


## ORIGINAL ARTICLE

# Laparoendoscopic single-site surgery for urachal remnant with extraperitoneal approach through a suprapubic port

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**Abstract**

**Introduction:** No standard procedure has been established for laparoendoscopic single-site surgery for urachal remnants (LESS-U). This study aimed to report the novel surgical techniques and initial outcomes of laparoendoscopic single-site surgery with an extraperitoneal approach through a suprapubic port for urachal remnants (spLESS).

**Methods:** Fifty-five patients (median age, 27 years; range, 15–69 years) who underwent LESS-U were analyzed. To overcome the limitations inherent in the conventional procedure (LESS-U through an umbilical port: uLESS), we modified the port placement and approached via the extraperitoneal space. spLESS is a novel procedure which reduces intestinal damage caused by the extraperitoneal approach and overcomes incomplete resection of the urachal remnant, especially in the bladder dome. Three trocars are inserted into the extraperitoneal space through a suprapubic port in spLESS, and complete resection of the urachal remnant from the umbilicus to the bladder is performed with an appropriate incision line. Patient characteristics and perioperative results were retrospectively collected. Cosmetic outcomes were prospectively evaluated using self-administered questionnaires (body image and photo-series questionnaire).

**Results:** spLESS and uLESS were performed in 43 and 12 patients, respectively. No differences were observed between the perioperative results. The cosmetic outcomes were compared between the groups using body image and photo-series questionnaires. No patient developed major complications; there was no recurrence in either group.

**Conclusions:** spLESS is a novel procedure which can completely resect the urachal remnant and reduce the risk of intestinal damage. spLESS is a safe, effective, and feasible procedure with high postoperative cosmesis.

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## KEYWORDS

extraperitoneal approach, laparoendoscopic single-site surgery (LESS), urachal remnant

## 1 | INTRODUCTION

A urachal remnant (UR) is a rare congenital anomaly which occurs in approximately 0.02%–0.064% of adults.<sup>1,2</sup> Previously, symptomatic UR was treated with open surgery. However, laparoscopic resection of UR (LAP-U) has been introduced as a less invasive treatment in recent years.<sup>3</sup> Laparoendoscopic single-site surgery for UR (LESS-U) was reported as a new procedure, which provides improved cosmetic outcomes by reducing the number of ports.<sup>4</sup> Modified LESS-U procedures have been reported by several institutes.<sup>5–12</sup> In these reports, LESS-U through an umbilical port (uLESS) with an intraperitoneal approach is the standard procedure. This procedure is simple and has high perioperative cosmesis. In July 2017, we began performing uLESS. In January 2018, uLESS approach was changed to an extraperitoneal approach to preserve the peritoneum and reduce the risk of intestinal complications. uLESS with extraperitoneal approach was considered a safer procedure because it was easy to repair the peritoneum for defects due to inflammatory adhesions with UR.

However, uLESS is associated with two problems, regardless of the approach selected. First, the distance of the surgical field from the umbilicus is very narrow, whether under direct vision or laparoscopy, and it is difficult to resect the inflamed UR from the surrounding normal tissue, such as the skin of the umbilicus and peritoneum. In cases where UR, peritoneum, and intestine have severe inflammatory adhesion, the risk of intestinal damage is elevated.<sup>11</sup> Second, there is a problem related to the resection range of UR, particularly on the bladder dome. The necessity of bladder dome cuff resection (BR) is controversial; however, we believe that BR is necessary for complete resection of UR. To overcome these problems, we improved and modified LESS-U procedure.

We started performing laparoendoscopic single-site surgery for UR with an extraperitoneal approach through a suprapubic port (spLESS) in December 2018. Unlike uLESS, spLESS allows UR to be resected at an appropriate and safe incision line as the distance between the port and UR attached to the umbilicus is appropriate. In addition, peritoneal preservation and repair are easy, reducing the risk of intestinal complications. Furthermore, BR from the suprapubic port wound can be easily performed under direct vision. We believe that the new techniques of spLESS are ideal for overcoming the problems

associated with uLESS. In this study, we report on these novel surgical techniques and the initial results of spLESS.

