American Journal of Emergency Medicine 79 (2024) 12–18

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Diagnosis and treatment strategies for pediatric urogenital tract foreign bodies: A retrospective study

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ARTICLE INFO

Article history:
Received 28 November 2023
Received in revised form 26 January 2024
Accepted 31 January 2024

Keywords:
Foreign bodies
Urogenital tract
Cystoscope
Vaginoscope
Pneumovesicum laparoscopy

ABSTRACT

Background: Foreign bodies in the pediatric urogenital tract are rare but urgent clinical conditions that can cause severe symptoms and complications. The current management remains challenging.
Objective: This study aims to provide an in-depth understanding of the clinical characteristics, diagnostic challenges, and treatment strategies for pediatric urogenital tract foreign bodies. Through a retrospective analysis of patient data, valuable insights into the management of this condition are offered to facilitate the development of more effective management strategies.
Methods: A single-center retrospective study design was employed, reviewing clinical data of 30 pediatric patients with urogenital tract foreign bodies admitted to Anhui Children's Hospital from October 2016 to May 2023. This included 16 cases of urethral and bladder foreign bodies and 14 cases of vaginal foreign bodies. Among them, there were 14 males and 16 females, with a median age of 6.3 years. Treatment methods included transvaginal endoscopic removal, cystoscopic removal, pneumovesicum laparoscopy removal, and perineal incisional foreign body removal. Surgical time, blood loss, hospitalization days, and postoperative follow-up results were recorded.
Results: Key clinical presentations included vaginal bleeding, abnormal vaginal discharge, hematuria, dysuria, urinary retention, and perineal pain. Preoperative routine examinations included ultrasound, abdominal radiography, and, in some cases, CT scans. All 30 patients underwent successful surgery, with a median surgical time of 30.5 min (IQR 16.8–50.8), minimal intraoperative bleeding, and a median postoperative hospital stay of 2 days (IQR 2–3). Follow-up from 3 months to 1 year revealed no abnormalities in the urogenital system, no residual foreign bodies, and no occurrence of severe complications. No cases of recurrent foreign body insertion were observed.
Conclusion: Early diagnosis and treatment of pediatric urogenital tract foreign bodies are crucial to reduce patient suffering and the risk of complications. The choice of surgical method depends on the type, size, and location of the foreign body, with endoscopy being the preferred option. Laparoscopic cystoscopy and open surgery are also effective treatment modalities.

1. Introduction

Children's urogenital tract foreign bodies(FB) represent a relatively rare but urgent and challenging condition in clinical practice [1]. Children, driven by curiosity or accidents, may introduce foreign bodies into the urogenital tract [2]. Once these foreign bodies enter the urogenital tract, they can lead to urinary obstruction, infection, pain, vaginal bleeding, and long-term urogenital dysfunction [3,4]. Managing such cases requires special attention as it involves complex medical interventions and touches upon sensitive psychological and social aspects. While international research on adult urogenital tract foreign bodies is relatively extensive, studies specifically focusing on children are scarce [5,6]. Given the limitations in children's ability to articulate and their inherent shyness, the diagnosis and treatment of these cases may present additional challenges. Therefore, this study aims to concentrate on pediatric urogenital tract foreign bodies to enhance a systematic understanding of this issue and drive the development of more effective management strategies.

This study retrospectively analyzed clinical data from 30 pediatric patients with urogenital tract foreign bodies admitted to Anhui Children's Hospital between October 2016 and May 2023. It comprehensively summarized the clinical characteristics, diagnostic challenges,

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https://doi.org/10.1016/j.ajem.2024.01.042
0735-6757/

treatment strategies, and postoperative follow-up results of pediatric urogenital tract foreign bodies. By providing valuable insights, the study aims to optimize the management of pediatric urogenital tract foreign bodies, reduce discomfort in affected children, prevent complications, and thereby enhance the overall quality of life and health status of these pediatric patients.

