Pediatric Surgery International (2025) 41:132
https://doi.org/10.1007/s00383-025-05978-z

ORIGINAL ARTICLE

Clinical characteristics of neonatal mesenteric hiatal hernia

Mengliang Han[1] · Huizhong Niu[1] · Feng Liu[1] · Xinjian He[2] · Pan Chen[1] · Mei Wu[1]

Accepted: 26 January 2025

Abstract

Background Neonatal mesenteric hiatal hernia (MHH) is a rare but serious congenital abnormality. Due to the lack of specific clinical features, it poses challenges for diagnosis and treatment. Early identification and timely intervention are crucial for improving neonatal outcomes. This study aims to explore the clinical characteristics, diagnostic methods, and treatment outcomes of neonatal MHH.

Methods A retrospective analysis was conducted on seven cases of neonatal MHH admitted to the First Department of General Surgery at Hebei Children's Hospital from January 1, 2010, to September 30, 2024. General information, clinical data, examination results, and surgical conditions of the patients were collected and analyzed.

Results The average hospital stay for the seven neonatal MHH patients was 16.57 days. No complications such as bowel obstruction were observed during the 12 to 24 months of postoperative follow-up. The clinical symptoms were primarily abdominal distension, with some patients also presenting with vomiting, abdominal pain, and other symptoms. The imaging examinations showed that most patients exhibited signs of bowel obstruction and some CT scans revealed features such as bowel loop aggregation and mesenteric vascular abnormalities. Laboratory tests indicated mild inflammation and slight functional abnormalities in some organs. Regarding surgery, five patients underwent conversion to open surgery. The hernia defects were mainly located at the terminal ileum and ileocecal junction. Six patients required bowel resection due to bowel necrosis and four of them underwent ostomy procedures. All patients recovered well postoperatively.

Conclusion Neonatal MHH is a rare and complex condition, with imaging playing a key role in early diagnosis. Laparoscopic surgery is the preferred treatment method due to its minimal invasiveness and quick recovery. Future efforts should focus on enhancing clinical awareness of this condition and integrating clinical symptoms with relevant examinations to improve early diagnosis and treatment outcomes.

Keywords Neonate · Mesenteric hiatal hernia · MHH · Clinical characteristics

Introduction

Mesenteric hiatal hernia (MHH) refers to a condition where the intestines protrude through an abnormal mesenteric hiatus. It has a low incidence rate. The international studies show that this disease accounts for 1.87% of children with intestinal obstruction, while domestic reports indicate that out of 167 cases of intestinal obstruction, only three were cases of hernia, accounting for 0.5% [1]. This condition is the most common type of internal hernias (IH), which typically refers to the protrusion of intestines through holes in the peritoneal ligaments, mesentery, or omentum, and is classified into two types: one caused by intra-peritoneal fossae or cystic masses, accounting for 40%, and the other caused by abnormal openings in the mesosalpinx, omentum, or broad ligament, accounting for 60% [2]. The disease was first discovered by Henerman in 1778 during an autopsy. Currently, there are two theories regarding its etiology: one suggests that after the normal rotation of the intestines during embryonic development, the visceral peritoneum does not completely fuse with the parietal peritoneum to form the mesentery, leading to the formation of the hiatus; the other theory proposes that the blood supply to the mesentery

✉ Huizhong Niu
nrlnhz@163.com

Xinjian He
hexinjian03@sina.com

[1] First Department of General Surgery, Hebei Children's Hospital, Shijiazhuang 050000, Hebei, China

[2] The Department of Ultrasound Diagnosis, Hebei Provincial Children's Hospital, Shijiazhuang 050000, Hebei, China

Published online: 09 May 2025

during embryonic development is obstructed, causing localized ischemia and necrosis, resulting in a defect [3]. This study aims to analyze the clinical features, diagnostic methods, and surgical treatment outcomes of neonatal MHH, providing a reference for the early diagnosis and treatment of this disease.

