per cent. for pyloric growths, 75 per cent. for the cardia, and 60 per cent. for neoplasm of the body, but in only 47 per cent. of patients with conclusive radiological findings (filling defects) (fig. 495) is the neoplasm found to be resectable.

Gastroscopy undertaken by an expert gives the highest percentage of correct pre-operative diagnoses. If the tumour can be visualised, its characteristics are obvious. Its nodularity, the presence of several irregular superficial ulcers, the multi-coloured base, the immotility of the adjacent mucosa, all point to the nature of the lesion. The mistake made most frequently concerns the question of malignancy in an ulcer in an inflamed state. In such cases a second examination after two weeks of gastric lavage, antibiotic therapy, and peptic ulcer régime is more conclusive (see fig. 466).

Biopsy of the Gastric Mucous Membrane.—Endoscopic removal of a fragment of pathological tissue under direct vision, such as can be obtained from the urinary bladder, the rectum and sigmoid colon, and the œsophagus, has not yet been made possible in the case of the stomach. Wood's flexible gastric biopsy tube enables small specimens of the mucous membrane of the body of the stomach near the greater curvature to be obtained. As the method is completely blind, it is of no direct value in the diagnosis of gastric ulcer or carcinoma of the stomach, but when radiographic and gastroscopic evidence is negative for carcinoma, the method is of great assistance

Sidney Charles Truelove, Contemporary. Assistant Physician, Radcliffe Infirmary, Oxford.
Ian Jeffreys Wood, Contemporary. Assistant Director, Walter and Eliza Hall Institute of Medical Research Melbourne, Australia.

in the diagnosis of atrophic gastritis (see p. 368), the symptoms of which simulate those of gastric carcinoma.

COLLOID CARCINOMA

Macroscopically the stomach appears infiltrated in all its layers. Its walls are thickened and the individual layers cannot be differentiated. They are replaced by a kind of areolar tissue, the interspaces of which contain a transparent gelatinous substance. Although the gross appearance and the radiographs of colloid carcinoma resemble those of leather-bottle stomach, the microscopical picture is quite different, and very characteristic. Groups of cancer cells often line the accumulations of colloid. The tubular glands are extremely distended with this substance. Colloid carcinoma represents about 6 per cent. of the total cases of gastric carcinoma.

The treatment is the same as that for leather-bottle stomach and the prognosis is almost equally gloomy.

LEATHER-BOTTLE STOMACH (*syn.* LINITIS PLASTICA)

There is a generalised and a localised form of leather-bottle stomach.

When localised, it is the pyloric antrum that is mainly involved. The stomach wall is enormously thickened (fig. 496), and feels, as its name implies, like leather.

FIG. 496.—Leather-bottle stomach, showing the enormous thickening of the stomach wall.

The enormous proliferation of fibrous tissue involves especially submucosa, which often appears as a dense layer, mother-of-pearl in appearance. In contrast to colloid carcinoma, the mucosa, submucosa, and muscularis remain well differentiated, and, astonishingly, the whole of the mucous membrane looks and feels quite normal. Microscopically there is a tremendous overgrowth of fibrous tissue in the subserosa and submucosa, which sometimes spreads between the muscle fibres and strangulates them. The blood-vessels show evidence of endarteritis. It is usually difficult or impossible to find any evidence of carcinoma, even in serial sections, but metastases are sometimes to be found in the regional lymph nodes. When distant metastases occur they are usually to be found in the liver or the ovary: on rare occasions bones are involved.

The symptoms are those of pyloric obstruction, but the small capacity of the stomach as revealed radiologically by a barium meal (fig. 497) makes the diagnosis tolerably certain.

FIG. 497.—Radiograph of a case of leather-bottle stomach.

Treatment.—In the localised variety, partial gastrectomy, and in the diffuse, total gastrectomy, offer hope of prolonging life, but the results, especially in the more common generalised variety, are among the worst, if not *the* worst, of all varieties of carcinoma of the stomach.

Boeck's sarcoid of the stomach occurs occasionally, and gives symptoms and X-ray findings identical with those of leather-bottle stomach.

Cæsar P. M. Boeck, 1845–1917. Dermatologist, Christiania (Oslo), Norway.

TREATMENT OF CARCINOMA OF THE STOMACH

No description of the treatment of carcinoma of the stomach is comprehensible without a knowledge of the lymphatic drainage of the organ, which has become all the more important since the operations of upper, lower, and total radical gastrectomy are so much to the fore.

