- KREEL, L., and ELLIS, H. (1965): Pyloric Stenosis in Adults: a Clinical and Radiological Study of 100 Consecutive Patients, *Gut*, 6, 253.
- MIALARET, J. In WEISS, A. G., and HOLLENDER, L. F. (1964): (Ed.) *La Vagotomie dans l'Ulcer Gastro-Duodeno-Jejunal*. Paris: Expansion Scientifique Francaise.
- MOODY, F. G., CORNELL, G. N., and BEAL, J. M. (1962): Pyloric Obstruction Complicating Peptic Ulcer, *Arch. Surg. (Chic.)*, 84, 462.
- MOYNIHAN, B. G. A. (1912): *Duodenal Ulcer* (2nd ed.). Philadelphia: Saunders.

- PARSONS, F. M., and WATKINSON, G. (1954): The Treatment of Pyloric Stenosis in Peptic Ulceration, *Postgrad. med. J.*, 30, 145.
- PORTIS, S. A., and JAFFE, R. H. (1938): Study of Peptic Ulcer Based on Necropsy Records, *J. Amer. med. Ass.*, 110, 6.
- REID, H., and MARCUS, R. (1948): Posterior Gastroenterostomy for Organic Pyloric Stenosis, *Brit. J. Surg.*, 35, 304.
- TONKIN, R. D., FIELD, T. G., and WYKES, P. R. (1962): Pancreatic Heterotopia as a Cause of Dyspepsia, *Gut*, 3, 135.

Case Reports

REVERSED INTESTINAL ROTATION

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DEVELOPMENTAL anomalies of the colon resulting from a derangement of intestinal rotation are not uncommon and include nonrotation, malrotation and failure of descent of the caecum. Reversed intestinal rotation, in which the transverse colon lies below the superior mesenteric artery, is probably the rarest and most interesting, for in 19 of the 28 recorded cases symptoms of the disorder were delayed well into adult life.

Case Report

The patient, a married woman aged 33 years, was admitted to hospital in September 1963, complaining of recurrent attacks of pain and vomiting of 10 years' duration. The attacks of pain and vomiting usually continued for several days during which time there would be absolute constipation and abdominal distension. She had 8 siblings, none of whom suffered with gastrointestinal complaints and had 4 children of her own who were alive and well.

On examination she was a thin woman who was not anaemic. The abdomen was not distended and the abdominal musculature seemed abnormally lax. In the umbilical region there was a large defect in the rectus sheath without actual herniation of peritoneal contents. No masses were felt in the abdomen, but it was noted that there was a fullness in the right iliac fossa. The bowel sounds were hyperactive and obstructive in character.

Special Investigations: Hb 80 per cent; W.B.C. 9,600/cu. mm.

Barium meal showed a normal stomach outline and a large diverticulum of the first part of the duodenum. No abnormality was detectable in the follow-through examination.

Operation: A laparotomy was performed through a right paramedian incision. An immediate striking feature on opening the peritoneum was gross varicosities of the mesenteric and omental veins. There was a volvulus of the ileum, caecum and ascending colon turning in a clockwise direction through 360 degrees (Fig. 1C.), and multiple adhesions between the loops of small bowel. The transverse colon and hepatic flexure could not be identified. Beyond the volvulus, the colon was seen to pass in a tunnel behind the third part of the duodenum and behind the superior mesenteric vessels, appearing at the left side

FIG. 1.—(a) normal intestinal rotation, (b) reversed intestinal rotation, (c) operative findings in the case described.

of these vessels to reach the splenic flexure. The transverse mesocolon was absent. On dividing the adhesions and untwisting the volvulus the small bowel was found to be suspended on a long, narrow mesentery: in addition the caecum and ascending colon had retained their primitive mesentery. On the lesser curvature of the stomach there was a small active ulcer and the presence of the duodenal diverticulum was confirmed.

The transverse colon was not constricted and moved quite freely in its tunnel behind the duodenum and the superior mesenteric vessels. It seemed likely that symptoms had been due to the volvulus and to prevent recurrence of the volvulus, the terminal ileum, caecum and ascending colon were sutured to the posterior abdominal wall in their normal anatomical positions with linen sutures. There were no complications in the immediate post-operative period and no symptoms in the months following operation.

