THE RADIOLOGICAL INVESTIGATION OF INTESTINAL OBSTRUCTION

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The value of radiology in the investigation of intestinal obstruction is concerned mainly in confirming the presence of an obstruction and in determining the site of the lesion. In the majority of cases the pathology of the lesion can also be determined, but in acute obstruction owing to the limited investigation which can be carried out, often only the presence and site of the lesion can be diagnosed.

In all cases of suspected obstruction great care must be taken in preparing the patient prior to the examination; it is essential that the bowel should be cleared out as much as possible. This should be done with care, and drastic purgatives should be avoided. A mild aperient should be given two days before the examination, and a laxative the day before. If an opaque enema is to be given, a simple enema should be given a few hours prior to the examination. Impacted faeces may give a false localisation to the site of the tumour.

A decision as to which examination should be undertaken first can only be made after due consideration of the clinical features of the case. If it is suspected that a lesion is present in the colon, then an opaque enema should be administered. If an opaque meal is given it may take days to clear out the bowel before an opaque enema can be given, and consequently there will be delay in arriving at a diagnosis. If a lesion is suspected in the small bowel, then an opaque fluid meal which may also be watched through the colon should be given.

Stress must be laid on the importance of fluoroscopic examination combined with digital palpation. By this method redundant loops of bowel can be fully explored, and there will not be any fear of missing small lesions on the lateral and posterior walls, which are only demonstrable in the oblique position. The different methods of examination are described below.

(1) Direct examination of the abdomen.

The value of this examination is mainly in cases of acute obstruction, and is dependent on the fact

that obstruction will result in distension of the bowel proximal to the lesion. The gas produced by the putrefaction of retained proteins will distend the bowel, and the distended outline of the bowel will be demonstrated on the radiograph as a dense dark shadow. The type and outline of the shadow, together with its position, will help to define the site of the obstruction. Radiographs should be taken with the patient standing, or at least sitting, in order that the gas will rise to the maximum vertical position, and will thus demonstrate a fluid level if fluid is present in the obstructed loop of bowel. The appearances of the gas-filled colon and small bowel differ widely, and a guide is thus given which will help to determine the site of the obstruction. The character of the shadow of the gas-distended small intestine varies with each section; the first two feet of the jejunum show up clearly by the cross notching of their plicae, and present an almost "feathery" appearance in the abdomen. The ileum is quite regular and shows no sign of any plication. The colon shows the clear-cut haustration which its anatomical pattern would suggest, but it is of course dilated. Obstructed small bowel loops almost invariably contain fluid, and the horizontal fluid levels can be distinguished and give an indication of the number of loops involved by the number of fluid levels present.

It is frequently found that the patient is unable to be brought down to the X-ray department because of an acute condition of the lesion, but with the powerful mobile sets now in use examination of such cases can be carried out in bed provided the patient is fit to sit up. A radiograph should be taken by placing the plate in front of the abdomen and centring the X-ray tube posteriorly.

In extreme cases a satisfactory radiograph can be obtained by placing the patient on his side in a prone position and placing the plate against the front of the abdomen. The tube should be centred over the lumbar spine and a horizontal projection used. If screening is possible it will be noted that in a case of obstruction with distension the diaphragms are elevated, and there is considerable restriction of their movement.

(2) Utilisation of Opaque Media. The Barium Enema

This method of examination is of value in sub-acute and chronic obstruction. The lower colon is cleared out as far as possible by the administration of a mild laxative. Drastic aperients should be avoided as they may cause a sub-acute obstruction to become acute. The bowel is further cleared by the administration of a simple enema given a few hours before the examination. The

