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ORIGINAL ARTICLE

A novel extraperitoneal approach exploration for the treatment of urachal mass: a retrospective observational single-center study

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Abstract

Background: To explore the extraperitoneal laparoscopic urachal mass excision technique and its safety and efficacy in treating urachal mass.

Methods: Baseline characteristics were collected from patients who underwent surgery to diagnose a urachal cyst or abscess in our hospital between January 2020 and August 2021. The full-length of the urachus and part of the top bladder wall were completely removed through the extraperitoneal approach. Patient outcomes were collected to evaluate surgical safety and efficacy, including operation time, intraoperative blood loss, drainage tube removal time, length of stay (LOS), and postoperative complications.

Results: All 20 surgeries were successfully performed laparoscopically, and no case was converted to open surgery. The mean body mass index of the patients was 24.6±2.2. The mean patient age was 49.3±8.7 years. The mean size of the cysts was 3.0±0.4 cm. The mean operation time was 56.3±12.0 min. The mean intraoperative blood loss was 28.0±6.4 mL. The mean drainage tube removal time was 3.0±0.5 days. The mean LOS was 5.2±0.4 days. The mean follow-up was 13.4±2.1 months. No postoperative complications were observed during the follow-up period. The short-term follow-up and small patient cohort limited our outcome evaluation.

Conclusion: Our results indicated that the extraperitoneal laparoscopic approach was a safe and effective method to treat urachal mass. Given the limitations of the study, further multiple and larger sample-sized trials are required to confirm our findings.

Keywords: Extraperitoneal; Laparoscopy; Urachal mass

1. INTRODUCTION

The urachus is a tube connecting the fetal bladder and umbilicus during the embryonic period. Atresia is complete at about 12 weeks of birth, and the urachus degenerates into the median umbilical ligament outside the peritoneum.[1] If the urachal atresia is not complete, there is a residual lumen in the middle, and the urachal epithelium secretes fluid, which becomes a urachal cyst. The incidence of urachal cysts is very low, at nearly 0.3 per 100 000 people, and it is more common in men.[2] Patients with small urachal cysts have atypical symptoms, especially as adults. Some patients have symptoms such as acute abdominal pain, abdominal masses, repeated urinary tract infections, and fever. Most patients are diagnosed by imaging examinations such as ultrasound and computed tomography (CT).

The primary treatment for urachal cysts is surgical resection. The traditional surgical method is open surgery. Due to the long resection range, the surgical incision is long, and the trauma is significant. Since laparoscopy has been used in clinical practice, it has gradually replaced open surgery and has become the main surgical method. The advantage of open surgery is that the operation can be performed outside the peritoneum without opening the peritoneum. In open surgery, secretions or pus from the urachus do not enter the abdominal cavity, reducing the risk of postoperative intestinal adhesions.[3] Laparoscopic surgery is mainly performed through the intraperitoneal approach, which will inevitably interfere with the intestinal tract, causing complications such as postoperative abdominal distension and adhesions. We decided to explore surgery through a completely extraperitoneal approach,[4] which could combine the advantages of the two surgical methods mentioned above.[5]

2. METHODS

2.1. Patients preparation

Twenty patients were included in the study from January 2020 to August 2021, including 12 males and eight females ranging in age from 32 to 64 years. The patient characteristics are presented in Table 1. All patients were diagnosed by CT/magnetic

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Table 1

Patients basic characteristics and perioperative outcomes

Parameter	Result
Preoperative	
Number of patients	20
Gender	
Male	12
Female	8
Age, y	49.3 ± 8.7
BMI, kg/m²	24.6 ± 2.2
Lesion location	
Inside the bladder	14
Outside the bladder	6
The size of cyst, cm	3.0 ± 0.4
Comorbidity	
Hypertension	2
Diabetes	1
Heart disease	1
Clinical symptoms	
Lower abdominal pain	2
Irritation sign of bladder	1
Gastrointestinal symptoms	0
Intraoperative	
Operating time, min	56.3 ± 12.0
Estimated blood loss, mL	28.0 ± 6.4
Postoperative	
Length of stay, d	5.2 ± 0.4
Drainage tube removal, d	3.0 ± 0.5
Follow-up, mo	13.4 ± 2.1

