LECTURES ON THE ANATOMY OF THE INTESTINAL CANAL AND PERITONEUM IN MAN.

Delivered at the Royal College of Surgeons of England.

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LECTURE III.

The Ending of the Ileum.—As a rule the ileum ascends to enter the cæcum, but in certain cases it descends to its termination, especially in those cases in which the order of the intestinal coils is found to be reversed. In not a few specimens the terminal part of the small intestine has been closely attached to the psoas muscle, not by direct adhesion, but by means of a fold of peritoneum that has passed from the left or under layer of the mesentery to the serous membrane covering that muscle. In some five instances I have found the last inch or last few inches of the ileum closely adherent to the cæcum. Such adhesion has been brought about by a certain readjustment of parts, and is quite independent of any pathological change. A good example is afforded in Fig. 16 c. Here the ileum, having crossed the psoas, reached the line at which the peritoneum was reflected from the posterior surface of the colon. At this point (M) the gut became suddenly bent upon itself, and ran vertically downwards along the back of the ascending colon and cæcum, to end at about the usual position (N). The segment of bowel between the points M and N measured 4 inches, and was closely adherent to the colic wall. This specimen may be taken as a fair type of the condition of things, when the terminal part of the ileum is adherent.

The Appendix and its Mesentery.—In spite of its insignificant size and its very slight physiological importance, there is centred about the vermiform appendix peculiar anatomical interest. In the adult, the average length of the appendix is four inches, the extremes being one inch on the one hand, and six inches on the other. The growth of the appendix would appear to be irregular and uncertain, and to be influenced in no way by the development of the main intestinal tube. It would seem that it may attain to its full length quite early in life, and I have met with an appendix four and three-quarter inches in length in the body of a child aged 3 years. The width of this process is more constant, and is, indeed, liable to very few fluctuations. In one remarkable case, in a male subject 37 years of age, I found the appendix to be four inches in length, and a little over half an inch in width. This extraordinary transverse diameter it retained up to its very extremity. The process was unprovided with a mesentery, and was attached vertically to the posterior aspect of the cæcum and colon.

In three subjects, amongst the one hundred examined, examples were afforded of practical obliteration of the appendix. In each instance, the body was that of a male adult. In each, the cæcum was found bound down by old peritoneal adhesions, due to a past perityphlitis, and buried in these adhesions the appendix was discovered. It appeared as a white tough fibrous cord, between one and one and a half inches in length, and about the size of a No. 9 catheter. It was placed vertically behind the cæcum, and had no trace of a mesentery. In one specimen, no canal could be detected in the cord, and no opening into the bowel made out; but, in the other instances, a patent canal was discovered that would just lodge a pin. Such specimens may be of interest in connection with the question as to whether the appendix has a function, or is functionless.

Appendices, under the length of three inches, may appear as quite straight tubes when processes so short are met with in the adult. In the great majority of instances, however, the appendix is much twisted upon itself. Its spiral form depends mainly upon the shortness of its mesentery. When the tube is untwisted—a measure that will usually involve some division of its mesentery—it most commonly forms a fairly regular curve, with the concavity towards the cæcum. This curve will carry the appendix behind the cæcum, and it will be usually found to continue the direction of the curve formed by the anterior muscular band. In more than one specimen, I have found

the process sharply bent upon itself at its extremity, so as to form a species of hook. In the fetus, the process is commonly curled up at the posterior and inferior aspect of the cæcum.

In the majority of cases, in the adult body, the appendix—when examined *in situ*—will be seen to lie behind the end of the ileum and its mesentery, and to point in the direction of the spleen. In the only other position that may be said to be at all common, the little tube ascends vertically behind the cæcum. This position nearly always depends upon an abnormality in the arrangement of the appendix mesentery, to which allusion will be subsequently made. In four instances where the appendix was so placed, the tip of the process was very near to, if not in actual contact with, the under surface of the liver; and, in one of the four specimens, it was found touching the gall-bladder. In these cases, and in several other instances where the appendix ran vertically behind the cæcum, the process would have been encountered in performing a right lumbar colotomy. When the cæcum occupies the pelvis, the appendix, of course, lies with it; but, in one or two specimens in which the cæcum occupied its normal position, the process was found hanging down into the pelvis. In one body—that of a male aged 10—the caecal coli was strictly limited to the iliac fossa, but the appendix—which measured 4½ inches—was lying in the pelvis, and in contact with the bladder. The strangest position assumed by this little tube was met with in the body of a woman aged 23. In this subject, the appendix was straight, measured nearly five inches, and had an extensive mesentery. It passed horizontally across the middle line in front of the lumbosacral eminence, so that its tip rested upon the left psoas muscle.

