

The Cadaveric Study on the Prevalence of Meckel's Diverticulum in Southern Nigeria

Edibamode Ezon-Ebidor Innocent, Paul John Nwolim^{*}, Efugha Chibuikem Godwin

Department of Anatomy, Faculty of Basic Medical Sciences, College of Health Sciences, University of Port Harcourt, Choba, Port Harcourt, Rivers State, Nigeria

*Corresponding author

Paul John Nwolim

Article History

Received: 31.08.2018

Accepted: 06.10.2018

Published: 30.10.2018

DOI:

10.36347/sjmcr.2018.v06i10.001



Abstract: Meckel's diverticulum is the most common congenital malformation of the gastrointestinal tract but occurs infrequently in the different population of the world. This study was carried out to determine the prevalence, morphology and sexual dimorphism of Meckel's diverticulum using adult Nigerian cadavers. A total of 41 adult cadavers were used, 32 males and 9 females from the Anatomy dissecting Laboratory of five selected universities in the southern part of Nigeria. Dissection of the lower abdominal wall was made to trace and search for the Meckel's diverticulum. In all the accessed cadavers (both males and females), Meckel's diverticulum was absent indicating a zero (0.0%) prevalence. This finding therefore suggests that the prevalence of Meckel's diverticulum in Nigerians is very low and may be absent in most Nigerians.

Keywords: Prevalence, Cadaver, Diverticulum and Sexual dimorphism.

INTRODUCTION

The small intestine is the longest part of the alimentary canal and extends from the pylorus of the stomach to the ileocecal junction. The greater part of digestion and food absorption takes place in the small intestine. It is divided into three parts: the duodenum, the jejunum, and the ileum. Distal to the duodenum, the small intestine and the large intestine, as far as the distal third of transverse colon, develop from the midgut.

The midgut increases rapidly in length and forms a loop to the apex, on which is attached the vitelline duct; this duct passes through the widely open umbilicus [1]. The vitelline duct in the early embryo connects the developing gut to the yolk sac. Normally, as development proceeds, the gut is obliterated, severs its connection with the intestine, and disappears. Persistence of the vitellointestinal duct can result in an umbilical fistula called Meckel's diverticulum [1]. A diverticulum (plura: diverticula) is the medical or biological term for an outpouching of a hollow (or a fluid-filled) structure in the body. However, in the embryonic stage, some normal structures begin their development arising from another structure [2].

A diverticulum can either be true or false depending upon the layers involved: False diverticula also known as "pseudodiverticula" do not involve muscular layers or adventitia. False diverticula, in the gastrointestinal tract for instance, involve only the submucosa and mucosa. True diverticula involve all layers of the structure, including muscularis propria and adventitia, such as Meckel's diverticulum [2].

A true diverticulum such as the Meckel's diverticulum is a true congenital diverticulum, is a

slight bulge in the small intestine present at birth and vestigial remnant of the omphalomesenteric duct, also called vitelline duct or yolk stalk[2]. Meckel's diverticulum, also known as ileal diverticulum is a congenital anomaly that occurs in 1-2% of the world population. A remnant of the proximal part of the embryonic yolk stalk, the diverticulum usually appears as a finger-like pouch [3]. It is the most common congenital malformation of the gastrointestinal tract present in 2%-4% of world population due to the persistence of the congenital vitello- intestinal duct [4]. Bleeding from Meckel's diverticulum due to ectopic gastric mucosa is the most common clinical presentation [4], especially in younger patients but is rare in the adult population. Meckel's diverticulum in the Nigerian population prevalence has not been fully explored. Hence, this study was conceived to investigate its prevalence in some selected Universities in south-south geopolitical region of Nigeria. This study was purely a cadaveric study. A cadaver, also called corpse (singular) in medical, literary, and legal usage, or when intended for dissection, is a deceased body [5]. Prevalence in epidemiology is the proportion of disease found to have been affecting a particular population (typically a disease or a risk factor or a congenital malformation) such as Meckel's diverticulum [6].