## 2 | MATERIALS AND METHODS

The present study included 55 patients with symptomatic UR who underwent LESS-U at the University of Tsukuba Hospital, Ibaraki, Japan, between July 2017 and December 2021. Among these 55 patients, 43 underwent spLESS, and 12 underwent uLESS. All patients had complete control of the umbilical infection with antibiotics and/or drainage. None of the patients had an active infection at the time of surgery. The clinical and perioperative data were retrospectively analyzed to compare the safety and efficacy of this novel LESS-U technique. Patient satisfaction with cosmesis of the operative scar after LESS-U was evaluated using postoperative self-administered quality-of-life (QOL) questionnaires: the body image questionnaire (BIQ) and photo-series questionnaire (PSQ).<sup>6,13</sup> BIQ includes the body image score (BIS) and cosmetic scale (CS). BIS is calculated as the sum of the five questions concerning the patient's perception of and satisfaction with their body after surgery. The total BIS ranged from 5–20. CS is the sum of three questions that assess the patient's satisfaction with the surgical scar. The total CS ranged from 3–24. To assess PSQ, patients were asked to rate photographs of representative scars after spLESS and uLESS on a scale of 1–10. The patients were then asked to rate their own scars. In this study, we evaluated the patients' personal scores of their own scars. Higher BIS, CS, and PSQ scores indicated greater patient satisfaction.<sup>6,13</sup>

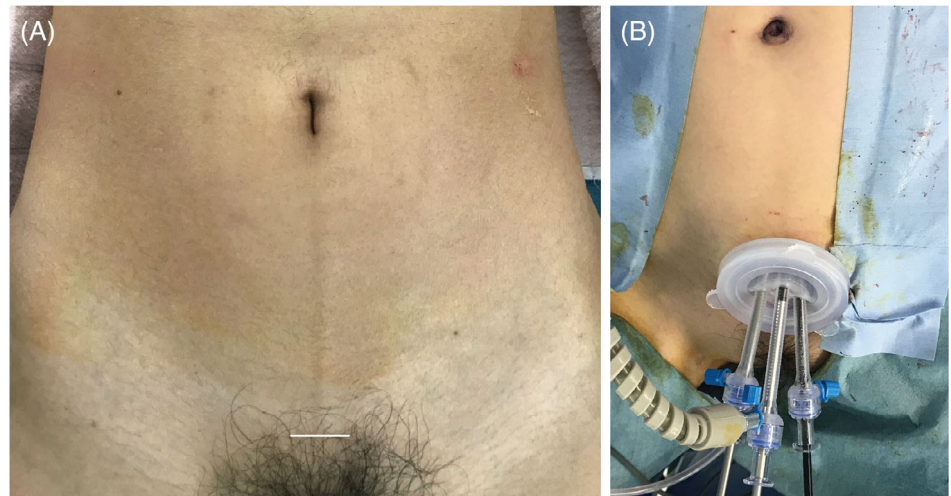
Continuous variables were compared using the Mann–Whitney *U* test. Nominal data were compared using the Chi-square test. Statistical significance was set at  $P < .05$ . Statistical analysis was performed using JMP<sup>®</sup> version 12.0.1 (SAS Institute Inc., Cary, NC, USA).

Data were collected prospectively after obtaining approval from the institutional ethics committee (IRB No. R01-214). Informed consent was obtained from all the patients in this study.