In one case, I found the tip of the process adherent to the left layer of the mesentery of the ileum in such a way that a loop was formed, beneath which a coil of bowel might readily have become strangulated. This was the only instance noted, in the hundred cases, of an appendicular loop.

The mesentery of the appendix is formed by a very definite fold of the serous membrane. It comes off from the left, or under layer, of the mesentery of the end of the ileum. Its origin from this layer is along a straight line, which is situated at a short distance from the intestine, and which is not quite parallel with the margin of the bowel. If the appendix be pulled away from the cæcum, so that its mesentery is fully displayed, it will appear to come off at right angles from the enteric mesentery. At one extremity, this little fold runs right up to the ileo-caecal junction, while, at the other end, it forms a free and concave margin. In its general outline it is triangular (Fig. 14 A). In the fetus it may extend to the tip of the appendix, but in the adult,

it often only reaches to the centre of the tube, or to the junction of its middle with its distal third. It is too short for the appendix, and this disproportion between the process and its serous fold accounts for the twisted condition of the former. In the free margin of this little mesentery there runs an artery, a branch of the ileo-colic. From this artery, at regular intervals, are given off branches to the appendix. The earliest and largest of these reaches the posterior wall of the cæcum.

Now, in eighteen per cent. of the bodies examined, it was found that the appendix, instead of being placed obliquely, as already described, ascended vertically behind the cæcum. In such cases, the process was often straight, or curved only at its extremity, and it was found that the mesentery of the appendix had unusual connections. These connections are susceptible of a ready explanation.

It has been already pointed out that the bowel grows out of proportion to the peritoneum that covers it, and this disproportion is especially to be noticed in connection with the colon. The instances of displacement of the mesentery of the appendix are to be explained upon the assumption that the relation between the growth of the cæcum and the serous membrane about it has been more conspicuously disturbed than usual. As the cæcum grows under the almost passive peritoneum, it tends to encroach upon it, and to clothe itself with such parts of the serous membrane as are in its immediate vicinity. It approaches the mesentery of the ileum, and takes some part of that layer upon its walls. With the mesentery goes also the mesentery of the appendix, and in one class of case the latter fold will be seen to arise in part from its usual site, and in part from the posterior wall of the cæcum. At the same time, the direction of the growth of the cæcum will have rendered the little mesentery more vertical (Fig. 16 A). If this disproportionate growth continue, it will be found that the appendix mesentery has become quite vertical, has attachment to the cæcum only, and has been rendered much scantier by the encroachment of that part of the bowel. Such a condition is presented by the specimen from which Fig. 16 B was drawn.

Taking another step in the same direction, the little mesentery will be found to have been so much unfolded by the growing cæcum, that it is still further reduced, while, near the root of the appendix, it has disappeared, and that process is actually adherent to the caput coli (Fig. 16 C).

In a more advanced degree of the same condition, the appendix is almost wholly adherent to the cæcum, while its mesentery is reduced to the scantiest proportions. This is illustrated by Fig. 16 D, from the body of a man, aged 33. In the last stage of all, the appendix has no mesentery at all, but is adherent, in a vertical line, to the posterior wall of the cæcum, its extremity being as a rule, however, free. These variations, in their different stages, have all been illustrated by examples provided by the one hundred bodies examined.

This account of the mesentery of the appendix may be completed by

observing that in rare instances a fold of peritoneum has passed from that margin of the process most remote from its mesenteric border, to join the serous membrane at the pelvic brim. This has only been noticed in instances where the appendicular fold took its normal origin from the mesentery of the ileum.

