

A STUDY ON GROSS FEATURES AND DIFFERENT POSITIONS OF ADULTS VERMIFORM APPENDIX

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ABSTRACT

BACKGROUND

Appendix is derived from a Latin word (Pendere) meaning at the end. It is a narrow worm-like tubular diverticulum, which arises from the posteromedial wall of caecum about 2 cms below the ileocaecal junction and is suspended by a peritoneal fold known as mesoappendix. The body of appendix is kinked on itself where the free border of mesoappendix ends. Hence, it is coiled like a worm and so is named the 'Vermiform Appendix'. The appendix is taken up for study in view of its different positions, varying anatomical relations, and the clinical complications when pathologically affected. The relations, measurements, positions, and arterial supply were studied by gross dissection in 61 specimens (Adults – 33 and foetuses – 28) from the population of Krishna and Warangal districts of Andhra Pradesh.

MATERIALS AND METHODS

The present study was done on 31 adult specimens, out the length of the appendix, the diameter of the appendix at base, length of the caecum, length of ascending colon were measured. The position of the appendix was classified as per Datta's classification. Mesenteric attachment to the vermiform appendix were noted. Even arterial supply of the appendix was studied.

RESULTS

Length of the appendix in adults varied from 2.00 to 25.00 cm as described by different authors, the average being 3.00 to 12.50 cm. The length of the caecum in adults were ranging from 5 to 8 cm. In the present study, the length of appendix was 14.4 cm. The origin of the appendicular artery was from inferior division of ileocolic artery. A single appendicular artery is observed in all the specimens almost coinciding with studies of Michels et al. In the present study, in adults, the mesoappendix was extending to the tip in 19 specimens and extending to a variable extent in 14 specimens. Regarding the positions, in adults, they were retrocaecal, retrocolic, and subcaecal positions were 21.21% and splenic, promontory, and pelvic positions were 78.8%.

CONCLUSION

The knowledge of anatomy of appendix is very important for thorough understanding of the pathology, signs, and symptoms of acute appendicitis. This study of different positions and gross features of vermiform appendix will be of great help to the surgeons when they do laparotomy and plan for further any surgical procedures.

KEYWORDS

Appendix, Appendicular mass, McBurney's point, Retrocaecal, Splenic, Blood supply of appendix, Promontory, Abdominal tonsil.

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INTRODUCTION: Appendix is an abdominal tonsil due to presence large aggregation of lymphoid tissue. It is worm like, has a base, body, and apex. Position of base of appendix is constant while the position of the tip of appendix is highly variable. The tip of the appendix has following position Retrocaecal-60%, Pelvic-30.0%, subcaecal-2%, Paracaecal-1%, Preileal-1%, Promonteric-1%, and postileal-5%. It is intraperitoneal organ and its mesentery is called mesoappendix.

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[Neeta Kulkarni].¹ McBurney's Point is a point lying at the junction of lateral one third and medial two third of spinoumbilical line from the anterior superior iliac spine to the umbilicus. It is clinically a paramount importance. It is area of maximum tenderness of appendicitis and area for grid iron incision for appendectomy. In 1889, McBurney's described clinical features of acute appendicitis and muscle splitting incision and pioneered the removal of acutely inflamed appendix before perforation occurred [McBurney-1889].²

In 1993, Ranganathan reported the position of the appendix is variable, the site of tenderness, and pain may be misleading [Ranganathan].³ In 1933, Wakeley reported the retrocaecal and retrocolic positions obtained in 65.5% of his 10,000 cases and the pelvic position with the appendix directed downwards over the psoas major muscle and thus

tending to hangover the brim of the pelvis in 31.01% of the patients [Wakeley-1933].⁴ In 1917, MacPhail found the average length of the appendix as 9.9 cm in 220 consecutive postmortem examinations and he also described that appendix is 1 cm longer in males than in females. [1917 MacPhail].⁵

AIM AND OBJECTIVES OF THE PRESENT STUDY:

The objective of present study is to

1. To study the gross features of appendix.
2. To measure the length and diameter of appendix. The percentages of incidence.
3. To record position of appendix and compare them with previous studies.
4. To record any other variations. Arterial supply.

MATERIALS AND METHODS: A total number of 61 specimens [Out of which 33 are adult cadavers (Male and female) and the rest are 28 dead fetuses (Male and female)] freshly collected from labour room and preserved by injecting the preservative fluid constituted the materials for the present study.