BRIEF ANATOMY

The intestine, which is the longest part of the digestive tube, is divided into long, less distensible, small intestine, and shorter, more distensible large intestine. Food has to be digested, metabolized and stored for expulsion in the intestines. Intestines suffer from bacterial infection like typhoid, tuberculosis; parasitic infection, like round worm, tape worm, etc. in addition to diarrhoea and dysentery. Good and healthy eating habits definitely prevent some of these conditions. The proximal one and a half parts of duodenum, including liver, gall bladder and pancreas, develop from foregut. The distal two and a half parts of duodenum, jejunum, ileum, and caecum, appendix, ascending colon and right two-thirds of transverse colon develop from midgut. Lastly, the left one-third of transverse colon, descending colon, pelvic colon and proximal part of rectum develop from hind gut [7].

The Small Intestine

The small intestine extends from the pylorus to the ileocaecal junction. It is about 6 m long. The length is greater in males than in females, and greater in cadavers, due to loss of tone than in the living. It is divided into (a) an upper, fixed part, called the

duodenum, which measures about 25 cm in length; and (b) a lower, mobile part, forming a very long convoluted tube. The upper two-fifths of the mobile intestine is known as the jejunum, and the lower three-fifths is known as the ileum. The structure of the small intestine is adapted for digestion and absorption [7].

Jejunum and Ileum

The jejunum and ileum are suspended from the posterior abdominal wall by the mesentery and, therefore, enjoy considerable mobility. The jejunum constitutes the upper two-fifths of the mobile part of the small intestine, while the ileum constitutes the lower three-fifths. The jejunum begins at the duodenojejunal flexure. The ileum terminates at the ileocaecal junction. The structure and functions of the jejunum and ileum correspond to the general description of the small intestine [7]. Together, the jejunum and ileum are 6-7m long and the mesentery is fan-shaped fold of peritoneum that attaches the jejunum and ileum to the posterior abdominal wall. The mesentery extends from the duodenojejunal junction on the left side of vertebra L2 to the ileocolic junction and the right sacroiliac joint. The average breadth of the mesentery from its root to the intestinal border is 20cm [3].

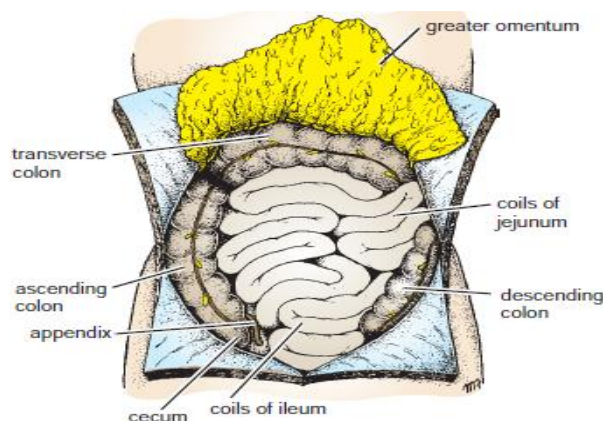


Fig-1: Diagram of the small and large intestine in the body [1].

Development of the Midgut

In the 5-week embryo, the midgut is suspended from the dorsal abdominal wall by a short mesentery and communicates with the yolk sac by way of the vitelline duct or yolk stalk. In the adult, the midgut begins immediately distal to the entrance of the bile duct into the duodenum and terminates at the junction of the proximal two thirds of the transverse colon with the distal third. Over its entire length, the midgut is supplied by the superior mesenteric artery. Development of the midgut is characterized by rapid elongation of the gut and its mesentery, resulting in formation of the primary intestinal loop. At its apex, the loop remains in open connection with the yolk sac by way of the narrow vitelline duct. The cephalic limb of the loop develops into the distal part of the duodenum, the jejunum, and part of the ileum. The caudal limb becomes the lower portion of the ileum, the

cecum, the appendix, the ascending colon, and the proximal two-thirds of the transverse colon [8].

Vitelline duct Abnormalities

In 2% to 4% of people, a small portion of the vitelline duct persists, forming an outpocketing of the ileum called Meckel's or ileal diverticulum. In adult, this diverticulum, approximately 40-60cm from the ileocecal valve on the antimesenteric border of the ileum, does not usually cause any symptoms. However when it contains heterotopic pancreatic tissue or gastric mucosa, it may cause ulceration, bleeding, or even perforation, sometimes, both ends on the vitelline duct transform into fibrous cords, and the middle portion forms a large cyst, an enterocystoma, or a vitelline cyst. Since the fibrous cords traverse the peritoneal cavity, intestinal loops may twist around the fibrous strands and become obstructed, causing strangulation or

volvulus. In another variation, the vitelline duct remains patent over its entire length forming a direct communication between the umbilicus and intestinal tract. This abnormality is known as an umbilical fistula, or a vitelline fistula. A fecal discharge may then be found at the umbilicus [8].