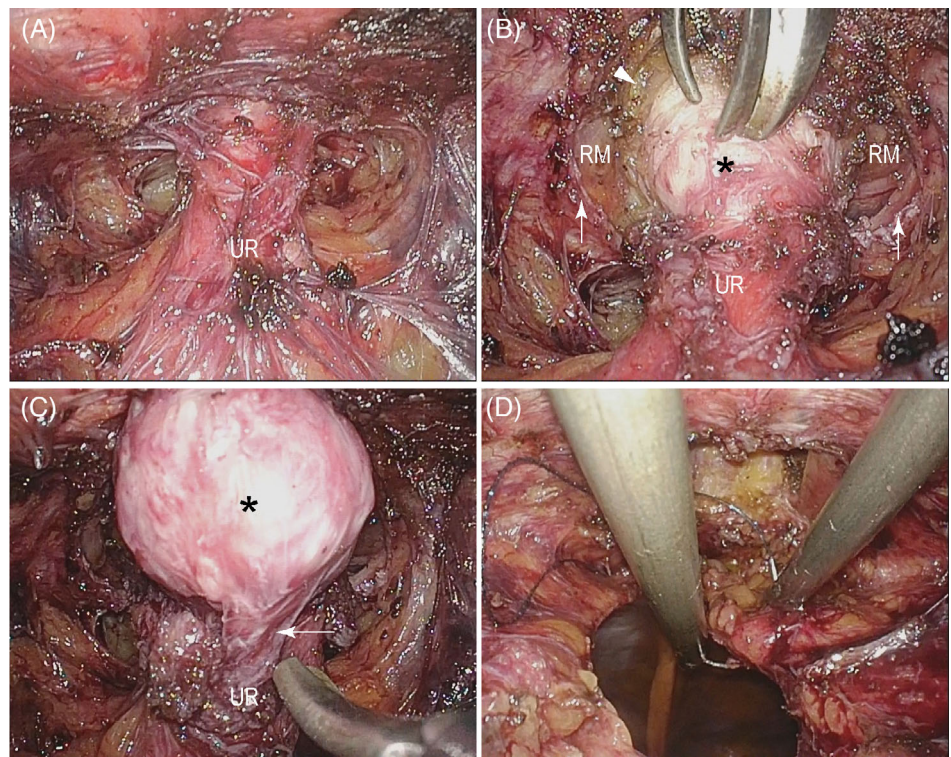
### 2.1 | Procedure of spLESS

The patients were placed in a lithotomy position with the surgeon standing between the legs of the patient. A

**FIGURE 1** (A) Incision site (white line), (B) position of instruments



**FIGURE 2** Laparoscopic technique for suprapubic laparoendoscopic single-site surgery (spLESS). (A) Laparoscopic findings of urachal remnant. UR: urachal remnant. (B) Laparoscopic findings of dermis of umbilicus. Asterisk: dermis of umbilicus; RM: rectus abdominis muscle; arrow: resection edge of the posterior layer of rectus abdominis sheath; arrowhead: fat tissue surrounding the umbilicus. (C) Laparoscopic findings of the wall of the fistula of UR attached to the bottom of the umbilicus (arrow). Asterisk: dermis of the umbilicus; UR: urachal remnant. (D) Laparoscopic findings of suturing technique for defect of peritoneum