BMI = body mass index.

resonance imaging plain scans or ultrasound before admission. Nineteen of the patients were diagnosed with urachal cysts, and one had a urachal abscess caused by a cyst infection. The course of the disease ranged from half a month to 3 years. Two patients had accompanying lower abdominal pain, and one had signs of bladder irritation. No gastrointestinal symptoms were observed. All patients underwent computed tomographic urography after admission to determine the lesion location further and identify the tumor (Fig. 1A). Fourteen masses were located on the top wall of the bladder, and six were confined to the urachus.

The operation time and intraoperative blood loss were recorded immediately after the completion of surgery. The drainage tube removal time and the length of stay (LOS) were collected. The postoperative complications were recorded at discharge. The first follow-up was performed 1 month after surgery for early-stage recovery evaluation. The study was approved by the Ethics Committee of the Affiliated Hospital of Qingdao University (No. QYFYWZLL26605), and all patients provided written informed consent. The enhanced recovery after surgery protocol was managed in the perioperative period.

2.2. Two-cut technique for extraperitoneal space establishment

After administering general anesthesia, the patient was placed in a supine Trendelenburg position, and then the buttocks were raised. First, a 2-cm vertical incision was made below the umbilicus (port A). The anterior sheath of the rectus abdominis was opened using a sharp knife from the right side of the white line (Fig. 2A). Then, the posterior rectus abdominis space was bluntly dissected inside the rectus muscle and entered with the fingers (Fig. 2B). After similarly managing the opposite side, an electric knife was used to cut the connective tissue connecting the rectus abdominis to the linea alba and peritoneum (Fig. 2C). An extraperitoneal dilator was placed into port A after the above process, and 750 mL of gas was injected to establish the extraperitoneal space.

2.3. Surgical procedure

A 12-mm trocar (point B) and a 10-mm trocar (point C) were placed at the intersection of the horizontal line of port A and

