THE RADIOLOGY OF DUODENAL ULCER.

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Of the many causes of indigestion and pain after food, ulceration of the stomach and duodenum ranks first. Whereas errors of diet and habit, anxiety and worry, dental sepsis, etc. may be numerically much commoner causes, the proof or definite exclusion of ulceration is important because on this will depend the type of treatment which should be adopted. If an ulcer is found, there is an absolute indication for an arduous, exacting and prolonged course of treatment. Failure to carry this out may be attended with the grave risk of a fairly recent ulcer becoming chronic and difficult to heal permanently, or hæmorrhage and perforation may intervene.

On the other hand, the vigorous treatment which is often required for an ulcer is wrong and unnecessary in a patient whose indigestion is due to worry or faulty colon function. It is, therefore, essential that the radiologist should render the diagnosis or the exclusion of an ulcer as definite as possible.

It is somewhat difficult to assess the degree of accuracy of diagnosis by means of radiology, as on laparotomy, ulcers in the duodenum may not be visible unless the cap is actually opened, a procedure not usually done for obvious reasons. However, over a large series of cases followed up at St. Bartholomew's Hospital (1927-1935) the X-ray finding (or exclusion) of gastric ulcer was confirmed on laparotomy in over 90 per cent. and of duodenal ulcer in over 85 per cent. of cases. Recently, so many patients have been treated medically that improvements in X-ray technique have been difficult to check up on a surgical follow up scheme.

The gastroscope has confirmed the high percentage of accuracy of X-ray diagnosis of ulcers of the stomach, but this method is inapplicable so far to the duodenum. Superficial erosion of the stomach and possibly of the duodenum may not be demonstrable on X-ray examination, but it is doubtful if these minute lesions in themselves cause symptoms, although they may sometimes result in a hæmorrhage.

Preparation of Patient.

No medicine containing bismuth should be given for at least five days prior to the examination, or its presence in the colon may cast opaque shadows which will interfere with the examination. No preliminary purgative is required. It is most important that the patient should have nothing to eat or drink for at least six hours prior to the examination. It is often convenient to examine patients early in the morning, but should they have far to travel, it is best to allow them a good breakfast at 8 a.m., and carry out the X-ray examination in the afternoon.

X-Ray Technique.

Preliminary screening of the chest and abdomen is carried out, and the stomach is examined as usual. The duodenal cap is then observed on the screen during the various phases of filling and emptying. If necessary, filling is helped

by gentle pressure over the pyloric end of the stomach, or by posture, the patient lying prone and partly inclined to his right side. Various angles of rotation are used so that as much of the cap as possible is seen silhouetted.

The duodenum is then examined by the technique known as "aimed dosed compression." A suitable compressor cylinder about 4 inches in diameter is placed against the fluorescent screen facing the patient, so that as the screen and compressor are moved towards the patient, the latter is made to press on the abdomen over the duodenal cap. Varying degrees of pressure are applied, and the result watched on the fluorescent screen. When the duodenal rugæ are clearly seen, the screen and compressor are locked in position and a skiagram rapidly taken. Skiagrams are taken in various phases of filling and emptying, and at various angles according to the screen appearances, any abnormality being at once recorded on a film.

X-Ray Appearances.

Normal Appearances. The normal duodenum should be considered in its various parts. The first part or cap presents a triangular or tubular appearance when it is completely filled, and its walls are smooth in outline. It fills and empties as a unit, or at the most with a brief preliminary constriction about the middle part. It is freely mobile on respiration and on palpation. On compression the rugæ are seen to be fairly regularly arranged, either running longitudinally (Fig. 1, Plate 1) or they may show a criss-cross pattern. The important point is the regularity and the fine spacing of the folds, which are about 1 to 1½ mm. wide. The second part runs downwards from the apex of the cap, and is irregular in outline owing to the nature of the mucosal folds.

Pathological Appearances. If a duodenal ulcer is present, there will usually be spasm of the cap which will give rise to a variety of deformities of the first part, depending on its degree and situation.

There may be only a shallow U-shaped incisura on one or other side, or in the base, or the cap may show considerable deformity. Bilateral spasm of the sides and base will result in the cap having a shape somewhat similar to that of a clover leaf. The spasm is often asymmetrical and so corresponding irregularities of shape will be present.