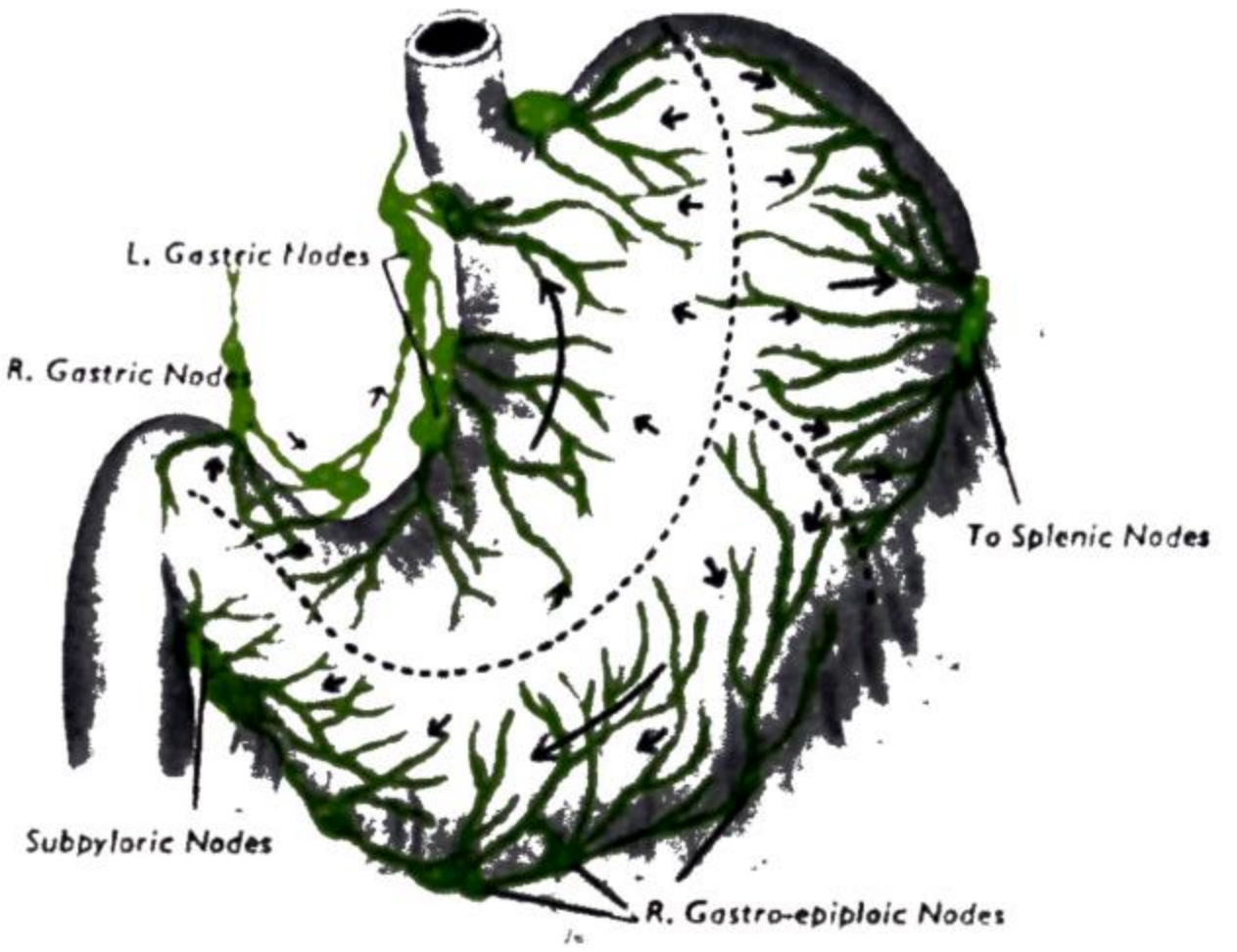


FIG. 498.—The lymphatic drainage of the stomach. *(After Jamieson and Dobson.)*

Lymphatic Drainage of the Stomach (fig. 498).—The lymphatic vessels of the stomach arise in its submucous and subperitoneal layers, and divide into four main sets that accompany corresponding blood-vessels. Each set drains both the anterior and the posterior surfaces of the stomach, and although they intercommunicate, their valves direct the lymph flow as follows :

The lymphatics of the proximal half of the stomach drain primarily into the left gastric and the splenic nodes, and thence into the left, middle, and right superior pancreatic nodes (fig. 499).

