

THE POSITION OF THE VERMIFORM APPENDIX AS ASCERTAINED BY AN ANALYSIS OF 10,000 CASES

By CECIL P. G. WAKELEY, D.Sc., F.R.C.S., F.R.S.E.

Lecturer in Anatomy, University of London, King's College, Surgeon to King's College Hospital and the Belgrave Hospital for Children, Consulting Surgeon to the Hammersmith and Maudsley Hospitals

SOME twenty years ago, while a demonstrator in anatomy at King's College, I became interested in the position of the appendix in dissecting room subjects, and soon ascertained that the commonest position which this blind diverticulum of the bowel took up was a retro-caecal one. The teaching of Treves, however, was, and is at the present day, adhered to in the standard text-books of anatomy, namely that the commonest position is one in which the appendix lies in relation to the root of the mesentery and is directed upwards and leftwards pointing towards the spleen. It is a pity that this statement has not been challenged by anatomists themselves, as it is one of the rarest positions in which to find the appendix at any age from the foetus to old age.

It must be acknowledged that Treves was a great teacher and a forceful and stimulating writer, and anything that came from his pen was accepted readily without question. The cases which Treves investigated were comparatively few, certainly not sufficiently numerous to draw any definite conclusions concerning the relative frequency of the various positions in which the appendix may be found. It is quite true that the appendix may be found in almost any position relatively to the caecum, as can be seen in fig. 1, but there are many reasons why it should not commonly occupy an anterior position as Treves suggested.

The ultimate position of the appendix is profoundly influenced by the changes in position and shape which the caecum undergoes during development and growth. The caecum together with the appendix are first indicated by a simple saccular diverticulum of the gut (fig. 2, *I*), the caecal diverticulum, whereby the small intestine is demarcated from the large. After the torsion which affects the great intestinal loop occurs, the caecal diverticulum occupies a position on the right side of the abdominal cavity in close apposition with the liver. At this stage no ascending colon can be said to exist. The position of the caecal diverticulum is from the first relatively low down (caudalwards) in the abdomen owing to the precocious development of the liver which at an early stage occupies the greater part of the abdominal cavity. With the headward retreat of the liver, the caecal diverticulum and the liver become separated, one from the other, and the gut distal to the caecal diverticulum elongating,

the ascending colon comes into existence. The separation of the caecal diverticulum and the liver, or descent of the caecum, as it is inappropriately termed, is, as far as the liver is concerned, to be regarded as a relative change in position only and is due to the fact that the body wall and neighbouring parts are now growing more rapidly than the liver. As far as the body wall is concerned the caecal diverticulum for a time maintains its original position. In addition to its relative descent, however, the caecal diverticulum also undergoes an actual descent from the neighbourhood of the iliac crest into the right iliac fossa. This must be accompanied by a further elongation of the ascending colon. The descent of the caecal diverticulum relative and actual, is accompanied by changes in form. At first a simple sacculation of the gut wall, the caecal diverticulum elongates and its proximal end growing more rapidly than its distal, it assumes a conical shape (fig. 2, 2), the caecum and the appendix not being definitely demarcated one from the other. Later, by the more rapid enlargement of the proximal and the relative constriction of the distal end, the appendix becomes differentiated from the caecum (fig. 2, 3). With the appearance of the taeniae, the caecum, like the rest of the large gut, becomes sacculated. At first more or less symmetrical, the right caecal sacculation enlarges, while the left diminishes (fig. 2, 3). At the same time the anterior wall which is subject to less resistance, grows more rapidly than the posterior. As a result of this asymmetrical growth, the appendiculo-caecal junction is displaced not only leftwards and upwards but also backwards (fig. 2, 4). The factors which influence the change in form of the caecum are in the first place its actual descent into the iliac fossa—a sloping floor which tends to tilt the caecum in such manner that it occupies an oblique position with its long axis directed downwards and inwards (fig. 2, 3 and 4). It is obvious that the right caecal sacculation must, as compared with the left sacculation, now occupy the more dependent position and is consequently subject to greater pressure from within—pressure due to the escape of the intestinal contents from the ileum into the caecum, to the gravitating effects of the erect posture on the contents of the ascending colon and to the anti-peristaltic wave which affects the proximal part of the large gut. Evidence that the actual descent of the caecum into the iliac fossa is an important factor influencing the shape of the caecum is afforded by the fact that the retention of an early form in the adult, such as a conical caecum, is more frequently found when the caecum occupies an abnormally high position, that is to say in cases where the actual descent of the caecum into the iliac fossa has failed to eventuate.

