Systematic review of mesodiverticular band: a rare cause of small bowel strangulation and hemoperitoneum in adults

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Introduction: Mesodiverticular band (MDB) is a rare congenital intestinal malformation. It originates from the embryonic remnant of the vitelline artery and is usually associated with Meckel’s diverticulum (MD). Persistent MDB may cause small bowel obstruction by trapping a loop of bowel, hemoperitoneum due to aneurysmal or traumatic rupture of MDB. The purpose of this article is to review the literature of MDB and identify the patterns of presentation, complications, and management options.

Methods: We searched PubMed for articles containing terms: “Mesodiverticular band,” “Vitelline band,” and “Vitelline artery remnant.” Abstracts were reviewed in detail and we included all the case reports available in full-text and in English language. We excluded all case reports of patients younger than 18 years of age.

Results: Only 20 case reports were included. Only adult patients were included. The male to female ratio was 3:1. The most common presentation was small bowel obstruction followed by hemoperitoneum. The majority required exploratory laparotomy with more than half requiring small bowel resection. One death report secondary to undiagnosed internal hernia.

Conclusion: MDB with MD is a rare cause of intestinal obstruction or hemoperitoneum in adults. It remains a diagnostic dilemma as it is usually diagnosed intraoperatively.

Keywords: Small bowel, Strangulation, Hemoperitoneum, Mesodiverticular band, Meckel’s diverticulum

Mesodiverticular band (MDB) is an embryologic remnant of the vitelline artery which carries the blood supply to Meckel’s diverticulum (MD)[1]. A persistent MDB is usually associated with MD that is caused by incomplete obliteration of the omphalomesenteric duct. As a result, a patent or obliterated arterial band persists and extends from the mesentery to the antimesenteric border of MD[2]. Eschricht 1834 was the first person who report a fatal case of small bowel strangulation secondary to MDB in an adult female[1]. The significance of this congenital lesion is not fully studied in adults since it is a very rare condition. Serious complications could develop if not diagnosed promptly and treated appropriately. Manning and McLaughlin[1] demonstrated that small bowel strangulation due to MDB was associated with an almost 100% mortality rate. This band creates a snare-like opening through which a loop of small bowel may herniate and become obstructed[1]. Rarely, a traumatic or aneurysmal rupture of the patent vitelline artery may result in hemoperitoneum[3]. Early diagnosis is important to prevent small bowel strangulation and small bowel resection with associated significant morbidity and mortality[2]. The aim is to review the current literature of this congenital band for its clinical rarity, diagnostic difficulties, complications, and management controversies.

Methods

Search strategy

A systematic search in PubMed was performed on April 1, 2021, with time frame 1950 to 2021. An advanced search strategy that contains the text terms in the title or abstract for “Meckel’s band,” “Mesodiverticular band,” “Vitelline band,” and “Vitelline artery remnant” was developed. The searches were limited to human case reports published in the English language only. The work has been reported in line with the PRISMA criteria[4] and in compliance with AMSTAR 2[5]. It is registered with Research Registry and the registration unique identifying number (UIN) is reviewregistry1231 (https://www.researchregistry.com/register-now/register-your-systematic-review#registryofsystematicreviewsmeta-analyses/registryofsystematicreviewsmeta-analysesdetails/61f20961a9753002023a6cc/).

Inclusion criteria

Articles reporting surgical outcomes in adult patients with MD were included. A similar condition in the pediatric age group was previously studied.
Exclusion criteria

Studies of patients with isolated MD or other types of omphalomesenteric anomalies were excluded. Animal studies and unpublished data from conference abstracts were excluded.

Data extraction

The following information was extracted from each article: age, sex, presentation, operative findings, and details of surgery, morbidity, and mortality.

Statistical analysis

Quantitative analysis was used to estimate the prevalence of the surgical outcome of MDB. Data from the case reports are collected and used to estimate the percentage and to determine the overall trend of the reported data set.

Results

From 263 abstracts, we identified 20 eligible studies. We included 20 cases of MDB in the literature review (Table 1). The patients were aged 18–74 years, male: female ratio was 3:1. The main clinical presentations were small bowel obstruction (SBO) followed by hemoperitoneum. The majority were incidentally found during surgery while only 4 patients were diagnosed pre-operatively with a CT scan of the abdomen suspicious for MD. Tc99 scintigraphy was performed in 1 patient with increase uptake in the right lower quadrant.

SBO was reported in 15 patients; 5 of them had strangulated umbilical hernia. MDB was associated with axial torsion of MD in 4 patients which resulted in the gangrene of MD and SBO (Fig. 1).

