## RESEARCH



# High-pressure distal colostogram in diagnosing anorectal malformations for male patients: our experience to get a high-quality image

Anxiao Ming<sup>1,2,3†</sup>, Yifeng Shao<sup>1,2,3†</sup>, Mei Diao<sup>1,2\*</sup>, Qi Li<sup>1,2</sup>, Xu Li<sup>1,2</sup> and Long Li<sup>1,2\*</sup>

## Abstract

**Objective** To summarize our experience with high-pressure distal colostogram (HPC) in diagnosing male anorectal malformations (ARMs) after colostomy.

**Method** A retrospective analysis was conducted on 103 male patients with anorectal malformations admitted to our hospital from January 2020 to June 2022. All children were found to have anal atresia after birth, with no obvious fistula in the perineum. A colostomy was performed 1–3 days after birth due to a suspected rectourethral fistula. A high-pressure distal colostogram was conducted on 98 patients who met the criteria and were included in this study. There were 68 cases of transverse colostomy, 13 cases of descending colostomy, and 17 cases of sigmoid colostomy. The average age is  $3.60 \pm 1.56(1.20-8.67)$  months. The type of anorectal malformation was confirmed during subsequent anorectoplasty.

**Results** 74 (75.5%) patients showed the rectal bladder fistula or rectourethral fistula through a high-pressure distal colostogram, including 14 cases of rectal bladder fistula, 23 cases of rectal prostatic fistula, 37 cases of recto-bulbar fistula. Three children (3.1%) showed tiny fistulas to the perineum and were identified as having rectoperineal fistulas. Twenty-one (21.4%) patients could not show the fistula during the colostogram. These patients were placed with a catheter into the bladder, the contrast was injected into the bladder then the high-pressure distal colostogram was conducted to determine the fistula. Ten children (10.2%) showed a tapered configuration at the distal rectal pouch's anterior aspect before the fistula protruded into the urethra. Based on the position of the fistula and the urethra, 2 cases of rectaurethral prostatic fistula and 8 cases of rectourethral bulbar fistula were determined. Seven cases (7.1%) had a distal rectum extended to the anterior urethra through a fistula and ended subcutaneously at the junction of the penis and scrotum, diagnosed as a rectoperineal fistula. Four patients showed no obvious abnormalities in

<sup>†</sup>Anxiao Ming and Yifeng Shao contributed equally to this work and should be regarded as co-first authors.

\*Correspondence: Mei Diao psps3001@hotmail.com Long Li lilong23@126.com

Full list of author information is available at the end of the article



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article are provide in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

the external genitalia, while three patients had skin depression at the junction of the penis and scrotum. Four cases (4.1%) presented a symmetrical blind distal rectum extending towards the anus, these were identified as imperforate anus without fistula. The type of anorectal malformation and the location of the rectourethral fistula shown in the colostogram were consistent with the confirmed results during subsequent anorectoplasty.

**Conclusion** In conclusion, a properly performed high-pressure distal colostogram combined with voiding cystourethrogram (VCUG) can identify the type of anorectal malformations and the location of the fistula in males.

Keywords Anorectal malformations, Male, High-pressure distal colostogram, Rectourethral fistula

## Introduction

Classifying Anorectal malformation (ARM) can be challenging due to the wide range of congenital anomalies. For most male patients, when they are diagnosed after birth, colostomies are often performed. Definitive surgical repair is usually performed at 6–8 weeks of age, or later, depending on the presence of associated congenital anomalies and the clinical status of the child [1].

Identifying the type and location of a fistula is crucial for surgeons to choose the appropriate surgical procedure for treatment. The surgical repair of these defects depends on the preoperative knowledge of the precise location of the rectum and the fistula, which is found in 95% of cases, anywhere from the perineum to the bladder neck. However, in children with Down syndrome, only 5% have a fistula [2]. The posterior sagittal approach is the most common method used for repairing these malformations. With this approach, surgeons can usually locate the rectum and its connection to the male urethra in 90% of cases. However, in the remaining 10% of cases, there is a rectobladderneck fistula. The rectum is positioned anterior to the sacrum and cannot be reached through the posterior sagittal approach. In such cases, laparotomy or laparoscopy is required to access the rectum [3]. Therefore, a precise preoperative assessment of the patient is crucial for ensuring optimal surgical correction.