enema solution is composed of barium sulphate in water to which a little tragacanth or acacia has been added. The latter maintains the barium in suspension. The solution is warmed to body temperature and administered through a large cannula by gravity. The passage of the enema is watched through the fluorescent screen and controlled by palpation, the patient being rotated so that the colon is viewed from all angles and all the loops of bowel may be "sorted out." The site of an incomplete obstruction is noted by a delay in the passage of the enema which can only be overcome by increased pressure. If complete obstruction is present there will be distension of the bowel below the lesion, and the patient will experience pain. The patient should be instructed to evacuate the enema after the examination, and screening should again be carried out. Occasionally with an incomplete obstruction it will be found that the barium solution has passed the obstruction after evacuation and is now outlining the defect. Particularly is this so with a simple partial ring stricture when the empty distal loop will throw the dilated proximal loop and the obstruction into relief. In the diagnosis of a polypoid growth the enema is drawn off and air is introduced into the rectum by means of a syringe. The air is palpated round the loops of the colon, and if a polypoid growth be present it will be outlined as a negative shadow in the lumen of the colon. Another method of demonstration is possible by the introduction of thorium dioxide in solution as an enema. This solution will adhere closely to the mucous membrane of the bowel. The latter examination is of value in doubtful cases of intra-mural tumours, and has the advantage of throwing the lining membrane of the colon into relief. The process is simple; the patient is prepared as for the ordinary enema, and a colon wash-out is given one hour before examination. The solution diognothorine (25 per cent) is diluted with distilled water to 5-10 per cent and a little introduced into the rectum. By moving the patient the solution will flow round the colon, particularly aided by palpation. It is important that little pressure is applied to the enema as dilatation of the colon at this stage will spoil the radiograph. When the whole colon has been outlined by the flocculated liquid, the excess of fluid is drawn off and air is introduced into the colon gradually until the whole of the lining of the colon is clearly visualised but not dilated. Defects are seen as negative shadows in the lumen of the bowel, and their size and situation estimated.

If a previous operation has been performed it is important that the enema should be stopped at the first sign of any abnormality in case any fistulous communication has been found and the

detail is obscured by flooding of the bowel with the solution.

The Barium Meal

This must be used with great care in cases which are suspected to be in the chronic or sub-acute stages of obstruction because there is great danger that a sub-acute obstruction may be converted into an acute obstruction by the introduction of barium into the tract. In doubtful cases it is advisable to precede the meal by a dose of liquid paraffin and follow the examination by a saline aperient. These precautions will prevent moisture from being absorbed from the solution and the barium faeces from being converted into hard "cement-like" blocks due to delay in their passage through the colon.

The meal should be administered under screen control. The stomach is examined and the passage of the meal through the small bowel and colon is watched at regular intervals up to six to eight hours, and then at twelve-hourly intervals through the colon. Obstruction in the early stages is noted by dilatation of the bowel above the site and by evidence of a filling defect or obstructive lesion. In the small bowel obstruction may be difficult to localise accurately owing to the wide distension of the bowel, but it is frequently possible to count the loops involved.

The rate of passage of the meal through the colon is a variable factor in normal individuals, but delay at any one site for twenty-four, forty-eight, and seventy-two hours is very significant. It is often difficult to outline the defect in the colon in the case of early obstruction due to the fact that the bowel empties below the lesion and the absence of dilatation does not draw attention to the site. It is always necessary to confirm the site either by administering a barium enema soon after the meal or by further examination after complete re-preparation. It is unwise to give a negative report on a colon which has been examined by means of a meal only and not investigated by a barium enema.

In the acute stage of obstruction examination should be carried out by the direct method and by means of a barium enema. In the chronic stage first by a meal and later by an enema. When the examination is completed radiographs should be taken in the prone and oblique positions and such other positions as are necessary to demonstrate the defect.

All help should be given in trying to decide the cause of the obstruction. This can only be done by considering all the pathological details of the lesion as seen in the radiograph and relating these findings to known pathological lesions. Radio-

logically the main causes of obstruction may be sub-divided into:—

1. Lesions of the lumen.
2. Lesions in the wall.
3. Lesions outside the wall.
4. Lesions of the nervous control of the bowel.

