

## NON-ROTATION OF GUT

WITH REPORT OF CASE OF LEFT-SIDED APPENDICEAL ABSCESS

E. ALAN PRICE, M.B., B.CH. (RAND), D.M.R.D., R.C.P. &amp; S. (ENG.)

*X-Ray Department, Johannesburg General Hospital*

AND

GERALD KANE, M.B., B.CH. (RAND), F.R.C.S. (ENG.)

*Johannesburg General Hospital*

The surgical importance of anomalies of intestinal rotation and the diagnostic difficulties related to their pre-operative recognition has prompted the study of this case.

The term 'non-rotation of gut' is synonymous with 'mesenterium commune' and with 'left-sided colon' a term used by earlier workers.<sup>9</sup> Some American writers<sup>6, 11</sup> group all anomalies of intestinal rotation and mesenteric fixation under the one term of 'malrotation'. We prefer, however, to use Dott's classification.<sup>4</sup> The term 'non-rotation of gut', according to this classification, refers to a complete failure of rotation of the mid-gut segment. This condition is not to be confused with 'situs inversus', where there is usually complete transposition of all the thoracic and abdominal viscera.

It is not the purpose of this paper to discuss in detail the embryology of intestinal rotation. The widely accepted work of Frazer and Robbins,<sup>5</sup> and Dott,<sup>4</sup> gives comprehensive accounts of the factors concerned and the mechanism.

The errors of development are commonest in the mid-gut, which extends from the duodenal biliary papilla to the left third of the transverse colon, and is that portion of the gut which is supplied by the superior mesenteric artery. During the first 4-5 weeks of intra-uterine life the mid-gut herniates through the umbilicus with the cord, carrying with it the superior mesenteric artery. Both the pre-arterial and post-arterial segments of the mid-gut are situated in the sagittal plane at that stage. Three stages are recognized in the rotation and return of the gut. The 1st stage takes place between the 4th and 10th weeks of intra-uterine life, while the loop lies in the umbilical cord. During this stage the pre-arterial segment rotates from the sagittal plane to the right in an anti-clockwise direction through 90° around the axis of the superior mesenteric vessels. As a result, the pre-arterial segment, which later forms mainly the small bowel, lies on the right side, and the post-arterial segment, which will form mainly the large bowel, lies on the left. Failure of the 1st stage of rotation, which is rare, occurs in the condition of exomphalos. The 2nd stage is the stage of return and occurs between the 10th and 11th week. It consists of a reduction of the umbilical hernia with the return of the jejunum, ileum, caecum and colon, in that order, behind the superior mesenteric vessels into the abdominal cavity. This results in a further 180° of anti-clockwise rotation. This stage comes to an end when the whole length of the colon is in its proper place

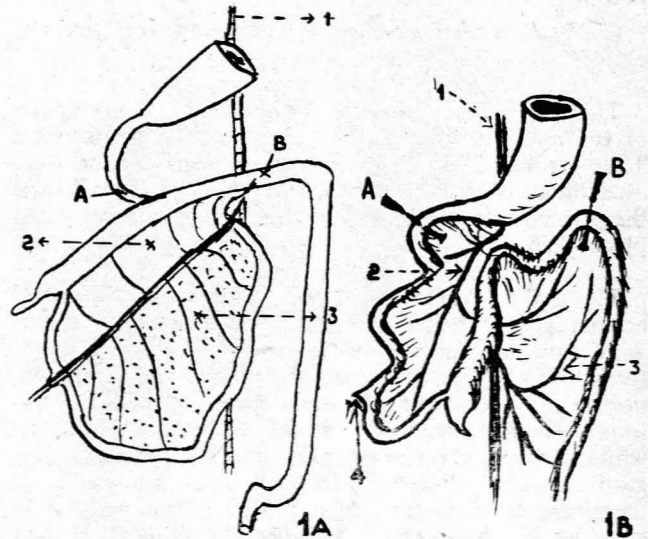


Fig. 1A. Ventral view at end of 2nd stage of rotation. The mid-gut loop has undergone an anti-clockwise rotation of 270°. A-B is mid-gut segment. 1=Aorta. 2=Post-arterial mesentery. 3=Pre-arterial mesentery.

Fig. 1B. Diagram illustrating 'non-rotation' of mid-gut loop. The normal anti-clockwise rotation has been arrested at 90°, and the embryonic position existing at the 8th week is carried forward unchanged into adult life. 1=Aorta. 2=Superior mesenteric artery. 3=Inferior mesenteric artery. 4=Site of the vitelline duct and artery.

relative to the small bowel; i.e., small bowel on the left side and the caecum on the right side in the sub-hepatic region (Fig. 1a). It will be seen that the mid-gut loop has now rotated on the axis of the superior mesenteric vessels through 270° from its original sagittal plane.