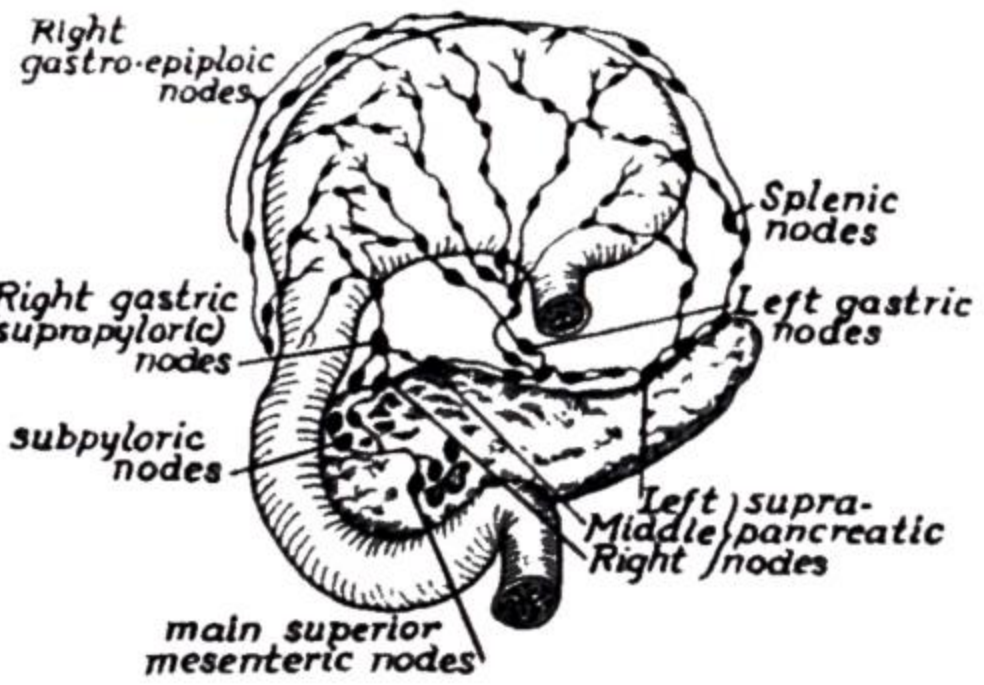


FIG. 499.—Stomach rotated to display the lymph drainage of the stomach. *(After J. C. B. Grant.)*

The lymphatics of the antrum drain into the right gastric nodes superiorly and the right gastro-epiploic nodes inferiorly.

The lymphatics of the pylorus drain into the right gastric (suprapyloric) superiorly and the subpyloric nodes, situated around the gastro-duodenal artery, inferiorly. The efferent lymphatics from the suprapyloric nodes converge on the para-aortic nodes around the cœliac axis, while the efferent lymphatics from the sub-pyloric nodes pass to the main superior mesenteric nodes situated around the origin of the superior mesenteric artery. The lymphatic vessels related to the cardiac orifice of the stomach communicate freely with those of the œsophagus, but intercommunication between the lymphatic vessels of the pylorus with those of the duodenum is less definite.

This concept of the primary lymph node drainage of the various areas of the stomach, founded on the anatomical preparations of the bygone Masters of this subject, has been substantiated fully by vital staining. At operation 5 ml. of pontamine sky blue with hyaluronidase injected into the muscularis at several points along both curvatures helps to define lymph nodes (stained blue), unless they are totally involved by neoplasm.

Whether or not there is histological evidence of regional lymph node involvement makes a tremendous difference in the prognosis of *completely operable* cases of carcinoma of the stomach.

40 per cent. of patients without regional lymph-node involvement survive five years or more.

10 per cent. of patients with regional lymph-node involvement survive five years or more.

Operative Treatment.—No treatment except operation can alter the inexorable course of carcinoma of the stomach, but drugs can be administered to relieve the pain.

Exploration.—Because of the impossibility of being certain whether the growth is operable or inoperable, and sometimes even whether the lesion is indeed neoplastic, in the first instance in a high percentage of cases (possibly 50 per cent.) the operation is exploratory. Usually as a result of this exploration the growth is found to be more extensive than it was thought to be.

