

Meckel's Diverticulum and Patent Vitello-Intestinal Duct in Children: A Review of 11 Years of Experience with 46 Cases

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ABSTRACT

Aim: The aim of this study was to review the management of symptomatic Meckel's diverticulum and patent vitello-intestinal duct (PVID) in children.

Patients and Methods: This retrospective study included 46 children (39 boys and 7 girls) who underwent exploratory laparotomy for the management of symptomatic Meckel's diverticulum and PVID between Jan 1, 2000 to Dec 31, 2010.

Results: During last 11 years, 46 (39 boys and 7 girls) children were treated for symptomatic Meckel's diverticulum and PVID under 12 years: 23 (50%) were infants, 5 (10.86%) were 1 to 5 years and 18 (39.13%) were 6 to 12 years of age. Majority $n=28$ (60.86%) presented with intestinal obstruction (including 5 cases of intussusception and 6 cases of PVID), followed by $n=6$ (13.04%) as perforation peritonitis, $n=4$ (8.69%) as lower gastrointestinal bleeding / melena, $n=4$ (8.69%) as umbilical discharge (PVID) and $n=4$ (8.69%) as incidental findings during

laparotomy for others. Findings at laparotomy in order of frequency were: Meckel's diverticulum with gangrenous bowel ($n=13$), PVID ($n=10$) 4 had prolapsed ileum and 3 of them were gangrenous, Meckel's diverticulum with bands ($n=9$), perforated Meckel's diverticulum ($n=6$), diverticulitis / bleeding ($n=4$) and normal Meckel's diverticulum / incidental findings ($n=4$). The surgical procedures done in order of frequency were: segmental resection of ileum containing Meckel's diverticulum and ileo-ileal anastomosis $n=25$ (54.34%), diverticulectomy / wedge resection $n=19$ (41.30%), segmental resection and ileo-ascending anastomosis $n=1$ (2.17%) and segmental resection with an ileostomy $n=1$ (2.17%). The mortality following laparotomy done for Meckel's and PVID was $n=4$ (8.69%).

Conclusions: Symptomatic Meckel's diverticulum and PVID is also an important cause of acute abdomen / intestinal obstruction in infants and children and delay in seeking treatment is not only associated with morbidity but prone to mortality as well.

Key Words: Intestinal obstruction, Meckel's diverticulum, Omphalomesenteric duct, Patent vitello-intestinal duct

INTRODUCTION

Omphalomesenteric duct (vitello-intestinal duct) is an embryonic structure which communicates the vitelline duct with the midgut. It normally disappears between the fifth and ninth weeks of intrauterine life [1], [2]. Meckel's diverticulum is the most common congenital anomaly of the small intestine and it is caused by an incomplete obliteration of the vitelline duct/omphalomesenteric duct. Meckel's diverticula are mostly asymptomatic but it may present as intestinal obstruction, diverticulitis, lower gastrointestinal (GI) bleeding and perforation peritonitis [1], [2], [3], [4], [5]. Meckel's diverticulum occurs in 2% population and may present at any age and a person with Meckel's diverticulum has a 4 to 6% lifetime risk of developing a complication [2], [6]. A patient with PVID may present with fecal discharge through umbilicus and few of them may present with prolapse of the ileum [7], [8]. Treatment options for the Meckel's diverticulum and PVID are: resection of the diverticulum/diverticulectomy (wedge resection) and anastomosis, segmental resection of ileum containing Meckel's diverticulum and ileo-ileal anastomosis and can be achieved by open surgery or laparoscopically [2], [5], [8], [9], [10], [11], [12], [13]. We are reporting our experience in children with 46 cases of symptomatic Meckel's diverticulum and PVID with brief review of literature.

MATERIAL AND METHODS

This is a retrospective, single institution study in children aged below 12 years, who underwent exploratory laparotomy for sym-

ptomatic Meckel's diverticulum and PVID. It was conducted in the department of paediatric surgery over a period of 11 years from Jan 2000 to Dec 2010. Details of clinical presentation, diagnosis and management of above patients were reviewed.

