as patients in British hospitals are treated as men and women with feelings which can be hurt and a personal dignity which can be outraged.

Conclusion

But I must bring to a close these disjointed remarks on medical education. I have no anxieties about our students. Their standard is as high as it ever was, and they are getting and taking an excellent training. To the seniors, of whom I am one, the two-edged compliment may be paid that it is impossible to improve us. But I do feel uneasy about the most important class in the profession, the young general practitioner in the twenties and the early thirties. Is panel practice giving him an assured income too soon? Is it taking away the incentive to study and to improve the standard of his practice? Is he sitting down at ease in Zion? I trust not, for it is upon him that we depend to maintain and to raise the prestige of our profession.

ELONGATION AND DILATATION OF THE COLON*

BY

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An approach to any problem of colonic disease must inevitably take into consideration the embryological origin of the large bowel, its adult anatomy, and its physiological duality.

Development

The colon is developed from two sources: (1) the midgut, supplied by the superior mesenteric artery; and (2) the hindgut, supplied by the inferior mesenteric artery, the juncture in the adult being about the middle of the transverse colon. Until the end of the first month the future small and large intestines are approximately of the same length, and the colonic rudiment is actually narrower than that of the small intestine. The second month sees the beginning of the rapid elongation of the primitive small bowel, but it is not until the fifth month that the calibre of the colonic rudiment begins to enlarge. The alimentary tube, originally straight, is rearranged after the second month by the rotation of the primitive bowel about the superior mesenteric artery; when this stage is completed the future caecum comes to lie anterior to the right kidney, the future splenic flexure has attained its adult position, and the future descending colon has been forced from its median position into the left flank by the rapid elongation of the small bowel. From this time until just after birth, when the adult anatomical arrangement is reached, there occur two processes which appear to be correlated with man's upright position: (1) descent of the caecum to the right iliac fossa as a result of elongation of the proximal part of the primitive colon, and (2) the disappearance of the dorsal mesentery from certain segments of the colon.

Normal Anatomy

To the complete peritoneal coat of the caecum may be added a short mesentery; the ascending colon is uncovered by peritoneum posteriorly. The transverse colon has a mesentery of varying length, which confers corresponding

mobility on this segment. The descending colon lacks a mesentery, and the iliac colon up to the brim of the true pelvis is fixed to the parietes, whereas the pelvic colon forms a long free loop with a fan-shaped mesentery which allows a wide range of movement, the loop being four to ten times as long as the root of the mesentery.

Developmental Anomalies

It is not a surprising matter that a tube having such a complicated development should be a site of anatomical anomalies. Thus Treves found a mesentery to the descending colon in 36 per cent. of 100 cases, and to the ascending colon in 26 per cent. According to Dott's (1923) classification, anomalous development which might lead to elongation of the colon may be due to excessive growth in length of a segment, to deficient fixation of a segment to the abdominal wall, or to deficient fixation of the common mesentery of the terminal ileum and caecum, so that the caecum, or an ileo-colic segment, possesses a wide range of mobility. To this list may be added the plication of a segment of the tube which occurs when its mesentery is congenitally short, although the tube itself is of normal length or even elongated (Bernard and de Tayrac, 1935).

The Nerve Supply of the Colon

As a part of the alimentary canal the colon is innervated by both sympathetic and parasympathetic fibres. The "midgut" colon (caecum, ascending colon, and right half of transverse colon) derives its nerves from the plexus accompanying the colonic branches of the superior mesenteric artery; this is made up of contributions from the semilunar ganglia (sympathetic, from the thoracic splanchnic nerves) and from the right vagus nerve (parasympathetic). The "hindgut" colon (left half of transverse colon, descending and pelvic colon, and rectum) is innervated by nerves accompanying the inferior mesenteric artery, which are derived from the pelvic splanchnic nerves (sympathetic), and by branches arising from the hypogastric plexuses (parasympathetic, from the second, third, and fourth sacral nerves). The latter nerves pursue an independent course unrelated to the vessels, and have been traced (Mitchell, 1935) as far as the splenic flexure. Thus the proximal part of the colon is influenced by the cranial parasympathetic outflow (right vagus nerve), whereas the distal part is influenced by the sacral parasympathetic outflow. It has been shown (Learmonth and Markowitz, 1930) that stimulation of the sympathetic nerves is followed by inhibition of colonic activity. The parasympathetic nerves are motor to the distal colon.