2. Clinical data and methods

2.1. Clinical data

This study employed a single-center retrospective research design. We reviewed case data of 30 pediatric patients with urogenital tract foreign bodies treated at Anhui Children's Hospital from October 2016 to May 2023. Detailed clinical data are presented in Table 1, including 16 cases of urethral and bladder foreign bodies and 14 cases of vaginal foreign bodies. Among them, there were 14 males and 16 females, with ages ranging from 1.5 to 13 years and a median age of 6.3 years(IQR 3.9–11.7). Clinical manifestations of vaginal foreign bodies included vaginal bleeding, abnormal vaginal discharge, and lower abdominal pain, with a median age of 4.9 years(IQR 3.6–6.3). Urethral and bladder foreign bodies presented with hematuria, urinary pain, difficulty urinating, and perineal pain, with a median age of 11.7 years(IQR 6.2–12.4). The duration of foreign body placement ranged from the shortest at 8 h to the longest at 1 year. The median duration for urethral and bladder foreign bodies was 1 days(IQR 0.4–4.5), while for vaginal foreign bodies, it was 25 days(IQR 5.8–180), with 4 cases having a placement time exceeding six months. The types of foreign bodies included needles, magnetic beads, thermometers, batteries, children's toys, hairpins, grains of rice, cotton fibers, toothpicks, springs, etc. Preoperative routine examinations included ultrasound and abdominal plain films (Fig. 1–6), with additional CT (Fig. 7–8)and MRI when necessary. Preoperative diagnoses through ultrasound were made in 18 cases, 14 cases through abdominal plain films, and 4 cases through CT. These detailed clinical data are further summarized in Table 2.Our department's medical team, including the author, is dedicated to removing all foreign substances, ensuring the precision and reliability of this study.

Fig. 1. Abdominal X-ray indicates a urinary bladder foreign body, which is a thermometer.

Table 1
Detailed clinical data of patients.

No	Sex	Age	Location	Type	Symptom	Length of stay (d)	Operation method	Surgery duration	Post-op stay
1	M	2.2	Urethra	Needle	Pain	0.42	Cystoscope	73	4
2	M	11.7	Bladder	Magnetic bead	Hematuria	3	pneumovesicumr	48	3
3	M	6.1	Bladder	Thread knot	Hematuria	1	Cystoscope	41	1
4	F	1.5	Bladder	Rice grain	Parents found	1	Cystoscope	80	2
5	M	13.1	Urethra-Bladder	Thermometer	Dysuria	14	Open	29	7
6	M	13.1	Bladder	Wire	Hematuria	3	pneumovesicumr	25	7
7	M	12.6	Urethra	Toothpick	Pain	14	Open	59	3
8	M	11.8	Urethra	Needle	Pain	0.42	Cystoscope	125	2
9	M	12.2	Bladder	Magnetic bead	Dysuria	5	Cystoscope	61	2
10	M	12.2	Urethra	Magnetic bead	Dysuria	0.5	Cystoscope	21	3
11	M	6.4	Urethra	Needle	Pain	0.33	Open	7	2
12	F	2.4	Bladder	Rice grain	Pain	0.375	Cystoscope	40	2
13	M	11.7	Urethra	Magnetic bead	Painful hematuria	0.5	Cystoscope	43	1
14	M	11.0	Urethra	Needle	Pain	1	Open	17	2
15	M	12.4	Urethra-Bladder	Thermometer	Dysuria	0.42	Open	66	2
16	M	8.8	Urethra	Needle	Pain	7	Open	124	6
17	F	5.2	Vagina	Toy	Vaginal bleeding	2	Vaginoscope	42	2
18	F	2.8	Vagina	Sponge	Vaginal bleeding	15	Vaginoscope	11	3
19	F	3.9	Vagina	Cotton	Vaginal bleeding	30	Vaginoscope	14	1
20	F	10.2	Vagina	Hairpin, etc.	Vaginal discharge	180	Vaginoscope	30	2
21	F	5.0	Vagina	Cotton	Vaginal discharge	20	Vaginoscope	28	3
22	F	4.8	Vagina	Cotton	Vaginal discharge	10	Vaginoscope	15	3
23	F	7.1	Vagina	Toy	Vaginal bleeding	60	Vaginoscope	31	1
24	F	6.2	Vagina	Hairpin	Vaginal bleeding	180	Vaginoscope	16	2
25	F	3.2	Vagina	Glass ball	Parents found	1	Vaginoscope	15	3
26	F	3.7	Vagina	Battery, etc.	Pain	0.5	Vaginoscope	36	4
27	F	5.2	Vagina	Cotton ball	Vaginal discharge	90	Vaginoscope	19	1
28	F	4.8	Vagina	Toy	Vaginal discharge	180	Vaginoscope	37	2
29	F	3.4	Vagina	Battery	Pain	7	Vaginoscope	7	3
30	F	6.7	Vagina	Button	Vaginal bleeding	365	Vaginoscope	27	4