The Ileo-Cæcal Fossæ.—About the cæcum, and especially in the vicinity of the ileo-cæcal junction, are certain fossæ collectively known as the ileo-cæcal. They possess not only considerable anatomical interest, but are also worthy of notice, as having been the reputed

seat of certain herniæ, some of which have been the subjects of strangulation. They have attracted the attention of certain anatomists, and notably of Luschka, Hartmann, Treitz, and Waldeyer. I might be allowed to say that the accounts given of these pouches are somewhat involved, are frequently contradictory, and, I might venture to add, are also incorrect. Certain fossæ are described as constant, that would appear to be exceedingly rare. The subject has suffered also from a reckless and exuberant nomenclature; and one little fossa, termed indiscriminately the fossa ileo-cæcalis infima, the fossa sub-cæcalis, and the recessus retro-appendicularis, I have entirely failed to discover.

I should be sorry if these were regarded as sweeping assertions, but they are founded upon a careful systematic examination of the parts in one hundred fresh bodies, a drawing of the involved regions having been made on the spot in each instance. Describing these fossæ as they are met with, it will be found that there are only two that can be said to be in any way constant. The ileo-colic artery, when it nears the cæcum, divides into two branches; one of these, passing behind the ileum, appears as the vessel that runs along the free margin of the mesentery of the appendix; the other branch crosses the front of the ileo-cæcal junction, and ends almost immediately upon the anterior surface of the cæcum. It is concave towards the small intestine, and gives off several branches to the caput coli, from its convex border. In its passage across the line of junction between the cæcum and the ileum, the artery produces a fold in the peritoneum. This fold covers the ileo-cæcal union, is concave at its free edge, and limits a fossa. This small pouch may be well termed the superior ileo-cæcal. It is not always present, it often forms but a slight fossa, and the largest pouch that I have met with in this situation took the point of the thumb to a depth sufficient to cover the nail. It is shown in the diagram of the cæcum of the Mangabey monkey (Fig. 15 A), and with this pouch the fossa in the human subject is practically identical. It is difficult to understand that it can ever be the seat of a hernia. The second fossa is not quite so simple. If the cæcum be turned upwards, so as to expose its posterior surface as it lies *in situ*, and if the appendix be drawn down so as to put its mesentery on the stretch, a pecu-

liar fold will be found to join that mesentery (Fig. 14 A). This fold, which may be of considerable dimensions, arises from that border of the ileum that is most remote from the insertion of its mesentery. It then passes over the ileo-cæcal junction on its inferior aspect; is adherent to the cæcum, and finally joins the surface of the mesentery of the appendix. Its line of attachment to the appendix mesentery forms an acute angle with the little tube itself, and seldom extends over more than one-half of the membrane.

The connection of this fold to the ileum often extends to the length of one and a half inches. The plica in question is distinguished from the other folds in the vicinity by its bloodlessness. Even in well injected specimens, it may not present any visible vessels. If it do present any arteries, then they will still be very small, and will be derived from the vessel that runs in the free margin of the mesentery of the appendix. For convenience of description, and until some name is devised, it may be called the bloodless fold. Between this fold and the appendix mesentery there is a fossa that is almost constant, and is often very capacious. It will commonly lodge two fingers as far as the first joints. It opens outwards, its apex is at the ileo-cæcal junction, and it is bounded on one side by the small intestine, and on the other by the caput coli. To this conspicuous pouch may be applied the name of the inferior ileo-cæcal fossa.

These are the only constant fossæ that are met with in this region. They may be observed in subjects of all ages, in the fœtus at full term, and even at an early period of intra-uterine life. I have found them both well marked in fœtuses that measured respectively $5\frac{1}{2}$ and $4\frac{1}{2}$ inches in length.

In connection with these fossæ, the greatest interest attaches to the bloodless fold. An examination of embryos that displayed the earlier stages of the development of the intestine afforded no certain clue as to the nature and origin of this singular membrane. A very full explanation, however, of its significance was at once afforded by an examination of the parts in the lower animals.

Regarded from the standpoint of comparative anatomy, objection may be taken to the practice of regarding the appendix vermiformis as something that is distinct from the cæcum. This process is simply an undeveloped cæcum, a cæcum of which only the proximal end has grown in proportion with the growth of the body. If the appendix in the human subject could be distended until it was nearly of the size of the caput coli, then the whole diverticulum would closely resemble the cæca of many of the mammalia. If, on the other hand, in a long mammalian cæcum, such as that of the kangaroo (Fig. 14 B), the distal part had not developed in proportion with the rest, then would a cæcum and appendix be produced that would compare with like named parts in the human subject.

