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Diagnostic accuracy of ascending cystourethrogram for localising recto-urinary fistulas in non-colostomized male neonates with high anorectal malformations: Cairo University paediatric surgery experience

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Abstract

Background Accurate preoperative identification of recto-urinary fistulas in male neonates with high anorectal malformations (ARMs) is essential for surgical planning, especially when considering single-stage repair. The ascending cystourethrogram (ACU) provides a simple, minimally invasive approach that eliminates the need for a preliminary colostomy. This study explored the feasibility and early clinical value of ACU in defining recto-urinary fistula anatomy in selected neonates.

Methods This prospective study included 35 male neonates with high ARM who underwent ACU before definitive repair. The presence and level of recto-urinary fistulas were recorded and compared with intraoperative findings. When imaging did not demonstrate the fistula, distal colostography was performed to confirm the diagnosis.

Results ACU identified recto-urinary fistulas in 30 of 35 neonates (85.7%; 95% CI: 70.6–94.1%). Detected fistulas included recto-bladder neck (14.3%), recto-prostatic (42.9%), and recto-bulbar (28.6%) types. In five cases (14.3%), a fistula was not visualised on ACU; however, distal colostogram confirmed the diagnosis in four. Relative to intraoperative findings, ACU demonstrated a sensitivity of 85.7% and a positive predictive value of 100%.

Conclusion ACU is a reliable, minimally invasive, and readily available technique for early localisation of recto-urinary fistulas in male neonates with high ARM, demonstrating close correlation with intraoperative findings. It can be safely performed within the first 24 h of life, enabling prompt anatomical assessment and supporting the appropriate selection of candidates for single-stage repair. These findings reinforce ACU's role as a practical first-line diagnostic tool in the management of high anorectal malformations.

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Background

Congenital recto-urethral fistula (RUF) is the most common form of anorectal malformations (ARMs) found in boys [1]. Differentiating RUF from lower fistulas, such as recto-bulbar connections, is often challenging in the neonatal period and requires a reliable imaging technique to accurately delineate the anatomy of the distal rectal pouch and its communication with the urinary tract.

There has been a growing trend toward single-stage definitive repair of complex ARMs, such as the one-stage laparoscopic-assisted anorectal pull-through (OSLAARP) [2]. The main limitation of this approach, however, is the lack of information about whether a recto-urinary fistula is present and, if so, its exact level. Accurate preoperative localisation of the fistula is crucial for planning such procedures.

Performing a colostomy in the neonatal period provides safe access for distal colostography. It helps prevent complications, such as inadvertent passage of faecal material through the fistula during anal contrast injection, which could result in urinary contamination, infection, or fistula injury. Several diagnostic modalities have been evaluated for this purpose, including ascending cystourethrogram (ACU), high-pressure colostogram [3], MRI [4], cystoscopy [5], and transperineal ultrasound [6]. Among these, ACU stands out as a simple, minimally invasive, and cost-effective technique. This study evaluated 35 male neonates to assess the effectiveness and diagnostic accuracy of ACU in detecting recto-urinary fistulas and determining their anatomical level.

Methods

This prospective study enrolled 35 male neonates with a confirmed diagnosis of high anorectal malformation who were clinically stable following initial resuscitation and scheduled to undergo OSLAARP. The study excluded female neonates, males with low anorectal malformations, patients with major associated anomalies precluding surgery, those with hemodynamic instability that prevented imaging, individuals with prior definitive anorectal surgery, and patients with incomplete imaging or operative records. The institutional review board approved the study, and the parents or legal guardians of all neonates provided written informed consent before participation. Following resuscitation and laboratory investigations, the neonate was prepared for the ACU study. The ACU findings were then compared with intraoperative observations and, in cases where the fistula was not visualised, with distal colostogram results.