RESULTS

Forty six (39 boys and 7 girls) exploratory laparotomies were performed at the author's department of paediatric surgery for symptomatic Meckel's diverticulum and PVID in children below 12 year of age from Jan 2000 to Dec 2010 and these children were included in this study. Age and sex distribution of above 46 cases is given in [Table/Fig-1]. They presented as intestinal obstruction $n=28$ (60.86%) which included 5 cases of intussusception [Table/Fig-2] where Meckel's diverticulum was lead point and 6 cases of PVID who also presented as obstruction. Six (13.04%) patients presented as diverticulum perforation peritonitis, $n=4$ (8.69%) as

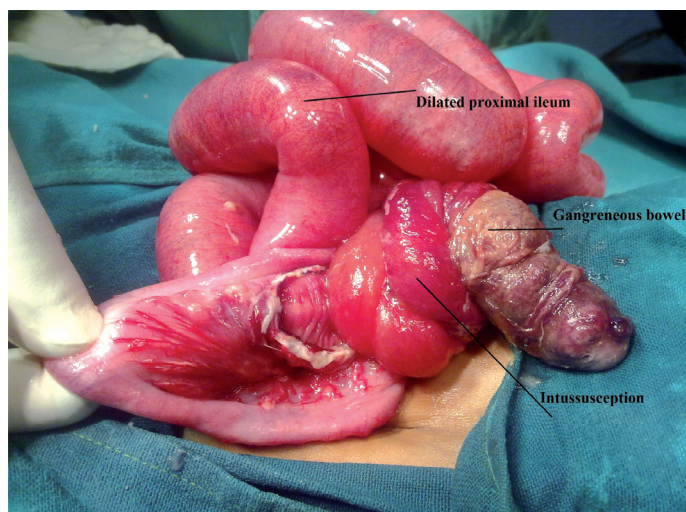
Age	Sex		Total (%)
	Male (%)	Female (%)	
Infants	19 (41.30)	04 (8.69)	23 (50.00)
1-5 yrs	05 (10.86)	00 –	05 (10.86)
6-12 yrs	15 (32.60)	03 (6.52)	18 (39.13)
Total	39 (84.78)	07 (15.21)	46

[Table/Fig-1]: Age and sex distribution for Meckel's diverticulum & PVID in children

lower GI bleeding / melena, $n=4$ (8.69%) as umbilical fecal discharge (PVID) and $n=4$ (8.69%) as incidental findings during laparotomy for others. Pre-operative diagnosis of PVID was clinically obvious in all the 10 cases and they presented as intestinal obstruction in 6 and umbilical discharge in 4 [Table/Fig-3a, Table/Fig-3b, Table/Fig-4]. Three of 4 cases who presented as lower GI bleeding/melena were also diagnosed pre-operatively by technetium-99m pertechnetate (Meckel's scan) scan. Rest of $n=33$ (71.73%) cases were diagnosed of having Meckel's diverticulum during laparotomy for intestinal obstruction/perforation peritonitis.

Findings at laparotomy in order of frequency were: Meckel's diverticulum with gangrene of bowel ($n=13$), PVID ($n=10$) 4 had prolapsed ileum and 3 of them were gangrenous, Meckel's diverticulum with bands ($n=9$) [Table/Fig-5], perforated Meckel's

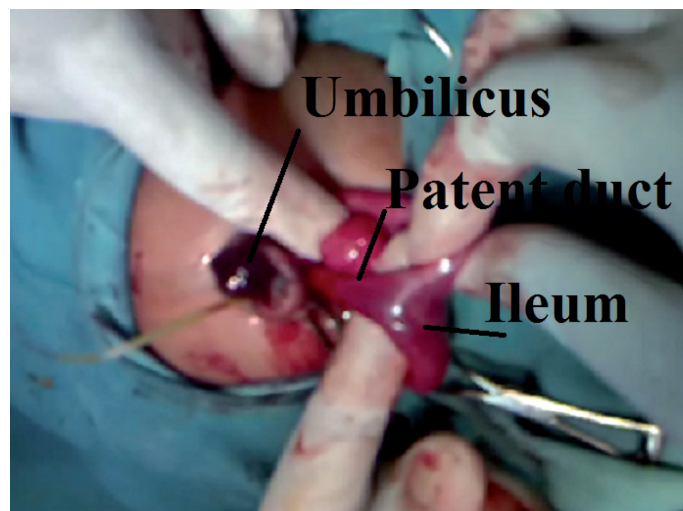
diverticulum ($n=6$), diverticulitis/bleeding ($n=4$), and normal Meckel's diverticulum/incidental findings ($n=4$). The surgical procedures done in order of frequency were: segmental resection of ileum containing Meckel's diverticulum and ileo-ileal anastomosis $n=25$ (54.34%) [Table/Fig-6], diverticulectomy/wedge resection $n=19$ (41.30%), segmental resection and ileo-ascending anastomosis $n=1$ (2.17%) and segmental resection with an ileostomy $n=1$ (2.17%). In 4 patients in whom Meckel's diverticulum was found incidentally in one patient appendectomy and Meckel's diverticulectomy was