Discussion

Since reversed intestinal rotation was first reported by Tscherning (1883) as an incidental finding of a post-mortem examination, 27 cases have been described occurring in neonates, children and adults. The symptoms were usually due to acute obstructive episodes caused by the volvulus, though sometimes there was obstruction of the transverse colon in the tunnel behind the superior mesenteric artery. Two cases were also reported in which there were adhesions about the duodeno-jejunal junction causing a high intestinal obstruction. It was rare for the diagnosis to be made preoperatively.

Reversed intestinal rotation results from an error in the second stage of midgut rotation, when during the 10th week of intrauterine life the midgut is returning to the abdominal cavity from the umbilical cord. Normal rotation takes place by the gut moving around the axis of the superior mesenteric artery for 270° in an anticlockwise direction (Dott, 1923), (Fig. 1a). In reversed intestinal rotation, the gut rotates 90° in a clockwise direction (Fig. 1b) so that after the return of the gut to the peritoneal cavity, the transverse colon moves to the right behind the superior mesenteric vessels and the duodenum lies anterior to the colon. The rest of the bowel can occupy a normal position but its surface is reversed. It is usual in this condition for the mesentery of the small and large bowel to fail in its attachment to the posterior abdominal wall and this predisposes to ileocaecal volvulus at a later date.

Little is known about factors leading to the development of reversed intestinal rotation. Dott (1923) suggested that any factor which allows the caecum to slip back first into the peritoneal cavity, before the small bowel returns, will produce the anomaly, and quotes Hunter's (1922) case in which there was a large mesenteric cyst in the umbilical cord, which it was thought, prevented the ileum from returning normally. Furthermore, he considered that if the umbilical opening is large, the caecum is more likely to return first, and it may be significant that in the present case there was a large umbilical defect which had been present since birth. Snyder and Choffin (1954) believe that the anomaly results from a failure of the duodenojejunal and hindgut loops to rotate normally and the extra-abdominal gut follows passively.

Of the 28 cases recorded, 14 recovered and 14 died.

The high mortality is probably due to the cases arising during the earlier part of this century and since 1930 there has only been one death in 11 cases. The methods of treatment employed for reversed intestinal rotation have been governed by the state of the bowel at operation. In seven cases the bowel was gangrenous requiring resection with four deaths. Ten cases were treated by untwisting the volvulus with fixation of the caecum, usually by a caecostomy, with four deaths. The fatal cases have been obstructed for several days, those which recovered had had intermittent symptoms for a long time and the operation was elective. A case treated by Gardner and Hart (1934) was treated by gastroenterostomy and transverse ileocolostomy as an elective procedure and also survived; two cases described by Warthen, Lattman and White (1952) had obstruction at the duodenojejunal junction from adhesions and an anterior gastroenterostomy was made with good results. In a case described by Truesdale (1935), the obstruction in the retroarterial tunnel was treated by manual dilatation of the tunnel together with a caecopexy.

Many operations have been devised to release the constriction at the retroarterial tunnel; these include colonic resection, displacement of the transverse colon anterior to the duodenum after colonic transsection and side-to-side anastomosis of the colon. More recently Butler (1958) has suggested that the whole midgut be rotated through 180° degrees in an anticlockwise direction; this would produce the condition of intestinal non-rotation and would be an improvement. But, as Estrada and Gurd (1962) point out, patients with intestinal non-rotation are particularly liable to symptoms of intestinal obstruction and to volvulus. Assuming that the retroarterial tunnel is formed post-partum and therefore has a bloodless plane of cleavage, they dissected this area and were able to turn the whole of the midgut through 360° in an anticlockwise direction, thus restoring the normal anatomy. The gut was then fixed to the posterior abdominal wall in its usual position. This procedure would seem to be indicated in all cases where there is obstruction behind the superior mesenteric vessels.

Summary

A case of reversed intestinal rotation is described. The current views on its aetiology are discussed and the results and treatment of a further 27 cases are reviewed.

I wish to thank Mr. R. L. Holt of Manchester Royal Infirmary for permission to publish this case, Miss Mary Brown for the diagrams and Mr. C. G. Clark for helpful advice with the manuscript.

