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THE TECHNIQUE OF GASTROSCOPY

BY

HAROLD C. EDWARDS, M.S., F.R.C.S.

SURGEON AND LECTURER IN SURGERY TO KING'S COLLEGE HOSPITAL, LONDON

The first attempt to examine the lining of the stomach by means of an endoscopic instrument was made by Kussmaul in 1868. The patient, or victim, was a professional sword-swallower. It goes without saying that the instrument was of the most primitive type, for it was only five years previously that endoscopy had been invented by Désormeaux (Fig. 1). It consisted of a straight metal tube with suitably placed mirrors lighted by a naked flame placed externally, for electricity had not been adapted to practical usage at that time. The next recorded attempt was by Mikulicz eleven years later.

FIG. 1.

FIG. 2.

FIG. 1.—The Désormeaux endoscope for urethroscopy. (After Moutier)

FIG. 2.—The Mikulicz gastroscope. (After Moutier.)

By this time electrical illumination was available, and the Mikulicz gastroscope carried a terminal light. This instrument was constructed after the principle of the cystoscope, with a long and a short arm, and a prism in the angle formed between the two. It measured well over half an inch in diameter (Fig. 2), and was naturally a dangerous instrument to use. Mikulicz, however, claimed to recognize carcinoma of the pyloric end of the stomach with it—a very definite advance, it will be admitted, so long before x-ray examination of the stomach came into being. In the succeeding years many types of instrument were invented. Nitze and Leiter made a flexible one with terminal vision, and in 1899 Rewidzoff designed a

gastroscope to the end of which a flexible guide could be attached to facilitate its passage into the stomach.

The problem confronting gastroscopists was twofold. It was necessary to devise an instrument which could be introduced into the stomach without danger and which would also give an adequate view of the inside once it had been passed. The two ideals were therefore safety and utility. The well-known gastroscope which Sussmann invented in 1911, an example of which I have in my possession, came a little nearer to satisfying both these ideals than any of its predecessors (Fig. 3). It is made of overlapping metal links, and is so constructed that it can be bent in one plané. It is passed into the stomach in this flexible state and then converted by means of a locking device into a straight and rigid instrument. At the distal end there is a revolving light and mirror, which can be turned through a complete circle by means of a wheel placed near the eyepiece. It has proved too dangerous an instrument, however, to be of practical value. My late colleague Mr. Arthur Edmunds, who introduced this gastroscope to King's College Hospital some twenty-three years ago, used to say that he

FIG. 3.—The Sussmann gastroscope.

personally would much prefer to submit to an exploratory laparotomy than to an endoscopic examination with this instrument.

The possibilities of endoscopy did not escape the attention of workers in this country. Mr. H. S. Souttar, working in collaboration with the late Dr. Theodore Thompson, designed and used a gastroscope the details of which were published in this *Journal* in 1909.¹ The advent and development of x-ray examination of the stomach appear to have inhibited advances in gastroscopy to some extent. Several workers, however, still persisted in their efforts with untiring zeal, amongst whom must be mentioned Korbisch, Hübner, Schindler, and Henning. In 1932, sixty-four years after Kussmaul's initial effort,

¹ *British Medical Journal*, 1909, ii, 843.

Rudolf Schindler, working in conjunction with the optical manufacturer Georg Wolf, designed an instrument which fulfilled the two ideals of safety and utility. The instrument is, indeed, a triumphant conclusion to the researches of nearly seventy years. It has converted a dangerous examination, the results of which were frequently inconclusive, into one which is without danger and the results of which are of very definite value.

The Wolf-Schindler Flexible Gastroscope

The essential difference between the Wolf-Schindler gastroscope and its predecessors is that its lower or distal portion is made of rubber and is thus flexible (Figs. 4 and 5). The most remarkable feature of this ingenious instrument is that the flexible part can be bent to a

FIG. 4.—The Wolf-Schindler gastroscope.

FIG. 5.—Scale drawing of the flexible gastroscope to illustrate how the flexible part may be bent. (1/4 size.) The drawings of the eye-piece and the distal end are actual size.

considerable angle in any direction without interfering with the visual field. This is made possible by a system of convex lenses situated within the flexible portion itself. The whole instrument measures 74 cm. in length, and can be divided for purposes of description into three parts. The first and third parts are rigid and the middle one is flexible. The first (or distal) part consists of a metal piece carrying a light and the objective eyepiece, and is surmounted by a round rubber sponge to wipe away mucus from the oesophagus and to act as a cushion between the instrument and the greater curvature of the stomach. The angle of vision is about 90 degrees. The light is an extremely brilliant one, taking current from a 9-volt battery.