Nomenclature.—A 'curative' resection consists of removing a block of tissue, including the growth, a margin of at least 1½ inches (3·8 cm.) beyond its palpable limits with the stomach unstretched, and the related lymph nodes. The term radical gastrectomy should be reserved for a monoblock dissection fulfilling these requirements, thus bringing the term 'radical' into line with operations for carcinoma in other situations, e.g. the breast. Radical operations upon the stomach are of three varieties—(1) radical total gastrectomy, (2) radical upper gastrectomy, and (3) radical lower gastrectomy.

FIG. 500.—The thoraco-abdominal approach to the stomach. (*After J. A. Visalli and O. F. Grimes.*)

Incision.—The first two procedures are carried out through an abdomino-thoracic incision (fig. 500) and the third is performed by the abdominal route. In order to be enabled to choose the more desirable of these incisions, radiographs and gastroscopic findings are taken into consideration.

Indications for Total Gastrectomy.—As the lesser curvature is only about 5 to 6 inches (12·5 to 15 cm.) long, it follows that if the criteria for the performance of radical resection are to be fulfilled, a growth impinging on the middle two-thirds of this curvature, as well as those situated in the mid-stomach, must be subjected to total gastrectomy.

Total Gastrectomy.—The operation is commenced by delivering the spleen and incising the peritoneum at its lateral border. The spleen with its hilar lymph nodes, the stomach, the splenic vessels, the tail and body of the pancreas are mobilised from left to right *en bloc*, the operation being essentially retroperitoneal. The left gastric artery and the splenic vessels are ligated retroperitoneally. The lymph nodes around the cardiac orifice are freed, and the lesser omentum is detached as far from the stomach as possible. Similarly, the nodes beneath the first part of the duodenum are mobilised and the greater omentum is detached from the transverse colon. Performed in this way, the peritoneum over the pancreas, and the tail, and, if thought advisable, the body, of the pancreas are included in the block resection of the stomach with its lymphatic field. The cut edge of the pancreas is closed with sutures and a soft rubber drain is passed down to this site, to be brought out through the laparotomy portion of the incision. The stomach having been excised, the continuity of the alimentary canal can be restored in the manner shown in fig. 501; this procedure is valuable because it prevents regurgitation of bile and pancreatic juice into the œsophagus, which is so vulnerable to these digestive ferments.

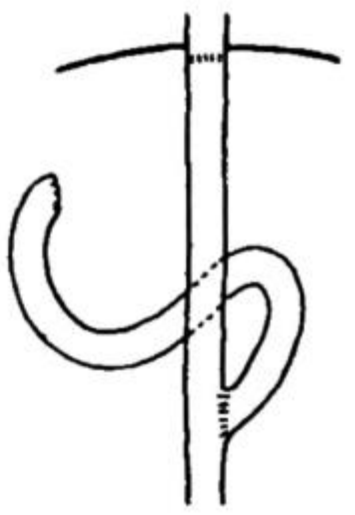


FIG. 501.—Total gastrectomy with œsophago-jejunostomy-en-Y (Roux's method).

Nutritional deficiencies that often occur after total gastrectomy are so disturbing that an endeavour is being made to provide the patient with a pseudo-stomach by interposing (*a*) an isolated loop of jejunum or (*b*) a segment of the transverse colon, each with its vascular supply intact, between the ends of the duodenum and the œsophagus, thus enabling food to pass along the duodenum, or (*c*) by fashioning the distal free end of the bisected jejunum into a food-containing pouch (fig. 502).

FIG. 502.—Hunt's method of constructing a jejunal food pouch.

The continuity of the alimentary canal having been restored by one or other of the methods described, the diaphragm is repaired and the wound is closed in layers. Water-seal drainage of the pleural cavity is not always needed; thoracentesis during the early post-operative period often suffices.

Upper Radical Partial Gastrectomy.—In essence, the operation consists of a block excision of the distal portion of the œsophagus, the proximal two-thirds of the stomach, the spleen, the body and tail of the pancreas, the lesser omentum, and the relevant part of the greater omentum, together with the regional lymphatics and lymph nodes (fig. 503 (a)). The continuity of the alimentary canal is restored by uniting the oesophagus to the lower end of the closed pyloric pouch (fig. 504). Ramstedt's operation is performed upon the pyloric muscle, in order to prevent post-vagotomy retention in the gastric remnant.