Methods

General information

This study is a retrospective analysis. Clinical data were collected from seven neonates with MHH admitted to the First Department of General Surgery at Hebei Children's Hospital from January 1, 2010 to September 30, 2024, including three male and four female patients. Informed consent was obtained from the patients' families, and the study was approved by the Ethics Committee of Hebei Children's Hospital (Approval No. 2024184).

Inclusion and exclusion criteria

Inclusion criteria: (1) Age at admission ≤ 28 days; (2) Complete clinical data; (3) Diagnosis confirmed intraoperatively.

Exclusion criteria: (1) Presence of other malignant tumors, hematologic diseases, immunological disorders, thrombotic diseases, or other chronic diseases; (2) Missing clinical data.

Data collection

Patient data were collected by reviewing the hospital's electronic medical records, including general information (sex, mode of delivery, and number of pregnancies), clinical data (duration of illness), surgical details (surgical method, hernia size, intraoperative blood loss), and preoperative laboratory results, including red blood cells (RBC), hemoglobin (Hb), platelets (PLT), white blood cells (WBC), neutrophil percentage (Neut%), alanine aminotransferase (ALT), aspartate aminotransferase (AST), total protein (TP), albumin (Alb), C-reactive protein (CRP), total bilirubin (TBil), direct bilirubin (DBil), creatine kinase (CK), lactate dehydrogenase (LDH), gamma-glutamyl transferase (GGT), D-dimer (DD), fibrinogen (FIB), prothrombin time (PT), thrombin time (TT), activated partial thromboplastin time (APTT), International Normalized Ratio (INR), serum Na+, serum K+, and serum Ca^{2+}.

Follow-up

Follow-up was conducted through outpatient visits and telephone calls. The follow-up content focused on postoperative complications.

Results

General information and clinical manifestations of neonatal MHH

A total of seven neonates with MHH were included in this study. All patients were followed up for 12 to 24 months after surgery, and no complications such as intestinal obstruction were observed. In terms of clinical presentation, three patients presented with abdominal distension, one with abdominal pain and vomiting, one with constipation and hematochezia, one was admitted due to an abdominal mass discovered during the mother's prenatal check-up, and one was admitted with suspected gastrointestinal malformation. On physical examination, three patients showed abdominal distension, presenting with significant bloating (see Fig. 1). One patient exhibited abdominal tenderness, rebound tenderness, and muscle rigidity. Ultrasonographic results showed that five patients had signs of intestinal gas accumulation and fluid collection, with one suspected of having intestinal obstruction, and one with no abnormalities detected. On abdominal X-ray, four patients showed intestinal gas accumulation, one had signs of abdominal distension with reduced intestinal gas, one was suspected of having

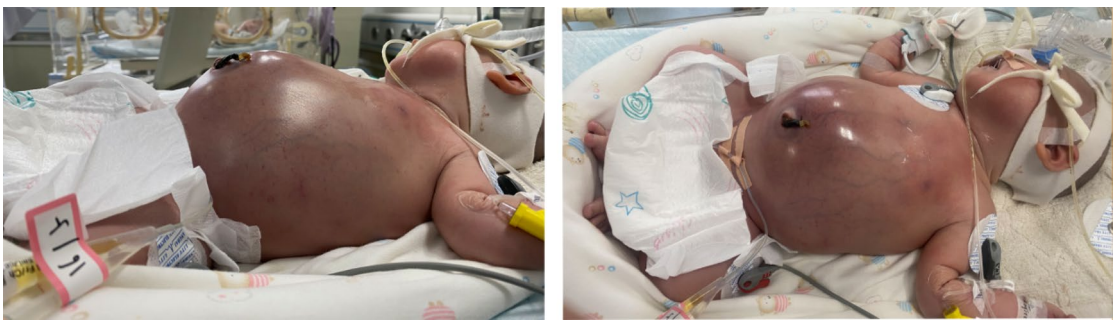

Fig. 1 Significant abdominal distension observed in neonates during physical examination

gastrointestinal foreign body malformation, and one patient showed subdiaphragmatic free gas, suggesting severe complications such as gastrointestinal perforation. CT examination revealed that one patient had signs of small bowel aggregation, one had mesenteric vascular abnormalities, and two had intestinal loops. The main reason for hospitalization was abdominal distension, with an initial diagnosis of intestinal obstruction. The average time from symptom onset to hospitalization was 20.57 h and the average total hospital stay was 16.57 days. The detailed information is presented in Table 1.

