

Laparoscopic Surgery of Urachal Anomalies: A Single-Center Experience

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ABSTRACT: **Background:** The traditional surgical approach to the excision of persistent urachal remnants is a lower midline laparotomy or semicircular infraumbilical incision.

Objectives: To report our experience with laparoscopic/open urachus excision as a minimally invasive diagnostic and surgical technique.

Methods: This was a retrospective study involving patients who were diagnosed with persistent urachus and underwent laparoscopic/open excision. The morbidity, recovery, and outcomes of surgery were reviewed.

Results: Eight patients (males:females 6:2) with an age range of 1 month to 17 years underwent laparoscopic or open excision (six and two patients respectively). All patients presented with discharge from the umbilicus. Although three patients had no sonographic evidence of a patent urachus, diagnostic laparoscopy detected a patent urachus that was excised laparoscopically. The operative time of laparoscopic surgery ranged from 19 to 71 minutes (the last case was combined with bilateral laparoscopic inguinal hernia repair), and the mean duration of hospital stay was 2.0 ± 0.36 days. Pathological examination confirmed a benign urachal remnant in all cases.

Conclusions: Laparoscopy is a useful alternative for the management of persistent or infected urachus, especially when its presence is clinically suspected despite the lack of sonographic evidence. The procedure is associated with low morbidity, although a small risk of bladder injury exists, particularly in cases of severe active inflammation.

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KEY WORDS: urachus, remnant, cyst, laparoscopy, morbidity

Urachus is the embryonal duct connecting the dome of the urinary bladder to the umbilical ring. It is normally obliterated prior to birth as the urachus goes on to definitively form the median umbilical ligament [1]. Urachal remnants represent a failure in this obliteration at birth that connects the bladder to the umbilicus [2]. Patent urachus is a rare congenital anomaly. It occurs in 1.6% of children under 15 years of age and in 0.06% of

adults [3]. There are four variants of urachal anomalies: urachal cysts, sinus, diverticulum, and patent urachus [4]. Non-closure of the entire tract leads to a patent urachus, which is the most common urachal anomaly, whereas closure of both ends but patency of the tract inbetween may trap fluid in an urachal cyst. Closure on the bladder side creates an umbilical sinus. A bladder diverticulum results when the distal tract involutes; it is the rarest urachal anomaly.

Persistence of the urachal lumen after birth manifests in a variety of clinical presentations, the most common of which is recurrent periumbilical discharge. A urachal cyst most commonly presents once it has become infected. An affected patient will present with infraumbilical swelling, abdominal pain and erythema. The symptoms may mimic appendicitis. A patent urachus drains urine and may predispose to cystitis or recurrent urinary tract infections.

Management of urachal remnants requires wide local excision of the urachus and adjacent extraperitoneal tissue. Patent urachus was traditionally performed via a lower midline laparotomy incision. Although effective, it shares the same associated morbidities of any laparotomy incision, such as inherent postoperative pain, risk of wound infection, bleeding, and slow return to normal activities. Since its first description in 1993 [5], laparoscopic surgery has been considered an alternative to conventional open resection of urachal remnants. The laparoscopic approach has the benefit of being able to confirm the presence of urachal remnant and enables magnified dissection along the extraperitoneal plane until the dome of the bladder in the space of Retzius, with minimal postoperative pain, rapid recovery and return to normal activities. The benefit of superior cosmesis compared to a lower midline incision is an added bonus. Studies on the laparoscopic management of urachal remnants and outcomes are scarce. There are only a few isolated case reports or small case series owing to the rarity of this pathology. In this retrospective review we present our center's experience with the laparoscopic management of symptomatic urachal remnants and their short-term outcomes.

PATIENTS AND METHODS

Eight children (mean age 8.9 ± 2.6 years, range 0.5–17) visited our institution with symptomatic urachal remnants between

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January 2014 and May 2016. The patients' medical records were reviewed retrospectively. We reviewed the perioperative and postoperative records to assess perioperative data, operation time, blood loss, complications, pathological evaluation, and follow-up. The patients were interviewed by telephone to evaluate their long-term outcomes.

Presentation of urachal remnants included umbilical discharge, low abdominal infraumbilical mass, with or without fever, local pain, and signs of inflammation. Preoperative evaluations included ultrasonography, blood and urine tests. Computerized tomography (CT) was used for patients with unusual presentations. Initial treatment of infected urachal remnant consisted of antibiotics and drainage; bacterial cultures and sensitivity tests were performed. After the patients' acute symptoms subsided, each patient underwent complete excision of the urachal remnant laparoscopically or by open approach.