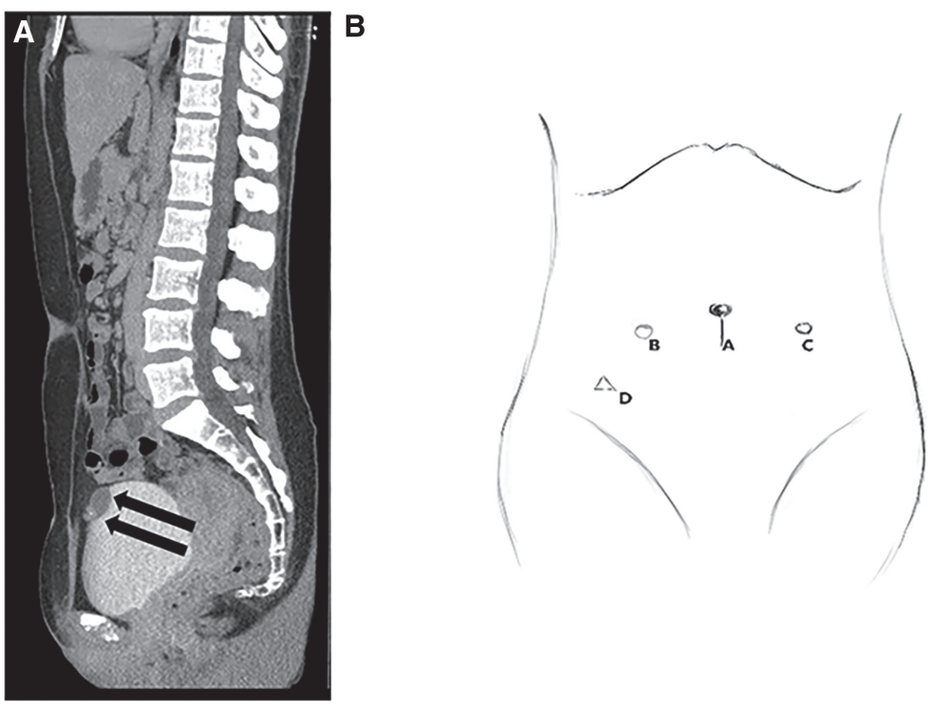

Fig. 1 Computed tomographic urography (CTU) of urachal cyst and trocars position. A, Contrast-enhanced sagittal CT image of the abdomen shows the urachus (arrow). B, Trocar composition of the surgery.

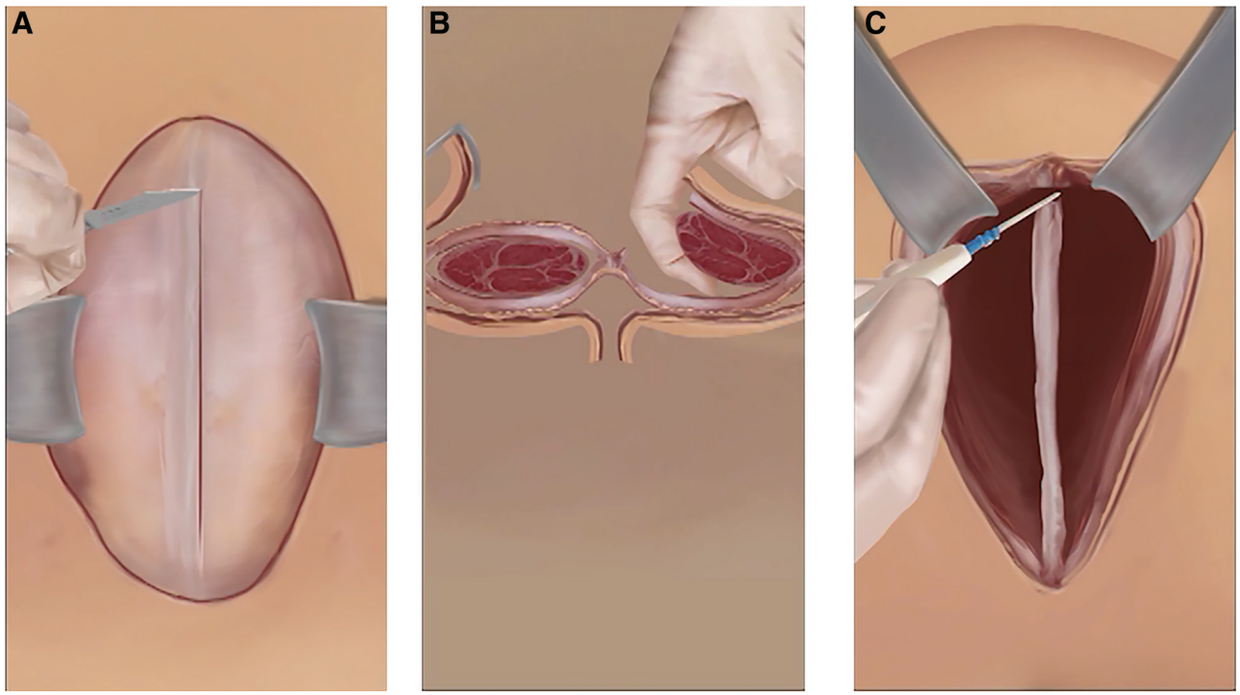

Fig. 2 Two-cut technique for extraperitoneal space establishment. A, A 2-cm incision was made 3 cm below the umbilicus. The skin and the subcutaneous tissue were separated from the anterior sheath of the rectus abdominis. The thyroid retractor was pulled laterally to maintain tension on the anterior rectus abdominis sheath. Then, the anterior sheath of the rectus abdominis was cut open. B, The thyroid retractor pulled the rectus abdominis muscle to expose the posterior sheath of the rectus abdominis. Then the space between rectus abdominis and retro rectus sheath was dissociated. C, The rectus abdominis was pulled up anteriorly and laterally with thyroid retractors on both sides, and the cut the tissue connecting the rectus abdominis to the linea alba and peritoneum.