Note: Patient No. 20 had foreign objects including a metal hairpin, plastic pencil eraser, pebbles, and fruit peels. Patient No. 26 had foreign objects including a battery and a spring.

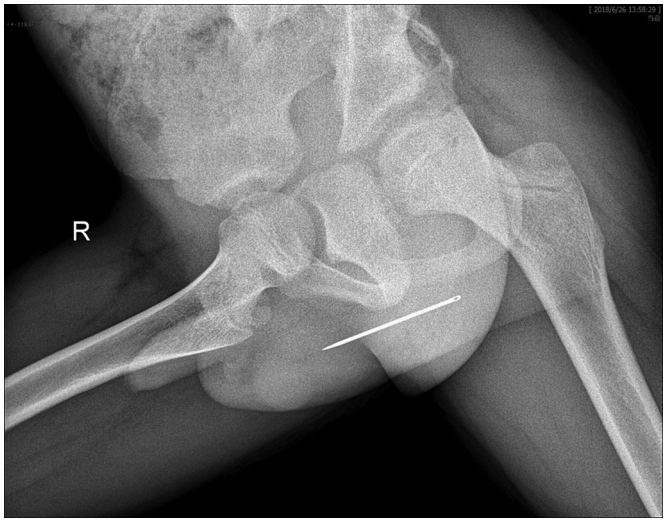

Fig. 2. Abdominal X-ray suggests a urinary bladder foreign body, which is a needle.

2.2. Therapeutic approaches

2.2.1. Surgical methods

All patients were planned for cystoscopy or vaginoscopy under general anesthesia. If the attempt to remove the foreign body via cystoscopy failed, pneumovesicum laparoscopy or open surgery was considered. Pneumovesicum Laparoscopy Surgical Procedure: A cystoscope was inserted through the urethra. Under cystoscopic guidance, four 2–0 absorbable sutures were used to suspend the top of the bladder. A small incision was made in the skin, and three trocars (two 5 mm and one 3 mm) were inserted under cystoscopic monitoring. CO2 was insufflated into the bladder through the trocars to maintain pressure.

Fig. 3. Abdominal X-ray suggests a urinary bladder foreign body, which is a wire.

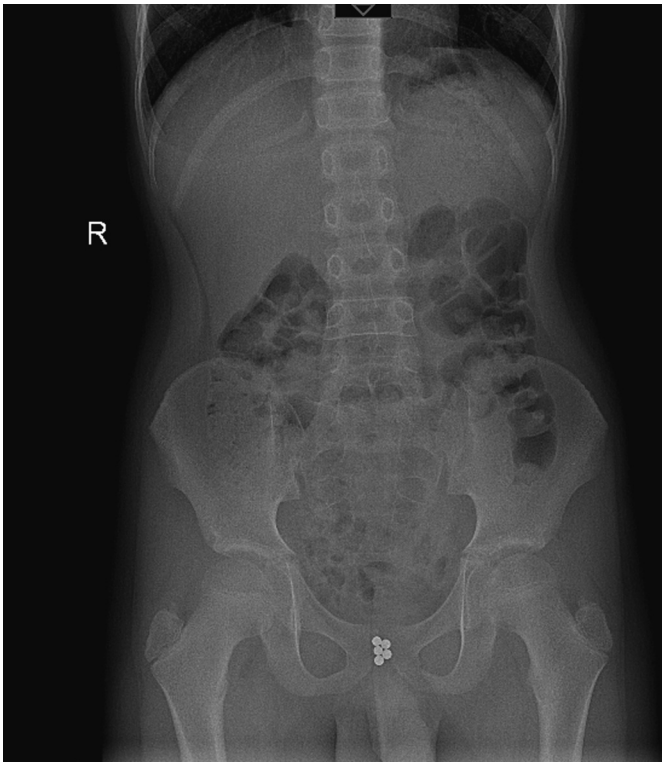

Fig. 4. Abdominal X-ray suggests a bladder foreign body, which is magnetic beads.