The identification of the location of the fistula can help to prevent postoperative complications [4]. Postoperative complications and intraoperative damage to anatomical structures, such as the genitourinary tract, nerves, and muscles, may occur if the specific anatomy of the defect is not well clarified preoperatively and if the surgical approach is not adequately planned [5]. It is also essential to describe the level of rectal fistula accurately to compare similar anatomic cases across institutions, enabling a precise study of long-term functional outcomes at a multi-center level [6].

A high-pressure distal colostogram (HPC) can help to identify the presence or absence of any fistula, as well as the type and location of the fistula, which is crucial for determining the surgical approach, postoperative efficacy, and prevention of complications [7]. A properly done high-pressure distal colostogram can help visualize the key anatomical features, providing critical information necessary to plan for a definitive operation. It is of utmost importance to perform the exam adequately, and several studies have reported the detailed technique and pitfalls of high-pressure distal colostogram [6–11]. However, obtaining a high-quality image that provides sufficient information for subsequent treatment remains challenging. Shojaeian et al. reported that, concerning the type of fistula in patients who were confirmed to have a fistula during surgery (8 patients), three (37.5%) patients showed inconsistency with the intraoperative findings [12].

The purpose of this study is to summarize our experience with high-pressure distal colostogram in diagnosing male ARM at our center.

## **Materials and methods**

A retrospective analysis was conducted on 103 male patients with ARM admitted to our hospital between January 2020 and June 2022. All the patients were diagnosed with ARM during their initial examination after birth. During these examinations, no fistulas was detected in the perineum. They underwent colostomy treatment within the first three days after birth at another hospital before being referred to our center for definitive surgical repair.

A standardized and precise high-pressure distal colostogram was performed on 98 patients to confirm the type of ARM. The ARM and fistula location classification was based on the Krickenbeck classification [13], with findings verified during subsequent definitive surgical repair. For clarity, the stepwise diagnostic and therapeutic approach is delineated in Fig. 1.

This study was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). The study was approved by the Ethical Committee of Capital Institute of Pediatrics (SHERLL2024063), and informed consent was obtained from all subjects and their legal guardian(s)/parents.

## Statistical analysis

Patient data were examined and presented by descriptive statistics.



Fig. 1 Stepwise approach for clarity



Fig. 2 A, A 2-month-old child after transverse colostomy. Irrigate the distal colon through the stoma; B, Filling defect of the distal colon; C, Rectourethral bulbar fistula was demonstrated after bowel cleansing;

## High-pressure colostogram

The distal colon was irrigated through the stoma to wash out the residual meconium. A significant filling defect indicated that residual meconium still remained in the distal rectum. Further irrigation should be performed to wash out the meconium or stools, and the distal high-pressure colostogram should be performed again (Fig. 2).

The contrast agent was water-soluble (Iodopanol 18.5 g/50 ml, diluted twice). A radiopaque marker was placed in the perineum where the anal dimple is located.



Fig. 3 High-pressure colostogram, fistula with urethra and bladder visualized, showing rectourethral fistula (arrowed), **A**, ARM with rectobladderneck fistula, a 3-month-old boy; **B**, ARM with rectal prostatic fistula, a 2-month-old,21-days-old boy; **C**, ARM with rectourethral bulbar fistula, a 2-months-old,29-days-old boy;



Fig. 4 (A) A 3-month-old, 18-day-old boy, a tiny thready fistula connecting the end of the rectum and the base of the penis subcutaneously (arrowed); (B) 2-month-old, 9-days-old boy, with the end of the rectum extending forward ending subcutaneously at the base of the penis (arrowed); (C) cutaneous opening at the root of the penis

The procedures of HPC were performed according to the previous reports [6, 8, 9] (Fig. 2B).

When only the bladder or distal part of the urethra could be visualized after HPC, we catheterized the bladder through the urethra and filled it with contrast. This allowed us to visualize the bladder and urethra and continue the HPC to show the relationship of the fistula with the bladder and urethra (Fig. 3A-C).

A rounded appearance of the distal rectal pouch suggests adequate pressure. When there is no fistula, this rounded appearance persists, and the symmetrical distal blind rectum extends towards the anus dimple (Fig. 4).

