THE PATHOLOGY OF THE CÆCO-COLIC SPHINCTERIC TRACT OF THE COLON.¹

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(PLATES LVII.—LXI.)

DURING the past four years I have encountered a large number of cases presenting pathological conditions, situated in the ascending colon at a point from 1 to 3 inches above the ileo-cæcal valve. Among these cases were included examples of developmental abnormalities such as constricting folds, of inflammatory disease in the shape of simple ulceration, fibrous stricture and pericolicitis, of solitary tuberculous stricture, and of malignant disease.

As regards the incidence of disease in the various segments of colon, my experience has been that the ascending colon takes second place in order of frequency of involvement, the pelvic colon being first. Whilst searching for some explanation of the apparent liability of this tract of the colon to pathological processes, a liability which seemed strange in view of the fact that the content of this part is normally of fluid consistence, I was struck by the frequency with which, at post-mortems, conducted within a few hours of death, the middle third of the ascending colon was found firmly contracted and empty, in marked contrast to the distended gas-containing caput coli.

My attention was then directed to the observations of Keith (1903¹, 1912²) on the comparative anatomy of this region. He has shown that in the proximal part of the colon of air-breathing vertebrate animals three definite segments may be distinguished, namely, the cæcum, the cæcal colon, and the cæco-colic sphincteric tract. The cæcum may be multiple and may have a more or less well-developed appendix; at its junction with the cæcal colon there is a sphincter, the cæcal sphincter. In the human subject this sphincter is represented by the frænula of the ileo-cæcal valve. The cæcal colon is that

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portion of the large intestine into which the ileum discharges; it is bounded on one side by the cæcal sphincter, on the other side by the cæco-colic sphincteric tract.

This tract which is usually in a state of tonic contraction is seen in its fullest degree of development in vegetable-feeding birds. It appears to regulate the outflow from the cæcum and cæcal colon, and indeed to act as a functional sphincter to the caput coli.

The presence in so many vertebrate animals of a sphincteric tract in the wall of the colon immediately distal to the caput coli, together with the frequent discovery at autopsies of a contracted zone in a corresponding region of the human colon, a region which coincided exactly with that in which I had found morbid conditions so frequently, suggested that in a more exact knowledge of the anatomy and physiology of this region lay the key to explaining its liability to pathological processes.

Cannon (1911³) demonstrated conclusively that anastalsis is the characteristic movement in the proximal part of the colon in the cat, and Elliot and Barclay Smith (1904⁴) have shown that when this part of the colon of a rat is artificially distended (*e.g.* with pea-soup), moving rings of contraction, in what we shall now call the cæco-colic tract, tend to retain the content in the caput coli. These anastaltic contractions are myogenic in origin and are not influenced by the injection of nicotine.

The observations of Roith (1912⁵), Stierlin (1911⁶), Bloch (1911⁷), Schwarz (1911⁸), and others have also established that anastalsis occurs in the proximal part of the human colon, and radiology has further disclosed the fact that in the onward passage of intestinal content there is normally a delay of a few hours in the cæcum. This delay allows of that bacterial digestion of the content which would appear to be the normal function of the cæcum.

According to Schwarz (1911⁸) and Singer and Holzknecht (1911⁹), constipation is generally due to spasm, very seldom to atony of the colon. In constipated patients they have observed that the movements in the cæcum and ascending colon are more active than normal. Stierlin has studied the same type of case and believes that the excessive cæcal digestion and inspissation of the content thus brought about, makes the latter a very unsuitable medium for the growth of those bacteria which, by producing gas and stimulating chemical substances, excite peristalsis; prolonged retention of content in the cæcum has consequently a parietic influence on its passage along the entire colon.

Plate LVII. Fig. 1, represents the proximal part of the colon of a patient who was under observation in hospital for many months suffering from a nervous disease to which she eventually succumbed. She had frequently complained of pain and a feeling of distension in the right side of the abdomen, and on examination at such times a tense distended cæcum was readily palpable. At the autopsy, before the abdomen was opened, a rounded prominence was visible in the right lumbar and iliac region of the abdomen. This was found to be the tense distended caput coli which contained liquid fæcal matter and gas. The colon immediately distal to this was firmly contracted and apparently stenosed. Only with the greatest difficulty could fluid under pressure be forced through the contracted portion. On opening

the gut it was found that there was no organic stenosis as had been supposed, but merely a tonic contraction of the cæco-colic tract. Apparently this cæco-colic spasm had, during life, periodically caused the cæcal distension of which the patient had so frequently complained.

Magnus (1908¹⁰) has shown that senna inhibits anastalsis in the cat's colon, and Stierlin has demonstrated that in the human cæcum this drug will prevent the physiological delay in the onward passage of the fæces. He has further shown that many of these cases of constipation are relieved by atropin and aggravated by physostigmin, clearly indicating that hyper-tonicity or spasm in the ascending colon is the underlying cause of such constipation.