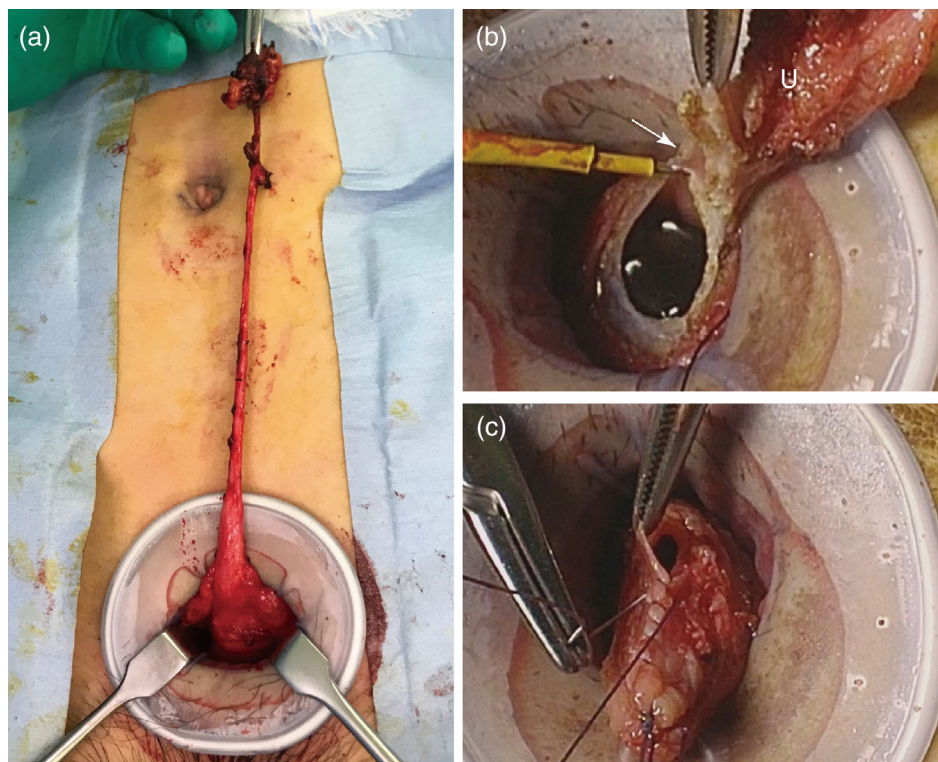


transverse incision of approximately 3 cm was made 4 cm above the pubic bone (Figure 1A). From this window, the space of Retzius was bluntly dilated with the forefinger. Multi-channel extraperitoneal port, LAP PROTECTOR and EZ Access (Hakko, Tokyo, Japan), were introduced into the space of Retzius through the incision. Three trocars were inserted through the multi-channel port into the extraperitoneal cavity (Figure 1B). A 5-mm flexible laparoscope (Olympus, Tokyo, Japan) was used for the laparoscopic procedure.

Scissors were used to carefully dissect UR, covered by preperitoneal fat, from the posterior layer of the rectus

abdominis sheath, while avoiding damage to the peritoneum. UR was further dissected in the cranial direction, and UR just below the umbilicus was sufficiently dissected from the rectus abdominis sheath (Figure 2A). An incision was made in the posterior layer of the rectus abdominis sheath. The umbilicus was pushed from outside the body, and the skin of the umbilicus was confirmed. UR and surrounding inflammatory tissues were excised from the umbilical skin at an appropriate resection line (Figure 2B). As the separation between UR and the umbilicus progressed, the wall of the fistula between the inflammatory tissue of UR and the dermis of





**FIGURE 3** Technique for bladder dome cuff resection under direct vision. (A) Findings of resected urachal remnant. (B,C) Findings of bladder dome cuff resection. Arrow: resected mucus of bladder dome

the umbilicus could be confirmed (Figure 2C). The ligament (the wall of the fistula) of UR was cut at the bottom of the umbilicus. After complete separation of UR and the umbilicus, UR and surrounding inflammatory tissue were carefully dissected in the direction of the bladder while preserving the peritoneum. The umbilical arteries were transected using a vessel-sealing device. In cases where the peritoneum was resected due to severe adhesion to UR, the peritoneum was repaired with running sutures using 3-0 V-Loc (Medtronic, Minneapolis, MN, USA) to prevent postoperative adhesion between the bowel and the abdominal wall (Figure 2D).

After excision of the full length of UR, except for the bladder dome, UR was pulled out of the body through the suprapubic incision (Figure 3A). Thereby, the bladder dome could be confirmed under direct vision, and BR could be performed out of the incision. As a result, UR in the bladder dome could be completely resected, and watertight bladder repair was easily performed with double-layer suturing (Figure 3B and C).

Following the resection of UR, a modified three-flap umbilicoplasty was performed. The original method was reported by Kim et al.<sup>11</sup> The umbilicus was everted to confirm the fistula at the bottom of the umbilicus (Figure 4A). A circular incision was then created around the fistula, and an inverted Y-shaped incision was made in the skin within the umbilical ring to produce the three skin flaps. After unfolding the three skin flaps, any inflammatory tissue remaining in the umbilical skin was

excised (Figure 4B). The subumbilical defect of the rectus abdominis was sutured closed, and the three flaps were sutured to the fascia. The postoperative appearance is shown in Figure 4C.