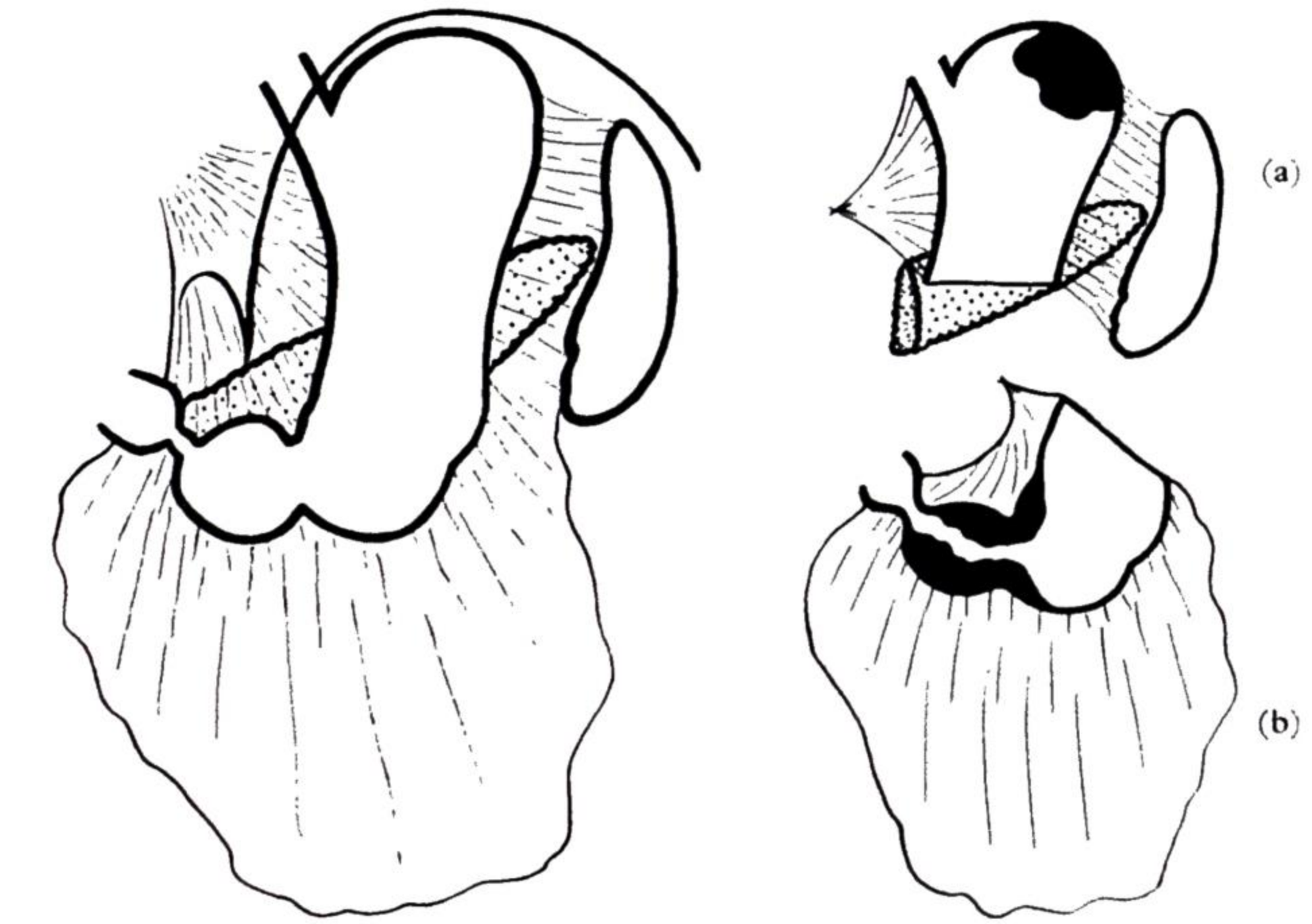


FIG. 503.—Normal disposition of the stomach. (a) parts removed in upper radical partial gastrectomy, (b) parts removed in radical lower partial gastrectomy. *(Drawn for this work by Harold Collinson, F.R.C.S. (Ed.), Auckland, New Zealand.)*