the right and left lateral edges of the rectus abdominis, keeping a distance of 5 to 6 cm between the three points. The pneumoperitoneum was established through port A, and the pressure was maintained at about 12 mmHg during surgery. If necessary, a 5-mm trocar was inserted 2 cm inside and above the right anterior superior spine as an assistant channel (port D) (Fig. 1B).

The anterior wall of the bladder was entirely freed down to the symphysis pubis from both sides to the pelvic fascia to expand the operating space of the extraperitoneal cavity. Blunt separation by an aspirator was applied to protect the iliac vessels (Fig. 3A). The surface tissue above the bladder tip was loosened to locate the urachus. After, the assistant lifted the anterior wall of the bladder to free the tissue around the urachus further to facilitate the exposure of the urachus (Fig. 3B). While undertaking this process, care was taken not to damage both sides of the peritoneum. An aspirator and harmonic scalpel alternately performed dissociation toward the distal end along the urachus to the lateral wall of the bladder. The urachus was cut off and cut

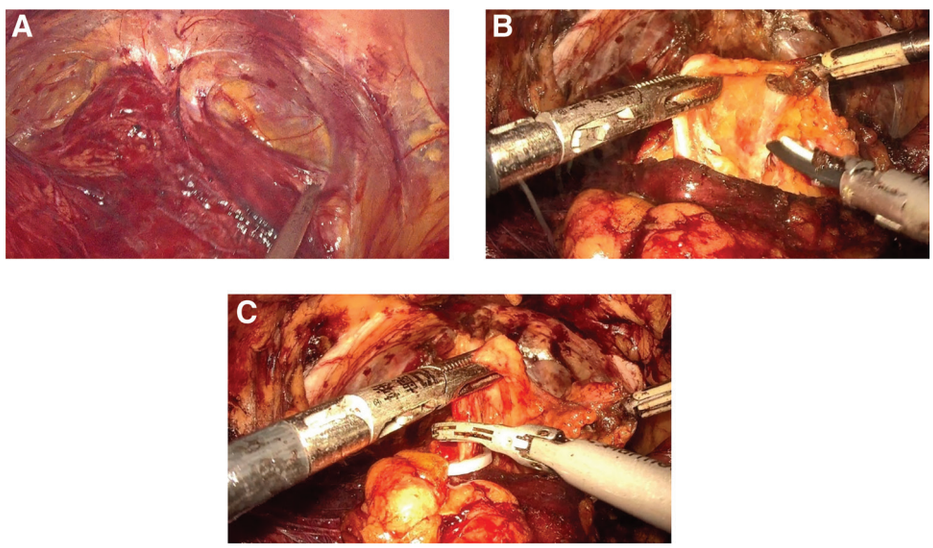

Fig. 3 Extraperitoneal space establishment and urachus dissection. A, Establish and expand the extraperitoneal cavity with blunt separation by aspirator and harmonic. B, Locate the urachus and free both sides of it. C, Cut off the urachus to locate the cyst.