The sphincter apparatus at the anus has two components: an internal sphincter, of unstriated muscle, which in man contracts on stimulation of the pelvic splanchnic (sympathetic) nerves (Rankin and Learmonth, 1930), and an external sphincter, of striated muscle, supplied by the (somatic) pudic nerves.

Physiology of Defaecation

Little need be added to the concise description of the mechanism of defaecation given in the admirable paper by Garry (1934), which I quote: "As in lower animals, eating food increases the activity of the human colon and frequently initiates a mass peristaltic action leading to defaecation. This response was first noted by Macewen in patients with caecal fistulae. Subsequently the name gastro-colic reflex was applied by Hurst and by Hurst and Newton. . . . For our knowledge of the movements of the large bowel in *man* we are deeply indebted to Hurst. . . . Three or four times a day a massive peris-

* Read in opening a discussion in the Section of Diseases of Children at the Annual Meeting of the British Medical Association, Belfast, 1937.

taltic wave drives the contents of the proximal colon bodily into the distal colon. Before and during the movement the haustral segmentation disappears. Holzknecht was the first to detect this mass movement in the human colon. In man the rectum is normally empty and faecal matter accumulates proximal to the pelvi-rectal flexure. As a result of one of the infrequent massive peristaltic waves faecal matter enters the rectum and the call to defaecation becomes clamant. In the act of defaecation itself strong peristaltic contractions occur throughout caecum and colon, the intra-abdominal pressure is raised by contraction of the diaphragm and of the abdominal muscles, and the faeces are forced through the relaxed sphincters of the anal canal." The stimulus for the act of defaecation is distension of the rectum (Hurst, 1934; Denny-Brown and Robertson, 1935).

Possible Mechanical Results of Variations in Arrangement of the Colon

These may be considered under two headings:

1. *In the Caecum.*—It has been stated that when the caecum is unduly long and perhaps continued into an ascending colon possessing a mesentery, it lies constantly in the pelvis, and the absence of direct attachment to the abdominal wall deprives this part of the tube of a "hold," so that its contractions are less effective and its contents tend to stagnate. Formidable lists of symptoms have been attributed to caecal and colonic stasis produced in this way. At least in the adult, general and abdominal symptoms are not inevitably associated with mobility of the caecum; and attempts to provide an anchorage for it by operation have been almost entirely given up.

2. *In the Transverse and Sigmoid Colon.*—In these situations there are two theoretical possibilities: (a) that mobility conferred by an unusually long mesentery may lead to kinking of the gut or to volvulus; (b) that an elongated segment of colon possessing a mesentery of normal length would tend to be plicated and kinked (Bernard and de Tayrac, 1935).

Both these conditions are said to occur in the sigmoid of infants, which is stated by some observers to be relatively longer than in the adult. It is quite clear that, at least in later life, the colon may deviate widely from the normal arrangement (if there is such) without the appearance of abdominal symptoms.

The rational view seems to me to be that the prolonged accumulation of gas and faeces in an elongated or mobile colon may lead to kinking, but that the cause of the accumulation is not the anatomical disposition of the colon itself.

Clinical Considerations

I am greatly indebted to Dr. William Brown, senior physician to the Royal Hospital for Sick Children, Aberdeen, for allowing me to utilize his clinical material. Members of the Section will be able to add their own experience; but I have found that the cases fall into certain groups:

1. Constipated children in whom the radiological examination discloses an anatomically and physiologically normal colon: the colon is normal in length and in mobility, and its contents are evacuated normally.

2. Constipated children in whom the radiological examination reveals an anatomical anomaly—for example, undescended caecum, mobile ileo-colic segment—and in whom satisfactory function can be produced and maintained by simple training and simple therapeutic measures.