During the laparoscopic procedure, a Foley catheter was inserted with the patient under general anesthesia in a supine position. The visualization port was accessed with a 5 mm trocar in the left upper abdomen and was insufflated by CO₂ with intraabdominal pressure maintained at 12–15 mmHg. Another two 5 mm working ports were inserted under direct vision on the right upper and left lower side of the abdomen. The patient was then placed in the Trendelenburg position. A 5 mm, 30° angled lens camera is typically used. First, any bowel or omental adhesions from prior surgeries or inflammatory reactions to the infected urachal remnant were lysed off with monopolar scissors, and the median and lateral umbilical ligaments were identified. The cephalic side of the urachus was dissected from the umbilicus, and the caudal stump of the median umbilical ligament was transected just above the bladder dome with ultrasonic scissors. The excised specimen was exteriorized with a laparoscopic retrieval bag via the left lower port and sent for histopathological examination.

RESULTS

Patient demographic and perioperative data are shown in Table 1. The patients, six boys (75%) and two girls (25%), had a mean age of 8.9 ± 2.6 years (range 0.5–17). The most common presentation was umbilical discharge in all patients (100%). On examination two patients had abnormal appearance of the umbilicus. In two patients, infraumbilical mass was palpated. Three patients presented with findings suggestive of an infection and were treated with antibiotics following by complete excision of the urachal remnant laparoscopically or by open approach within 2 months. No patients presented with hematuria, urinary retention or urinary tract infection. One patient presented with severe local pain and was operated in another hospital for suspected incarcerated umbilical hernia. During the surgery no hernia was detected. The patient continued

to suffer from umbilical discharge. Ultrasound examination demonstrated urachal cyst, and the patient underwent urachal remnant excision in our institution.

Although abdominal ultrasonography was done in all eight patients, only six (75%) had sonographic evidence of patent urachal remnants. Urachal cyst was found in four patients (4.5 x 2 cm, 1.5 x 0.7 cm, 1.2 x 0.9 cm, 1.1 x 0.7 cm), and patent urachus or urachal sinus in two.

Six patients underwent laparoscopic excision of urachal remnant, while two patients underwent open removal of urachus. The indication for open approach was a palpated infraumbilical mass (close to the umbilicus). At surgery, urachal cyst was found in both cases. Of the six patients who were operated by laparoscopic approach, all were found to have patent urachus without urachal cyst (despite preoperative ultrasonographic findings). This discrepancy between preoperative sonographic and intraoperative findings is reported in Table 2. There were two patients who presented acutely with umbilical omphalitis and overlying cellulitis. These patients were initially managed with parenteral antibiotics, and wide laparoscopic local excision was performed electively 8 weeks later after the inflammation had subsided.

Laparoscopic local excision was successfully completed in all cases without conversion to a lower midline incision [Table 3]. The mean operative time was 36 ± 6 minutes (range

Table 1. Patient demographics and clinical presentations

Variable	Value
No. of patients	8
Age (yr), mean (standard error)	8.9 ± 2.6
Gender (male/female)	6:2
Umbilical discharge	8 (100%)
Abnormal appearance of the umbilicus on examination	2 (25%)
Infraumbilical mass	2 (25%)
Findings suggestive of an infection (fever/erythema)	3 (37%)
Pain	1 (12.5%)
Sonographic evidence of patent urachus	6 (75%)

Table 2. Comparison between preoperative diagnosis and intraoperative findings

Preoperative diagnosis (n)	Postoperative diagnosis (n)
Urachal cyst (n=5)	Urachal cyst (n=2)
Patent urachus (n=3)	Patent urachus (n=6)
Urachal sinus (n=0)	Urachal sinus (n=0)
Urachal diverticulum (n=0)	Urachal diverticulum (n=0)

Table 3. Surgical outcomes

Variable	Value
Operative time (min), mean (SE)	36 ± 6
Postoperative hospital stay (days), mean (SE)	2 ± 0.3
Operation-related complications	0
Conversion to laparotomy	0
Return to normal activities (days)	6.3 ± 0.9

19–71). The longest operative time (71 minutes) was related to combined urachal excision and bilateral hernia repair. All patients started oral feeding on postoperative day 1. The mean postoperative duration of hospital stay was 2.0 ± 0.32 days. There were no instances of intraoperative complications such as bleeding or bowel injury and no patient required bladder repair. No patient demonstrated leak from bladder, and none had voiding difficulties. One patient complained of persistent periumbilical pain. Umbilical discharge disappeared postoperatively in all patients. Ultrasonography showed no evidence of an umbilical collection or urachal remnant. The histopathological examination revealed urachal remnant in the resected tissue in all patients with or without inflammatory granulation tissue.