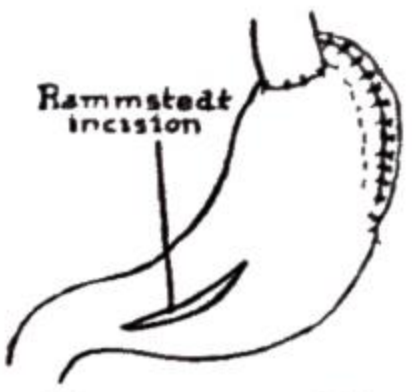


FIG. 504.—The anastomosis completed and a Ramstedt's operation performed. *(After J. A. Visalli and O. F. Grimes.)*

Lower Radical Partial Gastrectomy.—This operation for carcinoma of the pyloric end of the stomach involves separation of the greater omentum from the colon in its entirety, separation of the lesser omentum from the liver, and freeing the subpyloric lymph nodes. The left gastric vessels are dissected, stripping all fatty and lymphatic tissue around them towards the stomach before they are ligated and divided.

The parts removed are shown in fig. 503 (b). The restoration of the continuity of the alimentary canal does not differ from that following partial gastrectomy.

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Conrad Ramstedt, Contemporary. Chief Surgeon, Rafael Clinic, Münster.

Palliative Operations:

Local Resection.—The best palliative procedure is resection of that part of the stomach containing the growth, for not only does it forestall or relieve obstructive symptoms, but occult and obvious bleeding from the growth is no longer possible. In only a comparatively few patients in whom the neoplasm is too advanced for radical removal is the stomach free enough and the patient fit enough to undergo resection.

FIG. 505.—Palliative gastro-jejunostomy for incurable pyloric carcinoma. (*After Norman Tanner.*)

Palliative Gastro-jejunostomy.—For irremovable pyloric carcinoma, gastro-jejunostomy should be performed some distance from the tumour, so that the advancing growth will not invade the stoma, at any rate for some time. If the gastro-splenic omentum is detached from the greater curvature for a few inches, an antecolic anastomosis to this part of the stomach can be performed (fig. 505).

Short-circuiting an Incurable Growth involving the Cardia.—The simplest and the safest method is to mobilise the greater curvature by dividing the gastro-colic omentum. This permits the dome of the fundus to be drawn into the thorax to lie beside the œsophagus above the tumour. After incising the pleura over the œsophagus and mobilising the latter a little, a side-to-side anastomosis can be made between the œsophagus and the fundus.

Many inoperable growths are too extensive for this procedure, in which case a long Roux-en-Y jejunal loop is constructed. Lifting up the transverse colon, an incision is made through the peritoneum at the inferior border of the pancreas to the left of the inferior mesenteric vein. With the finger, a tunnel is constructed by burrowing upwards behind the pancreas. An incision having been made through the diaphragm, the free end of the jejunum is brought through this remarkably short passage, and an anastomosis made with the œsophagus (fig. 506).

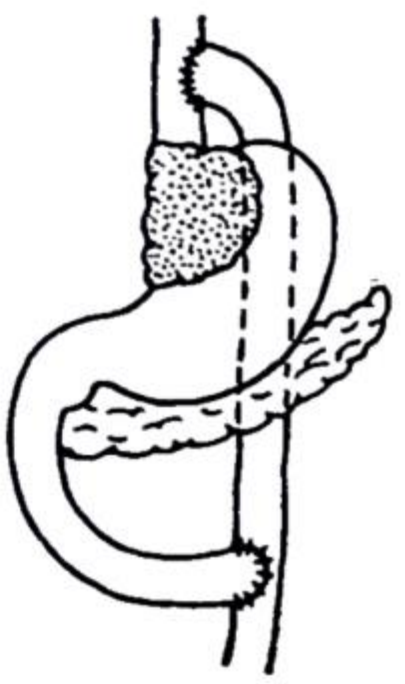

FIG. 506.—Palliative retro-pancreatic œsophago-jejunostomy.

Prognosis of carcinoma of the stomach is rather depressing. It has been found that for resectable neoplasms, the longer the history (over two years) the better the prognosis. This seeming paradox is explained by the fact that if two years have elapsed since the onset of symptoms, of necessity the neoplasm is a slowly-growing one. At the best about 20 per cent. of patients in whom radical resection is possible are alive after five years, and very few of those who have undergone total gastrectomy are completely restored to health. In an endeavour to improve results, O. H. Wangensteen practises what he calls a ' second look.' That is, in order to detect, and if feasible remove, a recurrence, after an agreed interval the patient is submitted to another laparotomy. The weighty objection to such a course is that the patient must be told that he has had a malignant neoplasm removed. The mental anxiety this engenders is, in the opinion of the majority who are entitled to sit in judgment, prohibitive.