It would appear, therefore, that in the cæco-colic tract we have a segment of the colon which offers not so much a passive obstruction to the onward passage of the intestinal content, as an active repulsion of it, until such time as cæcal digestion and absorption are completed.

All writers are agreed that the human cæcum approaches more nearly to the herbivorous than to the carnivorous type. As Keith points out, the diet of highly civilised races is so wholly different from the crude and primitive food-supply for which the human cæcum was originally evolved, that it is not surprising to find that this portion of the alimentary canal, working as it does under unnatural conditions, should be specially liable to morbid changes. That such changes should be particularly common in that region of great functional activity which controls the evacuation of the caput coli is only to be expected.

DEVELOPMENTAL ANOMALIES AND INFLAMMATORY LESIONS IN THE CÆCO-COLIC REGION.

All pathologists are familiar with the frequent occurrence of adhesions in the right half of the abdomen over the proximal part of the colon.

Mollison and Cameron (1908¹¹) in a series of fifty consecutive post-mortem examinations found adhesions in the region of the cæcum and ascending colon in thirty-five cases. Such adhesions are often erroneously ascribed to a former attack of acute appendicitis. In only three of the thirty-five cases observed by Mollison and Cameron were the adhesions definitely grouped round the appendix.

Hofmeister (1911¹²) found at operation on patients presenting the symptom-complex of cæcal stasis, associated with the presence of a large mobile cæcum, that there were adhesions involving and constricting the ascending colon in practically every case. Lane (1908¹³) has noted the presence of vascularised adhesions extending from the parietes in the right lumbar region to the ascending colon in cases with a tendency to visceroptosis. He regards such adhesions as being compensatory changes or to use his own term "crystallisation of lines of strain." Jackson (1909¹⁴) recorded a series of cases previously diagnosed as chronic appendicitis, in which, at operation, the appendix was seen to be normal, but in each of which he found a thin transparent vascular membrane stretching from the right flank over the

front of the ascending colon and slightly constricting the gut in this region. By dividing the membrane he was able to give such cases some relief. The term "Jackson's membrane" is now commonly applied to this condition.

Considerable confusion has arisen regarding the etiology of such adhesions and membranes in the cæco-colic region. Pilcher (1912¹⁵), Gerster (1912¹⁶), and other American writers hold that they are all the result of repeated mild infections, are in fact various stages of true pericolicitis. This view is, however, quite untenable, for whilst it is undoubtedly the case that pericolicitis with definite scarring and adhesions is quite common—I have found it twenty-nine times in 130 consecutive post-mortems—it is equally certain that a congenital vascularised peritoneal fold crossing the lower part of the ascending colon and formerly described by Jonnesco as the parieto-colic fold, occurs in a fair percentage (probably 10 to 15 per cent.) of bodies. Reid (1912¹⁷) has found this fold in a foetus 18 cms. long, and I have met with it frequently in the bodies of young children. The observations of Gray and Anderson (1912¹⁸) also strongly support this view.

In the cases where the omentum is fixed to the ascending colon and the transverse colon is pulled down alongside of it, a clear distinction must be drawn between those which are the result of old inflammatory mischief in the ascending colon, where the omentum has become glued to the seat of trouble, and where, through cicatrisation in and shortening of the omentum, the transverse colon has been drawn down, and those where there is a congenital attachment of the omentum to the ascending colon and possibly also to the cæcum. In the former class of case the omentum appears slued round and is adherent over an irregularly shaped area of thickened ascending colon; in the latter the omentum is found attached to the ascending colon in linear fashion along the anterior muscular band. Reid has found, in a foetus, the omentum attached down the front of the ascending colon and of the fully-descended cæcum as far as the root of the appendix. It is obvious that the constrictions and angulations of the colon which may be produced by the developmental anomalies referred to, may, by causing cæcal stasis, result in secondary inflammatory lesions in and around the colon which complicate the pathological picture.

I have found a definite fibrous stenosis of the cæco-colic tract in two cases at autopsy. As I have failed to meet with any similar case in the literature, the following brief notes may be of interest.

CASE 1 was that of a man, æt. 56, who died of pneumonia after the operation of laryngectomy for malignant disease of the larynx. Apart from the fact that he suffered from habitual constipation there was no history of abdominal trouble. On opening the abdomen, post-mortem, the caput coli was seen to be markedly distended, the omentum was fixed by adhesions over the lower part of the ascending colon and to the right flank (see Plate LVIII.

Fig. 2). The ascending colon at this point was of very small calibre, and it was overlapped to some extent by the distended caput coli. The upper part of the ascending colon formed an irregular convoluted mass, being bound together by adhesions. On opening the caput coli there was seen at its upper and posterior part the stenosed orifice of the cæco-colic tract of the colon. The latter admitted the tip of the little finger with difficulty, and on slitting up its wall there was seen a small ulcer surrounded by much cicatricial tissue. Microscopic examination proved this to be a simple inflammatory condition.