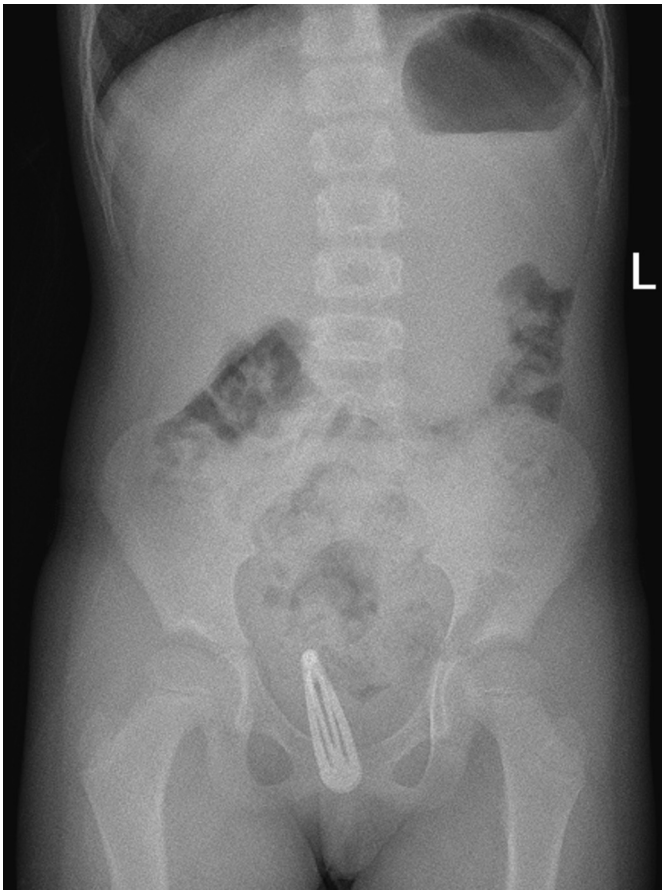

Fig. 5. Abdominal X-ray suggests a vaginal foreign body, which is a hairpin.

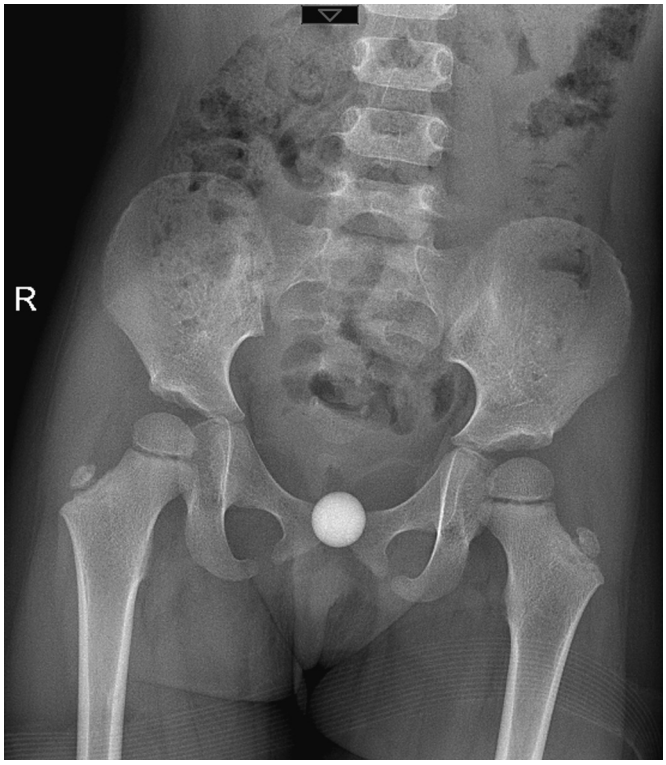

Fig. 6. Abdominal X-ray suggests a vaginal foreign body, which is a glass ball.

A laparoscope and graspers were then introduced, and the foreign body was extracted through the 5 mm trocar.