Fig. 1 A patient in the lateral decubitus position for the Ascending Cystourethrogram (ACU)

The team commenced antibiotics (co-amoxiclav and metronidazole) before and after contrast instillation. The following equipment was used (radio-opaque contrast Urografin 76% (Amidotrizoate meglumine; Sodium amidotrizoate), fluoroscopic X-ray machine, 6 Fr Nelaton catheter, and 50 ml syringe). The contrast was diluted by 50% with injectable normal saline. The patient was positioned in the lateral decubitus position (Fig. 1) with the hips and knees flexed. The fluoroscopic C-arm was placed over the patient's pelvis.

Without general anaesthesia, the operator cleaned the glans penis and the urethral meatus with a sterilising solution. The catheter was then placed just inside the urethral meatus, with caution not to over-insert it. The contrast medium was injected through the catheter under controlled pressure to visualise the urinary tract and any fistulous communication, using dynamic fluoroscopy. The operator gently stretched the penis and manually occluded the urethral meatus to prevent contrast medium leakage. The images were reviewed in real time by the performing surgeon. The study was considered negative when the images showed no fistula.

Data were analysed using descriptive statistics. Categorical variables, including the presence and anatomical level of recto-urinary fistulas, were summarised as frequencies and percentages. The team assessed ACU's diagnostic performance using sensitivity and positive predictive value, referencing intraoperative findings as the standard. Specificity and negative predictive value could not be reliably calculated because no true-negative cases were present in this cohort of patients with high anorectal malformations.

Results

The study successfully identified recto-urinary fistulas in 30 of 35 cases (85.7%; 95% CI: 70.6–94.1%), while five cases (14.3%) showed no visible fistulous communication on ACU. Using intraoperative findings as the reference standard, ACU demonstrated a sensitivity of 85.7% (95% CI: 70.6–94.1%) and a positive predictive value of 100%

(95% CI: 88.4–100%). Specificity and negative predictive value could not be calculated because there were no true-negative cases in this cohort; all patients had high anorectal malformations.

Among the visualised cases, five (14.3%) had recto-bladder neck fistulas (Fig. 2A), 15 (42.9%) had recto-prostatic fistulas (Fig. 2B), and 10 (28.6%) had recto-bulbar fistulas (Fig. 2C). The team performed colostomies in the five cases in which ACU did not demonstrate the fistula, enabling further anatomical assessment and staged repair. In one case, neither the ACU nor the distal colostogram identified the fistula; however, intraoperative PSARP revealed a small recto-bulbar fistula.

Discussion

This prospective study demonstrates that ACU can identify the presence and anatomical level of recto-urinary fistulas in a substantial proportion of non-colostomized male neonates with high anorectal malformations. In our cohort, ACU successfully detected a fistula in 85.7% of patients. These results suggest that ACU is a feasible and informative early imaging modality in selected neonates, particularly when early anatomical definition is required to guide surgical planning.

Accurate identification of fistula level remains a key determinant in selecting candidates for OSLAARP. Several diagnostic modalities have been described for this purpose, including cystoscopy, distal colostogram, VCUG, MRI, and transperineal ultrasound [3–8]. In a study of a comparable patient cohort, cystoscopy achieved the highest accuracy at 70%, followed by distal colostogram (66%) and VCUG (58%) [3]. More recently, a 2023 study reported that high-pressure distal colostogram provided greater accuracy than MRI in defining fistula type among males with ARMs after colostomy, although this approach requires prior diversion and multiple imaging procedures, which can delay definitive repair [4]. While cystoscopy allows direct visualisation, it can still miss up to half of fistulas on initial assessment and carries a risk of urethral trauma even when repeated [6]. Transperineal ultrasound offers a noninvasive alternative, but its accuracy is highly operator-dependent and may be limited by patient anatomy and fistula complexity; small studies suggest it can enable one-stage repair in selected neonates, but broader applicability remains uncertain [7, 8].

