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Sigmoid Volvulus in Children: A Structured Diagnostic and Therapeutic Approach

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ABSTRACT

Purpose: Sigmoid volvulus rarely causes bowel obstruction in children. Early diagnosis and treatment are critical for preventing complications such as bowel ischemia and peritonitis. This study aimed to develop a structured diagnostic and treatment algorithm for sigmoid volvulus in pediatric patients.
Methods: Two clinical cases of pediatric sigmoid volvulus were reviewed, focusing on the clinical presentation, diagnosis, and surgical treatment. These findings were compared with those in the literature to establish evidence-based recommendations.
Results: Sigmoid volvulus should be considered in children who present with abdominal pain and signs of intestinal obstruction. The initial diagnosis can be made using abdominal radiography with computed tomography scans, if necessary. Colonoscopy with endoscopic detorsion of the volvulus is recommended in the absence of peritonitis. Owing to the high risk of recurrence, early resection of the sigmoid colon is recommended. Rectal biopsy is a key component of the diagnostic algorithm as it helps to confirm or exclude Hirschsprung's disease. Acute surgical intervention is indicated in children with clinical signs of peritonitis and/or pneumoperitoneum. Resection of the affected sigmoid bowel with or without primary anastomosis is recommended. Indocyanine green fluorescence imaging is a promising method for objectively evaluating bowel viability when viability is uncertain.
Conclusion: The proposed diagnostic and therapeutic algorithm offers a clear approach for managing sigmoid volvuli in pediatric patients.

Keywords: Volvulus; Colon, sigmoid; Child; Diagnostic imaging; Endoscopy; Decompression, surgical; Treatment outcome

INTRODUCTION

Sigmoid volvulus is a typical disease in elderly individuals, with over 80% of the cases occurring in people aged over 50 years [1]. It is rare in childhood, with only 256 cases documented in available literature. There was a higher prevalence of sigmoid volvulus in male patients, with a ratio of 3.5:1 [2].

Conflict of Interest
The authors have no financial conflicts of interest.

Volvulus is characterized by rotation of the elongated sigmoid colon around its elongated mesentery, resulting in widening of the bowel loop and subsequent venous and arterial obstruction of the affected bowel segment [3]. The most common clinical symptom is intermittent recurrent abdominal pain. In older children, pain may recur at longer intervals, and the passage of gas and stool often improves the condition [4].

In the acute phase, the most prominent clinical manifestation is colicky abdominal pain associated with increased abdominal volume and distension. Patients may experience cessation of passing through gas and stools, nausea, and vomiting. A typical symptom of this condition is the presence of an empty rectal ampulla. An inadequate diagnosis can lead to shock, intestinal ischemia, and peritonitis with associated consequences [5].

The presence of a dilated sigmoid loop on plain abdominal radiographs should promptly indicate the possibility of sigmoid volvulus in pediatric patients. Additional computed tomography (CT) or magnetic resonance imaging of the abdomen was used to definitively confirm the diagnosis [6]. Colonoscopy is a valuable diagnostic tool that can facilitate therapeutic intervention in cases in which the clinical picture remain unclear. Colonoscopy can be used to detect the sigmoid colon in the early stages of disease. However, colonoscopy is contraindicated in cases of bowel ischemia or peritonitis.

Given the rarity of sigmoid volvulus in pediatric patients, there are currently no clear established guidelines in the available literature regarding the optimal management of this condition. Based on our experience and an analysis of the literature, we developed a simple diagnostic and therapeutic algorithm for the management of pediatric patients with sigmoid volvulus.

MATERIALS AND METHODS

Two clinical cases of pediatric sigmoid volvulus were reviewed, with a focus on clinical presentation, diagnostics, and surgical treatment. The findings were compared with literature to establish evidence-based recommendations.

RESULTS

Own observation (case report)

1. Patient 1

A 15-year-old female patient was admitted with progressive colicky abdominal pain for 1 day, accompanied by the absence of gas and stool. The girl reported nausea but with no vomiting. She also had a history of constipation for approximately 1 year.

Clinical examination demonstrated a markedly distended abdomen without audible peristalsis and an empty rectal ampulla. Abdominal radiography revealed significant bowel loop dilatation and pneumatosis. Considering the deteriorating clinical situation, surgical revision was indicated after the necessary preparation of the patient. Intraoperatively, sigmoid dilatation and volvulus with 360° rotation were noted (**Fig. 1**). Volvulus was detected, and the viability of the sigmoid colon was evaluated.