Spasm of the cap usually indicates that there is or has been a duodenal ulcer. Reflex spasm can occur from a diseased gall-bladder or appendix, but it is relatively uncommon. However, the fact that this can occur only makes the quest for the ulcer crater itself all the more important.

Direct Evidence of Ulcer Crater. Direct evidence of an ulcer crater may be revealed in several ways, according to its situation.

(i) The ulcer may be demonstrated as a niche projection from the cap, as in Fig 2, Plate 1, where the barium in the ulcer crater is seen as a projection in profile. In this case there is very little associated spasm. In Fig. 3, Plate 1; a projection is seen from the basal part and there is considerable spasm of the distal part.

On the whole, only a minority of duodenal ulcers are seen in profile, as they are most commonly situated on the anterior or posterior walls of the cap. In this position, when they might be seen silhouetted on rotation of the patient, they are unfortunately obscured by the pyloric end of the stomach.

(ii) The ulcers that cannot be seen in profile are best demonstrated by the technique of aimed dosed compression, referred to above.

Fig. 4, Plate I, shows a crater in the mid-part, the projecting fleck of barium being apparent on compression. Fig. 5, Plate I, shows the duodenal rugæ converging on an isolated fleck of barium, giving a sort of star pattern and indicating a chronic ulcer with scarring around.

Fig. 6, Plate I, shows a translucent area round the fleck of barium and the rugal folds are wider and more rigid than normal. This indicates considerable associated duodenitis, or oedema of the rugal folds.

Sometimes it is not possible to be certain whether a small barium shadow actually represents an ulcer crater, or is only in a mucosal fold. If the rugæ show any considerable degree of hypertrophy, superficial ulcers will be present, but they may be too shallow for the barium to adhere to them and so may not be seen radiologically. The finding therefore of gross hypertrophy of the duodenal rugæ is almost equivalent to finding the actual ulcer crater. If no crater is seen, it may be assumed that the ulcer is very small indeed, or only a superficial erosion.

Evidence of Healing following Treatment. In some patients after successful treatment the X-ray appearance of the duodenum may become normal and in these cases it is safe to assume that the ulcer crater has healed, and that the future prognosis is probably good.

In many cases, in spite of what appears to have been successful treatment, the deformity of the cap persists, and one is left with the impression that the radiological evidence of healing is at variance with the clinical evidence. These cases need a very careful radiological study, and if an ulcer crater was clearly demonstrated before, it is often seen to have become smaller or to have disappeared, but nevertheless the spasmodic deformity of the cap may still be present. This persistence of the deformity is difficult to account for. The deformity may sometimes be due to scarring, and then one would expect it to be constant and persistent, but that it is often definitely spasmodic is shown by its variations on careful screen examination.

Many such patients remain symptom-free for years, and yet yearly routine X-ray examination will show a constantly deformed cap. Extra care must be taken with such patients when the radiological evidence of healing is incomplete, or there is a great risk of the ulcer crater recurring. A carefully arranged regular diet and the avoidance of undue physical, emotional or mental strain may help to prevent a recurrence of the ulcer. A long period follow up of these cases reveals how necessary it is not to develop an undue optimism just because the patient is symptom-free, for relaxation of vigilance is so prone to be followed by a recurrence of ulceration.

Secondary X-ray Signs. When a duodenal ulcer is present, other parts of the alimentary tract may reveal abnormalities on X-ray examination, and these so called secondary signs are of some importance. None of them may be present in spite of the clinical and radiological proof of a duodenal ulcer, but one or more is usually present and may have some influence on the prognosis and treatment. The most important are those affecting the stomach.

(a) There is often *gastric hypersecretion*, as evidenced by a fluid residue in the stomach in spite of six hours' fasting, and no evidence of obstruction. Alternatively, fluid may only appear on the top of the barium a few minutes after it has been taken.

(b) The second sign is *hypermotility*. The peristaltic waves are exaggerated in depth and frequency. This hypermotility often involves the whole alimentary tract, the passage of barium to the rectum being definitely accelerated.

(c) The third sign is *abnormal functioning of the pyloric sphincter*. There may be initial delay in emptying in spite of vigorous peristalsis, or after a fairly rapid initial emptying, the sphincter may close and not relax again for some time.