Laboratory examination results of neonatal MHH

The laboratory examination results for the neonates with MHH showed a mild increase in WBC (mean 18.3×10^9/L) and CRP (mean 20.1 mg/L), indicating the presence of an inflammatory response. The Neut% (mean 69.04%) was elevated, suggesting a potential bacterial infection. RBC (mean 3.9×10^{12}/L), Hb (mean 129.29 g/L), and Plt (mean 272.71×10^9/L) were within normal ranges, indicating that the patients did not have anemia or platelet abnormalities. Total Protein (TP) (mean 51.24 g/L) and Albumin (Alb) (mean 34.5 g/L) levels were normal, reflecting good nutritional status. Regarding liver function, total bilirubin (TBil) (mean 143.5 μmol/L) and direct bilirubin (DBil) (mean 18.79 μmol/L) were elevated, with one patient showing a notably high bilirubin level. Both ALT and AST were mildly elevated, indicating potential mild liver injury. Additionally, creatine kinase (CK) and lactate dehydrogenase (LDH) were elevated to varying degrees, suggesting possible tissue damage. In coagulation function tests, INR and thrombin time (TT) showed no significant abnormalities, but activated partial thromboplastin time (APTT) (mean 40.4 s) was slightly prolonged, indicating mild coagulation dysfunction. D-Dimer (DD) (mean 15.26 μg/L) and fibrinogen (FIB) (mean 3.27 g/L) levels indicated some coagulation activity. Electrolyte levels ($Na+$, $K+$, and Ca^{2+}) were generally normal, with no significant abnormalities detected. Overall, laboratory results revealed mild inflammation and slight abnormalities in some organ functions in the neonates with MHH,

Table 1 Clinical data and imaging examination results of neonatal MHH

Rank	Sex	Age	Mode of delivery	Chief complaint	Duration of symptoms
1	Male	72 h	Normal delivery	Constipation, hematochezia	3 days
2	Female	13 h	Cesarean section	Abdominal mass during pregnancy	13 h
3	Female	10 h	Cesarean section	Abdominal distension	10 h
4	Male	22 h	Cesarean section	Digestive tract malformation	5 h
5	Female	19 h	Normal delivery	Abdominal distension	19 h
6	Female	57 h	Cesarean section	Abdominal distension	6 h
7	Male	26 h	Normal delivery	Abdominal pain, vomiting	19 h

Rank	Initial Diagnosis	Ultrasound Report	X-ray Report	CT Scan	Total Hospitalization Days
1	Hematochezia cause unknown	No abnormalities	Bowel gas accumulation	Bowel distension with fluid-gas levels	10
2	Abdominal mass	Partial bowel gas accumulation in the abdomen	Abdominal distension, fewer bowel gases	Malformation of digestive tract, intestinal duplication	18
3	Intestinal obstruction	Bowel distension, gas–liquid accumulation	Bowel gas accumulation	Mesenteric vessel twisting and torsion (whirlpool sign)	7
4	Digestive tract malformation	Intestinal obstruction	Foreign body malformation of the digestive tract	C-shaped bowel loop	16
5	Intestinal obstruction	Bowel gas–liquid accumulation	Bowel gas accumulation	Small bowel clustering signs	23
6	Peritonitis, digestive tract perforation	Bowel gas accumulation, abdominal fluid	Free gas below the diaphragm, suggestive of digestive tract perforation	Free gas under the diaphragm (suggesting digestive tract perforation)	30
7	Intestinal obstruction, peritonitis	Bowel gas accumulation, abdominal fluid	Bowel gas accumulation, elevated right diaphragm	M-shaped bowel loop	12