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Fig. 1. Preoperative finding of sigmoid volvulus.

Owing to the significant dilatation of the sigmoid colon (maximum diameter, 12 cm) and the risk of recurrence, a sigmoid stoma was created to manage the acute condition and decompress the bowel. After postoperative stabilization, Hirschsprung disease was ruled out.

Irrigography (barium enema) confirmed an elongated sigmoid colon without any evidence of obstruction. Delayed secondary resection of the sigmoid colon was indicated to address the elongated and redundant segments. Stoma reversal and sigmoid resection were conducted using an open approach with a primary anastomosis.

The patient's postoperative course was uneventful with full recovery of bowel function and resolution of constipation. During the 5-year follow-up, the patient remained asymptomatic and had no complications.

2. Patient 2

An 8-year-old boy with a history of chronic constipation was admitted to our hospital with intermittent colicky abdominal pain that rapidly progressed to abdominal distension and vomiting. The duration of symptoms was approximately 12 hours. Furthermore, the absence of gas and stool during the previous 24 hours was noted.

On clinical examination, the abdomen was distended in the upper region and diffusely painful. There was no evidence of peritoneal irritation and the rectal ampulla was empty. Abdominal radiography showed a typical "coffee bean" sign (**Fig. 2**). A computed tomography

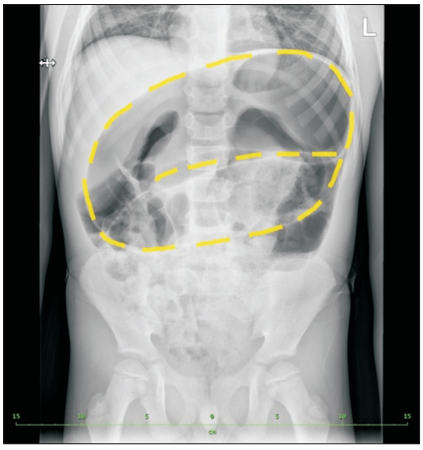

Fig. 2. Coffee bean sign.

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Fig. 3. Typical "whirl sign" indicative of sigmoid volvulus (arrows).

scan of the abdomen demonstrated a phenomenon known as the "whirl sign," which was consistent with the diagnosis of sigmoid volvulus (**Fig. 3**). After the necessary preoperative preparation, the patient underwent abdominal revision via transumbilical minilaparotomy. A 270° rotation of the elongated sigmoid colon around the long mesosigmoid was noted, with the sigmoid colon dilated to approximately 9 cm (**Fig. 4**).

After detorsion, bowel viability and quality were assessed using near-infrared fluorescence angiography with indocyanine green (ICG). Despite the favorable blood supply observed in the derotated sigmoid colon, significant dilatation of the colon and the potential risk of volvulus recurrence led to the decision to perform primary resection of the sigmoid colon with anastomosis. The viability of bowel segments before and after anastomosis was confirmed using ICG. Furthermore, rectal biopsy was performed to exclude the possibility of Hirschsprung disease.

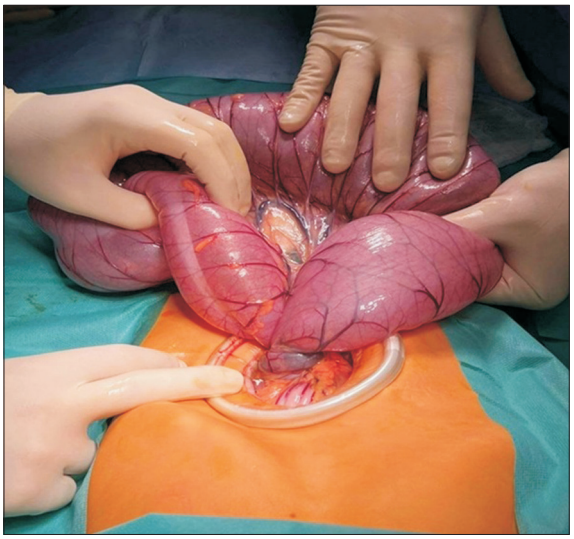

Fig. 4. The sigmoid colon is twisted around its longitudinal axis.

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The postoperative course was uneventful. The child was managed according to the enhanced recovery after surgery protocol, which included early verticalization, realimentation, and minimization of invasive inputs. The patient was discharged on postoperative day 7 and followed up by a pediatric surgeon. Histological examination revealed no evidence of Hirschsprung disease.