### 3 | RESULTS

The patient characteristics and perioperative results are presented in Table 1. There were no significant differences in patient characteristics between the two procedures. Umbilical resection was performed in almost all cases in both groups. In contrast, the frequency of the extraperitoneal approach and BR was significantly higher in the spLESS group ( $P < .01$ ). The median operative time and estimated blood loss in the spLESS group were 160 minutes and 5 mL, equivalent to that of the uLESS group ( $P = .36$  and  $.2$ ), despite the significantly higher rate of BR in the spLESS group. The median time for umbilicoplasty was 93 minutes (range, 39–187 minutes) in the spLESS group, including the time for port placement and wound closure. There were no instances of intraoperative complications. There were three cases of postoperative surgical site infections of the umbilicus (Clavien-Dindo grade II), and there was no difference between the two groups ( $P = .53$ ). The median follow-up was 25.5 months (range, 1–54 months), and no patients have developed recurrences of periumbilical discharge to date.

**FIGURE 4** Techniques for umbilicoplasty. (A) Findings of skin of the umbilicus. Arrow: the fistula of urachal remnant. (B) Findings of three skin flaps. Arrow: the defect of the rectus abdominis fascia. (C) Postoperative appearance. Arrow: suprapubic wound



**TABLE 1** Patient characteristics, perioperative results in spLESS and uLESS

	spLESS n = 43	uLESS n = 12	P value
Age: median (range)	25 (15–48)	29 (16–69)	.14
Gender (F/M)	14/29	5 / 7	.81
Classification of urachal remnant			.69
Urachal sinus	39	9	
Urachal cyst	2	1	
Urachal diverticulum	2	2	
Approach	extra 43 intra 0	extra 8 intra 4	<.01
Umbilical resection	41 (95%)	12 (100%)	NS
Bladder dome cuff resection	42 (98%)	3 (25%)	<.01
Operative time: median (range), min	160 (92–269)	166 (101–267)	.36
Estimated blood loss: median (range), mL	5 (0–52)	3.5 (0–46)	.2
Complication	SSI 2 (4.7%)	SSI 1 (8.3%)	.53

Abbreviations: extra, extraperitoneal approach; intra, intraperitoneal approach; NS, not significant; spLESS, suprapubic laparoendoscopic single-site surgery; SSI, surgical site injury; uLESS, umbilical port laparoendoscopic single-site surgery.

The cosmetic outcomes for the spLESS and uLESS groups are shown in Table 2. Thirty-four of the 55 patients (62%) answered the QOL questionnaires: 27 out of 43 (63%) in the spLESS group and seven out of 12 (58%) in the uLESS group. The median time when answering the questionnaire was 6 months after surgery. The median BIS, CS, and PSQ scores of the spLESS group were 20, 19, and nine, respectively, and those of the uLESS group were 19, 18, and eight, respectively. There were no significant differences between the two groups ( $P = .15, .49$  and  $.35$ ).

## 4 | DISCUSSION

To overcome limitations inherent in uLESS procedure, we modified the port placement and changed to approach via the extraperitoneal space. In this study, we evaluated the safety and feasibility of this novel procedure as an alternative to uLESS.

LAP-U was first reported in 1993,<sup>3</sup> and various LAP-U port placement techniques have since been reported.<sup>14–22</sup> In 2010, Patrzyk et al. first reported LESS-U as a highly cosmetic and useful procedure.<sup>4</sup> Since

TABLE 2 Cosmetic outcomes in spLESS and uLESS

	spLESS n = 27	uLESS n = 7	P value
Response rate	63%	58%	NS
BIS: median (range)	20 (16–20)	19 (18–20)	.15
CS: median (range)	19 (13–24)	18 (12–24)	.49
PSQ: median (range)	9 (5–10)	9 (6–10)	.35

Abbreviations: BIS, body image score; CS, cosmetic scale; NS, not significant; PSQ, photo-series questionnaire; spLESS, suprapubic laparoendoscopic single-site surgery; uLESS, umbilical port laparoendoscopic single-site surgery.

then, LESS-U has been used in several institutes, and its usefulness and safety have been reported.<sup>5–12</sup> In addition, it has been reported that reduced port surgeries, such as LESS-U, are highly satisfactory for postoperative patients in cosmesis, especially in young patients.<sup>5,6,23</sup> URs are more common in young patients who are interested in wound cosmesis. For this reason, we believe that postoperative cosmetics are more important in LESS-U than in other surgeries. In this respect, LESS-U could be considered the most suitable surgery for symptomatic UR.