When a fistula is present, usually there is a tapered configuration at the anterior aspect of the distal rectal pouch before filling the fistula and opacification of the bladder or urethra (Fig. 5) [6].

In cases in which there was no communication with the urethra, we also catheterized the bladder via the urethra and filled the bladder with contrast. When the bladder and urethra were visualized, we could define the relationship between the region of the fistula and the urethra according to the tapered configuration at the distal rectal pouch.



**Fig. 5** A 2-month-old,15-days-old boy, the rectourethral fistula was not visualized after HPC. A tapered configuration at the anterior aspect of the distal rectal pouch indicated the location of the fistula and the recto-bulbar fistula was diagnosed



Fig. 6 A 2-month-old, 18-day-old boy with rectal perineal fistula

### Results

The patient's average age was  $3.60 \pm 1.56$  (1.20–8.67) months. There were 68 cases of transverse colostomy, 13 cases of descending colostomy, and 17 cases of sigmoid colostomy.

Seventy-four (75.5%) patients identified the location of the fistulas through a high-pressure distal colostogram, which showed the rectal bladder or rectourethral fistula. The urinary tract was visualized, and both the bladder and urethra appeared to be filled with contrast, including 14 cases of rectal bladder fistula, 23 cases of rectal prostatic fistula, and 37 cases of recto-bulbar fistula.

Three children (3.1%) showed tiny fistulas on the skin at the anal dimple and were diagnosed with rectal cutaneous fistula (Fig. 6).

Twenty-one (21.4%) patients could not visualize the fistula during the colostogram. For these patients, the contrast was injected into the bladder, and a voiding cystourethrogram (VCUG) was performed. After the bladder and urethra were visualized, ten children (10.2%) showed a tapered configuration at the anterior aspect of the distal rectal pouch before the fistula protruded into the urethra. Based on the position of the fistula and the urethra, 2 cases of rectal prostatic fistula and 8 cases of recto-bulbar fistula were diagnosed. (Fig. 5)

Seven patients (7.1%) had a thready fistula extending to the base of the penis, diagnosed as a rectoperineal fistula (Fig. 4A, B). Four out of these patients showed no obvious cutaneous openings at the root of the penis, while three patients had concavities at the end of the fistula (Fig. 4C).

Four cases (4.1%) showed a symmetrical blind distal rectum extending towards the anus; these were identified as imperforate anus without fistula (Fig. 7).

The type of anorectal malformation and the location of the rectourethral fistula shown on the colostogram are consistent with the confirmed results during subsequent definitive surgical repair (Table 1).

## Discussion

All the cases in our series can identify the fistula's presence, type, and location after a well-executed high-pressure distal colostogram. High pressure is essential in the high-pressure distal colostogram procedure. Significant hydrostatic pressure is required to overcome rectal muscle tone by occluding the distal stoma with a balloontipped catheter and applying traction during the injection [6]. When the contrast material is instilled through a catheter without a balloon, or through a catheter with an inflated balloon outside the stoma, it often results in leakage of the contrast material out of the stoma. To ensure a tight seal and avoid leakage, after introducing a Foley catheter through the distal stoma, inflate the balloon and gently pull back to make sure the seal is tight. This step is crucial for obtaining high pressure in the distal pouch [6].



Fig. 7 ARM with no fistula, HPC showing the blind end of the rectum toward the anal dimple without fistula or a tapered configuration at the anterior aspect of the distal rectal pouch

Table 1	Types type and	proportion of	f anorectal malformations	
---------	----------------	---------------	---------------------------	--

Туре	Number of	Ratio(%)
	cases	
Rectobladderneck fistula	14	14.3
Rectourethral prostatic fistula	25	25.5
Rectourethral bulbar fistula	45	45.9
Rectal cutaneous fistula (subcutaneous at the root of the penis)	7	7.1
Rectal cutaneous fistula (anal dimple)	3	3.1
Imperforate anus without fistula	4	4.1
Total	98	100%

Water-soluble contrast should be selected as the contrast agent, and barium should be avoided. After the colostogram, the barium is not conducive to displaying the rectourethral fistula and is not easy to wash out.