DISCUSSION

Sigmoid volvulus is a rare bowel obstruction that occurs during childhood. Clinical symptoms require rotation of the elongated sigmoid loop to at least 180° (in 35% of cases); in a larger number of cases, the sigmoid loop rotates up to 360° (in 50% of cases) [7,8]. A literature review revealed the lack of established guidelines for the diagnosis and management of sigmoid volvulus in children. A diagnostic and therapeutic algorithm for the management of sigmoid volvulus was developed by the authors based on their clinical experience (in both adult and pediatric patients) and the available literature.

The initial assessment should focus on a comprehensive medical history, including the presence of chronic diseases, such as constipation and neurological or psychiatric disorders. It should also include a thorough search for specific symptoms, such as paroxysmal abdominal colic, absence of gas and stool, and progressive abdominal distension. In children presenting with symptoms of intestinal obstruction, it is advisable to include sigmoid volvulus in the differential diagnosis. It is imperative to assess the biochemical parameters associated with inflammation, including lactate levels and alterations in the acid-base balance. This is essential for identifying possible intestinal ischemia.

If a sigmoid volvulus is suspected, the initial radiological examination is an anteroposterior abdominal radiograph obtained with the patient in a standing position. This examination allows for the confirmation or exclusion of pneumoperitoneum, which indicates the possibility of bowel perforation and peritonitis [9]. An abdominal X-ray may reveal a specific symptom known as the “coffee bean sign.” This is a distended sigmoid loop in an inverted U shape.

If the radiograph does not show the presence of pneumoperitoneum or the “coffee bean sign,” a CT scan of the abdomen is usually indicated. CT with an intravenous contrast agent can definitively confirm or refute the diagnosis of sigmoid volvulus and facilitate the diagnosis of possible colonic ischemia [10]. In the study by Vindendries et al. [11], the positive diagnostic yield of CT for sigmoid volvulus was 89%. Despite the high reliability of this technique, the indications for CT in pediatric patients are carefully considered because of the significant radiation exposure associated with the examination [12,13].

Diagnostic and therapeutic management schemes for pediatric patients with sigmoid volvulus are shown in **Fig. 5**. Management plans vary considerably depending on the presence of pneumoperitoneum and peritonitis.

Sigmoid volvulus without pneumoperitoneum and peritonitis

If the patient showed no clinical signs of pneumoperitoneum, peritonitis, or intestinal ischemia, colonoscopy was the next step. It is recommended that sigmoid detorsion be performed as part of colonoscopy. This procedure may relieve or resolve clinical symptoms, allowing the patient to prepare for semielective surgical revision [14-18].

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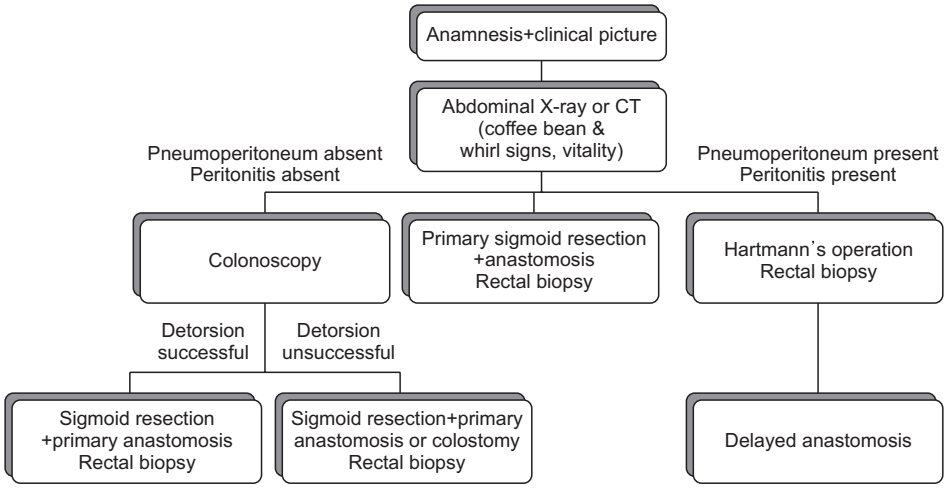

Fig. 5. Diagnostic and therapeutic management scheme.
CT: computed tomography.