Table 2 Laboratory examination results of neonatal MHH

Rank	WBC	Neut%	RBC	Hb	Plt	CRP	TP	Alb
1	13.4	56.9	4.08	145	247	23.6	52	36.2
2	7.2	73.3	3.65	122	167	22.96	63.3	41.1
3	29.2	85.7	2.98	95	243	11.01	39	27.3
4	19.1	73.5	3.76	142	272	21.79	50.3	39.8
5	20.9	59.2	3.69	127	193	16.72	47.4	32.2
6	7.8	64.5	4.28	152	198	10.5	45.7	29.3
7	30.5	70.2	4.84	122	589	34.1	61	35.6
Average	18.3	69.04	3.9	129.29	272.71	20.1	51.24	34.5
Rank	TBil	DBil	ALT	AST	GGT	CK	LDH	PT
1	205.9	20.4	12	27	67	55	312	12.3
2	44.9	30.5	10	19	131	98	252	11.4
3	174.3	36.4	10	18	115	37	482	123
4	236.5	13.4	4	14	195	31	410	13.7
5	190.7	9.8	7	79	323	156	1646	9.5
6	134.2	16.7	14	83	639	248	1080	19.3
7	18	4.3	16	36	13	695	241	14.1
Average	143.5	18.79	10.43	39.43	211.86	188.57	631.86	29.04
Rank	INR	TT	APTT	FIB	DD	Na^+	K^+	Ca^{2+}
1	10.3	19.8	35.9	1.81	10.52	137.3	3.84	1.135
2	0.99	20.1	38.9	1.62	16.26	142.2	3.65	1.218
3	1.07	18.8	40.4	1.79	18.59	133.5	4.18	0.978
4	1.2	16.2	47.2	6.25	29.44	131	5.2	0.901
5	0.81	19.8	35.9	6.13	29.77	136	3.5	1.1
6	1.71	24.5	53.2	1.53	0.66	139.1	3.41	0.834
7	1.24	14.6	31.3	3.79	1.58	133.3	4.11	1.162
Average	2.47	19.11	40.4	3.27	15.26	136.06	3.98	1.05

but the overall condition was stable. The detailed results are presented in Table 2.

Surgical treatment and postoperative recovery of neonatal MHH

All patients underwent surgical treatment, with laparoscopic surgery as the first choice. However, five patients were converted to open surgery due to limited abdominal space and difficulties in laparoscopic manipulation. The site of the hernia was mainly located at the terminal ileum and the ileocecal area, with the most distant reach being up to 70 cm. The size of the defect ranged from 1.5 × 1 cm to 5 × 3 cm. In terms of surgical duration, laparoscopic surgery had a shorter average time of about 1.92 h, while the surgery conversion to open procedure took longer, with an average of 2.71 h. Intraoperative blood loss was generally minimal, ranging from 5 to 60 ml. Regarding bowel resection, six patients required resection due to bowel necrosis, mainly of the ileum or cecum, with only one patient not undergoing resection. The length of the resected bowel ranged from 7 to 70 cm, with the longest resection being the terminal ileum (70 cm). Figure 2 shows the surgical outcomes of the neonatal hernia repair. In Fig. 2A, the mesenteric hernia defect with a diameter of about 2 cm is visible, showing no ischemia or necrosis, while Fig. 2B shows signs of intestinal ischemia and necrosis. Regarding stoma creation, four patients underwent stoma surgery. The proximal stoma length ranged from 20 to 70 cm, and the distal stoma length ranged from 10 to 30 cm. Postoperative recovery indicated that the shortest time for the patients to resume feeding was 4 days, and the longest was 7 days. The abdominal drainage tubes were gradually removed between the 5th and 10th postoperative days. The time for stoma closure varied greatly among individuals, with the longest stoma closure time being 105 days and the shortest 51 days. Overall, the surgical outcomes were favorable, and the recovery process was stable. Detailed information is presented in Table 3.