History of Meckel's Diverticulum

Meckel's diverticulum was first described by a German surgeon, Wilhelm Fabricius Hildanus in 1595 and later named after Johann Friedrich Meckel, who described the embryological origin of this type of diverticulum in 1809 [9].

It is the persistent proximal part of the vitellointestinal duct which is present in the embryo, and which normally disappears during the 6th week of intrauterine life. Some points of interest about it are as follows;

- It occurs in 2% subjects.
- Usually it is 2 inches or 5 cm long.
- It is situated about 2 feet or about 60 cm proximal to the ileocaecal valve, attached to antimesenteric border of the ileum.
- Its calibre is equal to that of the ileum.
- Its apex may be free or may be attached to the umbilicus, to the mesentery, or to any other abdominal structure by a fibrous hand [7].

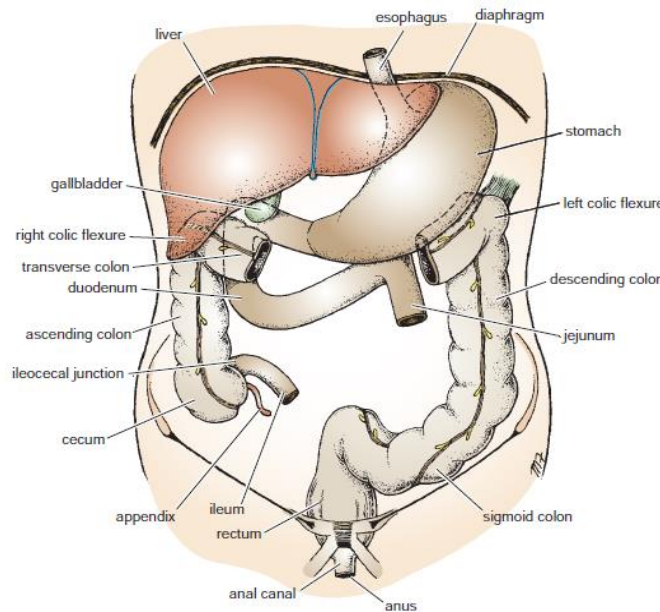


Fig-2: The ileocecal junction and other abdominal viscera [1]

It is always at the site of attachment of the yolk stalk on the anti-mesenteric border (border opposite the mesenteric attachment) of the ileum. The diverticulum is usually located 30-60cm from the ileocecal junction in infants and 50cm in adults. It may

be free (74%) or attached to the umbilicus (26%). Although its mucosa is mostly ileal in type, it may also include areas of acid-producing gastric tissue, pancreatic tissue, or jejunal or colonic mucosa [3].

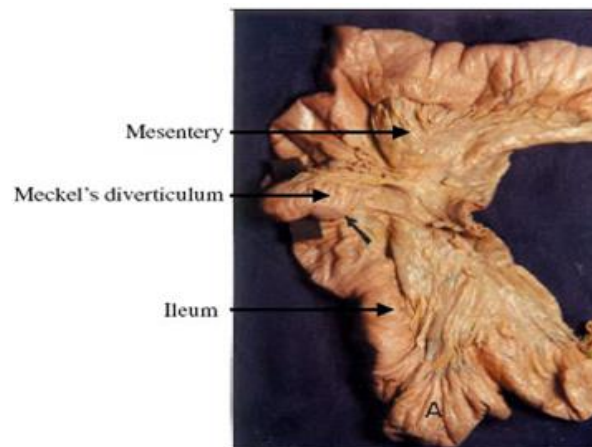


Fig-3: Cadaveric image of Meckel's diverticulum attached to a mesentery [10]

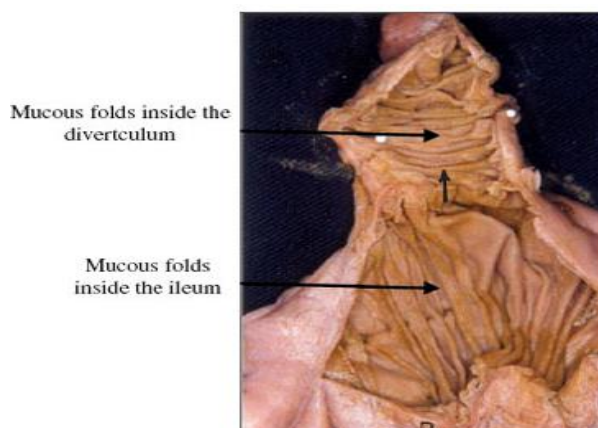


Fig-4: Interior of the Meckel's diverticulum showing; mucous folds of Meckel's diverticulum and mucous folds of the ileum [10]