In our study, 14 cases with vaginal foreign bodies underwent transvaginal endoscopic removal. For urethral and bladder foreign bodies, 8 cases underwent cystoscopic removal, 2 cases underwent laparoscopic cystoscopic removal, 2 cases underwent perineal incisional foreign body removal, and 4 cases involved the foreign body protruding through the urethra, requiring perineal incisional foreign body removal.

2.3. Statistical analysis

The research data recorded in the study table during the study period were analyzed using SPSS 21.0 statistical software. The normality of discrete and continuous numerical variables was tested using the Kolmogorov-Smirnov test. Normally distributed metric data are presented as mean ± standard deviation, while skewed metric data are represented by the median (interquartile range, IQR, Q1-Q3) of the variable. Enumerated data are presented in the form of case numbers and percentages (%).

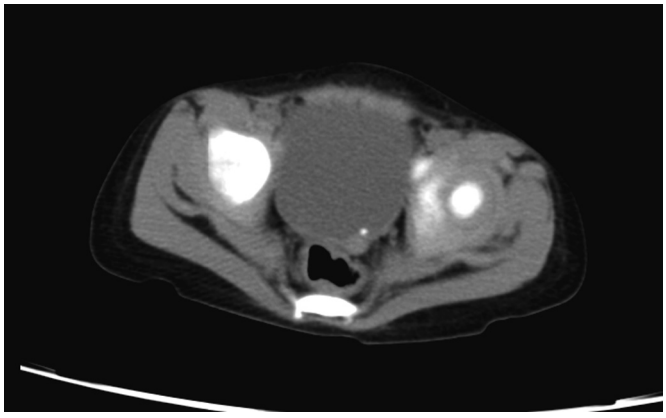

Fig. 7. CT scan indicates a bladder foreign body resembling grains of rice.

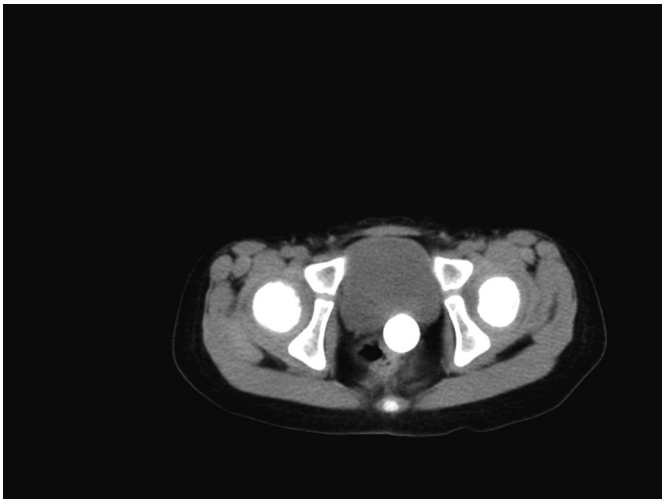

Fig. 8. CT scan indicates a vaginal foreign body, which is a glass ball.

3. Results

All 30 cases were successfully completed, with a median surgical duration of 30.5 min (IQR 16.8–50.8) and minimal intraoperative bleeding of 1 ml (IQR 0.5–1). The median postoperative hospital stay was 2 days (IQR 2–3), as detailed in Table 3. Urinary catheters were not retained for patients with vaginal foreign bodies, while for those with urethral and bladder foreign bodies, urinary catheters were retained postoperatively for an average duration of 8.0 ± 4.6 days. In endoscopic procedures, the catheter was removed within the first 1–7 days postoperatively, with an average duration of 4.6 ± 2.6 days. For perineal incisional procedures,

Table 2
Summarized clinical data of patients.

Median age, year	6.3(IQR 3.9–11.7)
Gender	
Male	14 (47%)
female	16 (53%)
Location	
Urethra	8 (27%)
Bladder	6 (20%)
Urethra-Bladder	2 (7%)
Vagina	14 (47%)
Symptoms	
Hematuria	4(13%)
Pain	10(33%)
Dysuria	2(7%)
Colporrhagia	6(20%)
Vaginal fluid	5(17%)
Asymptomatic (parent found)	2(7%)
Type of FBs	
Sewing needle	5(17%)
Magnetic beads	4(13%)
Thermometer	2(7%)
Battery	2(7%)
small toy	3(10%)
hairclip	2(7%)
paddy	2(7%)
cotton fibre	3(10%)
Other	20(10%)

Note: Others include buttons, toothpicks, cotton balls, springs, glass balls, thread knots, sponges.