The second (or flexible) part carries the optical system of lenses. It measures some 11 mm. in diameter, 27 cm. in length, and is made of a durable rubber. The wall consists of two rubber tubes, one lying inside the other, the space between them forming the channel along which air is blown into the stomach during the examination, the outer tube being perforated by four tiny holes situated near the distal end. The complete safety of the examination is due to this flexible portion, for its degree of

flexibility is such that it can lie within the cardiac orifice without damaging it, and is capable of bending when the distal part of the gastroscope comes into contact with the greater curvature of the stomach. With the instrument fully introduced the beginning of the rigid portion lies about 4 cm. above the cardiac orifice and 2 cm. above the oesophageal opening in the diaphragm.

The third part of the gastroscope is rigid, is of narrower calibre than the first and second parts, and measures 34 cm. in length. Some 8 cm. from the attachment of the flexible part the rigid part has a marking on it; when this is opposite the incisor teeth the distal end of the gastroscope has passed through the cardia into the stomach. The end of the rigid part carries an eyepiece, which, like that of the cystoscope, has a knob at its edge corresponding in position with the objective lens,

FIG. 6.—Radiograph of the gastroscope in position. While this radiograph was being taken the pylorus was under observation.

and two arms, one for the attachment of the light switch on the battery and one for the attachment of the bellows. The instrument is a delicate one, and requires great care in handling and maintenance. It can be cleaned with water and sterilized with alcohol.

The field of vision is circular, and the object is seen with remarkable clearness. After bending the flexible portion beyond a certain point the circular field becomes deformed. This point is said to be reached when the flexible part makes an angle of about 35 degrees with the vertical, but actually with the latest pattern instrument the angle to which the flexible part can be carried, provided it is curved gently and not abruptly, appears to be much greater than this, and by rough measurements is approximately 60 degrees. In practice, however, the flexible part never becomes bent when the gastroscope is *in situ* to anything like this extent, for once the instrument is in the stomach it behaves in very much the same way as the rigid type, and does not do more than bend in a very gentle curve (Fig. 6).

What has been said regarding the field and the angle to which the rubber part can be flexed holds good for all points of the compass. That is to say, if the eye-

piece be held firm the rubber part can be pointed north, south, east, or west, or towards any intervening point on the compass (Fig. 5), and the field remains intact provided the angle to which it is bent is not too great, and provided also that a double curve is not introduced. When the latter occurs the field is immediately interfered with and may completely disappear, even if the curves are slight. This may happen in practice if care has not been taken beforehand to see that the patient is lying in the correct position.

Operative Technique

Before gastroscopy is undertaken the patients will have had an x-ray examination of the stomach. This is necessary, in the first place, to exclude contraindications to the use of the gastroscope, and in the second, to define more clearly the indications. The chief contraindications are oesophageal stricture, aortic aneurysm, and oesophageal varicosities.

It used to be my practice to admit patients for examination the day before the operation; this has been found to be unnecessary, and they now attend as out-patients. The only instructions that are given to them are that they

FIG. 7.—The instruments used for applying the local anesthetic.

should not take any breakfast the morning of the examination, which is done at 10 o'clock. Further, following the practice of Henning, I used to give all patients an injection of morphine and atropine before the operation, but I have now dispensed with any premedication of this kind as I have frequently found it to be upsetting and its disadvantages, therefore, to outweigh any advantage. Shortly before gastroscopy a gastric residuum tube is passed and the residuum is withdrawn in the ordinary way and sent for analysis.

A local anaesthetic of 2 per cent. decicaine, to which a little adrenaline is added, is used. The instruments for its application are illustrated in Fig. 7. They consist of a short 5 c.cm. syringe, a long curved cannula, the last inch and a half of which is perforated and roughened so that it can hold a swab after the manner of a Playfair's probe; and a tongue depressor and a laryngeal mirror, each of which may be fitted to an apparatus holding an electric light. The anaesthetic should be as complete as possible, and there should be no hurry, therefore, over its application, which usually takes about five minutes. The base of the tongue, soft palate, the inner side of the cheek, and the gums are first painted with the solution and then the tonsils and the posterior wall of the pharynx. With the aid of the laryngeal mirror the epiglottis is then

painted back and front, and finally the cannula is passed down through the pharyngo-oesophageal sphincter. This part of the anaesthetic is of very great importance, for spasm of the muscle may give rise to considerable difficulty. In all 3 to 4 c.cm. of decicaine are used. In only one case in my experience have there been any grounds for suspicion that this amount may give rise to toxic symptoms.