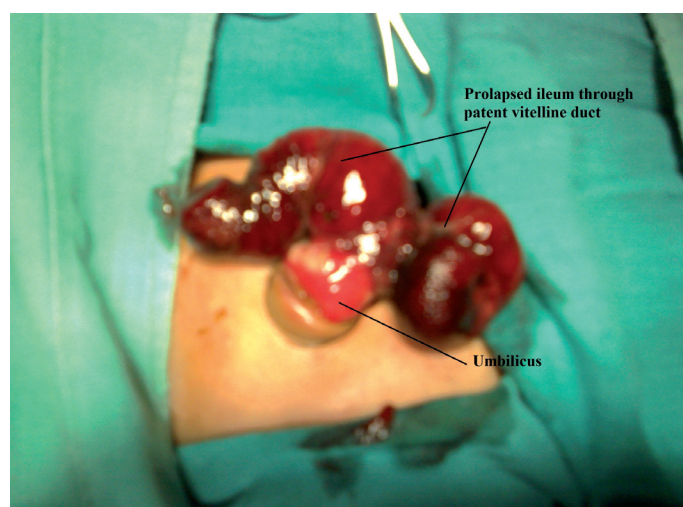
[Table/Fig-2]: Meckel's diverticulum presenting as an intussusception with gangrene



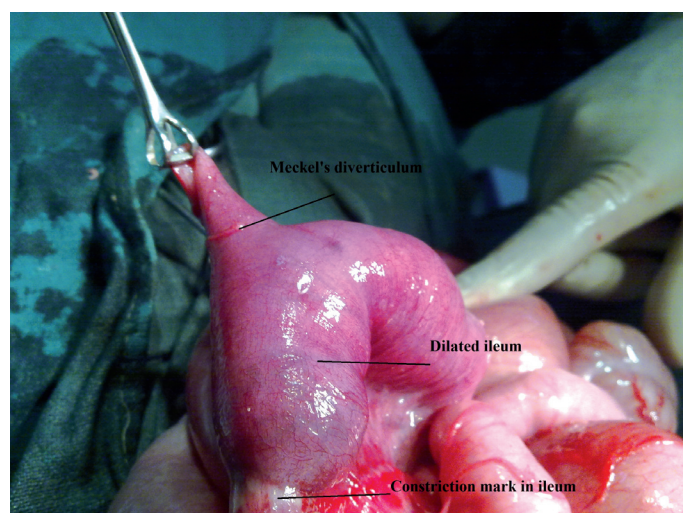
[Table/Fig-3a]: Patent vitello-intestinal duct – clinical photograph



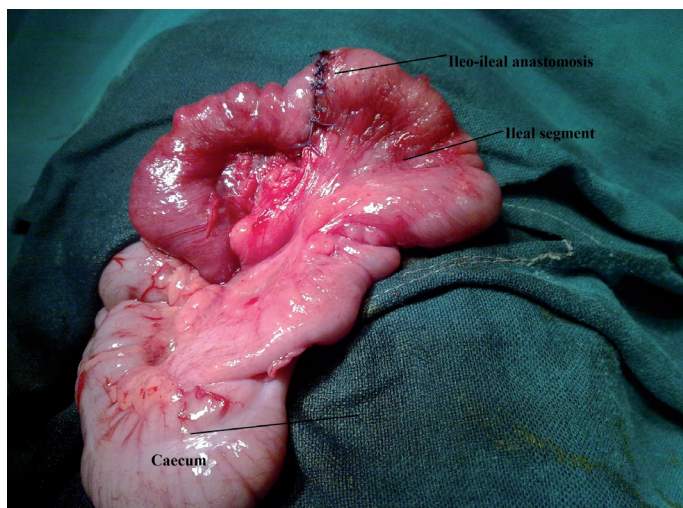
[Table/Fig-3b]: Patent vitello-intestinal duct – operative photograph