Table 3
Surgical outcomes.

Median surgical time, min	30.5(IQR 16.8–50.8)
Median blood loss, mL	1(IQR 0.5–1)
Median postoperative hospital stay, days	2(IQR 2–3)
Urinary Tract FB Remove drainage pipe, days, mean ± SD	8.0 ± 4.6
Postoperative follow-up period, month, mean ± SD	7.8 ± 3.0

the catheter was retained for 7–14 days postoperatively, averaging 9.3 ± 3.3 days. In laparoscopic cystoscopy procedures, the catheter was retained for an average of 12 days, and for perineal urethral incisional procedures, the catheter was retained for an average of 15 days. The duration of catheter retention depended on the location, shape, and surgical approach to the foreign body.

Postoperative follow-up was conducted from 3 months to 1 year, with an average follow-up duration of 7.8 months. Some patients experienced mild urinary tract infections in the early postoperative period, but symptoms were relieved after antibiotic treatment. Ultrasonography revealed no abnormalities in the urogenital system, and during this period, no severe complications such as residual foreign bodies, urethral strictures, urethral or vaginal fistulas were observed. None of the patients experienced a recurrence of foreign body insertion.

4. Discussion

The occurrence of foreign bodies in the urogenital tract is indeed quite rare in clinical practice, especially in pediatric patients. FBs can consist of various substances such as magnetic beads, needles, hairpins, pencils, wires, button batteries, cotton swabs, etc. [7-9]. These FBs can be self-inserted, inserted by others, iatrogenic, migrated from adjacent organs, or a result of penetrating trauma [10,11]. In this study, all 30 cases involved self-inserted foreign bodies. The reasons for self-insertion differ significantly between adults and children. Adults may be influenced by sexual behavior, psychological disorders, self-harm, artistic expression, or substance abuse [12,13]. In pediatric cases, it is often due to curiosity, imitative behavior, play, emotional stress, self-exploration, or may indicate underlying mental health issues [14,15]. FBs are more common in girls aged 4–9, while in boys, they are more prevalent in adolescents [14].This is consistent with the age of the children in our study, as young girls with excess curiosity tend to explore all holes and may place various small objects in the vagina. We found that girls inserted into the vagina anything that was easily accessible with their hands, such as toys, button batteries and a small part of a hairpin. Foreign bodies in the urethra are seen in older boys, mostly inserted by the child himself or when seeking sexual gratification, and are mostly sewing needles, magnetic beads, thermometers, etc.The insertion of foreign bodies into the urogenital tract, regardless of age, poses extremely high risks and can lead to significant physical injuries. If these foreign bodies remain in the body for an extended period, they may cause various serious complications [16]. Therefore, early diagnosis and treatment are crucial for patients with urogenital tract foreign bodies.

Due to the diverse sizes, shapes, natures, and locations of urogenital tract foreign bodies, their clinical manifestations vary. Long, slender foreign objects such as metal needles or thermometers may become lodged in the urethra, while some small, round objects like magnetic beads could potentially fall entirely into the bladder.Bladder foreign bodies typically result in spasmodic abdominal pain, hematuria, a sense of incomplete urination, and urinary interruption. Compared to foreign bodies in the bladder, symptoms of urethral foreign bodies are more pronounced, including pain, difficulty urinating, blood in the urine, purulent discharge, urinary retention, or sepsis [17,18]. Vaginal foreign bodies may cause increased abnormal genital secretions or genital bleeding, and studies suggest they are a rare cause of increased genital secretions and bleeding in pre-adolescent girls [19]. The prolonged presence of foreign bodies can lead to the formation of stones or the generation of granulation tissue around the foreign body, resulting in recurrent urogenital tract infections, fistula formation, and even sepsis [20]. Sharp foreign bodies such as needles, toothpicks, and the like, may penetrate the urogenital tract and migrate to other areas. These foreign bodies can potentially travel between the digestive system and the urogenital system, leading to potential multi-organ damage [14]. Some foreign bodies contain chemical substances, such as button batteries, thermometers, etc., which may contain heavy metals like mercury, cadmium, and lead. When these objects enter the urogenital tract, they can cause mucosal corrosion and ulceration. Prolonged retention can lead to damage, perforation, and even heavy metal poisoning. Considering the nature of these symptoms and potential complications such as urogenital tract trauma, urethral stricture, pain, and complications associated with long-term foreign body retention such as infection, urogenital tract perforation, and sepsis, we recommend prompt assessment and intervention for the patient.