DISCUSSION

The urachus, a remnant of the allantois, serves to excrete urine from the bladder via the umbilicus during the intrauterine life of a fetus [1,2]. After birth, the urachal portion fails to grow; thus, its lumen is narrow and usually obliterated by fibrous proliferation, giving rise to the median umbilical ligament. Occasionally, the allantois may fail to involute and depending on the completeness of this involution, a patent urachus, urachal cyst, urachal sinus or vesico-urachal diverticulum may arise [3].

Persistent clear fluid leakage (likely urine) in an infant is highly suggestive of a patent urachus, while cloudy, serous or bloody fluid is more indicative of a urachal sinus or cyst. In our series, umbilical discharge was the most common presentation and was seen in all patients. Two patients had abnormal appearance of the umbilicus on examination. In two patients infraumbilical mass was palpated. Infection is the most common complication of urachal remnants. The route of infection may be lymphatic, hematogenous or vesical, and is cultured from infected urachal remnants. It is the usual mode of presentation in an otherwise asymptomatic condition. *Staphylococcus aureus* is the most common organism cultured, although a wide variety of gram-positive and gram-negative microorganisms have been reported [6]. In our series, three patients presented with findings suggestive of an infection and were treated with antibiotics following by complete excision of the urachal remnant within 2 months. Abdominal pain may be the only symptom of disease and can mimic an acute abdomen due to appendicitis or Meckel's diverticulum [7]. One of our patients presented with abdominal pain and was operated in another institution for suspected incarcerated umbilical hernia; no hernia was found during the surgery. Because of persistent pain and discharge from the umbilicus, this patient underwent laparoscopic urachal remnant excision. Abdominal pain and umbilical discharge disappeared after surgery.

Galati et al. [8] reported 23 children with urachal remnants, 10 of whom underwent excision due to symptomatic problems. They found that spontaneous resolution with non-operative management is likely with remnants in patients younger than 6 months.

Although many methods are available today for diagnosing pathology of urachal remnants, none of these is completely accurate. Because CT and ultrasonography display cross-sectional images and the urachus in the anterior abdominal wall is located away from interfering intestinal structures, these modalities are ideally suited for demonstrating urachal anomalies. Ultrasonography is by far the most popular as it is easily performed, is non-invasive, and there are no concerns about radiation exposure. Ultrasound can be helpful in diagnosis of urachal remnant but is not sufficient, as shown by our series. Our data suggest that ultrasound has high sensitivity but low specificity rates. In four patients, ultrasound demonstrated urachal cyst that did not correlate with the intraoperative findings. Interestingly, in our series, two patients (25%) had no demonstrable urachal remnants on ultrasonography despite the typical clinical presentation. Diagnostic accuracy of ultrasonography for urachal remnants has been reported to range from 61.1% to 91.3% [9]. Siow et al. [10] described 14 patients with patent urachus. Only 71.4% of these patients had sonographic evidence of patent urachal remnant. Ueno and colleagues [11] described 56 children with anomalies of the urachus remnant identified by ultrasound; 20 of these cases were symptomatic urachal remnants, whereas the urachus remnants were seen incidentally by ultrasound scanning in the other 36 patients. In nine cases, including two symptomatic cases, urachal remnants disappeared spontaneously during the follow-up period. No symptom had developed during follow-up in asymptomatic cases [11]. Widni et al. [12] demonstrated that ultrasonography had a positive predictive value of 83% but a sensitivity of only 79%. Lack of specificity of ultrasound in the differential diagnosis of solid urachal masses has been reported by Yu and colleagues [13].

CT is the most important imaging modality in the diagnostic workup. It reveals the type of urachal anomaly with a sufficient degree of accuracy. Adult patients with urachal anomalies should especially undergo an abdominal CT and/or magnetic resonance imaging (MRI) scan because of the high risk of malignancy (up to 25%) and the increased risk of a malignant cystic urachal mass with increasing age [14].