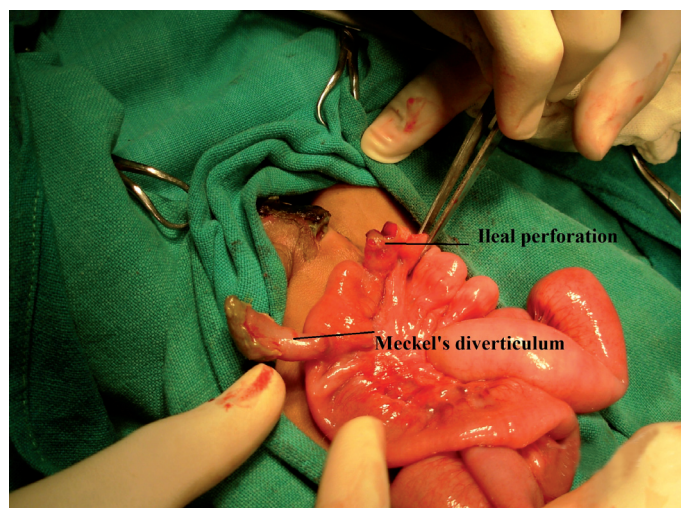
[Table/Fig-4]: Prolapsed ileum through patent vitello-intestinal duct



[Table/Fig-5]: Meckel's diverticulum – operative photograph



[Table/Fig-6]: Ileo-ileal anastomosis after segmental resection of Meckel's diverticulum



[Table/Fig-7]: Meckel's adjacent to ileal perforation – operative photograph

done, in second patient umbilical hernia repair and diverticulectomy was done in third patient who presented with scrotal fecal fistula Meckel's diverticulum was present adjacent to ileal perforation [Table/Fig-7] hence segmental resection and ileo-ileal anastomosis was done and in fourth adhesiolysis and diverticulectomy was done.

DISCUSSION

Meckel's diverticulum was first described by Fabricius Hildanus in 1598, but the name derives from the German anatomist Johann Friedrich Meckel who described the embryological and pathological features in 1809 [2]. Anomalies related with the total or partial absence of this involution are shown in 2% of the population and may present at any age [2], [5]. A wide variety of anomalies may occur and are; Meckel's diverticulum, patent vitello-intestinal duct, fibrous band attached to umbilicus to the small gut, cyst and umbilical polyp [2], [6], [9], [14]. Meckel's diverticulum is the most common congenital abnormality of the small intestine and it is caused by an incomplete obliteration of the omphalo mesenteric duct [2]. Although Meckel's diverticulum generally remains silent but life threatening complications may arise, making it an important structure for having a detailed knowledge of its anatomical and pathophysiological properties to deal with such complications [2], [6], [9], [14].

This present study was not an age, sex, or disease-matched study. The objective was to review our 11 years of experience with laparotomies done for symptomatic Meckel's diverticulum and PVID, in the department of paediatric surgery. This study comprised 46 children below 12 years of age and included $n=39$ (84.78%) boys and $n=7$ (15.21%) girls with a male to female ratio of 5.57:1. Twenty three (50%) were infants, 5 (10.86%) were 1 to 5 years and 18 (39.13%) were 6 to 12 years of age. Other studies also showed male predominance [3], [6], [8], [9], [11], [12].

Anomalies related with the total or partial absence of involution of the omphalo mesenteric duct/vitello-intestinal duct are reported in 2% of the population and may present at any age [1], [2], [5]. A person with Meckel's diverticulum has a 4 to 6% lifetime risk of developing a complication [2]. Symptomatic Meckel's diverticulum may present as diverticulitis, intestinal obstruction, lower GI bleeding and perforation peritonitis [2], [3], [9], [11], [12], [14]. Present study included 46 children (Meckel's diverticulum and PVID) who presented as: intestinal obstruction $n=28$ (including 5

cases of intussusception where Meckel's was a lead point and 6 cases of PVID who also presented as obstruction), perforation peritonitis $n=6$, lower GI bleeding (diverticulitis) $n=4$, umbilical discharge (PVID) $n=4$, and $n=4$ (8.69%) as incidental findings.

Meckel's diverticula are mostly asymptomatic. Even complicated disease is hardly diagnosed preoperatively and hence met with fatal outcomes, if not timely intervened. Plain radiograph of abdomen in erect position is most useful when intestinal obstruction or perforation of viscus is the concern. In majority of the cases of acute abdomen in children, USG of abdomen and pelvis can provide sufficient information. Ultrasound scans of abdomen can reveal intussusception but not the Meckel's diverticulum as the cause of it. Similarly CT scan of abdomen can provide features of small-bowel obstruction, intussusception, free fluid in cases with peritonitis, free air etc but rarely Meckel's as the cause [2], [14], [15]. Patients with diverticulitis/painless lower GI bleeding/melena may be evaluated with a radionuclide scan. Scintigraphy using technetium-99m pertechnetate (Meckel's scan) is considered as the method of choice for the pre-operative diagnosis of Meckel's diverticulum. The use of this test in children is of high diagnostic accuracy with sensitivity of 85% – 95% and specificity of 90% – 95% [16], [17]. Four of our patients who presented with lower GI bleeding/melena were evaluated with Meckel's scan, of which 3 (75%) were positive.