Inclusion Factors:

- Specimen number.
- Sex: Male/Female.
- Adult/foetus.
- Mesoappendix: Complete/Incomplete.
- Length of the appendix.
- Diameter of the appendix.
- Length of the ascending colon.
- Length of the caecum.
- Distance between ileocaecal junction to appendix.
- Position of the appendix.
- Arterial supply.

Exclusion Factors: To rule out any other variation in arterial supply, its morphology, any other morphological variations, or anomalies in the body.

Dissection Methods: A vertical incision from the xiphisternum to pubic symphysis was given. After the abdomen is opened, the stomach is identified, greater omentum was separated. The caecum and appendix were traced. The position of the appendix is confirmed by the direction of the tip of the appendix. The shape and extension of the mesoappendix was noted and the relation of the appendicular artery to the mesoappendix was also noted. Mesoappendix is severed and appendix is straightened and the length of the appendix is measured from base to appendix. The diameter of the appendix at the base is measured with Vernier callipers. Mesoappendix is observed whether it is complete or incomplete. The length of the ascending colon was measured from ileocaecal junction to hepatic flexure. Length of the caecum was also measured from lower end of the caecum to ileocaecal junction and the distance between ileocaecal junction to appendix was measured. Photographs were obtained in situ.

RESULTS: In the present study, 61 specimens are studied out of which 33 were adult specimens. The length of the appendix, the diameter of the appendix at base, length of the caecum, length of ascending colon were measured. The position of the appendix as per Datta's classification was noted. Mesenteric attachment to the vermiform appendix was noted. Vascular supply to the appendix was also studied.

Length of the Appendix: In the present study, the average length of the appendix in males was 6.56 cm varied from 2.2 to 11.5 cm. The average length of the appendix in females was 4.58 cm and varied from 3.3 to 6.2 cm. Thus in the present study, it clearly shows that length of the appendix in males is more when compared to females in adults and the average length of the appendix in adults was 6.03 cm varied from 2.2 cm to 11.5 cm.

Diameter of Appendix: Average diameter of appendix at the base in adults was 0.50 cm and varied from 0.30 to 0.80 cm.

Length of the Caecum: In the present study, the average length of the caecum in adults was 5.45 cm varies from 5.00 to 6.00 cm.

Length of the Ascending Colon: In the present study, average length of ascending colon in adults was 14.40 cm and varied from 8.00 to 24.00 cm.

Distance between Ileocaecal Junction to Appendix: In the present study, the average distance between ileocaecal junction to appendix in adults was 1.65 cm varies from 0.42 to 3.00 cm. Average distance between ileocaecal junction to appendix in fetuses is 0.39 cm and varied from 0.20 to 0.80 cm.

Positions of Appendix: In the present study, out of 33 specimens were studied in adults, retrocaecal position was seen in 7 specimens, paracaecal in 6 specimens, splenic position in 1 specimen, and pelvic position in 19 specimens. In the current study, the pelvic position was seen in more than half of the specimens (57.57%) and in the remaining retrocaecal 21.21%, paracaecal 18.18%, and splenic 3.03%. In the current study, paracaecal position was seen in most of the specimens (39.29%) and in the remaining retrocaecal 10.71%, splenic 3.57%, promonteric 3.57%, pelvic 35.71%, and midinguinal 7.14%.

Mesoappendix: Present study showed the mesoappendix of complete variety in 19 specimens and incomplete in 14 specimens out of 33 in adult specimens.

Arterial Supply: In the current study, it was observed that a single appendicular artery arising from inferior division of ileocolic artery supplied appendix in all adult specimens.

DISCUSSION: In 1994, Schwartz stated the relation of the base of the appendix to the caecum is essentially constant whereas the free end is found in a variety of locations. The 3 taenia coli meet at the junction of caecum with appendix and formed the outer longitudinal muscle layer of the appendix. Thus the taenia, particularly anterior taenia, maybe used as a landmark to identify elusive appendix. [Schwartz].⁶ In 1895, Berry reported the origin of vermiform appendix on the posteromedial side of caecum in 90% of his observations [Berry].⁷ Congenital absence of the appendix is apparently very rare, but occasional case have been reported. Some reported cases may have actually been a case of extreme hypoplasia in which a very tiny appendix could be overlooked.

