Original Articles.

THE NORMAL APPENDIX: ITS LENGTH, ITS MESENTERY, AND ITS POSITION OR DIRECTION, AS OBSERVED IN SIX HUNDRED AND FIFTY-SIX AUTOPSIES.¹

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For a number of years the Pathological Department at the Boston City Hospital has been in the habit, while making any autopsy, of observing and recording certain facts about the vermiform appendix in all cases, even where no pathological conditions existed in connection with it. This was done at the direction of Drs. Councilman and Mallory, with the idea that sooner or later the facts thus recorded might be of use to the Surgical Department. It occurred to us, therefore, on looking over the records, that there was already a sufficient number of cases to furnish, when tabulated, definite information as to the length of the appendix and its mesentery, and the frequency with which the appendix lay in its different positions, about which points there has been some diversity of opinion among the various anatomical and surgical writers. Upon application to the Pathological Department, the records were placed entirely at our disposal, and we decided to consider all the cases, excepting those in which the cause of death could be traced directly or indirectly to some trouble in the appendix.

Of the 1,400 autopsies recorded between Jan. 10, 1896, and May 29, 1902, we found that a note had been made as to the appendix in a large proportion of them. Omitting from this number the cases in which the appendix bore an etiological relation to the cause of death, there remained some 656 cases of men, women and children indiscriminately, in which some mention or record was made of the appendix. We give under each heading a few extracts from well-known authorities before presenting our figures.

THE LENGTH OF THE APPENDIX.

Quain (1), quoting Berry and Ranshoff, gives the average length 92 mm. ($3\frac{1}{2}$ inches), and the extremes 31 mm. (a little more than 1 inch) and 230 mm. (or a little less than 9 inches).

Gray (2) agrees with Quain exactly.

Treves (3) gives the average length as 4 inches, and the extremes 1 and 6 inches.

Deaver (4) gives the average length as about 4 inches, and the extremes as $\frac{1}{2}$ an inch and 9 inches.

In the series of cases we tabulated, the measurements were originally all made in centimetres, and for this reason they were probably more accurate than if made in inches. In tabulation we have used considerable care to take nothing for granted, except what is spoken of as being assumed.

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In the 641 autopsies of our series, in which the length of the appendix is recorded, we found the following:

Average length, 7.90 cm. (3 inches).
Shortest " 1. " cm. (a little over 1-3 of an inch).
Longest " 24. " cm. (a little over 9 1-3 inches).²

Relation between the length of the appendix and sex, age and body length.—There does not appear in our figures any apparent difference in the length of the appendix in the two sexes. Children, however, by these same figures, have a proportionately greater length of appendix than adults. Treves says that the appendix obtains its full length quite early in life.

Other than this, the appendix does not bear any necessary relation to body length. The longest appendices in our series, and also the shortest, were found—generally speaking—in bodies of medium length. The converse is also true, that the longest and shortest bodies do not necessarily have the longest and shortest appendices.

Relation between the length of the appendix and race.—All the subjects of autopsy were white, except twenty-three negroes, three Chinamen, and one "brown Hindoo." Of the last no length of appendix was given. These cases are too few to allow of any generalization. The average appendix length in the twenty-six bodies was, however, 8.2 cm. (approximately our general average).

MESENTERY: ITS PROPORTIONATE LENGTH.

Quain says that the appendix has a mesentery for more than half its length. The distal portion is generally quite free.

Gray says that the distal third or so is free from mesentery.

Treves says the mesentery "may extend to the tip of the appendix in the fetus, 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."

Deaver says that it occupies "the entire length (as I have usually found it)." It is, however, "at times absent."

Of the 277 cases of our series, in which mention is made as to the mesentery (meso-appendix), we find the following notes, most of them indicating what proportionate distance, measured from the base of the appendix, was supplied by mesentery:

	Per cent. of 243 cases, where measurement is given.	
No mesentery,	16 cases (6.5%).	
Mesentery reaching less than 1-2 the length of the appendix:	{ 1-3, 3 1-4, 5 "small," 1	9 cases (3.7%).
Mesentery reaching 1-2 the length of the appendix:	16 cases (6.5%).	
Mesentery reaching more than 1-2, but not for the entire length of the appendix:	{ 2-3, 29 3-4, 15 4-5, 1	45 cases (8.5%).
Mesentery reaching (practically) the entire length of the appendix:	128	
	{ "entire" 23 "for entire length" 1 "almost entire" 3 "almost for entire length" 1 "complete" 1 "10-11" 1	157 cases (64.6%).
Mesentery present, but no particulars given,	34 cases	
	277 cases	

² Nine and one-third inches in almost exactly the height of this page.