After allowing 5 to 10 minutes for the anaesthetic to take full effect the patient climbs on to the table and lies on his left side. The table should have a back rest for the patient to lean against, and should be capable of the Trendelenburg position (Fig. 8). The patient lies loosely, with his back leaning against the rest and the knees flexed. The head is steadied between the hands of an assistant and is held well back so that as straight a line as possible is made from the teeth to the cardiac orifice, and the eyes are covered with a piece of gauze. Very careful attention must be paid to the correct posture of the patient. Rarely is much difficulty encountered in passing the instrument, but if the patient is incorrectly placed and a double bend is made in the flexible portion the field of vision may be considerably reduced or even cut off altogether. Under such circumstances it is probably wise to withdraw the instrument and to rearrange

FIG. 8.—A suitable table for gastroscopy. The patient lies on his left side with his back against the rest. The Trendelenburg position is used only if excess of residuum in the stomach obscures vision.

the patient. The left side is chosen, as in this position the lesser curve, antrum, and pylorus may best be inspected.

The instrument is now thoroughly moistened with water. The surgeon wears a glove on the left hand, and the first and second fingers are placed in the patient's mouth and passed towards the base of the tongue, gently pressing it forward. The eyepiece end of the gastroscope is held by the assistant, and the operator takes the distal end in the right hand, passing it into the mouth between the first and second fingers of the left hand; the latter serve to guide the instrument to the posterior pharyngeal wall. During this manoeuvre the gastroscope is at right angles to the patient, but when the posterior pharyngeal wall is reached it is brought slowly into line with the oesophagus, the left hand is withdrawn, and the instrument gently pushed downwards. The resistance of the pharyngo-oesophageal sphincter may be felt, but is overcome by gentle pressure; the patient may give considerable assistance if he swallows. Once past this region the gastroscope is rapidly passed down the oesophagus until the resistance of the cardiac sphincter is felt. The resistance here is variable; it may be so slight as to escape

notice, but in no case is it very marked, and the gastroscope passes into the stomach easily after a moment's pause. The mark on the rigid part should now be opposite the teeth. It is of very great importance to avoid pinching the tongue or cheek against this part of the instrument. This stage of the operation should be performed as rapidly as possible, though of course no force must be used.

The bellows and light terminal are now attached and a little air is blown gently into the stomach and the rest of the introduction is made under vision. The instrument can be passed still further until it comes into contact with the greater curvature. This gives rise to a dull pain in the stomach, which in some cases causes considerable distress. It is not always necessary, however, even for a complete examination of the stomach, to pass the instrument thus far. In cases in which the discomfort produced is slight, the instrument can be passed to its fullest extent, the distal end being inclined somewhat towards the pylorus along the greater curvature so that the objective lens is brought nearer to the outlet of the stomach. While this is being done air is gently blown into the stomach so as to produce a sufficient degree of distension, and to blow away any bubbles that may obscure vision. With the patient thus lying on his left side all the fluid remaining in the stomach collects at the now most dependent part, which is near the splenic portion of the greater curvature. This collection can be seen as a white pool, to which the French authors apply the term "lac muqueux."

The actual operation causes very little discomfort in the average case. Much depends, of course, upon the type of individual with which one has to deal. In none of my cases so far has there been a failure to introduce the gastroscope into the stomach. In one patient, a man of 65, who subsequently underwent a partial gastrectomy for a very large ulcer high up on the lesser curve, gastroscopy was, he said, the least unpleasant of all the measures he had undergone. Curiously enough the ones he liked least were the injections of larostidin, which were given during the preliminary and unsuccessful medical treatment. On the other hand, a woman, aged 55, stated that she would prefer to have any one of her thirteen children over again rather than have the examination done. Nevertheless, this patient has submitted to gastroscopy on three occasions!

The Normal Stomach

In a favourable case practically the whole of the stomach mucous membrane can be seen. The fundus, however, (that is, that portion which rises above the level of the cardia) is not visible by means of the ordinary gastroscope, but can be inspected by means of the retrograde instrument devised by Henning of Leipzig, an instrument of which I have had no experience. The fact that this part of the stomach cannot be seen is not of very great moment, because it is so rarely that pathological conditions affect it. The pool of mucus which collects at the splenic aspect of the greater curvature obscures also that part of the lining of the stomach. The size of the pool varies considerably in the normal, sometimes being quite small. Its presence, however, is very useful, because it serves as a landmark. Another area which in the normal stomach cannot adequately be seen is the greater curvature of the pyloric antrum. The pylorus itself can be seen in most cases. Frequently it is obscured by the anterior antral pillar, but in some of these cases, when a peristaltic wave comes down the stomach, it has the effect of swinging the pylorus into the visual field. The distance of a lesion—for example, a chronic ulcer—from the cardiac end of the stomach may be calculated by subtracting from 24 cm. the distance in centimetres between the teeth and the proximal end of the gastroscope.