Collins classified the reported cases of so called agenesis into 5 types according to development of both caecum and appendix. In the cases, he reviewed there were 8 in which both caecum and appendix were absent and 3 with a rudimentary caecum, but no appendix. In 47, a normal caecum possessed no appendix, in 14 more only a rudimentary one, and in two cases the appendix had apparently grown concomitantly with the caecum, thus adding to that, rather than differentiating into a true appendix. In a study of series of 1,00,000 to 2,00,000 patients, agenesis of the appendix has been reported. According to Collins, the occurrence of incidence of agenesis of appendix is 0.0005% to 0.0009%. [Collins. D.C].⁸

In 1965, Pester found duplication of appendix in 30 cases. Apparently, duplication of the appendix and associated with duplication of the caecum is likewise quite rare, which were closely associated or even encircled by a common layer of muscle and with cavity communicating with each other or this may be far apart of the caecum [Pester].⁹ In 1968, Derojas and Irons reported an appendix with five diverticula.¹⁰ In 1978, Saebo reported three examples of pneumoperitoneum associated with a perforated appendix and found about 40 published reports of this condition.¹¹

Name of the Author	Length of the Appendix (Cms)	Average Length of the Appendix (Cms)
Gray	2-20	9
Ranganathan T. S	--	3 – 5
DU Plessis D. J.	2.5-23	9
Datta A. K	2-20	9
Hollinshead H. W	8-20	10
Chakrabarty N. C. and Chakrabarty D	--	5
Last R. J.	2-25	6 – 9
Cunningham	2-15	9
Mitchell G.A.G., and Patterson E. L	20	--
Jhonston T.B.	12.5	--
Lockhart R.D. and Hamilton G.F. and Fyfe F.W.	7.5-10	--

Keith L. More	8	--
Buchnans	5-15	--
MacPhail	--	9.9
Mustafi	2-20	9
Woodburne	--	8
Present Study	2.2-11	6.03

Table 1: Showing the Length of the Appendix as Study by Different Authors

According to foreign authors like Gray,¹² DU Plessis,¹³ Hollinshead,¹⁴ Cunningham,¹⁵ Hamilton,¹⁶ Mitchell,¹⁷ Jhonston,¹⁸ Lockhart,¹⁹ Last.R.J.,²⁰ the average length of appendix was about 9.00 cm while according to Indian authors like Ranganathan,³ Chakrabarty,²¹ the average length was 5.00 cm, but as per Datta,²² it was 9.00 cm. In the present study, the average length was 6.03 cm, which is closely related to Indian authors.

Name of the Author	Diameter of the Appendix at the base (Cms)
Hollinshead H.W.	0.60
Chakrabarty N.C. and Chakrabarty D.	0.50
Cunningham	0.50
Hamilton W.J.	0.60
Lockhart R.D., Hamilton G.F., Fyfe F.W.	0.50
Anson and McVay	0.80
Present study	0.50

Table 2: Showing the Diameter of the Appendix at the Base

The average diameter at the base of appendix was described as 0.6 cm by Hollinshead, Hamilton, and 0.5 cm by McVay, N.C. Chakrabarty, Cunningham, and Lockhart. In the present study, the average diameter at the base of the appendix was 0.5 cm, which is similar to Cunningham and Lockhart studies.

Name of the Author	Length of the Caecum in Adults (Cm)
Gray	6.00
Cunningham	5.00 – 7.00
Mitchell G. A. G. and Patterson E.L.	5.00 – 8.00
Jhonston T.B.	5.00 – 7.00
Philip Thorek	5.00 – 8.00
Present study	5.45

Table 3: Showing the Length of the Caecum in Adult

The length of the caecum in adults ranged from 5 to 8 cm. In the present study, the length is 5.45 cm, which is in conformity with all authors.

Name of the Author	Length of the Ascending Colon (Cms)
Gray	21.00
Cunningham	18.00
Datta	15.00
Anson and McVay	12.50 – 20.00
Present study	14.40

Table 4: Showing the Length of the Ascending Colon in Adults

The length of the ascending colon is described as 21 cm by Gray and 18 cm by Cunningham by Datta 15 cm. In the present study, the length was 14.4 cm, which is close line with Datta.