For LAP-U, including LESS-U, the transperitoneal approach was selected in all cases that have been reported,<sup>3–12,14–22</sup> and there are no reports on the extraperitoneal approach. In the transperitoneal approach, a peritoneal defect during ureteral resection is inevitable, and complete closure by suturing the peritoneum is technically difficult. There is no consensus concerning peritoneal suture repair; however, we believe that it is ideal to preserve the peritoneum as much as possible and repair it, as this may reduce the risk of intestinal complications. There was a report of serosal injury of the colon during LESS-U with the transperitoneal approach,<sup>11</sup> which may have been avoided by the retroperitoneal approach. We selected the extraperitoneal approach from the fifth case of LESS-U, and the patients did not develop any intestinal complications, such as intestinal injury or ileus.

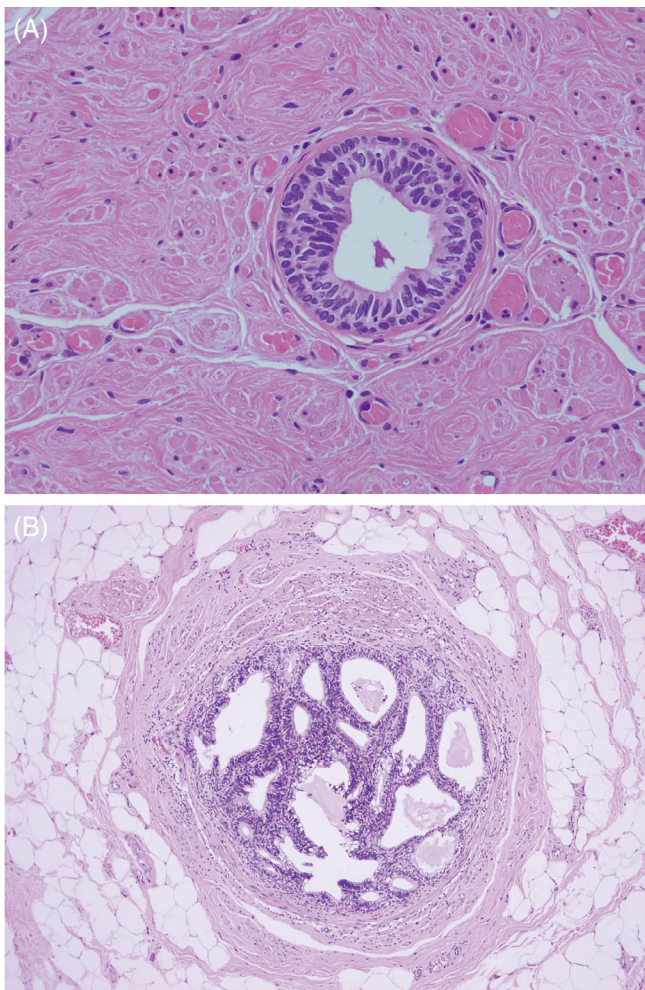
LESS-U is commonly performed through the umbilical wound.<sup>5–12</sup> The uLESS technique is probably the best technique in terms of cosmesis. However, a major problem with uLESS is the difficulty in resecting UR around the umbilicus. Under direct vision, it is difficult to resect UR from the surrounding tissue as the umbilical wound used for the multi-channel port is small in diameter. In laparoscopy, UR (especially in case of urachal sinus) is very close to the multi-channel port, making it difficult to resect UR at a safe distance. Therefore, we repositioned the multi-channel port from the umbilicus to the suprapubis. In this technique (spLESS), the distance between the umbilicus and the suprapubic port is appropriate, and it is easy to perform laparoscopic dissection around the umbilicus at an appropriate incision line. In addition, this procedure minimized the defect of the rectus

abdominis fascia (Figure 4B, arrow). Extensive resection of the rectus abdominis fascia has been reported to cause periumbilical hemorrhage.<sup>21</sup> Furthermore, to prevent postoperative umbilical hernia, it is desirable that the defect be as small as possible. In this regard, we considered spLESS as the most appropriate technique.