In contrast, ACU offers distinct advantages in the immediate neonatal period: it requires no sedation or general anaesthesia, uses readily available equipment, incurs minimal cost, and provides real-time dynamic fluoroscopic visualisation of the urinary tract and any fistulous communication. Performed within the first 24 h of life in stable neonates, it enables early assessment without preliminary colostomy, potentially facilitating single-stage repair in appropriately selected cases while avoiding colostomy-related morbidity. When ACU is inconclusive, escalation to high-pressure distal colostogram, MRI, or cystoscopy remains appropriate for definitive evaluation. Patients presenting with sepsis, severe distension, or instability are better managed with a staged approach. Figure 3 outlines a proposed diagnostic algorithm incorporating ACU as the initial modality in our practice. While these single-center findings are encouraging, larger multicenter studies are needed to further validate ACU's role and generalisability in the management of high anorectal malformations.

Although accurate fistula identification is essential for OSLAARP, significant bowel distension often presents a technical challenge. In our practice, bowel decompression was achieved by performing sigmoidostomy to decompress the distal rectal pouch, which was then closed primarily by the end of the procedure. Adjunctive techniques, such as transperineal intracath meconiolysis and evacuation (TIME) [9] and intraoperative bowel evacuation methods [10], may further improve laparoscopic access and operative conditions in centers pursuing neonatal OSLAARP. These methods merit consideration and additional evaluation to enhance the safety and feasibility of single-stage procedures in high anorectal malformations.

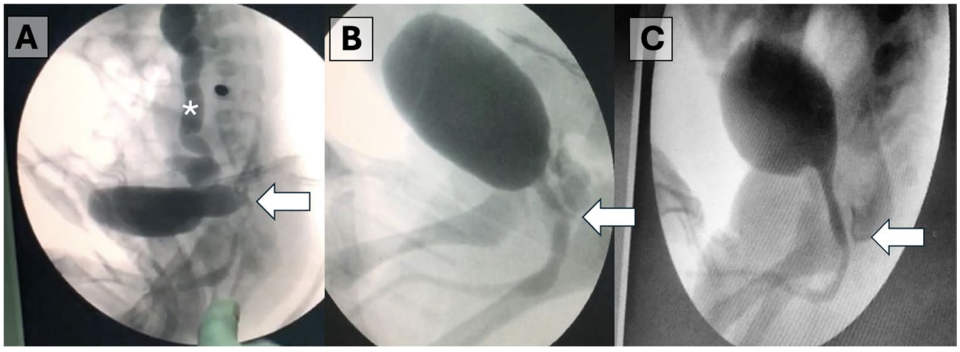

Fig. 2 Ascending Cystourethrogram (ACU) images demonstrating different types of recto-urinary fistulas (arrows): **A** recto-bladder neck with associated megaurethra (*), **B** recto-prostatic fistula, **C** recto-bulbar fistula