There have been works by several other authors on Meckel's diverticulum indicating age at onset [11-15], its prevalence and incidence, sexual dimorphism with respect to Meckel's diverticulum [16-24]. In spite of the volume of works that have already been done, there is paucity of literatures on its prevalence in Southern Nigeria.

Aim and Objectives

The aim of this study was to investigate the prevalence of Meckel's diverticulum in Nigerian Cadavers. The objectives were to investigate the prevalence of Meckel's diverticulum in Nigerians, the percentage of Meckel's diverticulum in sexual dimorphism, the length and shape of Meckel's diverticulum in southern Nigeria cadavers.

Significance of the Study

Meckel's diverticulum has been confirmed to be symptomatic and asymptomatic in some individuals. The symptomatic individuals can be diagnosed wrongly and symptoms may be confused with that of appendicitis. Therefore the knowledge of the prevalence of Meckel's diverticulum in different world populations and in Nigeria will serve as a regulation during diagnosis of patients exhibiting some similar symptoms.

Scope of Study

This study was purely a cadaveric study that involved selected universities in the southern part of Nigeria. The study was limited to the prevalence, morphology, morphometric and sexual dimorphism of Meckel's diverticulum.

MATERIALS AND METHODS

Research Design

The research design for the study was non-experimental study. It involved the macroscopic study of Meckel's Diverticulum in Nigerian cadavers for investigation with emphasis on its prevalence and sexual dimorphism.

Study Area

The research was carried out in five selected Universities within south-south and south-east geopolitical zones of Nigeria (University of Port-Harcourt, Niger Delta University, Imo State University, Abia State University and Madonna University).

Sampling Size and Techniques

A purposive convenience sampling technique was adopted for this study. A total of forty-one (41) cadavers were used for this study, selected from the medical schools of the five (5) tertiary institutions chosen for the study.

Ethical Clearance

Ethical Clearance was obtained from the Research Ethics Committee of the University of Port Harcourt, Nigeria before the commencement of the study.

Selection Criteria (Inclusion and Exclusion Criteria)

The following were put into consideration as selection criteria: Age of cadavers (children and adults), presence and intactness of the intestines and appearance of pubic and facial hairs.

Only adult cadavers who had their intestines intact were used in the study. The cadavers were examined and the cadavers that were deteriorating, no intestine and none with pubic hairs or facial hairs were not used.

Data Collection

A total of forty-one (41) cadavers (32 males and 6 females) were used for this study. Most of the cadavers used were already dissected but the body parts of interest were still intact, while the few undissected cadavers were dissected using dissecting kit. A longitudinal midline incision was made from the xiphosternal junction to the pubic symphysis and followed to the anterior superior iliac spine. A transverse incision from the mid-axillary line to the xiphosternal junction was done using a scalpel. The skin

and fascia of the abdominal region were reflected to gain access to the abdominal content where Meckel’s diverticulum were traced and identified.

Macroscopic inspection for Meckel’s Diverticulum

The intestine was examined for Meckel’s diverticulum, 2 ft before the ileocecal junction in all the adult cadavers under investigation. This 2-ft position

was ascertained by running a 2 feet thread from the ileocecal junction to the ileum.

Duration of the Study: March 13 - November 20, 2017.

RESULTS AND ANALYSIS

Table-1: Descriptive Statistics of Meckel’s diverticulum

Sex	No.	Age	Present/Absent	Length(cm)
Males	32	Adults	Absent	-
Females	9	Adults	Absent	-

Table-2: Prevalence of Meckel’s diverticulum

SEX	Meckel’s diverticulum		TOTAL
	Present	Absent	
Male	0 (0.0%)	32 (78.1%)	32 (78.1%)
Female	0 (0.0%)	9 (21.9%)	9 (21.9%)
TOTAL	0	41(100%)	41(100%)

Values are presented as frequencies and percentages.