It is well, therefore, to hold in mind that the simple cæca of most of the lower animals represent both the cæcum and the appendix of the highest mammal. In such animals as have a prominent cæcum, it will be noticed that a well-marked fold of peritoneum passes to it from the ileum. The subject may be here simplified by selecting the cæcum of some one animal (and I have arbitrarily selected the kangaroo) as a basis for the description of this very general fold. The fold always passes from that margin of the ileum that is most remote from the attachment of the mesentery to that border of the cæcum that is nearest to the small intestine (Fig. 14 B and C). It is a thin layer of peritoneum, with a well defined concave margin, and is singularly free from visible blood-vessels. It is the true mesentery of the cæcum; it is continuous over the ileum with the mesentery of that bowel; and it is evident that it has been derived from the latter membrane by the budding out and subsequent growth of the caput coli. As this diverticulum has developed, it has carried a part of the common serous investment of the intestine with it. It has nothing to do with conveying blood to the cæcum. This part of the bowel is supplied by the ileo-colic branch of the superior mesenteric artery. This vessel, on nearing the gut, divides into two branches—one small, the other large. The former crosses the ileo-cæcal junction on its anterior aspect, while the latter occupies an almost corresponding position on the posterior surface of the bowel.

As they run to their destinations, these arteries draw the adjacent peritoneum into folds, and near the free margins of these folds the arteries will be seen. The fold for the anterior artery is usually small, and covers the ileo-cæcal junction; while that for the posterior vessel is more extensive, and runs from the left or under layer of the mesentery of the ileum to join the mesentery of the cæcum. As may be expected, variations are met with in these folds in different animals; but such variations are slight, and the general arrangement of these processes of the serous membrane would appear to be singularly constant. In the Mangabey monkey, where the cæcum is very short, the disposition of these folds is precisely the

same as it is in the long cæcum of the kangaroo (Fig. 15 A and B). In the Spider monkey, there is a symmetry in the arrangement of the cæcal plicæ. The true mesentery of the cæcum is placed in the middle of the bowel, while on each side the anterior and posterior vascular folds run in a perfectly symmetrical manner. In this specimen, it will be seen that the two last named folds are of equal size (Fig. 14 D).

Now, on turning to the human cæcum, it will be seen that the anterior vascular fold exists as the plica that forms the superior ileo-cæcal fossa. The posterior vascular fold, with its distinct blood-vessel, exists in man as the mesentery of the appendix; while the fold in the human subject that has been termed the bloodless fold persists as the remains of the true mesentery of the cæcum and the appendix. The human appendicular mesentery is a substituted mesentery. The true serous fold of that process is represented by the non-vascular plica that runs from the surface of the ileum to the substituted mesentery of the appendix.

In the only anthropoid ape that I have had the opportunity of examining (a Silvery Gibbon), it is obvious that the condition of these folds is approaching that met with in the human subject (Fig. 15 C and D). The true appendicular mesentery is becoming less conspicuous; while the posterior vascular fold is unduly prominent, and forms, in fact, the greater part of the said mesentery. The specimen, indeed, shows the middle stage in the process of substitution—a

process that is completed in the cæcum of man. As an interesting comment upon the relations between these cæcal plicæ in man and in the lower animals, I had the good fortune to find two examples in the human subject of reversion to the lower condition. One specimen was from a female aged 70 (Fig. 17 A); the other from a male aged 64. In both, the cæcum was of simple and rudimentary outline; in both, the appendix was short and straight; and in both, its mesentery was formed entirely by what has been termed the bloodless fold—that is, the true mesentery. The substituted mesentery was represented by the slight fold *x*, which carried a branch of the ileo-colic artery, from which the appendix was supplied. In both, there was a slight superior fossa. It will be seen that these specimens exactly reproduce the condition met with in certain of the apes. (Compare Fig. 15 B.)

When the appendicular mesentery becomes displaced to the right, by the disproportionate growth of the cæcum, and appears at last to be attached vertically to the back of the caput coli (as already described), the bloodless fold—the representative of the true mesentery—of course follows it. As the appendix mesentery is encroached upon and taken into the covering of the cæcum, so the bloodless fold acquires unusual attachments (see Figs. 16 A, B, C, and D), until, at last, it may become quite dissociated from both the appendix and its serous fold; and, in such a specimen as is shown in Fig. 16 D, it is difficult to understand, at first, that the purposeless looking fold at the back of the cæcum is all that represents the true mesentery of the vermiform process.