(d) The *gastric rugæ* are often *hypertrophied*. The rugal folds are seen to be wider than normal on aimed dosed compression and the greater curvature will show a crenated appearance when the stomach is filled with the barium emulsion.

(e) If the ulcer heals by extensive scarring, organic *stenosis* may occur and the stomach will then show the changes associated with this condition, namely hypermotility with slow emptying of the barium. Often the hypermotility becomes exhausted and the stomach is then inert for a time. The stomach may show varying degrees of dilatation. There will be a fluid residue in spite of the six hours' fasting and all the barium will not have left the stomach in six hours. Obstruction is often an indication for surgical interference. On the other hand, in the absence of obstruction, hypersecretion and hypertrophic gastric rugæ suggest that the case is unsuitable for surgery. When either of these signs is marked, medical treatment is more difficult, and unless it be very thorough the results will not be very good. If these two secondary gastric changes become less apparent after treatment, the future prognosis is correspondingly improved. In a doubtful case, when one is uncertain whether the deformed cap is due to an ulcer or scarring, the presence of secondary signs will indicate that the ulceration is probably active or at the best, incompletely healed.

Duodenal ulcers may be present and yet cause no pain or discomfort, and the first evidence of their presence may be a hæmatemesis or melæna, or even a secondary anæmia, the cause for which is not obvious at first. Subsequent X-ray examination may show the ulcer clearly. Such cases often show comparatively little alteration of the duodenal rugæ, apart from the crater, for hypertrophy of the duodenal rugæ and secondary gastric changes are usually absent.

On the whole, the response to treatment is very satisfactory. However, even in these which are probably fairly acute ulcers, spasmodic deformity of the cap may persist in spite of apparently successful treatment.

A word may be usefully said about the type of stomach as revealed radiologically. On the whole, duodenal ulcers occur in patients with a short or medium "J" type of stomach. The long low type rarely shows a duodenal ulcer, but sometimes one may be found even in this asthenic type.

Symptomless bleeding may occur in quite young children, usually boys, and as young as eleven years. In young persons, if bleeding is due to an ulcer at all, it is usually due to a duodenal and not to a gastric ulcer. At the other extreme, in patients well over sixty, the sudden onset of a dyspepsia suggests carcinoma, but it is often a pleasant relief to find only a duodenal ulcer.

Duodenitis is a diagnosis which should be made with some reserve. An irritable cap, or cap that fills and empties rapidly, is not sufficient X-ray evidence for a diagnosis of duodenitis, and the only X-ray finding of value is the demonstration of hypertrophied duodenal rugæ on aimed dosed compression. Actually superficial ulceration is usually present, but the ulcers may be too superficial to cast a niche projection shadow, or to retain barium as a residual fleck. The finding, therefore, of hypertrophied duodenal rugæ, with or without secondary muscular irritability or secondary gastric signs, may justify a diagnosis of duodenitis, but the case should then be considered and treated as one of actual duodenal ulceration.

Adhesions. Adhesions may follow on duodenal ulceration. They are often impossible to demonstrate radiologically, but if they are sufficiently dense, the duodenum may occupy an abnormal position and will be comparatively fixed here. Persistent puckering out of one surface of the duodenum, without evidence of a residual fleck of barium here, may indicate the presence of an adhesion.

Sometimes the duodenum becomes adherent to the gall-bladder, and in a doubtful case a cholecystogram may give some help. The usual technique for a gall-bladder dye test is carried out, by the oral method, and 18 hours after the dye has been taken, a barium-meal examination is carried out and the relationship of the duodenum to the filled gall-bladder is noted, and whether they show relative mobility to each other on palpation and with changes of posture. A further occasional late result of duodenal ulcer is the formation of a duodenal diverticulum. This will be distinguished from a congenital diverticulum by the history of the case, and radiographically the abnormal appearance of the duodenal rugæ and the presence of secondary gastric changes would indicate that an ulcer was the cause of the condition.

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PLATE 1.

Dr. G. Simon - - - Radiology of Duodenal Ulcer

No. 1. Normal duodenum on compression.

No. 2. Niche projection.

No. 3. Niche projection.

No. 4. Crater on compression.

No. 5. Scarring round ulcer.

No. 6. Oedema round crater.