In colour the normal gastric mucous membrane can best be described as a dark orange, and in this respect it is quite different from the mucous membrane of other regions accessible to endoscopy, such as the rectum and the bladder. The surface is always moist, and consequently shines very brilliantly. The rugae in the normal stomach vary in size according to the degree of distension. Their presence causes shadows, and as the stomach is continually altering its shape very complex light effects are produced, which are somewhat disturbing to the inexperienced gastroscopist. The movement of the stomach is due partly to respiration, but chiefly to peristalsis. All these factors make gastroscopy a more difficult procedure in many ways than endoscopy of any other hollow viscus. The stomach is not nearly so well behaved, for example, as the bladder. Its shape continually alters, uniform distension cannot be obtained, and the irregularities of its contour make its inspection by endoscopy by no means easy. However, these difficulties can eventually be overcome by experience, but this experience must be obtained upon the living subject, for neither the cadaver nor the phantom stomach is of any use whatsoever in this respect.

The study of gastric movement which endoscopy allows is extremely fascinating, and I think the impression one gets of the stomach is entirely different from that which one previously derived from anatomical and physiological, and perhaps radiological, study. In the normal stomach peristaltic waves follow one another steadily and pass as rings, slightly raised from the rest of the stomach, from somewhere in the proximal end to terminate in the pylorus. In an actively contracting stomach two or more such waves may be in the field of vision at the same time. They produce a great bar of stomach wall, largest at the greater curvature aspect, which steadily migrates towards the pylorus, obliterating the definition of the antrum, and converting the antral chamber into a cone-shaped space and terminating by closing up the pyloric opening.

The antrum is a well-marked portion of the stomach. It has, as a rule, no definition at its greater curvature aspect, and its limit is usually defined by a wall forming about seven-eighths of a circle. Occasionally, when peristaltic waves come down, the antrum contracts with a sphincteric action, so that the antral chamber becomes shut off completely from the body of the stomach, and one thinks at first that one is looking at the pylorus. The manner of closing of the pylorus can be observed very closely in many cases. In the relaxed state it is a circular opening with a slightly crenated edge, and the dark grey lumen of the duodenum can be seen beyond it. When it contracts its walls rapidly swing together, and may remain in this state of contraction for some seconds. As the wall contracts a little of the mucous membrane from the duodenum may pout into the stomach, and with it a little bile may regurgitate.

The chief landmarks are the "lac muqueux" and antrum, and, of course, the pylorus when this is visible, but there are very distinct differences in the minute anatomy of the various parts of the body of the stomach which the gastroscopist eventually learns to appreciate. It is some time, however, before he can declare with confidence at what part of the stomach he is looking at any given time. The knob on the eyepiece of the instrument greatly helps orientation. The lesser curve of the stomach can readily be recognized by the fact that it has no rugae, but presents a smooth shining surface to inspection. The rugae on the anterior and posterior walls, however, are very numerous and well defined, and their definition increases as the greater curvature of the stomach is reached. They are arranged very much like the convolutions of the cerebrum, and their general tendency of

direction is in the long axis of the stomach. They are most numerous on the posterior wall near the greater curvature and towards the proximal end of the stomach. The depth of the depressions between the rugae, and therefore their thickness, vary according to the degree of distension to which the stomach is subjected.

With the patient lying in the left lateral position the stomach is "J"-shaped, and the lesser curve makes almost a straight line until the antrum is reached. Thus the latter can be inspected with the instrument lying practically straight in the stomach. However, if the stomach is looked at from above in this position it is not in one plane, but the pyloric end turns slightly backwards. Moreover, the opening of the pylorus is not situated exactly at the end of the "J," but is placed a little towards its anterior and upper wall. During the examination air has constantly to be blown into the stomach, in order to keep its walls under tension. Excess of air is to be avoided, although there is little danger of damaging the stomach in any way, even if an ulcer be present, because the air can escape so easily, either into the duodenum or through the cardia alongside the gastroscope. It is essential not to distend the stomach too greatly for the patient's comfort, for it might cause him considerable distress, both mentally and physically, should he involuntarily belch up a lot of wind when the examination is in progress. The distension should be sufficient to hold the walls of the stomach away from the end of the gastroscope and to blow away any "bubbles" that may interfere with vision. The duration of the examination itself should not exceed five to six minutes, which is long enough for the average patient, although on many occasions examination has been prolonged for a quarter of an hour or so. The patient complains of no other discomfort than of having some soreness of the throat on the day following the examination.