There are certain other folds of peritoneum in connection with the cæcum that are of inconstant character, and that may be briefly disposed of. These plicæ are, for the most part, found along the line at which the peritoneum is reflected from the back of the cæcum on to the posterior abdominal parietes. They can, therefore, only be displayed when the caput coli has been turned upwards (Fig. 17 B). They are usually placed vertically, and run from the back of the colon to the peritoneum covering the psoas or iliacus muscles. Very often they arise at the root of the appendix, or are continued down from the mesentery of that process (Fig. 17 B). In length and depth, they show the greatest variations. When two exist, they may enclose a

fossa (Fig. 17 B). These fossæ represent those termed retro-cæcal by some anatomists. They are, however, not deserving of a special name. They are rare, are most variable, and evidently more or less accidental. Some appear as mere shallow grooves, while others are large enough to take a bantam's egg. They can hardly be demonstrated, unless the cæcum be put upon the stretch. It may be noted, however, that these retrocæcal folds have much to do in keeping the cæcum in position. Folds are also often found at right angles to the long axis of the gut, and passing from the colon near the cæcum, transversely across the iliacus muscle. These folds are very irregular, and can often be more or less entirely obliterated by displacing the large intestine. They do not merit anatomical recognition.

(To be continued.)

ABSTRACT OF THREE LECTURES ON THE MUTUAL RELATION OF THE GREY MASSES OF THE CEREBRO-SPINAL SYSTEM, AND THEIR CONNECTIONS WITH PERIPHERAL NERVES.

Delivered at the Royal College of Surgeons of England.

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LECTURES I AND II. — THE CENTRAL GREY TUBE, AND THE INVOLUTED PARTS OF THE CEREBRAL CORTEX.

WERE it possible to unravel the cerebro-spinal system, it would probably be found to consist of an association of simple combinations of nerve-fibre and nerve-cell, simple as to the number of elements entering into the formation of each combination, but complex as to the connections between them. The object of our study is to trace the fibres of nerves, the functions of which we know, back to their ultimate terminations in cells, and to determine further the connections of the various cell-groups with one another. The mere topography of the system, although, in the history of the subject, necessarily the first to be studied, is of no interest until we have some notion of the meaning of the different regions. So difficult, however, is the investigation of the structure of the cerebro-spinal system, whether carried out by the microscope or by methods of dissociation, that exceedingly discrepant results are obtained by different observers; and it is necessary, in order to obtain a general conception of the plan upon which this system is built up, to have recourse to fundamental morphological and physiological considerations.

Formed as an involution of the epiblast, the central nervous system retains, throughout its whole extent, its tubular character. This tube, at first uniform, undergoes a differentiation into three concentric layers, of which the internal constitutes the epithelium of the spinal canal, the middle the grey matter, and the peripheral the white matter of the cord, and of its continuation throughout the basal part of the system. It is with the grey matter alone that we have any further concern; this, owing to the lozenge-shaped section of the primitive central canal, is constricted into four columns, which subsequently become the two anterior and two posterior cornua, united above and below the central canal by the anterior and posterior commissures. The anterior and posterior roots of the spinal nerves are connected with their respective cornua. Within the grey matter, we find three distinct kinds of cells: 1, large motor cells (measuring from 67 to 135 μ) with distinct process of Deiters, collected in two separate groups in the anterior and lateral horns respectively, except in the cervical and lumbar enlargements, where these groups fuse together; 2, a dorso-mesial group of cells (Clarke's column) resembling the cells of the anterior horn in form, but not in size, their diameters varying from 40 to 90 μ ; 3, spindle-shaped cells, of an average length of 18 μ , apparently devoid of an axis-cylinder process. These cells are diffused through the matrix of the posterior horns.