Name of the Author	Single appendicular Artery	More than one Appendicular Artery
Shah and Shah	70%	30%
Michels et al.	92%	8%
Solanke	20%	80%
Last. R.J.	--	Often
Present study	100%	--

Table 5: Showing the Incidences of Single Appendicular Artery and More Than One Appendicular Artery

In the present study, single appendicular artery was observed in all the specimens almost coinciding with Michels et al. [92%]. While in Shah and Shah study, they were supplied by single appendicular artery in 70% of cases. Solanke studies showed appendices were supplied by more than one appendicular artery in 80% of cases.

	Pelvic	Ileocaecal	Retrocaecal	Retrocolic	Subcaecal	Preileal	Postileal
Wakeley	31%	1.4%	65.28%	65.28%	2.26%	1%	0.4%.
Khan	30.0%	Ileocolic 1%	65.0%	65.0%	2%	30.0%	----
Collins	78.5%	78.5%	21.5%	Subcaecal 21.5%	21.5%	--	---
Present study	57.57%	Paracaecal 18.18%	21.21%	Splenic 3.03%	Paracaecal 18.18%	Splenic 3.03%	

Table 6: Showing Incidences of Different Positions of Appendix by the Various Authors

The vermiform appendix may occupy one of the several positions. The direction of the tip of the appendix was taken as the criterion to describe the position of the appendix.

1. Gray has described the positions as retrocaecal, retrocolic, pelvic, subcaecal, preileal, and postileal.
2. As per Wakeley, pelvic, ileocaecal, retrocaecal, and retrocolic positions are described. Buschard and Kjaeldgaard.²³ classified positions as anterior (Pelvic and ileocaecal) and posterior (Retrocaecal and subcaecal).
3. Khan. B. K.²⁴ described various positions of appendix as retrocaecal, retrocolic, preileal, pelvic, paracolic, subcaecal, and ileocolic.
4. As per Karim. O. M.²⁵, Boothroyd. A. E, Wyllie. J. H, described the positions of appendix are ileal, umbilical, inguinal, and pelvic.
5. As per Datta. A. K., described the positions as subcaecal, paracolic, retrocaecal, retrocolic, splenic, promontory, pelvic, and midinguinal.

Blood Supply of Appendix: In 1946, Shah and Shah²⁶ studied the blood supply to the appendix, reported that among 60 bodies, 70% had single appendicular artery while 30% had more than one. While in Solanke²⁷ studies,

appendices were supplied by more than one appendicular artery in 80% of cases. In the present study, single appendicular artery was observed in all the specimens almost coinciding with Michels. et al. studies. In the present study, out of 33 adult specimens, retrocaecal position was seen in 7 specimens, paracaecal in 6 specimens, splenic position in 1 specimen and pelvic position in 19 specimens. In the current study, the pelvic position were seen in more than half of the specimens (57.57%) and in the remaining, retrocaecal 21.21%, paracaecal 18.18%, and splenic 3.03%. In the current study, paracaecal position is seen in most of the specimens (39.29%), and in the remaining retrocaecal 10.71%, splenic 3.57%, promonteric 3.57%, pelvic 35.71%, and midinguinal 7.14%.

As per Wakeley, the positions described are pelvic 31%, ileocaecal 1.4%, Retrocaecal and retrocolic 65.28%, subcaecal 2.26%, preileal 1%, and postileal 0.4%. Khan described as retrocaecal and retrocolic 65%, preileal and pelvic 30%, right paracolic and subcaecal 2%, and ileocolic 1%. Buschard K. and Kjaeldgaard A. found retrocaecal and subcaecal positions more in Danish people and pelvic and ileocaecal positions in other people.

As per Collins, pelvic and ileocaecal are (78.5%) and retrocaecal and subcaecal were (21.5%). As per Wakeley, pelvic and ileocaecal are 32.4% and retrocaecal and subcaecal are 67.7%. Karim O. M. described the positions of appendix as ileal 15%, umbilical 15%, inguinal 11%, and pelvic 6%. Datta's classification is followed to study the different positions of appendix in present study. In the present study in adults, retrocaecal, retrocolic, and subcaecal positions are accounted for 21.21% and splenic, promonteric, and pelvic positions are 78.8%.

The present study is in lines with Collins. In the present study, the results were nearer to Collins.

Mesoappendix: The mesoappendix is a triangular peritoneal fold enclosing the appendicular artery and appendix. This extends to a variable length. As per Datta, Gray, and Keith L. More, the mesoappendix is up to the tip of the appendix whereas as per Hollinshead and last the mesoappendix extends to a variable length. In the present study in adults, the mesoappendix is extending to the tip in 19 specimens and extending to a variable extent in 14 specimens.