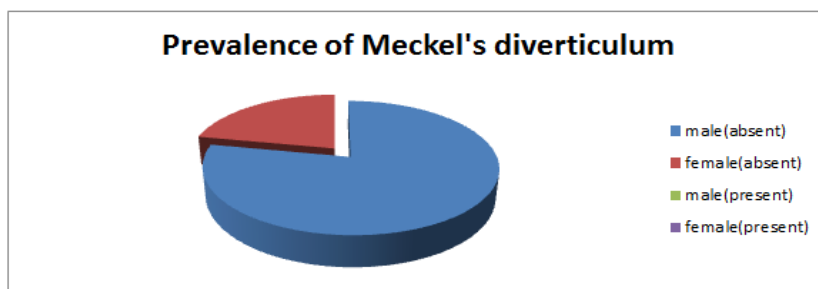


Fig-5: The prevalence of Meckel’s diverticulum in male and female

DISCUSSION

Investigation on the prevalence of Meckel’s diverticulum in the time past in different geographical locations such as the European and Asian countries have revealed varying prevalence falling within the range of 0-23%. The prevalence of Meckel’s diverticulum in the studied sample revealed a total absence, accounting for zero percentage prevalence (0.0%). Some prevalence of 0.0% was observed in the males and female cadavers. The absence or presence of the diverticulum could be due to age difference. This result is consistent with the report of previous studies done on prevalence of Meckel’s diverticulum in different populations [11, 12]. and geographical location [19,20, 25, 26].

Age Relation

According to Soltero and Bill [12], the incidence of complications from Meckel’s diverticulum decreases with increase in age. Based on this, a high probability may be placed that amongst the cadavers used for the research, some might have undergone this complications in their early life and the diverticulum might have been removed accounting for its absence as at the time of study.

Jeng-jung *et al.* [11] stated that its rate of occurrence is more in children than in adults according to their study involving a total of 126 patients diagnosed of Meckel’s diverticulum, and of this number, 82 were pediatric patients while the remaining 44 were adults of above 18 years of age. Comparing such finding to this present study involving adult cadavers rated to be 25 years and above, such absence may be attributed to the fact that its prevalence is very low in adults.

Population study in relation to the geographical location

According to Ajaz *et al.* [25], the incidence of Meckel’s diverticulum in autopsy cases was 0.3% in world population but may be placed as high as 2% when surgical cases are being reviewed. Nayak *et al.* [26], from their study, reported only one case of Meckel’s diverticulum over 20 years period in south Indian cadavers, the prevalence of Meckel’s diverticulum was observed to be very low in south India.

Rojhan and Hejazi [20] stated that Meckel’s diverticulum occurs more frequently in Iran from the research the conducted using 100 cadavers and the result showed that Meckel’s diverticulum was present in 6 of the cadavers. Ameh and Nmadu [19]. reported only

one case of Meckel's diverticulum that caused intussusceptions in Ahmadu Bello University Teaching Hospital, Zaria, Nigeria for over a period of 25 years. The results of these previous studies agree with the findings of this present study which indicated zero prevalence in the 41 cadavers studied for the Nigerian population.

CONCLUSION

This study has revealed zero prevalence of Meckel's diverticulum in the Southern Nigerian population under study.

RECOMMENDATION

Long term research on Meckel diverticulum in both cadavers and surgical cases is therefore recommended with a larger sample size especially during the cadaveric investigation.

ACKNOWLEDGEMENTS

We want to appreciate the entire management and staff of the Department of Anatomy, University of Port Harcourt.