When diagnosing FBs in the urogenital tract, it is necessary to consider the patient's medical history, symptoms, clinical examinations, and imaging studies comprehensively. Sometimes, further specialized examinations may be required to ensure an accurate diagnosis. Young children, due to a lack of knowledge, fear, or embarrassment, often find it challenging to provide a clear history of foreign body implantation, adding to the diagnostic difficulty [21]. When dealing with pediatric patients, it is especially important to use patient and sensitive communication methods to better understand their situations. Key information includes the nature, size, length, quantity, and time of insertion of the foreign body to facilitate better diagnosis and treatment [22].Sharp or corrosive foreign bodies may cause mucosal rupture, leading to bleeding and painful symptoms, making early detection and diagnosis relatively easier. However, for some smaller, smooth, or disc-shaped foreign bodies, it may be challenging to cause noticeable symptoms in the early stages. Additionally, children may hide their medical history due to shame, making early detection and diagnosis even more challenging. In our study, seven cases had foreign bodies for more than one month, four cases for over six months, with the longest duration being one year. Therefore, in such cases, doctors need to conduct a more careful assessment and inquiry, relying on detailed medical history collection and more sensitive clinical observation to ensure timely detection and management.The preferred diagnostic auxiliary examination is ultrasound (B-mode), which is a non-invasive, radiation-free, and cost-effective method, considered safe and comfortable for pediatric patients [23]. A study indicated that ultrasound examination has an overall sensitivity of 81% in diagnosing urogenital FB [24]. In the case of urogenital foreign bodies, ultrasound can provide information about the location, size, nature of the foreign body, and the presence of other abnormalities in the urogenital system [25].Abdominal plain radiography is more intuitive for radio-opaque foreign bodies, allowing direct visualization of the shape and size of the foreign body. Its sensitivity for detecting abnormalities reaches up to 91% and is usually sufficient for locating and identifying metal and radio-opaque FB [24,26]. However, abdominal plain radiography is unreliable for detecting radio-opaque FB and exposes children to radiation. Ultrasonography is highly useful in diagnosing radio-opaque substances [27]. In our study, 26 cases of foreign bodies were considered preoperatively through ultrasound and abdominal plain radiography, with a diagnostic rate of 86.7%. CT scans can provide better soft tissue images and higher diagnostic value when ultrasound and abdominal plain radiography cannot determine the presence or displacement of foreign bodies [28]. We have four confirmed cases diagnosed through CT imaging.

For children with a clinically confirmed diagnosis or a high suspicion of urogenital system foreign bodies, surgical treatment should be considered early after thorough preoperative preparation to minimize damage to the urogenital tract [12]. Cystoscope, a widely utilized endoscopic tool in urology, features a clear light source and operational channel, making it the preferred instrument for diagnosing and ruling out various foreign bodies in the urogenital system [21].The clear goal of the surgery is to achieve the removal of foreign bodies with minimal