The clinical picture of acute appendicitis varies depending on the position of appendix, which may present in a number of ways. The position of appendix is determined by the length of its mesentery. Gladstone and Wakeley after study of 10,000 cases presented the statistics pertaining to various positions of appendix as follows, whether it is free or fixed. Retrocaecal - 74%, Pelvic - 21%, Paracaecal - 2%, Subcaecal - 1.5%, Preileal - 1%, Postileal - 0.5%.

Sir Frederick Treves described the positions of appendix with reference to clock as follows: Paracolic-11 o'clock, promonteric-3 o'clock, retrocolic-12 o'clock, Pelvic-4 o'clock, Splenic-2 o'clock, Midinguinal-6 o'clock.

Gladstone and Wakeley after study of 10,000 cases presented the statistics pertaining to various positions of appendix as follows whether it is free or fixed. Retrocaecal-74%, Pelvic-21%, Paracaecal-2%, Subcaecal-1.5%, Preileal-1%, Postileal-0.5%.

Paracolic is one when the appendix lies on the lateral side of the ascending colon. Splenic position is when the appendix is intraperitoneal pointing towards the spleen either behind or in front of the terminal ileum. If the appendix is transversely placed, medially directed towards the promontory of the sacrum, it is promonteric in position. While it hangs freely within the true pelvis, it is called pelvic type, often it is seen lying on the psoas muscle producing flexion deformity of the right hip due to spasm. The inguinal type passes down towards the middle of the inguinal ligament.

In the present study, out of 33 specimens in adults, retrocaecal position was seen in 7 specimens, paracaecal in 6 specimens, splenic position in 1 specimen, and pelvic position in 19 specimens. In the current study, the pelvic position were seen in more than half of the specimens (57.57%) and in the remaining retrocaecal 21.21%, paracaecal 18.18%, and splenic 3.03%. In the current study, paracaecal position was seen in most of the

specimens (39.29%), and in the remaining, retrocaecal 10.71%, splenic 3.57%, promonteric 3.57%, pelvic 35.71%, and midinguinal 7.14%.

The appendix is taken up for study in view of its different positions varying anatomical relations and the clinical complications when pathologically affected. The relations, measurements, positions, and arterial supply were studied by gross dissection in 61 specimens (Adults - 33 and fetuses - 28) from the population of Krishna and Warangal districts of Andhra Pradesh.

In adult males, the length of the appendix varies from 2.2 to 11.5 cm and in the females from 3.04 to 6.2 cm. The length of the appendix in fetuses varied from 1.3 to 4.75 cm. The length of the appendix in males was longer than in females in adults. The diameter at the base of the appendix in adults was 0.5 cm and in fetuses 0.3 cm. The length of the caecum and the ascending colon in the present study was similar to studies of various authors. Pelvic positions were more common in 57.57% in adults and paracolic positions were more common in fetuses (39.29%). The extent of the mesoappendix was variable and in the present study both complete and incomplete types were observed. The origin of the single appendicular artery from inferior division of ileocolic artery is observed which, is in conformity with many authors.



Photograph No. 1: Showing Retrocaecal Position of Appendix in Adults

Description of Photograph No. 1:

- Appendix lies behind the caecum. It is in retrocaecal position.
- This is the commonest position of the appendix.
- Present in more than 60% of cases.
- Complete type of mesoappendix is seen.



Description of the Photograph No. 2: Appendix is in Retrocaecal Position. Complete type of Mesoappendix is Seen

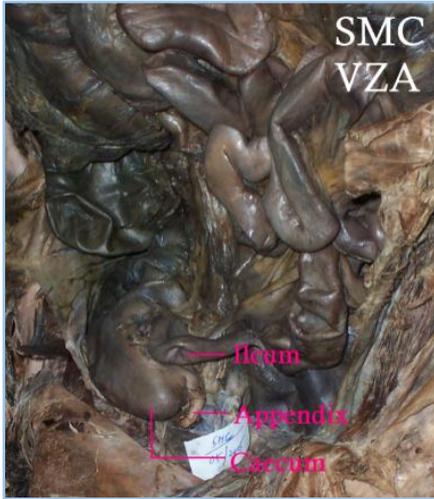


Description of Photograph No. 3: Appendix is in Paracaecal Position, which Lies Anterior to Caecum. Incomplete type of Mesoappendix is seen.