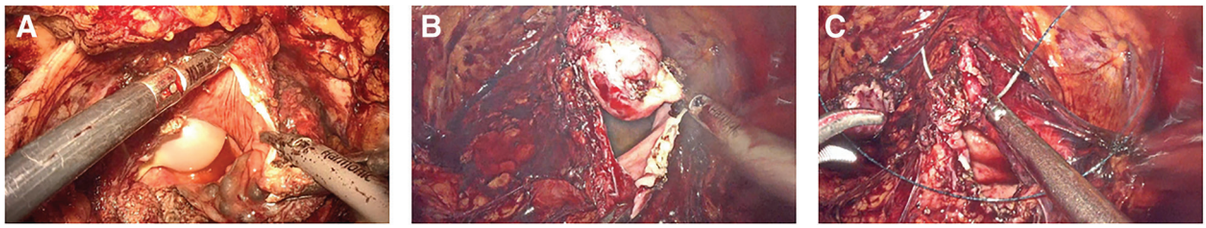

Fig. 4 Excision of the urachal cyst and bladder leakage suture. A, The bladder is incised transversely to expose the urachus further. B, Cut off the urachus 3 cm from its edge. C, The bladder was closed with a 3-0 V-lok absorbable suture.

across the lateral wall of the bladder to find the mass (Fig. 3C). The side wall of the bladder was pulled to expose the boundary of the mass, which was completely removed at a distance of 3 cm from its edge (Fig. 4A). The bladder incision was continuously sutured with 3-0 V-lok absorbable sutures (Fig. 4B, C). Finally, the bladder was filled with 300 mL of saline to confirm its tightness. One drainage tube was placed through port B. The incisions were sutured layer-by-layer after withdrawing all instruments and trocars.

3. RESULTS

All surgeries were performed successfully through the extraperitoneal approach without conversion to open surgery. The mean body mass index of the patients was 24.6 ± 2.2. The mean patient age was 49.3 ± 8.7 years. The mean size of the cysts was 3.0 ± 0.4 cm. The mean operation time was 56.3 ± 12.0 min. The mean intraoperative blood loss was 28.0 ± 6.4 mL. Two patients had small peritoneal tears during the stripping process, which were settled in time by Hem-o-lok. The tubular structure, lined with transitional epithelium and columnar epithelium, confirmed the presence of the urachus according to the final histopathological diagnosis. Fibrous tissue hyperplasia and inflammatory reaction were observed in some patients. No tumors were seen, and the diagnoses were a urachal cyst or abscess. The mean drainage tube removal time was 3.0 ± 0.5 days. The mean LOS was 5.2 ± 0.4 days. The mean follow-up was 13.4 ± 2.1 months. All patients are living well without obvious discomfort based on outpatient reviews. No complications have been observed to date. The perioperative outcomes are listed in Table 1.

4. DISCUSSION

The urachus is located outside the peritoneum, running between the peritoneal anterior bladder space and the transverse abdominal fascia. The length of the normal urachus varies from 3 to 10 cm.[6] The wall of the urachus is divided into three layers. The innermost layer is the transitional epithelium, similar to the urinary tract. The middle layer is fibrous connective tissue. The outermost layer is a smooth muscle layer identical to the detrusor muscle.[7] Urachal malformations are divided into four types: cyst, diverticulum, sinus, and fistula (patent urachus). Urachal cysts are usually located in the lower one-third of the remnant urachus with a low incidence and hidden onset, usually with atypical symptoms such as abdominal pain and an abdominal mass.