Hemoperitoneum was reported in 4 patients and all were diagnosed intraoperatively with a viable loop of the small bowel. Two of them had been associated with blunt trauma to the abdomen and the condition was diagnosed during surgery. The third patient presented with acute abdominal pain with hypotension subsequently found to have a ruptured aneurysm with an active blush on a preoperative computed tomography scan. The fourth patient with worsening postoperative anemia status posts aortobifemoral bypass.

The majority of reported cases underwent exploratory laparotomy with small bowel resection performed in more than half of reported cases. No postoperative complications or mortality were reported. One death report was diagnosed on postmortem examination and there was evidence of internal hernia secondary to MDB without any prior surgical intervention (Table 2).

Discussion

MD is the most common congenital anomaly of the gastrointestinal tract[26]. It is caused by incomplete obliteration of the omphalomesenteric duct, resulting in a variety of congenital anomalies[1]. MD is often asymptomatic, but it may present with complications[26]. The most common complication of MD in pediatric populations is lower gastrointestinal bleeding while the most common complication in adults is SBO[26]. MD can cause SBO by various mechanisms. It may cause intussusception, in which the diverticulum acts as the lead point; internal hernia secondary to the MDB; and volvulus around the omphalo-diverticular band[26].

The MDB is a congenital remnant of the vitelline artery and it usually extends from the tip of the MD to the ileal mesentery[3]. The presence of this band may lead to SBO result from entrapment of a loop of the small intestine with risk of strangulation if not released in a timely manner[23]. SBO, either from an MDB or an adhesive band, is almost undistinguishable clinically or radiologically[27]. A CT of

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**Table 1**

Reported adult cases of MDB demonstrating age, sex, presentation, type of surgical approach, status of the bowel and the procedure performed.

| References          | Age & sex | Presentation          | Approach    | Bowel status | Procedure     |
|---------------------|-----------|-----------------------|-------------|--------------|---------------|
| Osborne et al[6]    | 30 M      | Acute abdomen         | Laparotomy  | Gangrenous MD| Diverticulectomy|
| McAneny et al[7]    | 35 M      | Hemoperitoneum        | Laparotomy  | Viable       | SBR           |
| D’Souza et al[8]    | 23 F      | SBO                   | Laparotomy  | Viable       | SBR           |
| Mukherjee et al[9]  | 68 M      | Hemoperitoneum        | Laparotomy  | Viable       | MDB division  |
| Prall et al[10]     | 31 M      | SBO (recurrent)       | Laparotomy  | Viable       | Diverticulectomy|
| Yoo et al[11]       | 74 F      | SBO                   | Laparotomy  | Viable       | SBR           |
| Yerk et al[12]      | 48 M      | SBO                   | Laparotomy  | Gangrenous MD| Postmortem    |
| You et al[13]       | 42 M      | SBO                   | Laparotomy  | Viable       | Diverticulectomy|
| Kazemi et al[14]    | 36 M      | Hemoperitoneum        | Laparotomy  | Viable       | SBR           |
| Sethi et al[15]     | 18 M      | SBO                   | Laparotomy  | Ischemic     | SBR           |
| Dutta et al[16]     | 55 M      | SBO                   | Laparotomy  | Ischemic     | SBR           |
| Sengul et al[17]    | 42 F      | Strangulated umbilical hernia | Laparotomy | Ischemic | SBR |
| Cartanese et al[18] | 42 M      | SBO                   | Laparotomy  | Gangrenous MD| Diverticulectomy|
| Al Jabri et al[19]  | 26 F      | SBO                   | Laparotomy  | Viable       | Diverticulectomy|
| Sasikumar et al[20] | 26 M      | SBO                   | Laparotomy  | Gangrenous MD| SBR           |
| Michopoulos et al[21]| 35 M   | SBO                   | Laparotomy  | Viable       | Diverticulectomy|
| Tutar et al[22]     | 36 M      | SBO                   | Laparoscopy | Viable       | SBR           |
| Sommerhalder et al[23]| 51 M  | SBO                   | Laparotomy  | Viable       | SBR           |
| Matsuamoto et al[24]| 26 F      | SBO                   | Laparoscopy | Viable       | Diverticulectomy|
| Yagian et al[25]    | 35 M      | SBO                   | Laparotomy  | Ischemic     | SBR           |

F indicates female; M, male; MD, Meckel’s diverticulum; MDB, mesodiverticular band; SBO, small bowel obstruction; SBR, small bowel resection.
the abdomen usually cannot differentiate Meckel’s as a cause of SBO due to the inability of distinguishing the diverticulum among loops of the small bowel[27]. Tc 99 scintigraphy may provide a helpful tool in the diagnosis in the presence of ectopic gastric tissue when performed in high suspicion in individuals with a history of gastrointestinal bleed[25]. The surgical management of MD should include either wedge resection with excision of any associated band or segmental small bowel resection in the presence of a nonviable segment[28].