1. Lesions of the Lumen.

Rarely does obstruction occur due to *impacted faeces* except in aged patients, mental patients and children. Occasional cases have been recorded in which a *gallstone* has been impacted in the region of the ileo-caecal valve, the stone being clearly visible (if calcified) in the straight radiograph, and the presence of gas-distended loops of bowel proximal to the lesion confirms the diagnosis. In cases of obstruction in aged and mental patients a large dilated and atonic colon with masses of impacted faeces in the pelvic and descending colon is frequently found. In the direct radiograph this is recognised by the gas-distended bowel proximal to the lesion, and the mottled appearance of the impacted faeces in the colon. It will be found impossible to administer a barium enema, but when the bowel has eventually been cleared out the a colon will be found to hold as much as one to two gallons of enema solution so atonic has it become.

2. Lesion in the Wall.

These may be *inflammatory* lesions or *malignant* defects. In the small bowel inflammatory lesions are relatively common and malignant lesions rare. The reverse may be said to hold true for the colon. In the small bowel the commonest cause of a lesion is *tubercle*, which occurs in two types—the *ulcerative* and *hyperplastic*—radiologically little differentiation can be made between the two types. Usually the ulcerative type is associated with a tuberculous lesion elsewhere in the body, and a radiograph of the chest demonstrating a tuberculous lesion will aid in formulating a diagnosis. Ulcerative lesions give rise to a greater number of strictures than the hyperplastic type, and the part of the bowel usually involved is the lower ileum.

In the simple stage the hyperplastic type is seen as masses of glands in the abdomen associated with adhesions and obstruction. In the direct radiograph calcified glands will be seen in the abdomen together with loops of gas-distended small bowel, and examination by barium meal will reveal defects in filling associated with palpable masses. The usual site is the ileo-caecal region.

It is difficult to distinguish between a tuberculous lesion and a *plastic regional ileitis* (Krohn's disease). The main characteristic point is that an

ileitis presents a "string-like" appearance of the terminal ileum which is clearly defined, and a regular narrowing of the bowel is localised to the terminal loop of the ileum. At a later stage there will be a fistulous formation to other parts of the colon. In tuberculous ileitis the fistulae, when present, occur more frequently to the surface of the abdomen than to other parts of the bowel.

Appendicular abscesses are noted by the fact that they rarely cause any obstruction, but cause a persistent defect of the caecum associated with a palpable mass. The history is the most important point in differentiation. It is impossible to distinguish radiologically between a simple and an actino-mycotic abscess of the caecum or appendix.

Some tumours do occur in the small bowel. *Adenomata* are not common, but when present tend to be pedunculated and are usually multiple. If obstruction supervenes there is nothing characteristic to distinguish this condition from other causes. *Carcinoma* of the small bowel, which is rare, is seen in the form of an annular stricture and leads to obstruction rapidly. In the colon the commonest cause of obstruction is carcinoma, but it is rarely recognised radiologically until it causes complete obstruction. The most frequent type is an adeno-carcinoma which protrudes on the lumen of the bowel and soon ulcerates. The schirrus type tends to encircle the bowel and causes a ring stricture. The former is recognised by the presence of a constant defect associated with a tumour mass, the latter by a small constant defect and, rarely, by a palpable mass which if present is due to impacted faeces. The commonest site for carcinoma is the pelvic colon, followed by the caecum and lastly by the splenic flexure and the transverse colon. The first characteristic appearance is a disturbance of the normal haustration of the bowel with fixation, followed later by a constant defect involving a section of the bowel proximal to which are dilated loops of bowel. A defect of this type is constant and shows no sign of any contractions. If a radiograph taken with two exposures with a short interval between is made on the same plate it will be observed that the bowel on either side of the defect has moved (seen by a double shadow), but the defect has remained immobile. The tumour is best demonstrated by an enema, when a mass will be palpable at the site of the tumour.

The greatest difficulty is experienced in *tumours of the caecum*, where it is almost impossible to distinguish radiologically between carcinoma and tubercle or actinomycotic abscess. A helpful point in diagnosis is that malignancy more frequently fixes the caecum and shows obstruction to the small bowel with a comparatively small defect.