3. Constipated children who suffer from periodic diarrhoea from the retention of faeces, and in whom the radiological examination after barium enema shows a distended colon, which the child can successfully evacuate after the bowel has been thoroughly emptied and trained.

4. Constipated children in whom the radiological examination after barium enema appears to show kinks either in the mobile parts of the colon or at a flexure, usually the splenic flexure. After simple treatment and training the constipation may be remedied, although the "kinked" appearance after a barium enema persists.

5. Constipated children in whom a barium enema outlines an elongated loop of colon, usually the pelvic colon, this appearance persisting after regular and satisfactory evacuations have been secured by appropriate treatment.

6. Constipated children in whom the barium enema discloses an elongated and distended colon; treatment may or may not result in satisfactory evacuation (megacolon). (Perhaps it is superfluous to remind members that the barium enema is a measure of the distensibility of the colon, and not necessarily of its tone. This important point has been emphasized by Hurst, who very rightly insists that the physiological efficiency of the large bowel can be assessed more accurately after a barium meal.)

From consideration of this clinical grouping it is quite clear that anatomical abnormalities of the colon do not inevitably cause constipation, and the success of a simple regime in cases showing elongation and/or dilatation seems to me to provide weighty evidence against the possibility of such anatomical conditions ever directly causing constipation. This view is supported by the observations of Khalik, Erfan, and Askar (1932), who found that anatomical variations in the length and calibre of the colon were common in infants who did not suffer from constipation. In the presence of faecal stasis it is conceivable that the possession of a long colon may increase and tend to perpetuate the condition by so altering the alignment of the large bowel that the massive onward movement of its contents preliminary to defaecation is impeded.

Treatment.—If I exclude cases of megacolon, which I shall deal with separately, it seems to me that certain general deductions can be made as to treatment. In the absence of evidence that anatomical peculiarity has any repercussion on colonic function, I would lay down the rule that surgical intervention in such cases is not indicated. It is true that successful cases of partial colectomy have been published, and that from time to time sympathetic neurectomy has been utilized in so-called intractable cases of constipation. I would like to make it clear that I do not now believe that neurological operations are ever indicated in constipation (apart from megacolon), whether the patient is a child or an adult. The severity of colectomy (even in young children) has been greatly reduced by the use of modern methods; but "successful" cases, to my mind, do not prove the efficacy of the treatment, but merely that a shortened colon can function adequately—which is a surgical commonplace.

Megacolon

"Megacolon can be defined as dilatation and hypertrophy of a part of the colon or of the whole colon, occurring in the absence of a gross obstructive lesion" (Adamson and Aird, 1932). It is a rare disease. [4 in 131,000 cases in a general hospital (Walton, 1930); 1 in 2,620 cases in a children's hospital (Hurst, 1934).]

The present view is that the enormous hypertrophy and dilatation so characteristic of the disease are the result of neuro-muscular dysfunction, and are congenital. The nature of this dysfunction is still problematical. The local changes in Auerbach's plexus described by Cameron may well, as Adamson and Aird (1932) point out, be secondary to other pathological changes in the wall of the bowel. The occasional association of dilatation of the bladder and/or ureters with megacolon focuses attention on their common nerve supply—pelvic splanchnic sympathetic

nerves and sacral parasympathetic nerves; it must be realized that over-activity of the one or under-activity of the other might produce the same result; and, indeed, Adamson and Aird have produced the condition in animals by dividing the parasympathetic nerves to the distal colon. Of neurogenic hypotheses mention may be made of spasm of the internal sphincter (Fenwick), achalasia of the sphincter ani (Hurst), and incoordination of the musculature of the colon, so that it does not relax before a peristaltic wave (Hawkins).

My own view is that the colon does not behave as if a terminal obstruction were present, for in such cases surgeons are accustomed to depend on early distension of the caecum as a constant diagnostic sign, and this is inconstant in megacolon. Adamson and Aird (1932) put the incidence of the disease as pelvic colon alone 37 per cent., with dilatation of the upper part or the whole of the rectum in 34 per cent. of cases. In only 25 per cent. does the dilatation extend to the ileo-colic valve, and in the remainder the descending, transverse, and ascending colon are involved with decreasing frequency. Radiological observations on the barium-filled colon show that it is active, although its activity is without result and may even give the impression of being purposeless.