Complications related to MDB may present at any age, in contrast to the usual presentation of MD in the first 2–4 years of age. Reported MDB is 3-folds more common in males, similarly to symptomatic MD. Misdiagnosis occurs frequently in adults because of the poor sensitivity of imaging studies, and its delay in the recognition of this anomaly in older age patients[16]. Preoperative diagnosis was only reported in 4 cases with CT scan findings of a blind loop of bowel with a band connected to the mesentery[18,22–24]. Matsumoto et al[23] confirmed the preoperative diagnosis with Tc99 scintigraphy which demonstrates increased uptake in right lower quadrant.

SBO was the most common presentation, and half of them were associated with ischemia of the small bowel or gangrene of MD, requiring small bowel resection with anastomosis. SBO is usually caused by the entrapment of a loop of the small bowel under the band. Less frequently, we may encounter an axial torsion of MD and segmental small bowel volvulus secondary to axial rotation of the ileum possibly related to short MDB[6,8,15,20]. Sasikumar et al[20] report SBO due to ileal compression by the band associated with axial torsion of MD.

Hemoperitoneum is another potential complication of MDB. It resulted from traumatic rupture of a patent vitelline artery in 2 reported patients who required small bowel resection due to adjacent ileal injury. Sommerhalder et al[13] report one patient with aneurysmal rupture of the vitelline artery with estimated blood loss of 2 L that required exploratory laparotomy with blood transfusion while Mukherjee et al[9] reported a patient with bleeding MDB postaortobifemoral reconstruction with postoperative anemia initially thought to be related to surgical bleeding. No death from hemoperitoneum was reported.

Interestingly, 90% of all reported cases underwent exploratory laparotomy although the majority of the reported cases were published in the last 2 decades where laparoscopic techniques were available widely. No morbidity was reported and most postoperative recoveries of 19 patients were uneventful. However, no follow-up was documented. One death was reported although the patient was seen by the primary care physician who did not recognize the condition and sent him home; subsequently, the patient died with postmortem examination confirm the presence of strangulated bowel secondary to MDB[12].

This study has some limitations. The first limitation is the small number of reported cases in regards to MDB because this condition is rare, we anticipated that the power might not meet targets.

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**Table 2**

Demographic, presentation and operative finding and approach in adults with reported MDB.

| Total cases included | 20 |
|----------------------|----|
| Age (y)              | 18–74 |
| Sex (%)              |     |
| Male                 | 75 |
| Female               | 25 |
| Clinical presentation (%) |   |
| Small bowel obstruction | 70 |
| Hemoperitoneum       | 20 |
| Acute abdomen        | 5  |
| Strangulated Littre’s hernia | 5 |
| Surgical approach (%) |     |
| Exploratory laparotomy | 90 |
| Laparoscopy          | 10 |
| Viability of bowel (%) |    |
| Viable               | 60 |
| Ischemic segment     | 25 |
| Gangrenous MD        | 15 |
| Surgical procedure (%) |    |
| Small bowel resection | 55 |
| Diverticulectomy     | 35 |
| Division of MDB      | 5  |
| Death (%)            | 5  |

MD indicates Meckel’s diverticulum; MDB, mesodiverticular band.
However, also because the condition is rare, the findings of this study provide a useful surgical recommendation. Secondly, a few cases that used an open surgical approach were reported before the era of laparoscopy and resulted in a higher percentage of open cases that used an open surgical approach were reported before the study provide a useful surgical recommendation. Secondly, a few studies which leave the possibility of residual confounding.

Conclusion
Mesodiverticular band is considered a rare cause of small bowel obstruction and hemoperitoneum in adults. Preoperative diagnosis is challenging due to the rarity of the condition with overlapping clinical and imaging findings with other causes of small bowel obstruction. Incidental findings of MDB should be divided due to possible serious complications.

Lessons learned
Incidental finding of mesodiverticular band in an adult should be excised due to increased risk of internal herniation and volvulus.

Ethical approval
Approval was given by HCA Research Department.

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Author contribution
S.B. collected the data, reviewed the case reports, and draft the article. S.S.H.F. help in formatting the article and revising the discussion. J.M. and S.M. reviewed the article and check the grammar.

Conflicts of interest disclosure
The authors declare that they have no financial conflict of interest with regard to the content of this report.

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