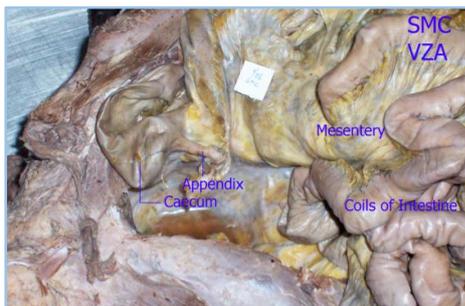
Photograph No. 6: Showing Pelvic Position of Appendix in Adults

Description of the photograph No. 6: Pelvic position of appendix is seen. Tip passes downwards towards the pelvic brim. Complete type of mesoappendix is seen.



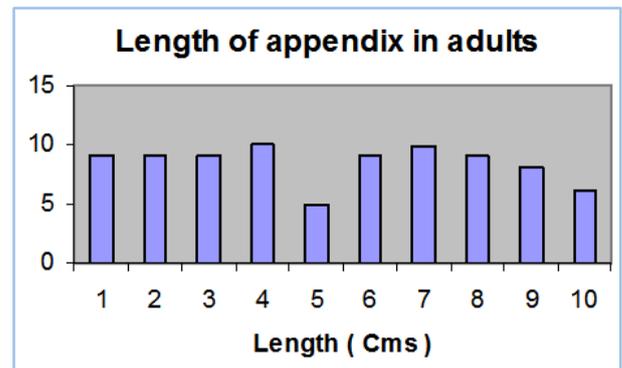
Photograph No. 4: Showing Paracaecal Position of Appendix in Adults

Description of Photograph No. 4: Paracaecal position is observed in this photograph, which lies below the caecum incomplete type of mesoappendix is observed.

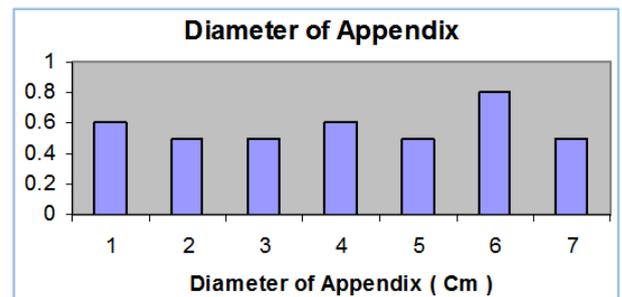


Photograph No. 5: Showing Pelvic Position of Appendix in Adults

Description of the photograph No. 5: Pelvic position of appendix is seen in this photograph. The tip passes downwards medially towards the pelvic brim. Mesoappendix is extending up to the tip of the appendix (Complete type). Mesentery with coils of intestine is seen.

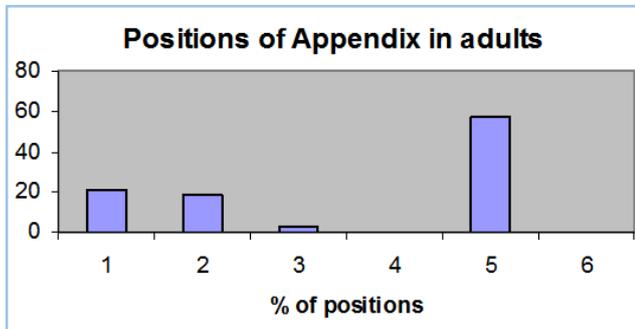


1. Gray.
2. DU Plessis. D. J.
3. Datta. A. K.
4. Hollinshead. H.W.
5. Chakrabarty. N. C. and Chakrabarty. D.
6. Cunningham.
7. MacPhail.
8. Mustafi.²⁸
9. Woodburne.
10. Present Study.



1. Hollinshead, H.W.
2. Chakrabarty, N.C and Chakrabarth, D.
3. Cunningham.
4. Hamilton, W.J.

5. Lockhart R.D., Hamilton G.F., and Fyfe F.W.
6. Anson and McVay.
7. Present Study.



1. Retrocaecal - 21.21%.
2. Paracaecal - 18.18%.
3. Splenic - 3.03%.
4. Promonteric - 0.00%.
5. Pelvic - 57.57%.
6. Midinguinal - 0.00%.

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