Indications for Gastroscopy

Gastroscopy is unquestionably a very useful addition to our methods of investigating cases of gastric disorder. Whether it will become a routine method, as cystoscopy has in diseases of the urinary tract, is a matter that will be decided in years to come. It must be remembered that modern gastroscopy is in its infancy, for it is only four years since the Wolf-Schindler instrument, which has made gastroscopy a practical procedure, was invented. It can never replace radiological examination, which must be made first, in order that all contraindications to gastroscopy may be excluded. Its present indications may be summarized thus:

1. Cases in which there is reason to suspect a lesion in the stomach despite negative radiographs—for example, chronic gastritis.
2. Cases in which the *x*-ray examination shows evidence of a lesion affecting the stomach, but does not give sufficient information for a definite diagnosis to be made—for example, persistent spasm, deformity as the result of an extragastric lesion, gastro-jejunitis following gastro-enterostomy.
3. Cases of chronic ulcer of the stomach in which doubt exists as to whether or not the ulcer is malignant.
4. To confirm the *x*-ray diagnosis in rare conditions—for example, simple tumour of the stomach, polyposis ventriculi.

In addition to these absolute indications gastroscopy is of very considerable value in checking the results of medical treatment of chronic gastric ulcer. It provides the most reliable criterion of the healing of an ulcer.

I wish to disclaim any originality in the technique described, which is in the main an imitation of that described by Schindler and practised and taught by Henning at Leipzig.

LATENT ADOLESCENT PULMONARY TUBERCULOSIS

BY

R. C. WINGFIELD, M.B., B.Ch. Oxon, F.R.C.P.

AND

A. MARGARET C. MACPHERSON, M.D., M.R.C.P.

This investigation is the fifth of a series^{1 2 3 4} from the Brompton Hospital Research Department on the pathogenesis of pulmonary tuberculosis.*

The relatively large number of young adults who are admitted for treatment in our tuberculosis institutions with already extensive disease causes grave concern. It is a common experience that in a considerable proportion of these cases the symptoms of ill-health that lead them to seek medical advice are slight in proportion to the lung lesions present. Further, these symptoms are mainly of comparatively recent appearance.

In short, too many patients do not seek treatment until their disease is well entrenched. This undoubted fact is the reason why our tuberculosis service spends most of its energies, time, and money in endeavouring to patch up hopelessly damaged individuals by preventing the further activity and inroad of the disease. This is attempted either by making use of the natural means of healing promoted by prolonged rest, or inducing some form of mechanical collapse which, though of great life-saving value, must be regarded as a drastic method of treatment—a last resort made necessary by the gravity of the situation. Nor are the results really good. The treated patients can seldom take up again an *absolutely* normal life in the healthy community. Many do so, or appear to do so, for a time, but it is usually at the price of self-denial and restraint on their part and trouble and expense on the part of their friends, relations, or public assistance bodies. Financial circumstances force most of our working-class patients to try to make this desperate attempt, and they do it at great risk: in fact, one might say that they risk their lives to get their living. Over one and all of them hangs the shadow of that sword of Damocles—relapse. The cause of this state of affairs is that pulmonary tuberculosis is, during long periods of its activity, often a symptomless disease. This is well known to most observers, and lately actual statistical proof of it has been published.⁵

Latent Lesions

Another observation has been made by one of us—namely, that in taking detailed histories of recently diagnosed adult cases there is often a suggestion of a definite period of ill-health in adolescence which might, in the light of their present state, be ascribed to active pulmonary tuberculosis, but which had not been recognized as such. As examples may be mentioned pleurisy, atypical pneumonia or bronchitis, anaemia, and nervous breakdown for no known cause.

The combination of these two observations led to the formation of a nebulous hypothesis that perhaps the extensive lesions of adult disease are really in many cases deposited during adolescence with the accompaniment of slight or, at any rate, unexplained constitutional disturbance: that these lesions are carried unrecognized, perhaps extending slowly and without symptoms, until they make their presence known in adult life, either by reason of

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