The principal treatment for a urachal remnant is the complete excision of the whole tract. This requires a long midline skin incision in the lower abdomen, which inevitably causes the cosmetic disadvantage of a conspicuous scar. To alleviate this drawback, laparoscopic excision of the urachal remnant was first demonstrated in 1993 by Trondsen et al. [5]. Since this report, several trials of laparoscopic surgery to correct the urachal anomaly have been reported [15-17]. However, the

techniques, including port placement arrangements and division and suture of the bladder, have not yet been standardized. A laparoscopic excision of the urachal remnant has been suggested to be technically feasible and minimally invasive. It has also been claimed that a laparoscopic procedure provides better cosmesis, thus contributing to the quality of life of young female patients in particular.

In our series, six of eight patients with urachal remnants underwent laparoscopic surgery and two underwent open traditional surgery. Wide local excision of urachal remnants down to the dome of the bladder along with adjacent inflammatory tissue was performed. Inadequate resection risks recurrence of periumbilical discharge as well as possible malignant transformation of the urachal remnant. The mean operative time was 36 minutes, lower than reported previously [15-17]. The mean postoperative duration of hospital stay was 2 days. One patient complained of persistent abdominal pain. No patient had umbilical discharge postoperatively. Ultrasonography showed no evidence of an umbilical collection or urachal remnants.

The primary limitation of this study was the small number of patients and the retrospective analysis. Another limitation was the lack of a control group and lack of comparison between those with and without urachal resection.

In conclusion, the history and physical examination of patients with urachal remnant are crucial for the correct diagnosis. Ultrasonography may be helpful in the diagnosis of urachal remnant, but not sufficient; it has high sensitivity but low specificity rates. While laparoscopic excision seems to be a safe and less invasive method for the treatment of urachal anomalies, a prospective, large, multi-institutional randomized study is needed to prove the advantages of the laparoscopic compared to the open approach.

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References

- Larsen WJ. Human Embryology. 3rd edn. New York: Churchill Livingstone 2001: 258.
- Naiditch JA, Radhakrishnan J, Chin AC. Current diagnosis and management of urachal remnants. *J Pediatr Surg* 2013; 48: 2148-52.
- Blichert-Toft M, Nielsen OV. Congenital patent urachus and acquired variants. Diagnosis and treatment. Review of the literature and report of five cases. *Acta Chir Scand* 1971; 137: 807-14.
- Galati V, Donovan B, Ramji F, Campbell J, Kropp BP, Frimberger D. Management of urachal remnants in early childhood. *J Urol* 2008; 180: 1824-6.
- Trondsen E, Reiertsen O, Rosseland AR. Laparoscopic excision of urachal sinus. *Eur J Surg* 1993; 159: 127-8.
- Qureshi K, Maskell D, McMillan C, Wijewardena C. An infected urachal cyst presenting as an acute abdomen – a case report. *Int J Surg Case Rep* 2013; 4: 633-5.
- Yu JS, Kim KW, Lee HJ, Lee YJ, Yoon CS, Kim MJ. Urachal remnant diseases: spectrum of CT and US findings. *Radio Graphics* 2001; 21: 451-61.
- Galati VG, Donovan B, Ramji F. Management of urachal remnants in early childhood. *J Urol* 2008; 180: 1824-7.
- Muško N, Dobruch J, Piotrowicz S, Szostek P, Borówka A. Infected urachal cyst in a young adult. *Cent Eur J Urol* 2014; 67: 199-201.
- Siow SL, Mahendran HA, Hardin M. Laparoscopic management of symptomatic urachal remnants in adulthood. *Asian J Surg* 2015; 38: 85-90.
- Ueno T, Hashimoto H, Yokoyama H, Ito M, Kouda K, Kanamaru H. Urachal anomalies: ultrasonography and management. *J Pediatr Surg* 2003; 38: 1203-7.
- Widni EE, Hollwarth ME, Haxhija EQ. The impact of preoperative ultrasound on correct diagnosis of urachal remnants in children. *J Pediatr Surg* 2010; 45: 1433-7.
- Yu JS, Kim KW, Lee HJ, Lee YJ, Yoon CS, Kim MJ. Urachal remnant diseases: spectrum of CT and US findings. *Radiographics* 2001; 21: 451-61.
- Jeong HJ, Han DY, Kwon WA. Laparoscopic management of complicated urachal remnants. *Chonnam Med J* 2013; 49: 43-7.
- Siegel JF, Winfield HN, Valderrama E, Smith AD. Laparoscopic excision of urachal cyst. *J Urol* 1994; 151: 1631-3.
- Jorion JL. Laparoscopic removal of urachal cyst. *J Urol* 1994; 151: 1006-7.
- Stone NN, Garden RJ, Weber H. Laparoscopic excision of a urachal cyst. *Urology* 1995; 45: 161-4.