The commonest inflammatory condition of the colon is *diverticulitis* superimposed on a *diverticulosis*. The diagnosis of diverticulosis is made by the appearance of diverticula formation seen after an opaque meal. In the early stages of diverticulosis there is evidence of breaking up of the haustral segmentation of the colon, and this is followed later by small bead-like projections of the bowel. A superimposed diverticulitis is always associated with a palpable mass at the site of a narrow irregular defect of the bowel. The lesion usually extends further along the axis of the bowel than does a malignant defect. It is extremely difficult to detect a malignant defect which is superimposed on a diverticulosis.

3. Lesions Outside the Wall.

The commonest lesion to involve the bowel from outside the wall is an *abdominal tumour*, and the most common cause is an *ovarian cyst*. The bowel will be found to be displaced by the tumour mass to which it is bound down by adhesions. Rarely do other tumours involve the bowel, though they frequently cause displacement. *Pancreatic tumours* will displace the bowel forwards and will compress the duodenum. They are readily recognised, particularly by the duodenal displacement, in the lateral view, and by the splaying out of the duodenal loop. *Renal tumours* rarely cause displacement and compression.

Obstruction by *volvulus* is usually recognised in the acute stage. If sub-acute the presence of very mobile bowels and redundant looping of the colon will aid diagnosis of this condition.

Obstruction in a *hernial sac* is recognised by the presence of the hernial sac containing loops of bowel. The radiograph will show the barium-filled bowel in an abnormal situation.

Intussusception is rarely sent for diagnosis radiologically as it is easily recognised clinically. In the adult; however, it does sometimes result from the presence of a papillomatous mass. By the enema the rounded end of the apex of the intussusception is recognised, and the mass palpable behind this will confirm the diagnosis. After evacuation of the enema barium will be found in the loop of bowel forming the intussusception.

4. Lesions of the Nervous Control of the Bowel.

I.e. *Paralytic ileus* and *achalasia of the pelvi-rectal sphincter* (Hirschprung's disease). These are distinguished by the marked dilatation of the bowel which accompanies these legions.

In paralytic ileus the whole abdomen will be seen filled with widely distended loops of small bowel, and rarely will fluid levels be seen. In Hirsch-

prung's disease the appearance of the colon depends on whether the colon is loaded with faeces or distended with gas.

In this condition the colon becomes markedly dilated as far back as the caecum particularly in long established cases. The narrowing of the colon is at the pelvi-rectal junction and is quite regular. The colon retains its haustration till late in the disease, despite the dilatation.

Finally, the correlation of the clinical findings and the radiological appearances must be considered before a final diagnosis is made. The time spent by the radiologist in investigating and localising the site of the lesion before operation will be amply repaid in time saved for the surgeon.

PHYSIOLOGICAL MECHANISMS IN INTESTINAL OBSTRUCTION AND ITS TREATMENT

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INTRODUCTION

It is probably true to say that physiological principles should provide the basis for medical and surgical treatment as far as possible. To agree with this statement does not mean that we lose sight of the individuality of the individual, the value of empiric treatment, or the effect that projection of a highly developed nervous system can have on the functions of many of the tissues of the body. Nevertheless, it should be a problem of considerable interest to review the physiological principles involved in the symptomatology and treatment of intestinal obstruction.

INTESTINAL OBSTRUCTION

Intestinal obstruction may come on suddenly and be complete, or it may come on more slowly and eventually become acute or complete. Furthermore, the obstruction can occur in any part of the intestinal tract, and, as we shall see later, the urgency of the condition decreases as the obstruction is sited near the distal part of the gut.

The causes of intestinal obstruction are many. No doubt obstruction occurs more frequently in certain sites than in others, and the causes thereof may be linked with anatomical factors and, very rarely, developmental factors. If one may generalise, obstruction is due to intrinsic or extrinsic mechanisms:

(1) In the wall of the gut itself, e.g. neoplasm.