Treatment options for the Meckel's diverticulum and PVID are diverticulectomy / wedge resection and anastomosis, segmental resection containing Meckel's and ileoileal anastomosis and can be done by open surgery or laparoscopically [2], [5], [9], [11], [14], [18], [19], [20]. In recent decade, laparoscopy is being used more frequently for the management of Meckel's diverticulum and is said to be safe, cost-effective and efficient for the diagnosis as well as for definitive treatment of Meckel's diverticulum. The definitive procedure can be done laparoscopically or by laparoscopic assisted method. Compared with conventional laparotomy, it has the advantage of precise operative diagnosis, less traumatic access, fewer intraoperative and postoperative complications, and shorter recovery period [11], [12], [19], [20]. During present study the surgical procedures done for Meckel's diverticulum and PVID in order of frequency were: segmental resection of ileum containing Meckel's diverticulum and ileo-ileal anastomosis $n=25$ (54.34%), diverticulectomy/wedge resection $n=19$ (41.30%), segmental resection and ileo-ascending anastomosis $n=1$ (2.17%)

and segmental resection with an ileostomy $n=1$ (2.17%). All the procedures were done by open surgery.

Management of incidental finding of Meckel's diverticulum during other abdominal surgery remains controversial [6], [21], [22]. In the past, if a Meckel's diverticulum was encountered in a patient undergoing abdominal surgery for some other intra-abdominal condition, many surgeons recommended its removal. This practice was questioned when a large series described an overall 4.2% likelihood of complications in Meckel's diverticulum and a decreasing risk with increasing age. Recent analysis (2008) showed resection of incidentally detected Meckel's diverticulum has a significantly higher postoperative complication rate than leaving it in situ. The long-term outcome of patients with incidentally detected diverticulum left in situ showed no complications. Seven-hundred fifty-eight patients would require incidentally detected diverticulum resection to prevent one death from Meckel's diverticulum [22]. We encountered 4 Meckel's diverticulum during abdominal surgery for other conditions and diverticula were removed. In 4 patients in whom Meckel's diverticulum was found incidentally; in one patient appendectomy and Meckel's diverticulectomy was done, in second patient umbilical hernia repair and diverticulectomy was done, in third patient who presented with scrotal fecal fistula. Meckel's diverticulum was present adjacent to ileal perforation hence segmental resection and ileo-ileal anastomosis was done and in fourth adhesiolysis and diverticulectomy was done.

Complications are known to occur and are generally the same as with other laparotomy/laparoscopic procedures done in children for intestinal obstructions/perforation peritonitis, etc and major complications are anastomotic leak, faecal fistula, wound dehiscence, intra-abdominal abscess, septicaemia, post-operative adhesions, intestinal obstructions etc. Six (13.04%) of our patient developed major complications and needed re-exploration for: anastomotic leak in 4, fecal fistula in 1 and burst abdomen in 1. Since the cell lining of the vitello-intestinal duct are pluripotent, there may be heterotopic gastric mucosa in about 25 - 85% cases, pancreatic mucosa in 5% and rarely colonic mucosa may be present [2], [5], [6], [14], [18].

Mortality is reported with laparotomy done for symptomatic Meckel's diverticulum and PVID in children and reported to occur more in cases with PVID with prolapsed ileum [2], [8], [9]. We observed $n=4$ (8.69%) deaths following laparotomy done for Meckel's diverticulum and PVID. Two of them were the patients who needed re-exploration for anastomotic leak and another one was of septicaemia following segmental resection for gangrenous bowel. Fourth of our patient was an infant who had scrotal fecal fistula and had Meckel's adjacent to ileal perforation and segmental resection and anastomosis was done and died of septicaemia.

CONCLUSION

Meckel's diverticulum constitutes the most common benign malformation of the digestive tube and it may present as intestinal obstruction, perforation peritonitis and diverticulitis, lower GI bleeding and many of them with gangrenous bowel. Urgent surgical intervention is needed to prevent morbidity as well as mortality. Patent vitello intestinal duct is also frequently observed and, many

of them present with prolapsed ileum and have higher mortality, therefore the ducts should be excised.

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