POSITION AND DIRECTION OF THE APPENDIX.

Quain speaks of the principal directions of the appendix as being (in order of frequency): (1) Up and to left; (2) down and to left; (3) into pelvis, and says that the appendix is sometimes entirely behind cecum.

Gray quotes various authorities, all of whom differ.

Treves says: "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 cecum."

Deaver says: "In the majority of cases the appendix will hold one of eight positions. Dr. Bristow suggests a very simple method of classifying these positions and directions, which consists in locating a central point in the right iliac fossa which, in its most common position, will represent the attachment of the appendix to the cecum, and from this central point lines are drawn that radiate in eight different directions." He goes on to say that Fowler substituted the points of the compass for the numbers used by Dr. Bristow. He also states that the central point is a point from 2 to 2½ inches on a line from the anterior superior spine of the ilium in the direction of the umbilicus. Deaver, following Fowler's suggestion as to the points of the compass, states that the appendix is most commonly found in one of the following five positions: (1) N.E.; (2) S.E. or S.; (3) N., to right of colon; (4) N. or N.E., in front of colon; (5) under the cecum, generally N.

We found some note referring to the position and direction of the appendix in 572 cases of our series. We assume that the position of the cecum was in the right iliac fossa in all these cases, unless it was otherwise noted, and that the direction as given corresponded to a line from "a central point" similar to that referred to by Deaver, as above. In some of the cases position only is referred to, as "behind cecum," "in pelvis," etc. These we have thought best to place with the others where direction only was spoken of, but under distinctive headings.

When our cases had been tabulated we found that most of them divided themselves naturally into eight groups, indicating eight different directions from a common centre, and it was not until after we had arranged our diagram that we learned we had been anticipated by others in this method of demonstration. As, however, the nomenclature used by us is somewhat different from that before used in connection with the diagram, we shall later reproduce the latter, as we believe it still to be the best method of graphically recording the different directions in which the appendix may point.

In the following tables we have preserved, so far as possible, the diction used in the original records. Such words, however, as "upwards,"

"downwards," "inwards," etc., have been shortened to "up," "down," "in," etc.

The groups have been arranged in such a way as to indicate the order of frequency of the different positions and direction:

Down and in (the most common position or direction):

"Down and in"	54
"Hanging over pelvic brim"	116
"Behind cecum, down and in"	6
"Inner side of cecum, down"	1
"Below cecum, and in"	1
"Loops into pelvis, tip just under mesentery of ileum"	1
	179

Behind cecum (the second commonest position³; direction not given):

"Curled" } up { behind } "cecum"	68
"Coiled" } up { beneath }	
"Behind cecum"	32
"Posterior to cecum"	2
"Back"	1
"Curled behind cecum at level of costal border"	1
	104

Down (the third commonest position or direction):

"Below cecum"	37
"Behind cecum, down"	13
"Down"	8
"Caudad"	5
"Curled up below cecum in right iliac fossa"	4
"Below cecum, down"	2
"Directed down"	2
"Down and back"	2
"From anterior surface of cecum passes directly back"	2
"Directed down, appendix in close contact with abdominal wall"	1
"Down, back and up"	1
"Down, back and up, folded on itself"	1
"Below and behind cecum"	1
	79

In (the fourth commonest position, or direction):

"Toward median line"	53
"Inner side of cecum, curled up"	2
"To median line"	1
"Toward median line, 4 cm. from end of cecum, parallel with ileum for 5 cm., then turns back"	1
"Behind cecum, in"	1
"In and slightly back"	1
"Extends to median line at pelvic brim"	1
"Inner side of cecum, in wards"	1
"Behind loop of small intestines"	1
	62

Up:

"Up behind cecum"	40
"Up and back"	5
"Up"	3
"On top of cecum"	2
"In front of cecum, directed up"	1
"Posterior to cecum, cephalad"	1
	52

Up and in:

"Up and in"	23
"In and up behind cecum"	6
"Inner side of cecum, up and in"	3
"Up, back and in"	3
"Up and in for half its course, and doubled on itself"	1
"Up and in, passes over anterior surface right kidney to within 1 cm. of upper margin, closely united to renal capsule"	1
"Points almost towards umbilicus"	1
"Behind ileum and cecum"	1
	39

³ It is, of course, true that the great majority of appendices are, at their origin, behind the cecum. If we were to add, therefore, to the class "behind cecum" all these which, though originating there, eventually assumed a definite direction, that class would stand first of all. We have not done this, because the full descriptions recorded in each case seemed to us to justify the present classification.