The term 'non-rotation' refers to a failure in the 2nd stage. The returning bowel fails to undergo the usual extra 180° of anti-clockwise rotation and thus retains the same primitive relationships as during the 6th week of intra-uterine life, viz. the small bowel on the right side and the colon and caecum on the left side (Fig. 1b). This is the commonest variation met with in radiological practice.<sup>10</sup>

In those cases where the 2nd stage of rotation is incomplete a distribution of the gut intermediate between the normal and non-rotation results. This is known as 'malrotation'.

Other rarer anomalies of rotation which may occur during the second stage are:

(a) *Reversed Rotation.* This consists in a clockwise rotation of the mid-gut loop. The post-arterial segment passes behind the artery and thus the transverse colon comes to lie behind the duodenum. The viscera otherwise attain normal positions except for the anterior and posterior relationship, which is reversed.

(b) *Paraduodenal Hernia.* According to Andrews,<sup>1</sup> during the 2nd stage of rotation the caecum and colon, as a result of an anomalous 90° clockwise rotation, envelop the small bowel in either the mesentery of the ascending colon (right paraduodenal hernia) or the mesentery of the transverse colon (left paraduodenal hernia).

(c) *Undescended Caecum.* This, however, may be congenital or due to adhesions.

The 3rd stage is concerned with the fixation of parts of the mid-gut mesentery to the posterior peritoneum. The normal fixation of the duodenum, caecum and ascending colon to the posterior abdominal wall, and the formation of the extended mesenteric root, takes place then.

The majority of cases of non-rotation are discovered accidentally and give rise to no symptoms. Patients with such anomalies, however, may present with symptoms and signs of intestinal obstruction or strangulation, or may complain of vague gastro-intestinal symptoms usually diagnosed as of a functional nature, while a small proportion may present a picture suggesting coeliac disease.<sup>6</sup> In such cases knowledge of the presence of an intestinal positional anomaly is of considerable importance, because the clinical picture, the diagnosis and the subsequent therapy may be greatly influenced by it. In the 48 cases collected by Dott<sup>4</sup> the erroneous fixation of the bowel was the directly predisposing cause of intestinal obstruction in 27% of the cases. The precipitating factor was either torsion or volvulus. The 2 main conditions which are apt to be overlooked and misdiagnosed in patients with this anomaly are (1) the various types of intestinal obstruction associated with non-rotation, particularly volvulus neonatorum in which there is a clockwise volvulus of the mid-gut from duodenum to transverse colon around the duodeno-colic isthmus; and (2) an abnormally situated appendix becoming diseased or, in other words, a left-sided appendicitis. A case of the latter condition is now presented.

#### CASE REPORT

H.M.G., a 52-year-old female, was admitted to hospital in 1948 complaining of abdominal pain and vomiting of 3 weeks' duration. Three weeks before admission she started vomiting in the middle of the night and experienced severe cramp-like pain all over the abdomen. This attack continued for 12 hours. She then stopped vomiting but felt a dull pain in her 'left groin' and for the rest of the 3 weeks she had frequent attacks of sharp pain and vomiting. The attacks followed after meals and started with a 'swelling' coming up on the left side of the abdomen. Since the onset the patient had had diarrhoea, but before this illness she had been constipated. Two days before admission a doctor told her that she had a temperature of 102.2°F. There was nothing significant in her past history except that she had had an uncomplicated cholecystectomy 2 years earlier.

At examination immediately on admission her temperature was 100.2°F, the pulse 110 per minute and the respiratory rate 28 per minute. Her tongue was dry and there was guarding and tenderness as well as an indefinite swelling on the left side of the abdomen and particularly in the left iliac fossa. A gynaecological examination was negative. Otherwise no significant abnormalities were found.

She was operated on under general anaesthesia 4 days later, via an oblique left lower abdominal incision. The large bowel was found matted and a left-sided pelvic abscess was opened, which delivered a large quantity of foul-smelling pus, found on culture to contain coliform bacilli. No obvious cause could be found for the pus formation. No foreign body was seen or felt and no diverticula were noted. Two drains were inserted and the wound closed. A transverse colostomy was then established through a supra-umbilical mid-line incision. There was no apparent difficulty in finding the segment of the transverse colon and no anomaly of the mesocolic attachment was recorded. The patient was put on penicillin and made good progress. She was discharged 4 weeks later with the colostomy acting well. The final diagnosis entered on the case sheet was diverticulitis with pelvic peritonitis.