It is essential to make sure that there is no meconium obstruction in the distal colon. We suggest irrigating the distal colon through the stoma to wash out the residual meconium to make it easier to show the fistula. If a significant filling defect is found in the distal end of the rectum after imaging, it indicated that there is still residual meconium in the distal rectum. Further irrigation should be performed to wash out the meconium or stools, and the distal high-pressure colostogram should be performed again. Therefore, washing out the meconium before the colostogram is crucial to displaying the rectourethral fistula.

The location of the colostomy can impact the results of imaging. For patients with transverse colostomy, there is difficulty in washing and cleaning the meconium at the distal colon, which results in residual meconium left in the distal colon. Under these conditions, the contrast agent was unable to pass through the rectourethral fistula, and the distal end of the rectum could not be visualized, leading to the possibility of misdiagnosing a low-type fistula as a high-type one. The most favorable location for a colostomy is the descending colon or the proximal end of the sigmoid colon. This location helps clear the meconium in the distal colon, making it easier to capture distal high-pressure images. Additionally, it ensures that there is enough length for the distal colon to be pulled out through the perineum during anorectoplasty [14]. In this study, 71 children (69%) underwent a transverse colostomy after birth, which may cause the failure of high-pressure colostogram.

In certain cases, children may be fitted with a loop colostomy instead of a separate one. However, this can result in feces passing into the distal colon and collecting at the distal end of the stoma. Such a situation can compromise the accuracy of high-pressure distal colostogram and trigger recurrent urinary tract infections. Therefore, when deciding to perform a colostomy, a divided colostomy is recommended.

In some cases, the contrast in the distal colon could not pass through the fistula to the bladder or urethra despite sufficient pressure. To address this, we catheterized the bladder via the urethra and filled it, allowing us to image both the bladder and urethra. This helped us define the relationship between the region of the fistula and the urethra, based on the tapered configuration at the distal rectal pouch. In this condition, voiding cystourethrogram is also recommended [6]. While maintaining the pressure in the distal colon, voiding images of the bladder and urethra can help to locate the fistula. However, keeping the pressure of the distal colon is usually difficult when the patient is voiding.

Although a cystogram can offer more detailed information, it is an invasive examination. Ensuring patient safety and preventing complications, such as urinary tract infections (UTIs), is essential. Operators must follow strict handwashing protocols to reduce microbial contamination, using sterile gloves and drapes during the procedure. The area where the catheter will be inserted should be cleaned with an antiseptic solution, such as povidone-iodine or chlorhexidine. After the procedure, remove the catheter as soon as possible to prevent prolonged exposure of the urethra and bladder to potential bacteria. It is essential to keep the patient well-hydrated before and after the procedure to promote frequent urination, which can help flush out any potential bacteria in the urinary tract.

When there is no fistula, this rounded appearance of the distal rectal pouch persists, and the distal rectum extends towards the anal without the tapered configuration towards the urethra. Four cases (4.1%) presented a symmetrical blind distal rectum extending towards the anus; these were identified as imperforate anus without fistula. In previous studies, only 5% of cases without Down syndrome had a blind rectal pouch without a fistula. The location of the distal end is lower than the level of the bulbar urethra.

The cutaneous perineal fistula is the simplest type of ARM, with the lowest part of the rectum opening anterior to the sphincter. This condition can manifest in various ways in males. A midline fistula may appear anywhere from the base of the penis to the midline raphe, or just anterior to the center of the sphincter. During the study, it was found that 7 cases (7.1%) had a thready fistula that connected their distal rectal end to the base of the penis subcutaneously. Without high-pressure colostogram, the tiny distal fistula may not be distinguishable and could be misdiagnosed as a rectourethral bulbar fistula or as having no fistula. The posterior sagittal approach is the most common method for repairing these malformations. For children with a lower position of the blind end of the rectum, radical operation can also be performed through the perineum.

Three patients were diagnosed with rectal perineal fistulas, each having tiny openings just anterior to the

center of the sphincter. However, the tiny openings were not found after birth and a colostomy was performed. For these patients, the radical operation could also be performed through the perineum after birth, avoiding colostomy. Therefore, for children with anal atresia, a careful perineal examination is important.

This study has the following limitations: 1, The pressure for high-pressure distal colostogram was determined based on the distal rectum's morphology, without using instruments to measure the contrast pressure. Further research is needed to quantitatively measure the pressure in the distal rectum to facilitate the application of this technique. 2, The location of the colostomy was not standardized, which may have affected the contrast imaging results.