My opinion at the moment is that the whole picture points to the presence of local segmental neuro-muscular incoordination when the disease does not involve the rectum, and that when the rectum is dilated there is added achalasia of the sphincter ani internus.

Treatment.—It has been shown by Morton and Scott (1930) that after spinal anaesthesia the colon may be able to evacuate its contents. As this procedure paralyses parasympathetic as well as sympathetic nerves one must conclude that the intrinsic neuro-muscular mechanism is adequate in such cases. In less severe types, preliminary enemata, training of the bowel, and the administration of liquid paraffin are usually adequate if the patient (and the parents) are intelligent and co-operative; when the rectum is involved, graduated dilatation of the internal sphincter, as suggested by Hurst, may also be usefully employed. When such simple measures are not effective the operation of sympathectomy may be considered, with the purpose of depriving the distal colon of its inhibitory nerves. Of the many technical procedures suggested, by far the most eclectic is that devised by Telford and Stopford (1934), and I consider that it should be employed exclusively. It consists in the resection of the mesially directed branches of the lumbar ganglia from the second to the fourth inclusive, and avoids the paralysis of the vasoconstrictor nerves to the legs which follows the (equally efficacious) removal of the lumbar cords, and the sterility which follows resection of the presacral nerve in male patients.

The results of sympathectomy are distinctly good; in the series collected by Ross (1935), twenty-one out of twenty-nine patients were benefited, and many other surgeons have reported successes. My own experience is similar. The mechanism of the improvement is obscure. Any explanation must take into account the often dramatic immediate improvement in function, which disposes of valves, kinks, or elongations as the essential cause of the failure of evacuation of the colon. Indeed (and this emphasizes the point made by Hurst), there is often little change in the appearance of the colon after a barium enema, though its function is satisfactory. I do not think one can go further than to say that the distal colon, under the unbalanced dominance of its extrinsic motor nerves, regains its physiological adequacy. It is interesting to note that when the urinary tract is dilated it

shares in the improvement following sympathetic neurectomy (Adamson and Aird, personal experience).

Conclusion

In conclusion I advance as a basis for this discussion the view that elongation and dilatation of the colon are not primary causes of dysfunction of the colon, but incidental findings; and that their surgical correction should never be attempted. The condition of megacolon is an exception, in which the dilatation and elongation are part of the disease. It may be possible to persuade a megacolon to function adequately by medical treatment; if this fails, sympathetic neurectomy is likely to be successful.

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PULP-SPACE INFECTION

BY

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In the past attention has been drawn to the treatment of septic fingers and hands, notably by the works of Kanavel, Fifield, and Eckhoff. In attempting to follow their teaching I have collected the details of 183 cases of sepsis in the hand, among which were fifty-one of pulp-space infection. An account of my practice and treatment, with results and analysis of these cases, is here given.

Anatomy

In order to appreciate the difficulties met with in the treatment of pulp-space infection it is necessary to review certain fundamental anatomical points. The skin on the volar aspect of the finger is bound down to the periosteum on the front of the terminal phalanx by the dense fibrous tissue strands. The pulp is composed of fat, and is divided by the dense connective tissue framework into a series of loculi. Sweat and sebaceous glands lie in the fat, their ducts passing outwards to the epidermis.

Infection in many cases can be traced to a breach in the continuity of the skin, and is confined to one or a number of loculi in direct relation to the nidus of infection. An infection of these loculi tends to be directed backwards towards the periosteum of the terminal phalanx. Generalized involvement of the pulp is checked until the later stages by the fibrous walls. Inflammatory swelling, held within the limits of firm-walled loculi, is associated with greatly increased tension in the pulp, causing pressure, with diminished blood supply to the pulp and bone.

Classification

There are five main types of pulp-space infection, the classification depending on the time at which they are