Six months later when the patient returned to hospital for closure of the colostomy she developed a left-sided empyema before the operation was undertaken and therefore closure had to be postponed. Recently she again presented herself for closure of the colostomy. She was then referred for X-ray examination of the gastro-intestinal tract and the following were the findings:

'The barium meal passed normally along the oesophagus into the stomach, which was normally placed, presented no unusual features, and emptied at a normal rate. There was deformity at the duodenal cap but no active ulceration was noted. The 1st and 2nd parts of the duodenum took a normal course, the latter passing vertically downwards a little to the right of the mid-line. The direction of the lower flexure was reversed so that the 3rd part of the duodenum and the jejunum was situated in the right hypochondrium (Fig. 2). On following the course of the meal through the gastro-intestinal tract, it was found that the whole of the small intestine, with the exception of the last fragment

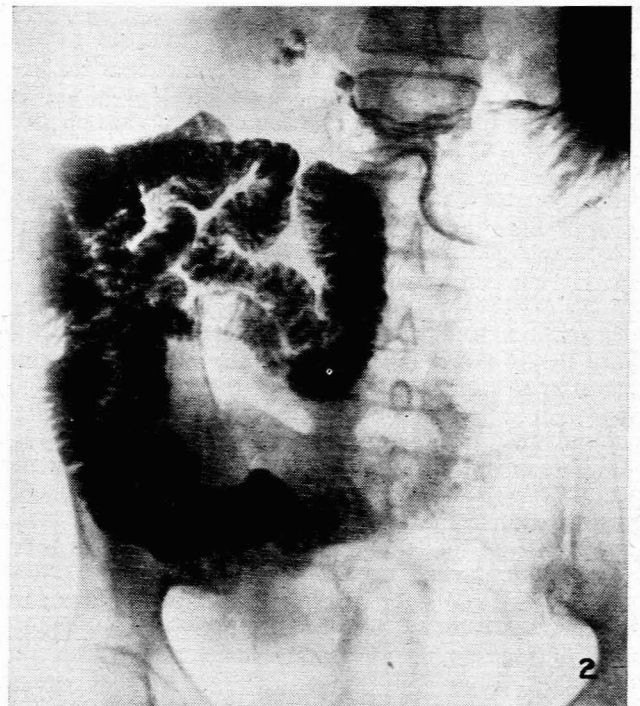


Fig. 2. Case of 'non-rotation'. Supine post. ant. view showing the jejunum situated completely to right of vertebral column and the absence of the normal duodeno-jejunal flexure.

of the terminal ileum, lay on the right side of the abdomen. The rate of passage of the meal through the small bowel was rather rapid. Within an hour it was at the caecum and within 2 hours had reached the colostomy. Films taken 3 hours after the examination showed the terminal ileum entering the caecum from right to left instead of from left to right as is the case in the normal. The caecum and ascending colon were on the left side and the descending colon rose rather high. The appendix was filled and, on screening, both the caecum and appendix were found to be fixed and immobile, but no tenderness was elicited (Fig. 3). Six hours after the administration of the meal, the barium was entirely in the colon. No trace of diverticulosis or diverticulitis was noted, and the portion of the colon distal to the colostomy was perfectly patent and functioned well. A barium enema which passed normally confirmed the absence of diverticula or diverticulitis. No stricture or irregularity of the lumen could be detected and there was no disturbance of the motility or distensibility of the colon. Fluoroscopic examination of the thorax showed the heart and great vessels to be normally situated and the patient showed no radiological evidence of any other abnormality. The conclusions were that the X-ray appearances were those of failure of the 2nd stage of rotation of the mid-gut loop. The absence of any diverticulitis, while the caecum and appendix were fixed and immobile, suggested that the original pathological condition was a left-sided appendiceal abscess'.

It was suggested to the patient that an appendectomy would be advisable but she refused operation. Extra-peritoneal closure of the colostomy was then performed.

#### DISCUSSION

This case of left-sided appendiceal abscess presented itself as one of diverticulitis with pelvic peritonitis. There was, however, no evidence of diverticulitis either radiologically or at operation. The possibility of perforation of the sigmoid colon by a foreign body such as a fish bone is unlikely when one considers the onset of symptoms, which started with central abdominal colic, indicating obstruction to some part of the bowel lumen. All the characteristic features of non-rotation of the gut were well demonstrated. According to Babaiantz and Kadruka<sup>2</sup> the characteristic radiological features of non-rotation are as follows:

1. Right-sided inversion of the 3rd part of the duodenum.
2. Absence of the duodeno-jejunal flexure.
3. The small intestine is on the right side.
4. Position of the proximal colon on the left side.
5. Absence of the hepatic flexure.
6. The terminal ileum enters the caecum from right to left instead of from left to right.