Up and out:

"Up, behind and to right of cecum"	7
"Up and outside (or outer side of) cecum"	6
"Up and out"	6
"Up and out, behind cecum"	3
"Up and out, close to iliac crest"	1
"Up and out, over anterior surface of cecum"	1
"Up, back and out"	1
"Up and slightly back on right of ascending colon"	1
"Up, outside attachment of cecum"	1
"Outer side of cecum, extends up"	1
"Outside cecum, up and doubled twice upon itself"	1
	29

Out:

"Out"	2
"Behind cecum, out"	2
"Behind and to right of cecum"	2
"Outside of cecum, along parietal wall"	1
"Curled up on itself, exterior to cecum"	1
"Back and out"	1
	9

Down and out:

"Behind cecum, down and out"	2
"Below and to right of cecum"	2
"Down and out"	1
	5

In pelvis (unclassified):

"Wholly within pelvis"	4
"Free in pelvis"	3
"With cecum in pelvis"	3
"Within pelvis"	1
"In pelvis, directed upwards"	1
"S-shaped loop in pelvis"	1
"Deep in pelvis"	1
	14

While we do not consider this classification ideal, we deem it the best one under the circumstances. Several of the cases might possibly be classed under some other heading, but these cases are mostly small in number, so that, if they were so placed, they would not materially influence the result.

Reverting to our diagram we find that in more than half (320) of the cases the appendix points within the right lower quadrant (that is, "in" "down and in" and "down"). If now we add to this number those which are classed simply under the heading "behind cecum" without any direction being given (104), we find that in 424 of our total of 572 cases, or in 74%, the appendix is

either "behind the cecum" (without specified direction), or it points "in," "down," or "down and in," the last being by far the most frequent position or direction of all.

UNUSUAL CASES.

(a) *Conical cecum*.—There were nine cases where it was recorded that the cecum tapered into the appendix.

(b) *Fibrous cord*.—There were six cases where the appendix was represented by a white, glistening, fibrous cord (obliterated appendix). In an additional one the distal portion only was obliterated.

(c) *Miscellaneous*.—One appendix "is directed up behind cecum; passes over anterior surface of right kidney to within about 1 cm. of its upper margin"; another is "curled up behind cecum, which is situated high up, just below costal margin"; a third extends "up and in, the tip lying close to gall-bladder." A fourth extends "up externally to the right border of the liver"; a fifth lies "between the right lobe of liver and right kidney"; a sixth lies "behind peritoneum under cecum, and extends upward to lower border of right kidney"; a seventh lies "transversely across abdomen, slightly upwards, reaching beyond the middle line."

CONCLUSIONS.

From the foregoing statistics the following conclusions would appear to be justified:

(1) *Length*.—The average length of the appendix in men, women and children, indiscriminately, is 7.9 cm. (or 3 inches); the extremes being 1 cm. (a little over 1-3 of an inch) and 24 cm. (a little over 9 1-3 inches).

There is apparently no relation between the length of the body, the sex or age of the subject, and the length of the appendix, except that children are apt to have an appendix proportionately longer than adults.

(2) *Mesentery*.—Fully one-half of all appendices have a mesentery (meso-appendix) which reaches nearly to, or quite to, the tip. Of the other half by far the greatest proportion have mesenteries reaching as far as the middle point of the appendix or beyond it. Occasionally an appendix has no mesentery at all.

(3) *Position (or direction)*.—The commonest position (or direction) for the appendix is "down and in" (that is, toward the pelvis), the appendix very frequently hanging over the brim. The second commonest position is "behind the cecum." The third is "down" and the fourth is "in." The appendix is in one of these four positions in about three-quarters of all cases.

REFERENCES.

1. Quain. Elements of Anatomy. Tenth edition, 1896.
2. Gray. Anatomy. American edition from thirteenth English edition, 1896.
3. Treves. Lectures on the Anatomy of the Intestinal Canal and Peritoneum in Man, British Medical Journal, 1885, p. 415.
4. Deaver. A Treatise on Appendicitis, 1896.

* See footnote on page 582.