SARCOMA OF THE STOMACH

Sarcoma of the stomach accounts for about 3 per cent. of gastric neoplasms.

Lymphosarcoma is the most common variety. The tumour, which can be either a primary lymphosarcoma or, rarely, a part of a more generalised lymphosarcomatosis, occurs more often in men than in women (3 : 1). The symptoms are those of a gastric ulcer without remissions. Often a lump can be palpated in the epigastrium, and even after the tumour has become large it remains movable. When lymph-node involvement is absent or circumscribed, radical partial or total gastrectomy is indicated, in which case the five-year survival rate is about 30 per cent. In all

Owen Harding Wangensteen, Contemporary. Professor of Surgery, University of Minnesota, Minneapolis, U.S.A.

inoperable cases a piece of the growth should be removed for histological examination. Lymphosarcoma includes two histologically distinct types: reticulum-celled = large cells, and the small-celled type. At least one patient with reticulosarcoma (reported from Glasgow) was in good health five years after treatment with nitrogen mustard. There is little proof that post-operative radiotherapy improves the results, but usually it is given.

The macroscopical, and often the microscopical, differentiation between lymphosarcoma and anasplastic carcinoma is very difficult.

Leiomyosarcoma occurs with equal frequency in men and women. The symptoms, clinical features, and X-ray findings are identical with those of leiomyoma (see p. 349), but even more often than is the case with leiomyoma, the first symptom is a massive hæmatemesis and/or melæna. The presence of a barium-filled sinus extending into the tumour visualised by X-rays is extremely characteristic of leiomyosarcoma. Unlike a carcinoma of similar dimensions, the gastric acidity is unchanged. Usually these tumours metastasise late, and when they do so often secondary growths are found in the liver. The treatment is partial gastrectomy. The tumour is more vascular than a carcinoma. It is stressed particularly that leiomyosarcomata should be attacked with vigour, regardless of the magnitude of the procedure, as the results are so much more gratifying than those of carcinoma of the stomach. At least 50 per cent. of the patients are alive five years after the operation.

Neurofibrosarcoma behaves precisely as a leiomyosarcoma, from which it is distinguished only by histological examination.

Fibrosarcoma, derived from the subserosa, is the rarest variety and the least malignant; it sometimes gives rise to a tumour of immense size, and in the female such a tumour is liable to be mistaken for an ovarian cyst.

DUODENAL NEOPLASMS

Neoplasms of the duodenum are exceedingly uncommon. Adenomatous polyps and adenomata have been reported from time to time as a cause of severe melæna. Carcinoma of the first part of the duodenum, where ulceration is so common, is so rare that many of great experience have never seen a case. The bar to spread of carcinoma of the pyloric end of the stomach into the duodenum is Brünner's glands, but there is no such obstacle to the spread in the submucous layer which, indeed, occurs with some frequency—hence the necessity for excising 1 inch (2·5 cm.) of the duodenum when performing radical lower partial gastrectomy. Carcinoma of the second part of the duodenum has been described, but most of these cases appear to arise in the ampulla of Vater (see p. 475). Carcinoma of the third part of the duodenum occurs from time to time, and the prognosis after local resection is favourable.

Johann Conrad Brünner, 1653–1727. Professor of Anatomy, Heidelberg.

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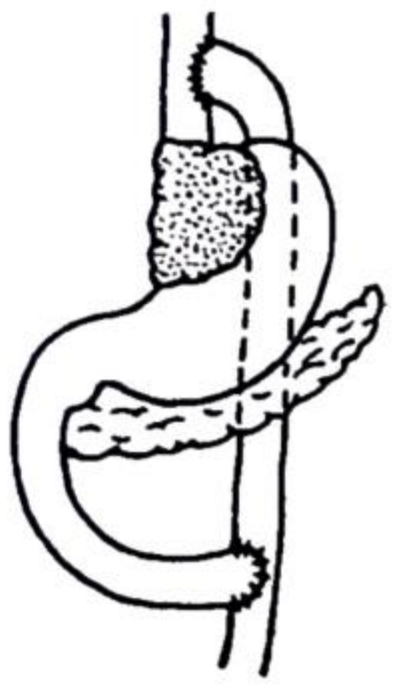

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