Surgery should be the first choice for treatment because urachal cysts can be infected or become malignancies.[8,9] Traditional open surgery not only has long incisions, significant trauma, and obvious scars but also seriously damages the appearance of the umbilical. Since Trondsen[10] reported using laparoscopy to treat urachal cysts in 1993, many surgeons have tried to use laparoscopic surgery to treat urachal lesions.[11,12] The scope of laparoscopic urachal mass excision includes the entire length of the urachus, the median umbilical ligament, and part of the bladder top wall, which is connected to the remnant urachus. Sometimes, it is difficult to separate the top wall of the bladder from the peritoneum due to adhesion, especially in patients with a history of abdominal surgery. The laparoscopic approach can be used for diagnostic exploration, and other lesions can be treated simultaneously. The operative space is large, and the anatomy is seen through the transabdominal approach. Therefore, the transabdominal approach has become the main surgical treatment method.[13] However, the urachus and bladder are anatomically located outside the peritoneum. The destruction of the peritoneum to complete this type of operation is not following the normal anatomy and will interfere with the intestinal tract. If the abscess ruptures during surgery, pus will flow into the abdominal cavity causing infection with disastrous consequences.[14] Some researchers have reported that suturing the peritoneum after surgery could restore the continuity of the peritoneum. However, the drainage tube must be placed into the abdominal cavity, which will inevitably interfere with the abdominal cavity. Other reports have discussed the combined application of the transabdominal and extraperitoneal approaches to complete urachal surgery. Although the urachus can be removed full-length, it is necessary to remove part of the peritoneum when bladder wall resection is performed around the urachus.[15,16] This surgery neither retains the advantages of open surgery nor preserves the complete peritoneum.

Our method focused on how to judge the boundary between the bladder and peritoneum. The key was to strip the peritoneum carefully. If the peritoneum is damaged during surgery, attention must be paid to estimating whether there is any intestinal injury. If a peritoneal incision occurs, it can be repaired with Hem-o-lok clips, and carbon dioxide will not enter the abdominal cavity too much to affect the operation. When dealing with an unclear gap between the peritoneum and the bladder, selectively cutting open part of the peritoneum will not affect the surgery or increase the risk of complications. It is relatively simple to expose the urachus after separating the peritoneum. In our experience, it was quite easier to locate the urachus if one separates from the boundary between the peritoneum and the bladder to the center. When removing the urachus, attention should be paid to separating it upward to the umbilicus and eradicating it. The bladder should be fully freed during surgery for more complicated cyst infections. Larger urachal abscesses often adhere tightly to the peritoneum or even the colon or ileum wall. Finding the boundary can be facilitated if both side walls of the bladder are fully dissociated. When the boundary is difficult to judge, the bladder is moderately filled, and then a weak place is cut at a certain distance from the abscess at the anterior wall of the bladder. Then, dissociation toward the abscess should proceed after recognizing the boundary.

A completely extraperitoneal approach can take advantage of minimally invasive and open surgery peritoneal preservation technology. This operation fully simulates open surgery through a minimally invasive laparoscopic method. There is no need to open the peritoneum, and the intestinal tract will not enter the peritoneal space after surgery, which can reduce the probability of postoperative intestinal adhesions. Bacterial pus will not enter

the abdominal cavity when the abscess is ruptured during surgery, and urine will not enter the abdominal cavity after the bladder is opened. Postoperative intestinal adhesions and infections can also be avoided as much as possible. Another advantage of the extraperitoneal approach is that the bladder dissection can be performed more completely by separating the anterior, side, and top wall, reducing suture tension and decreasing the occurrence of a postoperative urinary fistula. Thus, it can avoid the repair needed when postoperative urine extravasation or a urinary fistula occurs, which benefits from the absorption and healing capacity of the peritoneum. The abovementioned factors can contribute to reducing the incidence of postoperative urinary infections.

According to our experience, the most significant limitation of this approach is the location of the cyst. This surgical approach might not be appropriate for cysts close to the umbilicus. The operator may not operate smoothly due to the limited operating space. And they might encounter difficulties when dealing with cysts large enough to influence the extraperitoneal space, which we have not encountered yet. The surgical method should be carefully selected when encountering the type of patients mentioned above. The transabdominal surgical approach might be a better choice in those cases.

Our study confirmed that the extraperitoneal laparoscopic approach was a safe alternative for treating cysts located in the middle and lower segments, which are the most common situations we have dealt with. Our surgical approach has advantages for patients with abdominal adhesions and previous surgery history. The perioperative outcomes indicated that our approach treating a urachal mass can be considered a preferred strategy. Given the limitations of the study, further multiple and more extensive sample-sized trials are required to confirm our findings.

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