complications [14]. The treatment strategy for urogenital FBs depends on various factors, including the shape, nature, location, and size of the foreign body [29]. Specific methods include manual removal, endoscopic treatment, laparoscopic treatment, open surgery, etc. [30,31]. For small anterior urethral foreign bodies with smooth and blunt surfaces, lubricating the urethra with vaseline oil and pushing the foreign body towards the distal urethra with vascular forceps can be attempted. If unsuccessful, surgical treatment should be considered [32]. For foreign bodies in the posterior urethra, bladder, and vagina, endoscopic removal is usually the preferred treatment method [33,34]. Endoscopy has high value in both the diagnosis and treatment of FBs. This non-invasive surgical method, using cystoscopy or vaginoscopy, allows direct visualization of the foreign body and attempts to extract it with graspers [35]. Compared to open surgery, this endoscopic approach typically reduces patient discomfort, lowers the risk of postoperative complications, and shortens the recovery time. Due to the relatively narrow urethra in children, if the foreign body in the posterior urethra is large, it can be pushed into the bladder for removal [36]. When endoscopic treatment fails, open surgery is usually adopted, including suprapubic cystotomy for intravesical foreign bodies and external urethrotomy for foreign bodies lodged in the penile urethra. In our study, for larger FBs or those with significant adhesion to bladder tissues, we used pneumovesicum laparoscopy to extract the foreign bodies. This minimally invasive surgical approach is associated with less trauma, minimal bleeding, and faster recovery compared to traditional methods [21]. We successfully applied this method in two cases in our study. In this research, two cases involved mercury thermometers, which were discovered during cystoscopy in the urethra-bladder region. Due to the risk of rupture, we did not push them into the bladder but instead used a perineal urethral incision to remove the thermometer. Additionally, four cases involved sewing needles, and cystoscopy revealed that the foreign bodies had penetrated the urethra and migrated towards the perineum. To safely extract these foreign bodies and avoid further damage to the urethra, we utilized a perineal small incision and successfully located and removed the needle tips. For urethral-bladder foreign bodies, especially sharp objects, entry into the urethra can cause urethral injury. To prevent and reduce the likelihood of urethral stricture, we extended the duration of catheterization postoperatively. Especially in cases where partially sharp foreign bodies were found to have penetrated the urethra, causing urethral injury, we further prolonged the catheter retention time. Through postoperative follow-up, we have not observed the occurrence of urethral stricture, indicating that prolonging catheter retention time may help reduce the risk of postoperative urethral stricture. In comparison to the urethra, the vagina has a relatively short and wide anatomical structure, providing a broader space for endoscopic operations [37]. We chose to use a vaginoscopic foreign body forceps to successfully remove the 14 cases of vaginal foreign bodies in this study, and the entire process proceeded smoothly.

This study has some limitations, including a single-center retrospective design and a relatively small sample size, which may not comprehensively represent the population of children with urogenital foreign bodies. Long-term follow-up data are limited and do not provide detailed information about the long-term health and complication development of patients. Despite these limitations, the study still provides valuable insights for healthcare professionals to enhance the diagnosis and treatment of urogenital foreign bodies in children, improving the quality of life for patients. Future research could address these limitations by expanding the sample size, delving into the characteristics and treatment outcomes of patients in different age groups, and conducting longer-term follow-ups for a more comprehensive understanding and management of this rare but significant clinical issue.

5. Conclusion

Although urogenital foreign bodies in children are uncommon, their potential for inaccurate historical information can lead to misdiagnosis, highlighting the critical importance of early and accurate diagnosis and treatment. Endoscopic removal of foreign bodies is an effective and safe treatment method, minimizing patient discomfort and reducing the risk of complications. In cases where endoscopic surgery fails, options such as laparoscopic removal of bladder foreign bodies or open incisional removal may be considered, depending on the nature and location of the foreign body. Educating parents and children to raise awareness of potential risks is also an effective preventive measure, contributing to a reduction in the incidence of urogenital foreign bodies.

Ethics approval

This study was conducted with the approval of the Ethics Committee of Anhui Children's Hospital.

Ethics accordance

All procedures performed in this study involving human participants were in accordance with the ethical standards of the committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to participate

Informed consent was obtained from parents or legal guardians who were present during examination, history and sampling sessions.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CRediT authorship contribution statement

Chengpin Tao: Writing – review & editing, Writing – original draft, Project administration, Methodology, Formal analysis, Data curation, Conceptualization. **Bo Peng:** Formal analysis, Data curation, Conceptualization. **Changkun Mao:** Formal analysis, Data curation, Conceptualization. **Xin Yu:** Formal analysis, Data curation, Conceptualization. **Yongsheng Cao:** Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare no conflicts of interest associated with this work. No financial support from any organization for the submitted work, nor any financial relationships with any entities that could be perceived to influence the work, are reported. No patents or patent applications related to the content of the manuscript have been filed.

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