The value of pre-operative knowledge of the X-ray appearances or, if that is impossible, at least of post-operative roentgen studies is demonstrated by this case. The surgeon and radiologist should be aware of and keep in mind the possibility of a left-sided appendix, and should know the radiological appearances of non-rotation of the gut, for otherwise the condition may be passed over undetected. The diagnosis is almost impossible without X-ray examination. This is not so in situs inversus, where the detection of a dextrocardia and left-sided liver dullness will suggest left-sided appendicitis. The difficulty is further increased by the fact that some appendicitis patients with this anomaly are recorded as complaining of pain in the right iliac fossa although the appendix is on the left side. According to Blegen,<sup>3</sup> in a survey of 57 patients who were operated on for left-sided appendicitis, 21 or 37% had pain in the right iliac fossa. Evidence

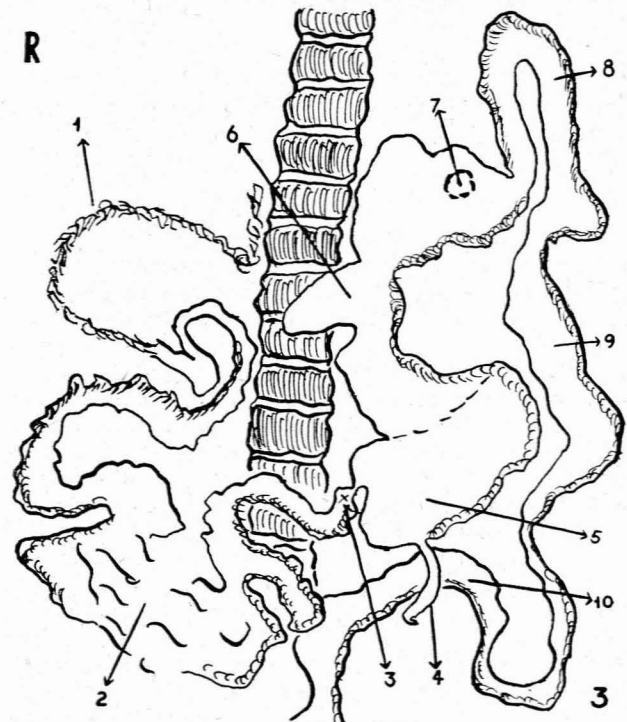


Fig. 3. Supine post. ant. view 3 hours later.

Sketch of Fig. 3. 1. Jejunum. 2. Ileum. 3. Ilio-caecal junction showing terminal ileum entering the caecum from right to left. 4. Left-sided appendix overlying the sigmoid colon. 5. Caecum. 6. Ascending colon. 7. Site of colostomy. 8. Splenic flexure. 9. Descending colon. 10. Sigmoid colon. Note: Small intestine is completely on the right, and large intestine on the left.

suggests that in the left-sided appendix, although the viscera are transposed, the component parts of the nervous system are not reversed.

Those patients in whom non-rotation is discovered accidentally on X-ray should be told of their anomaly and instructed to tell any doctor attending them in the future.

This case also raises the question whether an appendix which was previously diseased and associated with an abscess can fill on subsequent examination. Gramse *et al.*<sup>7</sup> found that, out of 32 patients who underwent appendiceal drainage and returned for interval appendectomy, in 13 (40%) the removed appendix was found to be healthy and normal on histological examination. Hindmasch<sup>8</sup> discussing the pathology of appendicitis states, 'In many cases of appendicitis in which occlusion of the lumen was present, it was noted that the infective process tended to stop at the point of obstruction. Only the distal portion was involved by the diseased process'. It would therefore appear that the proximal portion may remain unaffected by the disease and, after subsequent fibrosis of the perforated end, remain viable and the lumen patent.

#### SUMMARY

1. The embryology and mechanism of non-rotation of the gut are briefly described.
2. The pathological complications which may arise from this anomaly are mentioned.
3. Left-sided appendicitis and the diagnostic diffi-

culties encountered as a result of this uncommon situation are discussed.

4. A case of left-sided appendiceal abscess diagnosed as ruptured diverticulitis and pelvic peritonitis is reported.

5. The characteristic radiological features of non-rotation of the gut are described.

6. The changes which may take place in an appendix after drainage of appendiceal abscess are referred to. It would appear that a large percentage may resume a healthy viable state.

We wish to acknowledge our thanks to Dr. Josse Kaye, Chief Radiologist, Johannesburg General Hospital, Mr. M. K. Tucker and Dr. Kenneth F. Mills (Superintendent, Johannesburg General Hospital) for their support and permission to publish this case.

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