CASE 2 was that of a woman, æt. 49, who died after an exploratory laparotomy which revealed that she had irremovable carcinoma of the uterus with secondary invasion and stenosis of the rectum.

The colon was loaded with scybalous fæces up to a point 2 inches beyond the ileo-cæcal valve. There the colon was surrounded by adhesions and very markedly stenosed. Proximal to this the caput coli was distended with fæcal matter. On opening the bowel what appeared like a diaphragm with a small aperture in its centre separated the caput coli from the ascending colon. There was no ulceration at any point. Microscopic sections of the wall at the point of stricture showed marked hyperplasia of fibrous tissue; there was no evidence of malignant disease.

As Pilcher (1912¹⁵) points out, the lymphatic connections between the cæcum and ascending colon and the right kidney expose the latter to the risk of infection in cases of stasis or ulceration in the proximal colon, hence the frequency of right-sided pyelitis due to the colon bacillus.

In many cases of right-sided perinephric abscess a history of preceding intestinal catarrh or of pronounced constipation can be obtained, and the probability is that from some slight ulceration in the cæco-colic tract there has been a lymphatic spread of infection to the retro-colic cellular tissue.

Whilst it is common to meet with the results of inflammatory trouble in the cæco-colic region in the post-mortem room, localised acute colitis of this region is rarely found. This condition, however, although seldom fatal is by no means rare. Clinically it is generally mistaken for the very much commoner condition of acute appendicitis, and many eminent surgeons have denied that it occurs independently of the latter disease.

Recently, however, Röpke (1910¹⁶), Herhold (1911²⁰), Haim (1911²¹), Crämer (1912²²), and others have again directed attention to the frequency of localised acute colitis. Crämer has emphasized the fact that the upper part of the cæcum and lower part of the ascending colon are often the site of acute inflammation. Bittorf (1904²³) has recorded a case of acute inflammation without ulceration in the wall of the ascending colon, and Pallin (1911²⁴) has reported two cases diagnosed as appendicitis and operated on as such; in each instance the appendix was seen to be healthy, but a definite localised turgid inflammatory swelling of the ascending colon was found.

Localised ulceration in the cæcum, colon, and cæco-colic tract is by no means rare. Plate LIX. Fig. 3, represents a simple ulcer of the cæcal colon; the specimen was removed at operation from a man æt. 54, the induration around the ulcer having closely simulated carcinoma.

Zickler (1909²⁵) records a case of perforation of a simple ulcer of the ascending colon; and it is noteworthy that of the five cases of localised pericolicitis due to ulceration described by Roberts (1908²⁶) the trouble was located in the ascending colon in three.

TUBERCULOSIS OF THE CÆCO-COLIC TRACT.

The cæco-colic tract appears to be a seat of election for tuberculosis in the colon. I have met with two cases of tuberculous stricture in this region; in the one, that of a boy, æt. 17, it was a solitary tuberculous lesion (see Plate LX. Fig. 4), in the other there were, in addition, several strictures in the ileum. Küttner (1909²⁷), within eighteen months, operated on four patients suffering from solitary tuberculous stricture of the ascending colon, which region he regards as being one of the most frequent sites for tubercle in the large intestine.

MALIGNANT DISEASE OF THE CÆCO-COLIC TRACT.

In the descriptions given in most text-books of pathology of the incidence of malignant disease in the various segments of the colon, the ascending colon is not mentioned as one of the favourite sites for carcinoma. This apparent comparative immunity from malignant disease appears to be borne out by most statistical records. Thus Barnard (1910²⁸) found in the medical and surgical records of the London Hospital, from 1900 to 1905, 188 cases of carcinoma of the colon, only six of which were recorded as being in the ascending colon.

My own experience was so out of keeping with these records that I made a thorough investigation of the literature on this subject. It was soon obvious that many tumours of the colon situated at a point distal to the ileo-cæcal valve had been classed as cæcal, and that the small frequency-ratio ascribed to the ascending colon in no way represented the actual ratio, when standard anatomical boundaries were recognised.

Many clinicians regard as cæcum the whole of the gas-containing proximal end of the colon up to that point in the flank where it becomes narrower and less readily accessible to examination. It is at the upper end of what is clinically regarded as cæcum that I have so frequently found tumours as well as other morbid conditions.

My personal experience of carcinoma of the colon is drawn from forty-one cases which I have had occasion to investigate. In this number there were included eight cases of carcinoma of the cæco-colic tract, this region occupying along with the transverse colon the second place in the frequency list, the pelvic colon being easily first.