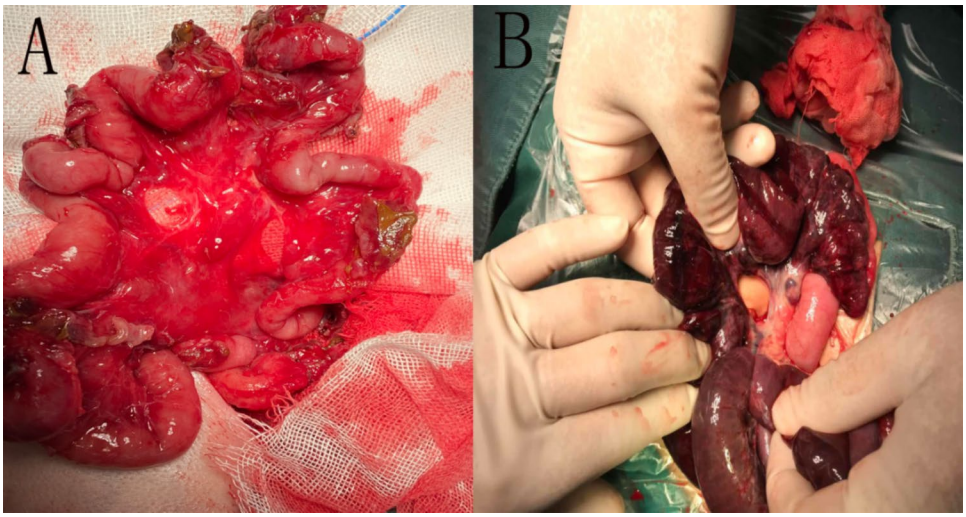

Fig. 2 **A** Mesenteric defect with a diameter of approximately 2 cm. **B** Signs of intestinal ischemia and necrosis

Table 3 Surgical treatment and postoperative recovery of neonatal MHH

Rank	Surgical method	Location of the hole	Hole size	Surgery duration (h)	Blood loss (mL)	Excision (Yes/No)	Excision site
1	Laparoscopy	70 cm from the Cooper's ligament	3×4	1.25	20	No	–
2	Conversion to open surgery	30 cm from the ileocecal valve	5×3	2.83	60	Yes	Ileum
3	Conversion to open surgery	End of ileum	3×3	3.67	10	Yes	Cecum
4	Conversion to open surgery	15 cm from the ileocecal junction	2×2	1.92	8	Yes	Ileum
5	Laparoscopy	End of ileum	2×2	1.92	5	Yes	Ileum
6	Conversion to open surgery	12 cm from the ileocecal junction	1.5×1	1.83	12	Yes	Ileum
7	Conversion to open surgery	40 cm from the ileocecal junction	2.5×2.5	2.5	10	No	–

Rank	Excision length (cm)	Stoma created (Yes/No)	Proximal length of stoma (cm)	Distal length of stoma (cm)	Postoperative days before eating	Days of abdominal drain tube removal	Stoma closure days
1	–	No	–	–	4	5	–
2	9	Yes	60	30	7	10	98
3	22	Yes	20	10	5	5	105
4	30	Yes	45	15	5	5	74
5	36	Yes	70	10	4	6	51
6	7	No	–	–	7	9	–
7	–	No	–	–	5	7	–

Discussion

The study by Sunami et al. found that the majority of MHH cases involve mesenteric defects in the small intestine (64%), followed by the sigmoid mesocolon (22.4%), transverse mesocolon (12.2%), with the ascending and descending mesocolons being the least affected (each 0.7%) [2, 4]. Generally, MHH is more commonly seen in neonates and children, with adult cases being relatively rare [5]. In our study, the majority of neonates with MHH had small intestinal mesenteric defects, which is consistent with literature reports. Common triggers for MHH include factors such as intense physical activity or heavy labor after meals, which increase abdominal pressure and

cause the free-moving intestine to enter the mesenteric defect, leading to mesenteric hernia formation [6]. Symptoms associated with MHH in affected children often include abdominal pain, distension, nausea, and vomiting [7]. Abdominal pain is typically intermittent, worsened after eating or strenuous activity and is mainly located around the navel or lower abdomen. Persistent pain may cause irritability in the child. Abdominal distension often accompanies palpable gas and liquid-filled bowel loops, causing noticeable abdominal bloating [8, 9]. When the intestine is obstructed, nausea and vomiting may occur. Vomiting that is green or bile-stained suggests high-level obstruction. If the herniated bowel is compressed and strangulated, it may lead to ischemia or necrosis, manifesting as continuous severe abdominal pain and possibly even systemic symptoms such as fever and shock [10, 11].