REFERENCES

1. Snell RS. Clinical Anatomy by Regions. 9th ed. China: Lippincott Williams and Wilkins. 2012; pp.172-179.
2. Velanovich V. Gastric Diverticulum. *Surgical Endoscopy*. 1994; 8(11): 1338-1339.
3. Moore KL, Dalley AF and Agur AMR. Moore Clinically Oriented Anatomy. 7th ed. Baltimore: Lippincott Williams and Wilkins. 2014; pp. 342-345.
4. Sagar J, Kumar V and Shah DK. Meckel's diverticulum: A systematic review. *Journal of Royal Society of Medicine*. 2006; 99: 501.
5. Roach and Mary. The Curious Lives of Human Cadavers, New York, NY: W. W. Norton & Company. 2004; Pp. 40-41.
6. Rothman KJ. Epidemiology: An Introduction. Oxford University Press. 2012; Pp 53.
7. Chaurasia BD. Human anatomy=regional and applied dissection and clinical. 6th ed. CBS publishers and distributors Pvt L.T.D. New Delhi. 2013; P258-265.
8. Sadler TW. Langman's Medical Embryology. 12thed. China: Lippincott Williams & Wilkins, a Wolters Kluwer business. 2012; pp 225-227.
9. Edmonson JM. Johan Friedrich Meckel the younger: Meckel's diverticulum. *Gastrointest Endosc*. 2001; 54: 19-20.
10. Madhyastha S, Prabhu LV, Saralaya V and Prakash. Meckel's diverticulum- A case report. *Int. J. Morphol*. 2007; 25(3): 519-522.
11. Chen JJ, Lee HC, Yeung CY, Chan WT, Jiang CB, Sheu JC, Wang NL. Meckel's diverticulum: factors associated with clinical manifestations. *ISRN gastroenterology*. 2014 Apr 1;2014.
12. Soltero MJ, Bill AH. The natural history of Meckel's diverticulum and its relation to incidental removal: a study of 202 cases of diseased Meckel's diverticulum found in King County, Washington, over a fifteen year period. *The American Journal of Surgery*. 1976 Aug 1;132(2):168-73.
13. Leijonmarck CE, Bonman-Sandelin K, Frisell J, Räf L. Meckel's diverticulum in the adult. *British Journal of Surgery*. 1986 Feb;73(2):146-9.
14. Viravud Y, Roongruangchai J, Palakornkul V and Sriparaya K. Meckel's diverticulum in Thais. *Siriraj Med J*. 2007; 59(2): 183-184.
15. Das PC, Rao PL and Radhakrishma K. Meckel's diverticulum in children. *J Postgrad Med*. 1992; 38: 19-20.
16. Arnold JF, Pellicane JV. Meckel's diverticulum: a ten-year experience. *The American Surgeon*. 1997 Apr;63(4):354-5.
17. Mackey WC, Dineen P. A fifty year experience with Meckel's diverticulum. *Surgery, gynecology & obstetrics*. 1983 Jan;156(1):56-64.
18. Cullen JJ, Kelly KA, Moir CR, Hodge DO, Zinsmeister AR, Melton 3rd LJ. Surgical management of Meckel's diverticulum. An epidemiologic, population-based study. *Annals of surgery*. 1994 Oct;220(4):564.
19. Ameh EA, Nmadu PT. Intestinal volvulus: aetiology, morbidity, and mortality in Nigerian children. *Pediatric surgery international*. 2000 Jan 1;16(1-2):50-2.
20. Rojhan MS, Hejazi R. Incidence of Meckel's diverticulum in 100 cadavers. *Postgraduate medical journal*. 1974 Nov;50(589):694.
21. Aarnio P, Salonen IS. Abdominal disorders arising from 71 Meckel's diverticulum. In *Annales chirurgiae et gynaecologiae* 2000 (Vol. 89, No. 4, pp. 281-284).
22. Varcoe RL, Wong SW, Taylor CF, Newstead GL. Diverticulectomy is inadequate treatment for short Meckel's diverticulum with heterotopic mucosa. *ANZ journal of surgery*. 2004 Oct;74(10):869-72.
23. Beyrouti MI, Ben MA, Beyrouti R, Abid M, Ayadi L, Abid O, Derbel R, Feriani N, Azzaza M, Khalifa MB, Boujelben S. Complications of Meckel's diverticulum. Report of 42 cases. *La Tunisie medicale*. 2009 Apr;87(4):253-6.
24. Akcakaya A, Alimoğlu O, Ozkan OV, Sahin M. Complicated Meckel's diverticulum. *Ulusal travma ve acil cerrahi dergisi= Turkish journal of trauma & emergency surgery: TJTES*. 2003 Oct;9(4):246-9.
25. Malik AA, Shams-ul-Bari KA, Khaja AR. Meckel's diverticulum—Revisited. *Saudi journal of gastroenterology: official journal of the Saudi Gastroenterology Association*. 2010 Jan;16(1):3.
26. Yamaguchi M, Takeuchi S, Awazu S. Meckel's diverticulum: investigation of 600 patients in Japanese literature. *The American Journal of Surgery*. 1978 Aug 1;136(2):247-9.