Once the asymmetrical growth has commenced, these factors will make it progress until what may be termed the extreme form of caecum may be attained, where the primitive left wall has almost or completely disappeared and the greater part of the caecum is derived from the original right and anterior walls with which part of what was primitively ascending colon may be secondarily incorporated (fig. 2, 5). In short, during growth, the caecum may be considered to undergo a helicoidal torsion whereby the appendiculo-caecal

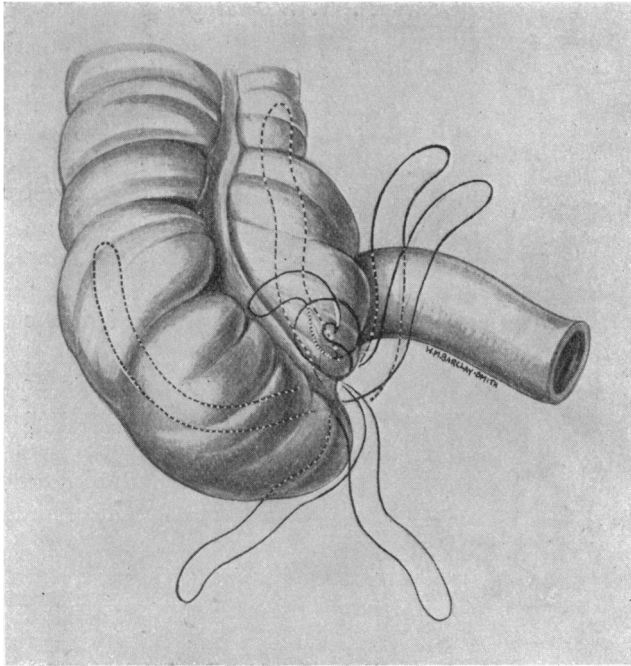


Fig. 1. Drawing showing the various positions which the vermiform appendix may occupy in relation to the caecum and terminal ileum.

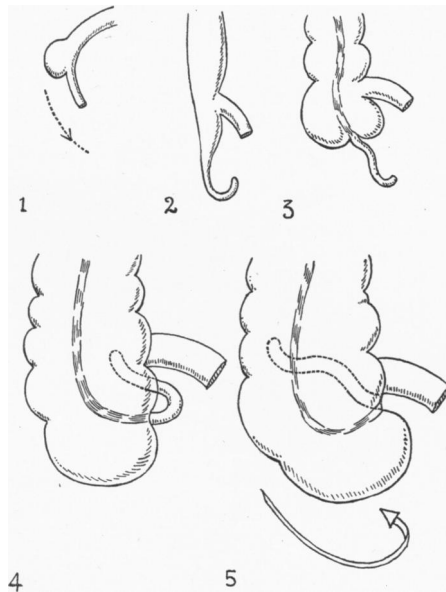


Fig. 2. Diagrammatic representation of the caecum diverticulum as it appears during different stages of development.

junction is displaced leftwards, upwards and backwards to such extent that in the extreme form it may actually lie behind the ileo-caecal junction. The method of growth of the caecum must be the main factor in determining the position of its primitively apical part, the appendix, which will be successively displaced leftwards, upwards and backwards, ultimately to lie behind the caecum which may be described as its natural position.

The position of the appendix posterior to the caecum is reflected in the disposition of its blood-vessels. The arteries to the appendix are derived from the ileo-caecal artery or sometimes from its posterior caecal branch and occupy a posterior position (fig. 3).

In the case of such a mobile part of the gut as the appendix, and taking into account the rapid and extensive changes which the neighbouring parts undergo, together with the changes in position which the appendix itself undergoes as it follows the caecum, it is obvious that it must be subject to more or less accidental circumstances which will modify its ultimate position and account for the many and various positions in which it may be found.