In conclusion, a properly performed high-pressure distal colostogram combined with VCUG can identify the type of anorectal malformations and the location of the fistula in males.

#### Author contributions

AM and YS contributed equally to this paper, listed as co-first authors, who conducted the data collection and wrote the paper. MD conducted an analysis of the data. QL and XL QL and XL reviewed and revised the first draft. LL has oversight and leadership responsibility for the research activity planning and execution, including mentorship external to the core teams.

#### Funding

The project is supported by the Research Unit of Minimally Invasive Pediatric Surgery on Diagnosis and Treatment, Chinese Academy of Medical Sciences 2021RU015, Beijing Hospital Authority's Ascent Plan, Code: DFL20221101.

#### Data availability

The datasets generated and/or analyzed during the current study are not publicly available due to the protection of personal privacy but are available from the corresponding author on reasonable request.

#### Declarations

#### Ethics approval and consent to participate

This study was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki). The study was approved by Ethical Committee of Capital Institute of Pediatrics (SHERLL2024063) and informed consent was obtained from all subjects and informed consent was obtained from all subjects and their legal guardian(s)/parents.

#### **Consent for publication**

All subjects and their legal guardians/parents have been informed that the manuscript contains personally relevant details and recognizable images. All subjects and their legal guardians/parents have given written informed consent for the release of their personal or clinical details and any recognizable images in this study.

#### Competing interests

The authors declare no competing interests.

#### Author details

<sup>1</sup>Department of Pediatric Surgery, Capital Institute of Pediatrics, Beijing 100020, China

<sup>2</sup>Research Unit of Minimally Invasive Pediatric Surgery on Diagnosis and Treatment, Chinese Academy of Medical Sciences2021RU015, Beijing 100730, China

<sup>3</sup>Peking Union Medical College, Chinese Academy of Medical Sciences, Beijing 100730, China Received: 18 September 2024 / Accepted: 5 March 2025 Published online: 21 March 2025

#### References

- Wood RJ, Levitt MA. Anorectal malformations. Clin Colon Rectal Surg. 2018;31(2):61–70.
- Torres R, et al. Anorectal malformations and Down's syndrome. J Pediatr Surg. 1998;33(2):194–7.
- 3. Levitt MA, Pena A. Anorectal malformations. Orphanet J Rare Dis. 2007;2:33.
- Bischoff A, Bealer J, Pena A. Controversies in anorectal malformations. Lancet Child Adolesc Health. 2017;1(4):323–30.
- Pathak M, Saxena AK. Postoperative complications following laparoscopic-assisted anorectoplasty: a systematic review. Pediatr Surg Int. 2020;36(11):1299–307.
- Kraus SJ, Levitt MA, Peña A. Augmented-pressure distal colostogram: the most important diagnostic tool for planning definitive surgical repair of anorectal malformations in boys. Pediatr Radiol. 2018;48(2):258–69.
- 7. Ralls M, et al. Radiology of an orectal malformations: what does the surgeon need to know? Semin Pediatr Surg. 2020;29(6):150997.
- Halleran DR, et al. A call to arms: accurate identification of the anatomy of the rectourethral fistula in anorectal malformations. J Pediatr Surg. 2019;54(8):1708–10.

- Abdalla W, De La Torre L. The high pressure distal colostogram in anorectal malformations: technique and pitfalls. J Pediatr Surg. 2017;52(7):1207–9.
- 10. Rahalkar MD, Rahalkar AM, Phadke DM. Pictorial essay: distal colostography. Indian J Radiol Imaging. 2010;20(02):122–5.
- Mickelson JJ, MacNeily AE, Blair GK. The posterior urethra in anorectal malformations. J Pediatr Surg. 2007;42(3):585–7.
- Shojaeian R, et al. Evaluating the utility of cystoscopy, distal colostography, and sonography for locating the fistula in patients with anorectal malformation: a case series. Ann Med Surg (Lond). 2023;85(5):1436–41.
- Holschneider A, et al. Preliminary report on the international conference for the development of standards for the treatment of anorectal malformations. J Pediatr Surg. 2005;40(10):1521–6.
- 14. Bischoff A, et al. Error traps and culture of safety in anorectal malformations. Semin Pediatr Surg. 2019;28(3):131–4.

## **Publisher's note**

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.