Typical neonatal symptoms include repeated crying, refusal to eat, or poor weight gain [12]. Some infants may exhibit milder or asymptomatic symptoms due to varying defect sizes. If the defect is small and no bowel herniates, or if the herniated bowel can spontaneously reduce, the child may be entirely asymptomatic and the condition might be discovered only during imaging or surgery [13]. In our study, neonatal patients primarily presented with abdominal distension. Due to the lack of specific clinical manifestations, symptoms are often masked by complications. The average time from symptom onset to hospitalization in most cases was 20.57 h, with initial diagnoses often pointing to intestinal obstruction.

Imaging plays an indispensable role in diagnosing pediatric MHH. Abdominal X-rays, while useful as an initial screening tool, show typical signs of bowel obstruction (such as bowel dilation and air-fluid levels) but do not clearly locate the hernia or identify its type. In contrast, abdominal CT scans are considered more effective diagnostic methods, clearly showing the location of bowel loops and the hernia pathway. CT can also identify abnormal twisting or aggregation of the bowel within the abdominal cavity, confirming MHH [14, 15]. Additionally, CT scans can assess whether there is restricted blood flow, ischemia, or necrosis of the bowel, providing crucial information for determining the need for urgent surgery [16, 17]. Ultrasound also has some diagnostic value in neonates, especially in evaluating bowel obstruction and dilation, although it is less effective in pinpointing the exact location of the hernia [18]. Advances in three-dimensional imaging techniques have made spiral CT more effective in displaying features like small bowel aggregation, abnormal mesenteric vascular collection, and torsion, improving diagnostic accuracy [19, 20]. Furthermore, laparoscopy can not only aid in diagnosis but also allow for direct repair after confirming the hernia, especially in difficult cases. Given that the disease lacks specific clinical manifestations, it is easily misdiagnosed as other types of bowel obstruction or acute abdomen. Therefore, comprehensive assessment, including the patient's history, physical examination, and imaging findings, is essential. When diagnosing this disease, special attention should be paid to signs such as space-occupying lesions, abnormal mesenteric vessels, and secondary changes in imaging to improve sensitivity and specificity, facilitating timely surgical treatment and preventing complications like bowel necrosis, ultimately saving the infant's life.

In this study, all patients underwent abdominal ultrasound, X-rays, and CT scans. Most imaging results suggested bowel obstruction and bowel gas and fluid accumulation, though the hernia was not clearly identified. In CT scans, some patients displayed typical signs such as small bowel aggregation, bowel loops, and mesenteric vessel pulling or twisting (whirlpool sign). The laboratory tests showed mild increases in WBC, CRP, and Neut%, indicating an inflammatory response, while elevated liver function markers, CK, and LDH suggested potential tissue damage. Similarly, coagulation markers showed mild abnormalities, with prolonged APTT and elevated DD and FIB levels, indicating slight coagulation issues. The nutritional status, electrolytes, and other indicators suggested that despite mild inflammation and some functional abnormalities, the overall condition of the infants was good. These findings suggest that for neonates with MHH, laboratory tests should be used as supportive diagnostic tools, combining clinical manifestations and imaging results to improve early diagnostic accuracy.