One of the most important circumstances modifying the ultimate position of the appendix is the urogenital ridge which may persist to a greater or less extent as the genito-mesenteric fold. The appendix, as it follows the caecum upwards and leftwards, must come into close approximation with this ridge, and will tend to be deflected downwards thereby, towards the ovary (pelvic cavity) in the female, or towards the abdominal inguinal ring in the male.

I will now proceed to consider the relative frequencies of the positions which the appendix may occupy, founded on the investigations in 10,000 cases.

Table listing the different positions which the appendix may occupy with their relative frequencies in 10,000 cases.

Position of appendix	No. of cases	Percentage
1. Anterior or pre-ileal	100	1.00
2. "Splenic" or post-ileal	40	0.40
3. Pelvic, or psoas muscle near or hanging over the brim of the pelvis	3101	31.01
4. Sub-caecal beneath the "caput caeci"	226	2.26
5. Post-caecal and retro-colic	6528	65.28
6. Ectopic	5	0.05

THE VARIOUS SITES OF THE APPENDIX

(1) *The anterior or pre-ileal position* is rare (1.00 per cent.). The distal extremity of the appendix is directed upwards and forwards over the terminal part of the ileum. There is a long meso-appendix frequently extending up to the tip of the organ and there is often an ileo-caecal fold.

(2) *The "splenic" or post-ileal position* is even more rare (0.40 per cent.), only 40 cases being observed in the 10,000 cases examined. This is the commonest position, according to the teaching and writings of the late Sir Frederick Treves, and still quoted in most of the standard text-books of anatomy.

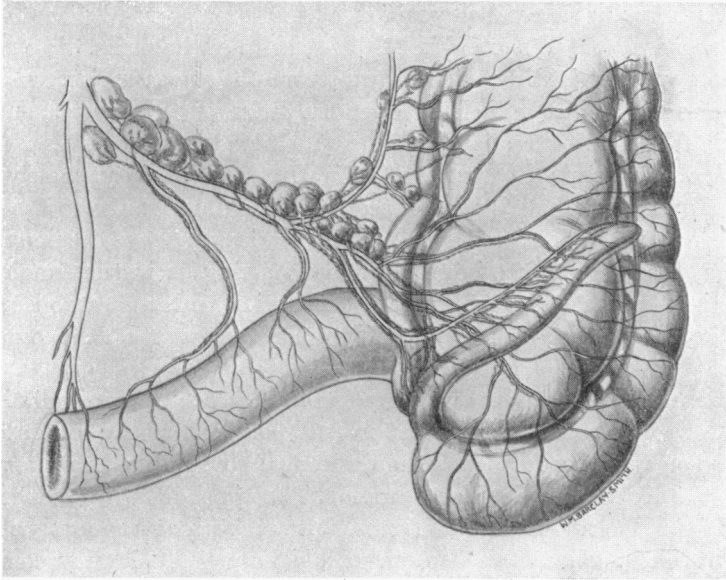


Fig. 3. The caecum and appendix from behind, showing the relations of blood-vessels and lymphatics.