It must be remembered that the above mentioned groups of cells constitute continuous columns, presenting, nevertheless, a distinctly metameric arrangement. Birge has shown that, in the frog, the number of motor cells in the spinal cord equals the number of large motor fibres in the anterior roots; and, further, that the number of cells in each metamer equals the number of large motor fibres in the anterior root leaving that metamer. Although there are certain difficulties in

carrying out this investigation which should make us hesitate in accepting the exact numerical equivalence as proved, Birge's results are strongly confirmatory of the opinion that every motor fibre is connected with a nerve-cell immediately before its exit from the cord. The variation in size of the posterior cornu, and consequently in the number of spindle-shaped cells which it contains, indicates that a similar connection obtains of the fibres of the posterior roots with nerve-cells of their own metamer.

Gaskell has, quite recently, called particular attention to the white rami communicantes (rami adheventes of Remak) of the sympathetic system, composed of the smallest medullated (leucenteric) fibres; and has further remarked that the number of cells in Clarke's column in any particular region appears to vary as the number of leucenteric fibres derived from that region. As the result, therefore, of Gaskell's researches, this column, hitherto so anomalous in position, in the character of its cells, and in its pathological alterations, falls into place as containing the primary centres of the visceral nerves; and we are justified in considering the central grey tube of the cerebro-spinal system as composed of metameric groups of three varieties of cells, well defined as to their histological characters, and severally connected with three kinds of nerve-fibres, equally distinct as to their anatomical and physiological relations.

As the spinal cord passes into the medulla, its central canal opens out into the fourth ventricle. The posterior columns, previously separated only by the median fissure, become widely divergent, and the posterior cornua are consequently displaced outwards. The physiological reason for this change is to be found, as it appears to the lecturer, in the peculiar needs of the nervous system with regard to the circulation. Subject to rapid exaltation and depression of functional activity, it demands a correspondingly variable nutrient supply. A very slight alteration in the pressure upon the nerve-cells would be injurious; and yet, since it forms a solid parenchymatous mass, local turgidity must produce pressure upon, and displacement of, neighbouring regions. To prevent such pressure, and to remove rapidly all products of action (a function of the lymphatic system not sufficiently recognised), every nerve-cell and fibre swims in a little bath of lymph. Where, however, the grey centres reach a certain size and functional importance, they are brought into contact with a sea of lymph, by which their alternating pressures are widely distributed, and their products of action rapidly removed.

With the displacement of the posterior column outwards, the anterior column of cells is brought up into the floor of the fourth ventricle close to the median line, where it constitutes the nucleus of the hypoglossal nerve. The lateral column is isolated by the crossing fibres of the pyramid, as the antero-lateral nucleus of Clarke, and the nucleus ambiguus. Clarke's column, the cells of which retain the same characters as in the cord, swells out into the nucleus of the vagus, the great leucenteric nerve of the thoracic viscera. From it also arise fibres of the glosso-pharyngeal nerve, which Vulpian has shown to possess a vaso-dilator influence upon the back of the tongue; and into its anterior part Duval has traced the pars intermedia of Wrisberg, ramus visceralis of the seventh pair, from which the chorda tympani vaso-dilator nerve of the submaxillary gland is derived. The sensory part of the glosso-pharyngeal nerve probably terminates in the spindle-shaped cells of the grey matter of the medulla, homologous with the posterior cornu of the cord. In the pons Varolii we find the abducens arising from the anterior, the facial from the lateral, and the auditory passing into the posterior cell-columns.

The motor nucleus of the fifth nerve appears to belong to the lateral column, the sensory to the posterior column, of the whole hind and mid-brain. In the mid-brain, the grey matter resumes its tubular arrangements; indeed, this part, the region of the corpora quadrigemina, preserves, to a greater extent than any other part of the central nervous system, its primitive form. From the ventral (motor) part of the grey tube arises the third nerve; the fourth arises from its dorso-lateral part.

The optic thalamus and corpora striata are usually associated together as "basal ganglia," and constitute the second node in Meynert's projection scheme. They are considered to be of a higher value than the grey matter of the spinal cord, to constitute, as it were, an intermediate office or bureau between the cord and the cortex, exercising a censorship over all messages received from and forwarded to the front, and capable, in the absence or somnolence of their chief, of re-directing and returning them. The lecturer believes that this scheme was based originally upon Carpenter and Todd's classification of reflex actions. Intermediate centres were required to carry out the kind of reflex they termed "ideo-motor." But neither two nor twenty serially ascending centres would suffice for the proper allocation of such official work. Every gradation of reflex action is possible, from