Surgical intervention is the only effective treatment for this condition and is usually performed in an emergency setting to avoid bowel necrosis and related complications. The main goal of surgery is to reduce the incarcerated or strangulated bowel and repair the defect to restore normal bowel function [11]. The laparoscopic surgery is typically the preferred treatment because it involves less trauma and faster recovery, making it suitable for most cases. During surgery, the surgeon inserts a laparoscope and necessary instruments through a small incision to carefully observe the abdominal cavity, assess the bowel's condition, and locate the hernia. During reduction, particular attention is paid to blood supply. If ischemia or necrosis is observed, the affected part of the bowel should be promptly resected, and bowel anastomosis or ostomy may be necessary to ensure the infant's safety. For patients with poorer overall conditions, an initial stoma may be considered, followed by subsequent anastomosis in a second-stage surgery. The repair of the defect can be done by direct suturing or reinforcing with biological materials depending on the size and location of the defect. Postoperatively, infants need close monitoring in the hospital to track vital signs, bowel function, and wound healing, with gradual resumption of oral feeding as bowel function improves. Regular follow-up is also crucial to detect any complications such as hernia recurrence or

bowel dysfunction. In our study, all patients underwent laparoscopic surgery, and five cases required conversion to open surgery. The average blood loss (12.5 ml), surgery duration (1.6 h), postoperative feeding time (4 days), and abdominal drainage removal time (5.8 days) in laparoscopic surgeries were all shorter than in the converted open surgeries, where the average blood loss (17.5 ml), surgery duration (2.1 h), feeding time (5.5 days), and drainage removal time (7.8 days) were longer. This highlights the advantages of laparoscopic surgery, especially in terms of smaller trauma and faster recovery. Regarding necrotic bowel management, in the five cases of bowel resection, 4 required ostomy, with an average proximal length of 48.75 cm and distal length of 16.25 cm. The average duration of stoma closure was 82 days. While stoma surgery effectively avoids short-term complications, it requires long-term follow-up to ensure bowel function recovery and prevent further complications. Special attention should be given to nutritional support, bowel recovery, and wound healing during post-stoma care. Overall, most patients were able to resume feeding relatively early post-surgery (average 5.5 days), and the average drainage removal time was 6.7 days, suggesting that with proper postoperative management, bowel function can recover quickly. This aligns with the advantages of laparoscopic surgery, which minimizes abdominal interference and aids in faster restoration of bowel function.

Conclusion

MHH is a rare and complex condition, and early diagnosis and timely surgical intervention are crucial for improving the prognosis of affected children. Imaging examinations, particularly CT scans, play a critical role in the early detection and accurate diagnosis of MHH. Laparoscopic surgery remains the preferred treatment option due to its advantages of minimal trauma and quick recovery. The combination of clinical symptoms, laboratory tests, and imaging examinations will contribute to the early diagnosis and treatment of this condition.

Author contributions Mengliang Han: Manuscript drafting; Huizhong Niu: Manuscript drafting and review; Feng Liu: Manuscript drafting and revision; Xinjian He: Data collection and analysis; Pan Chen: Data collection; Mei Wu: Literature review and manuscript revision. All authors read and approved the final draft of the manuscript.

Funding Medical Science Research Project of Hebei Province, 2021 (No. 20210286).

Data availability The original contributions presented in the study are included in the article. Further inquiries can be directed to the corresponding authors.

Declarations

Conflict of interest The authors declared that no competing of interests existing in this study.

Ethical approval and consent to participate The study was approved by the Ethics Committee of Hebei Children's Hospital (Approval No. 2024184), and informed consent was obtained from the patients' guardians.