REFERENCES

- BUTLER, M. F. (1958): Volvulus of the Caecum Complicating Non-rotation of the Midgut, *Brit. med. J.*, **i**, 689.
- DOTT, N. M. (1923): Anomalies of Intestinal Rotation: the Embryological and Surgical Aspects with a Report of Five Cases, *Brit. J. Surg.*, **11**, 251.
- ESTRADA, L., and GURD, F. N. (1962): Surgical Correction of Reversed Rotation of the Midgut Loop, *Surg. Gynec. Obstet.*, **114**, 707.
- GARDNER, C. E., and HART, D. (1934): Anomalies of Intestinal Rotation as a Cause of Intestinal Obstruction, *Arch. Surg.*, **29**, 942.

HUNTER, J. I. (1922): A Mesenteric Cyst of Jejunal Origin Complicated by Retrojejunal Position of the Transverse Colon, *Brit. med. J.*, ii, 800.

SNYDER, W. H., and CHOFFIN, L. (1954): Embryology and Pathology of the Intestinal Tract: Presentation of 40 Cases of Malrotation, *Ann. Surg.*, 140, 368.

TRUESDALE, P. E. (1935): Retroposition of the Transverse Colon, *J. Amer. med. Ass.*, 104, 1697.

WARTHEN, R. O., LATTMAN, I., and WHITE, S. C. (1952): Reversed Rotation of the Bowel, *Amer. J. Dis. Child.*, 83, 487.

TSCHERNING, E. (1883): *Nord. med. Ark.*, 15, 1, Cited by BLACK, C. E., *Tr. West. S.A.*, 24-87, 1915.

AN UNUSUAL CASE OF INTUSSUSCEPTION IN CHILDHOOD

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INTUSSUSCEPTION though not common after the first year of life, can occur at any age, even sexagenarians being reported in the literature. The following case is unusual, not only is respect of age and sex, but also because of the presence of mesenteric adenitis, Meckel's diverticulum and a polyp.

Case Report

Miss S. G., age 10 years, was admitted to hospital as an emergency with a 30-hour history of anorexia, abdominal pain and vomiting. She had been quite well until the morning of the day prior to admission when she began to have central abdominal pain of a colicky nature, mainly around the umbilicus. The pain did not radiate, nor was it relieved or aggravated by coughing and change of posture. The same day she vomited several times, the vomit being watery and yellowish. In the evening it was noted that her tongue was not coated, her temperature was 97°F, her pulse was 60 per minute, and that maximum, though slight, abdominal discomfort was just to the right of the umbilicus.

The following morning her temperature had risen to 99°F, her pulse increased to 90 per minute, and it was noted that she had foetid breath. By the time of her admission in the afternoon her temperature was just over 100°F, and her pulse 112 per minute. There had never been any change in her bowel habit or in the motions passed. Indeed she had passed a normal motion on the morning of admission.

Past History: She had had central abdominal discomfort on several occasions in the previous eighteen months, which had been ascribed to "nerves." These attacks were usually in the morning with no associated features, and disappeared of their own accord in about two hours.

On Examination: She was a well-developed girl. Temperature 100°F and pulse 112 per minute. There was a small area of deep tenderness in the abdomen just above the umbilicus where guarding and positive rebound tenderness were elicited. There was no rigidity, and no mass was palpable. The liver, spleen and kidneys were

impalpable. Rectal examination was not well tolerated; however there was no blood or mucus on the examining finger, neither was any other abnormality detected. There were no other abnormal findings on physical examination.

A provisional diagnosis of appendicitis or mesenteric adenitis was made.

Operation (RTJHA): This was performed three hours after admission. A right oblique incision revealed approximately 100 ml. of bloodstained fluid. The appendix appeared normal. There were many grossly enlarged lymph nodes in the mesentery. An ileo-ileal intussusception was found, due to an abnormality of the ileum in the region of a Meckel's diverticulum. The head of the intussusception was about 18 inches from the ileo-caecal valve (Fig. 1).

Appendectomy was performed. The ileum was pulled through the wound, and the intussusception was reduced. Both the intussuscepiens and the intussusceptum were oedematous, and had a few dark haemorrhagic patches, but were considered still viable. However, even after the reduction, a small polypoid mass attached to the anti-mesenteric border of what was the head of the

Fig. 1.—Diagram of small bowel intussusception prior to reduction.

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