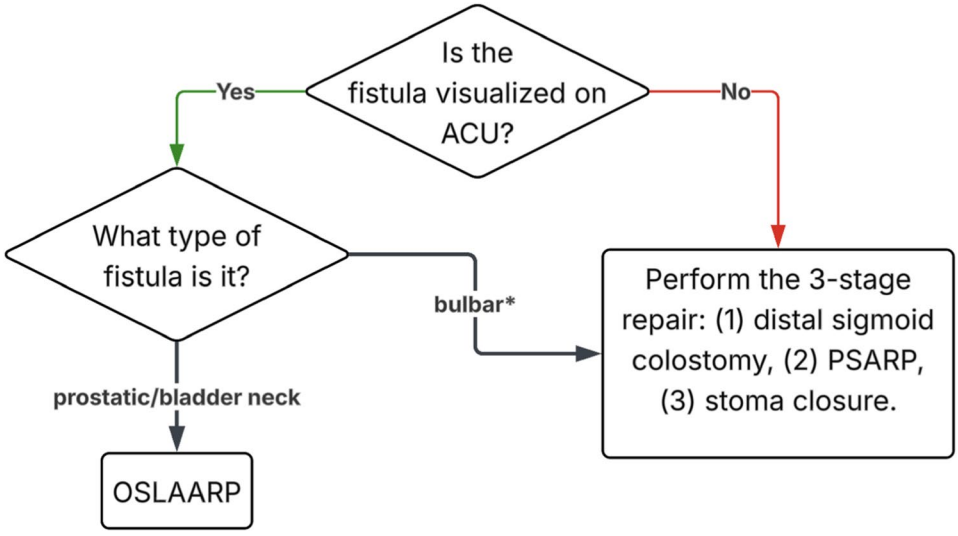

Fig. 3 Diagnostic algorithm showing the role of ACU in determining the appropriate surgical strategy for male neonates with high anorectal malformation. When a prostatic or bladder neck fistula is visualised, the team performs OSLAARP; for bulbar or non-visualised fistulas, they follow a three-stage approach. (*) Bulbar fistulas can be managed either in a staged or single stage posterior sagittal anorectoplasty (PSARP) depending on the institution's experience

This prospective study has several limitations. The sample included only 35 clinically stable, non-colostomized male neonates with high anorectal malformations on their lateral decubitus abdominal Xray, which allowed safe early ACU and OSLAARP consideration. Because all patients had high ARMs, no true-negative cases were present, making it impossible to calculate specificity, negative predictive value, or overall accuracy. No formal sample size calculation was performed, as the study was exploratory and recruitment was constrained by the rarity of eligible stable cases in a single-center setting. The exclusion of unstable neonates, those with sepsis and delayed presentation more than 48 h, was done to prioritize safety, but it naturally limits how broadly the findings apply to all newborns with anorectal malformations.

No standardized direct comparison with other imaging methods was conducted within the same patients. This decision avoided adding extra procedures or risk in stable neonates but means the results cannot be directly ranked against high-pressure colostogram, VCUG, or ultrasound. Verification was selective rather than uniform. ACU-positive cases underwent intraoperative confirmation during OSLAARP, whereas ACU-negative cases received distal colostogram, which may introduce verification bias. Image interpretation occurred in real time by the operating surgeon to support immediate planning, which matches normal clinical workflow but does not allow blinded review or measurement of observer variability.

Despite these constraints, ACU demonstrated consistently high detection rates, providing meaningful early anatomical information that may support surgical planning in selected neonates. Rather than replacing established investigations, ACU can serve as a practical initial diagnostic step, guiding further imaging or operative strategy. Larger, multicenter studies with standardized comparative modalities, blinded interpretation, and robust diagnostic validation are needed to clarify its precise role in the management of anorectal malformations.

Conclusion

ACU is a reliable, minimally invasive, and readily available technique for preoperative localisation of recto-urinary fistulas in non-colostomized male neonates with high ARM. In our series, it accurately identified the fistula level in most cases, providing crucial anatomical detail for surgical planning while avoiding the risks, costs, and delays associated with colostography or other complex imaging methods. ACU can be safely performed within the first 24 h of life, allowing early and accurate identification of recto-urinary fistulas. This early anatomical definition supports the safe selection of candidates for single-stage repair. These findings reinforce ACU's value as a practical first-line diagnostic tool in the management of high anorectal malformations.

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his memory, in recognition of his enduring contributions and inspirational leadership.

Authors' contributions
H.E. and A.F. conceived and designed the study. A.A. collected the clinical and imaging data. A.A. and U.Z. performed the data analysis and interpretation. A.A. and U.Z. prepared the manuscript, figures and illustrations. All authors critically revised the manuscript and approved the final version for submission.

Data availability
The data supporting the findings of this study were generated in the Pediatric Surgery Department at Cairo University and include clinical, imaging, and intraoperative data from neonates with high anorectal malformations. Due to the sensitive nature of patient data and ethical restrictions, the datasets are not publicly available. De-identified data are available from the corresponding author upon reasonable request and with appropriate institutional approval.

Declarations

Competing interests
The authors declare no competing interests.

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