After successful colonoscopic detorsion, it is essential to evaluate the viability of the derotated sigmoid gland and leave the decompression flatus tube in situ. This prevents volvulus recurrence and allows for further decompression of the colon [19]. Early sigmoid resection should be offered to pediatric patients after successful endoscopic detorsion to prevent the recurrence of volvulus. Ideally, surgery should be performed as soon as possible during hospital stay [20].

If endoscopic detorsion is unsuccessful, the child should be referred for acute surgical exploration with manual detorsion and resection of the affected colon. A short median laparotomy was conducted to gain access to the patient's abdominal cavity. This allowed the surgeon to perform the detorsion procedure, assess the condition of the de-rotated dolichosigmoid, and perform resection with the creation of a primary anastomosis. In cases where sigmoid volvulus with signs of bowel ischemia is discovered intraoperatively, the recommended management is the same as that for volvulus with pneumoperitoneum and peritonitis (see below for details).

In our patient, intraoperative assessment of bowel viability and resection margins was performed using indocyanine green fluorescence angiography. ICG (Verdye, 5 mg/mL) was intravenously administered at a dose of 0.1 mg/kg. Intestinal perfusion was evaluated 30 second after ICG administration. Fluorescence angiography provides an objective assessment of bowel vitality, which is critical in the decision-making process regarding primary anastomosis in the acute surgical setting and potential concerns regarding the viability of the affected bowel segment [21]. To the best of our knowledge, this is the first report on the utility of fluorescein angiography in the assessment of sigmoid viability after detorsion in pediatric surgery.

The surgical procedure for patient #1 was conducted almost two decades ago by senior colleagues, and the approach adopted reflects the standard practices and individual preferences of the operating surgeon at that time. Conversely, the procedure for patient #2 demonstrated the evolution of our surgical approach, informed by the experience accumulated over the past two decades. This includes the integration of modern technologies, such as indocyanine green fluorescence angiography, which has enhanced our

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ability to evaluate intestinal viability and optimize surgical outcomes. Objective verification of intestinal viability using ICG was the main reason why resection with primary anastomosis was performed in patient #2.

Sigmoid volvulus with pneumoperitoneum and peritonitis

Sigmoid volvulus with clinical signs of perforation, peritonitis, and septic shock has been reported in approximately 5–25% of adults with sigmoid volvulus [22,23]. Given the low incidence of sigmoid volvulus in the pediatric population, there are no data on the incidence of this disease in children.

The patient underwent an acute laparotomy after a short preoperative preparation. The aim of the preparation was to correct electrolyte imbalance and decrease the toxin load. Intraoperatively, resection of the devitalized bowel is conducted without detorsion and with minimal manipulation to prevent the release of endotoxins, potassium, and bacteria into the circulation and to prevent perforation of the colon [24,25]. The Hartmann procedure was the method of choice [26].

Hirschsprung disease and sigmoid volvulus

Approximately 10% of the children with sigmoid volvulus have a histologically confirmed diagnosis of Hirschsprung's disease [27]. Hirschsprung's disease is characterized by the absence of ganglion cells in the myenteric and submucosal plexuses (aganglionosis). This rare disorder results in progressive oral dilatation of the colon from the affected (aganglionic) bowel [28]. Hirschsprung's disease is diagnosed by histological examination of seromuscular samples obtained via rectal biopsy [29]. In children with sigmoid volvulus, a rectal biopsy should be conducted at the time of primary surgery [30].

It is generally recommended that centers specializing in the treatment of Hirschsprung's disease perform the surgical techniques with which they have the most experience, particularly regarding the management of postoperative complications and long-term follow-up. Current evidence does not indicate that a single approach is superior to others in terms of surgical complications or long-term bowel function [31]. Soave, Duhamel–Martin, and Swenson pull-through procedures remain the most well-established and widely practiced surgical techniques for this condition [32].

In conclusion, sigmoid volvulus should be considered in the differential diagnosis of acute abdominal pain, abdominal distension, flatus, and stool cessation in children. Special attention should be paid to children with neurological or psychiatric disorders or a history of chronic obesity. The first and most helpful imaging modality is native abdominal radiography in the anteroposterior projection.

Given the high risk of recurrence, early sigmoid colon resection and primary anastomosis are recommended. Rectal biopsy is an essential component of diagnostic algorithms because its results have a major impact on subsequent treatment strategies. ICG seems to be a promising method for the objective assessment of bowel viability in cases of doubtful viability.

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