References

1. Caldeman C, Fogelström A, Wester T et al (2024) Long-term gastrointestinal morbidity in patients born with gastroschisis: a national register-based cohort study. J Pediatr Gastroenterol Nutr 79(5):983–990. https://doi.org/10.1002/jpn3.12366
2. Edwards HM, Al-Tayar H (2013) A transmesenteric congenital internal hernia presenting in an adult. J Surg Case Rep. https://doi.org/10.1093/jscr/rjt099
3. Horiuchi Y, Nishimura E, Sashi E et al (2024) An adult case of large defect of small mesenteric hiatal hernia causing small bowel obstruction. Surg Case Rep 10(1):246. https://doi.org/10.1186/s40792-024-02040-3
4. Murphy DA (1964) Internal hernias in infancy and childhood. Surgery 55:311–316
5. Silva LP, Miyasaka CK, Martins EF et al (2004) Effect of bullfrog (*Rana catesbeiana*) oil administered by gavage on the fatty acid composition and oxidative stress of mouse liver. Braz J Med Biol Res 37(10):1491–1496. https://doi.org/10.1590/s0100-879x2004001000007
6. Zheng XX, Wang KP, Xiang CM et al (2021) Intestinal gangrene secondary to congenital transmesenteric hernia in a child misdiagnosed with gastrointestinal bleeding: a case report. World J Clin Cases 9(19):5294–5301. https://doi.org/10.12998/wjcc.v9.i19.5294
7. Milošević V, Petrović T, Banjanin I et al (2024) Case of a fatal congenital transmesenteric hernia in infancy. Leg Med (Tokyo) 71:102540. https://doi.org/10.1016/j.legalmed.2024.102540
8. Yasin NA, Ahmed MR, Mohammed AN, Ali AM (2024) Congenital trans-mesentric internal hernia: a rare cause of acute intestinal obstruction in adult. Ann Med Surg (Lond) 86(10):6121–6124. https://doi.org/10.1097/ms9.0000000000001931
9. Parida L (2022) Small bowel internal hernia and sigmoid volvulus through a congenital mesenteric defect. J Pediatr 246:280–281. https://doi.org/10.1016/j.jpeds.2022.03.027

10. Wu YY, Liu PF (2023) A case of congenital mesenteric hernia in the adult. Asian J Surg 46(4):1785–1786. https://doi.org/10.1016/j.asjsur.2022.10.041
11. Martin LC, Merkle EM, Thompson WM (2006) Review of internal hernias: radiographic and clinical findings. AJR Am J Roentgenol 186(3):703–717. https://doi.org/10.2214/ajr.05.0644
12. Koranne MS, Banker A (2020) Congenital transmesenteric hernia-importance of a timely intervention. Surg J (N Y) 6(2):e98–e100. https://doi.org/10.1055/s-0040-1710533
13. Alshamari M, Norrman E, Geijer M et al (2016) Diagnostic accuracy of low-dose CT compared with abdominal radiography in non-traumatic acute abdominal pain: prospective study and systematic review. Eur Radiol 26(6):1766–1774. https://doi.org/10.1007/s00330-015-3984-9
14. Reddy SA, Yang C, McGinnis LA et al (2007) Diagnosis of transmesocolic internal hernia as a complication of retrocolic gastric bypass: CT imaging criteria. AJR Am J Roentgenol 189(1):52–55. https://doi.org/10.2214/ajr.06.0898
15. Yuansheng X, Yi W, Jinyan F (2021) Internal hernia in pregnant woman due to congenital transmesenteric defect. Pak J Med Sci 37(5):1540–1544. https://doi.org/10.12669/pjms.37.5.4116
16. Songadkar SV, Hansalia DS, Pathak HV, Desai JA (2024) Congenital transmesenteric hernia with closed-loop small bowel obstruction and intestinal gangrene in an adult. Cureus 16(2):e53560. https://doi.org/10.7759/cureus.53560
17. Xianqing S, Jian S, Wei S (2022) Congenital mesocolon bands: a rare cause of incarcerated internal hernia. Asian J Surg 45(3):959–961. https://doi.org/10.1016/j.asjsur.2021.12.043
18. Heath K, Byard RW (2019) Lethal small intestinal herniation through a congenital mesenteric defect. Forensic Sci Med Pathol 15(1):140–142. https://doi.org/10.1007/s12024-018-0009-4
19. Dritsas ER, Ruiz OR, Kennedy GM et al (2001) Paraduodenal hernia: a report of two cases. Am Surg 67(8):733–736
20. Nouira F, Dhaou BM, Charieg A et al (2011) Small bowel obstruction caused by congenital transmesenteric defect. Afr J Paediatr Surg 8(1):75–78. https://doi.org/10.4103/0189-6725.78934