Five of the eight cæco-colic tumours were of the stenosing scirrhus type of carcinoma, the other three were of the bulky colloid infiltrating type. Whilst on reflection it was clear that these tumours

had all originated at approximately the same point in the ascending colon, at first sight they appeared to be affecting widely different segments. One found that in determining the exact anatomical position of a lesion which obstructs the lumen of the bowel in the region of the ascending colon regard must be had to three factors. Firstly, the degree of obstruction of the lumen caused by the lesion; secondly, the tendency or otherwise of the disease to infiltrate and cause shrinkage of the wall of the gut around; thirdly, the competency or incompetency of the ileo-cæcal valve.

Thus in three of the above-mentioned cases a scirrhus cancer, involving only a narrow ring of bowel-wall and producing a very marked stenosis of the lumen, was associated with a competent ileo-cæcal valve (see Plate LXI. Fig. 5). In consequence of this the cæcum and cæcal colon were greatly dilated and their walls hypertrophied, the growth being displaced upwards in the abdomen, a condition which at first sight gave the impression that the stricture was close to the hepatic flexure.

On the other hand, in the three cases of infiltrating colloid cancer the obstruction of the lumen was less marked, and in place of dilatation there was shrinkage of the caput coli, so much so that until the gut was laid open the disease appeared to be practically on a level with the ileo-cæcal valve.

In one case where the tumour was of the scirrhus type and the obstruction almost complete the ileo-cæcal valve was incompetent; consequently, although the cæcum was greatly hypertrophied it was not dilated; the lower few feet of ileum, however, showed marked dilatation and hypertrophy. In this case the backward pressure in the appendix had led to inflammatory changes in this organ (see Plate LXI. Fig. 6), and death occurred as the result of perforative appendicitis with general peritonitis.

CONCLUSIONS.

From the evidence which has been adduced I think it will be granted that, as Keith has shown, there is, in the proximal part of the colon of most vegetable-feeding, air-breathing vertebrates, a region of vital constriction, that post-mortem and radiological evidence points to the existence of a strictly comparable region in the human colon, and that this corresponds closely to that in which I had independently noted the frequent occurrence of morbid processes.

It is generally recognised that in other parts of the alimentary tract pathological lesions are particularly prone to occur at, or just proximal to, regions of anatomical or physiological constriction. In the stomach, for example, the pyloric antrum and prepyloric region are favourite sites for disease. The comparison between the stomach and the proximal end of the colon is very striking, and it has long been

recognised that, in vegetable-feeding animals, a distinct relationship as regards size exists between the two. Thus those animals which are provided with a large and complicated gastric organ have a relatively small cæcum, and *vice versa*. The cæcum may, therefore, be regarded as the second stomach for the final bacterial digestion of the foodstuffs.

It is worthy of note that a sympathy of action appears to exist between the first and second stomachs and that cæcal and appendicular troubles are very often associated with disorders of gastric secretion.

Whilst the cæco-colic tract must be regarded as a region of vital constriction, which offers a barrier to the premature emptying of the cæcum, we have as yet no definite physiological evidence as to the nature or the control of its activity, or, indeed, whether in the physiological sense of the term it merits the name of sphincter. Stimulation of the sympathetic nerves supplying the proximal part of the colon does not cause contraction of this part as does similar stimulation of *its* nerves the ileo-sphincter. It does not follow, however, that because the cæco-colic tract does not react in the same way to stimulation of its nerves, it can have no sphincteric function. It is quite possible that its activity is controlled by some chemical stimulus, acting through the local nerve mechanism in the wall of the colon in a manner analogous to the conditions which obtain in the cases of the pyloric and pre-pyloric gastric sphincters.

Whilst our knowledge of the physiology of the proximal part of the colon is still so incomplete it would be rash to draw any far-reaching conclusions, merely from pathological evidence. I believe, however, we have sufficient data to warrant our regarding the cæco-colic tract of the colon as a region of special functional strain with a corresponding liability to disease.

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DESCRIPTION OF PLATES LVII.-LXI.

PLATE LVII.

FIG. 1.—Spasm of the cæco-colic tract causing distension of the caput coli. During life painful distension of the cæcum had been frequently noted.

PLATE LVIII.

FIG. 2.—Fibrous stenosis of the cæco-colic tract with pericolicitis and omental adhesions. The lateral view, inset, shows how the distended caput coli bulges over and hides the stenosed area.

PLATE LIX.

FIG. 3.—Ulcer simplex of the caecal colon.

PLATE LX.

FIG. 4.—Solitary tuberculous stricture of the cæco-colic tract.

PLATE LXI.

FIG. 5.—Malignant stricture of the cæco-colic region; ileo-cæcal valve competent, great distension of the caput coli.

FIG. 6.—Malignant stricture of the cæco-colic region; ileo-cæcal valve incompetent; dilatation and hypertrophy of the small intestine, appendix inflamed and perforated.

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

FIG. 5.

FIG. 6.