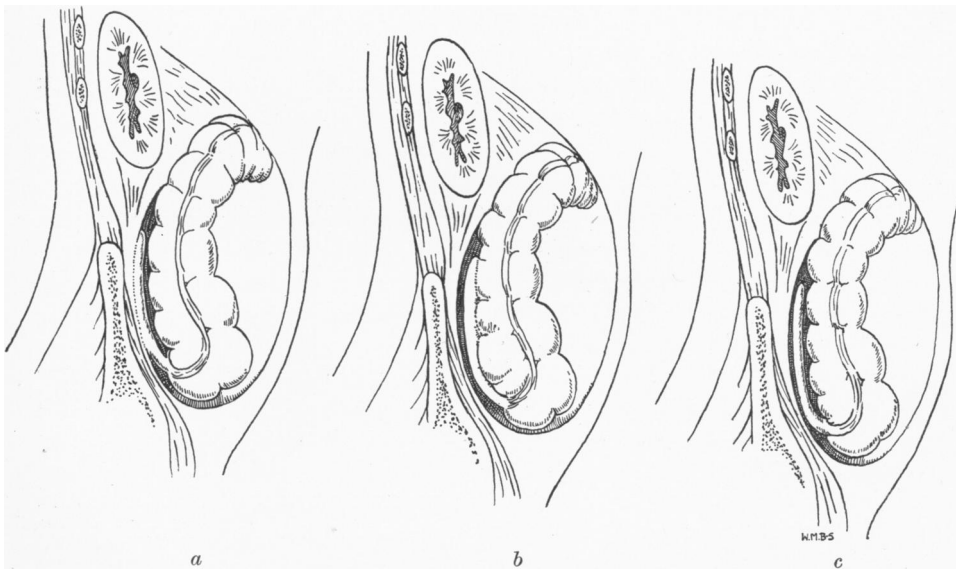


Fig. 4. Drawings showing various retro-caecal dispositions of the appendix.

When the appendix assumes this position, an ileo-caecal fold (the bloodless fold of Treves) may be present and may contain lobules of fat.

(3) *The pelvic or descending position* of the appendix is its second most common position, and was found in 31·01 per cent. of the series. As a rule, the tip of the appendix is directed downwards on the psoas major muscle and according to its length may hang over the brim of the pelvis. A genito-mesenteric fold is quite frequently present in these cases, and causes a downward kink of the terminal part of the ileum. In all probability, the position of the appendix in these cases is determined by this fold, which lies to its left side, and passes vertically downwards from the posterior aspect of the ileum or left side of the mesentery to the internal abdominal ring, or in the female to the ovary. This relationship is important in connection with the establishment of a secondary connection between the lymphatic vessels of the ovary and appendix.

(4) *The sub-caecal position* of the appendix, in which the appendix is found beneath the caput caeci, was present in 2·26 per cent. of the cases. The appendix lies on the iliac fossa and the peritoneal covering of that fossa alone separates the organ from the iliacus muscle. The appendix with its mesentery, is twisted in a clockwise direction from left to right, and frequently its tip is directed upwards. Should an ileo-caecal fold be present, it may completely cover the root of the appendix.

(5) *The post-caecal and retro-colic positions* of the appendix account for 65·28 per cent. of the cases and constitute by far the most common site. This is in accordance with the general experience of surgeons, pathologists and anatomists of the present day, but differs very markedly from the statistics which have been published by older writers and quoted in many of the English text-books of Anatomy. There are various positions in which a retro-caecal or retro-colic appendix may be found, and the following is the order of frequency:

(a) The appendix may be quite free, lying in a post-caecal or retro-colic pouch of peritoneum. Quite frequently, the meso-appendix is quite short in these cases (fig. 4 c).

(b) There may be a short mesentery which holds the appendix in contact with the posterior surface of the caecum and ascending colon.

(c) The appendix may be so adherent to the posterior surface of the caecum and colon, that together with these two structures it forms the anterior wall of a retro-colic pouch of peritoneum (fig. 4 b).

(d) The appendix may be extra-peritoneal owing to the fact that the retro-colic pouch has become obliterated, due to inflammatory processes. In such cases, any inflammation associated with an extra-peritoneal appendix may cause a perinephric abscess.

(e) The appendix may be quite from the posterior surface of the caecum and colon but adherent for nearly its whole length to the posterior abdominal wall (fig. 4 a).

(6) *Ectopic positions* of the appendix are curiosities. Five cases only were

met with in the whole of the 10,000 cases examined. In one case, there was complete transposition of the abdominal viscera. In two cases, the appendix was pre-hepatic in position, while in the two remaining cases, it was lying with the caecum in the umbilical region below the stomach and transverse colon.

REFERENCES

- BUCHANON'S *Manual of Anatomy* (1925). Baillière, Tindall and Cox, London. p. 767.
GLADSTONE, R. J. and WAKELEY, CECIL P. G. (1924). *Brit. J. Surg.* vol. xi, p. 503.
GRAY'S *Anatomy* (1930). Longman, Green and Co., London. p. 1255.
MORRIS, H. (1907). *Human Anatomy*, p. 1110. J. and A. Churchill, London.
TREVES, F. (1885). *Brit. Med. J.* vol. i.
WAKELEY, CECIL P. G. (1919). *Lancet*, vol. ii, p. 1071.
WAKELEY, CECIL P. G. and GLADSTONE, R. J. (1928). *Lancet*, vol. i, p. 178.