The suprapubic port provided a good view of the full length of UR and allowed adequate access to the umbilicus and bladder dome. This technique is feasible for excising URs, whether the inflammatory lesion is at the umbilicus or at the bladder, and it may reduce the risk of incomplete excision of UR. Regarding the extent of resection, Maemoto et al. reviewed 210 cases of LAP-U<sup>22</sup> and reported that 102 patients (48.6%) underwent umbilical resection (the wall of the fistula resection at the bottom of the umbilicus). The recurrence of periumbilical discharge has been reported to develop in cases without umbilical resection.<sup>15,19,22</sup> To prevent recurrence, we believe that umbilical resection and complete resection of inflammatory tissue are necessary.

In addition, spLESS has another advantage in that the bladder can be more easily and reliably resected under direct view by pulling the bladder dome out of the suprapubic incision. In contrast to open surgery, there are no general criteria for the indication of BR in LAP-U. The main reason for this may be that BR is difficult in laparoscopy, especially in uLESS. There are various discussions on the necessity of BR. Some report that BR was not required if there were no findings on the image,<sup>16,18,19</sup> while others affirm that BR is necessary considering future malignant transformation.<sup>6,9,15,24</sup> However, it is difficult to find a minute lesion at the bladder dome, even if various imaging studies (cystoscopy, ultrasound, computed tomography and magnetic resonance imaging) are performed. In addition, Maemoto et al. reported that epithelium was present in the resected UR tissue in four out of 14 and 44 out of 210 cases reviewed.<sup>22</sup> Therefore, we investigated the presence of epithelium in the muscle of the bladder dome. We performed a pathological investigation of the muscle at the bladder dome in patients with no evidence of epithelium in the preoperative images. As a result, epithelium was





**FIGURE 5** Microscopic findings of the urachal remnant in the muscle of the bladder dome with hematoxylin and eosin stain. (A) Finding of a typical epithelium. (B) Finding of the mucus-production columnar epithelium

found within the muscle layer of the bladder in 16 out of 22 cases (73%) (Figure 5A). Among them, urothelial cells were found in 11 cases, while columnar epithelium or stratified squamous epithelium was found in five cases. One case showed mucus-producing columnar epithelium (Figure 5B). We presume that such epithelia have malignant potential. For this reason, unless the entire length of UR, including the bladder dome, is resected, epithelial components with malignant potential may remain in the body. To prevent malignant transformation in the future, we suggest BR as a standard procedure, even in cases where there are no findings in the bladder dome in preoperative images. As BR can be performed easily and reliably under direct vision, spLESS is a highly curative surgery.

A significant problem with umbilical resection is the postoperative deformation of the umbilicus. There are several reports of umbilicoplasty to minimize deformation.<sup>9,11,16,21</sup> We improved the method by Kim et al.<sup>11</sup> to

perform umbilicoplasty. Our modified method differs from the original method in that the skin of the umbilicus is everted before incision (Figure 4A). Therefore, the wall of the fistula at the bottom of the umbilicus can be confirmed and completely resected without any problem even in patients with severe preoperative inflammation and deformity of the umbilicus. This method minimized incision of the skin in the umbilical ring ensuring that the umbilical skin can be preserved as much as possible. Thus, the postoperative deformation of the umbilicus is minimized (Figure 4C). Regarding the postoperative appearance, the difference between uLESS and spLESS is the presence of a suprapubic wound. The suprapubic wound was hidden by underwear and/or pubic hair; however, we expected a reduction in postoperative patient satisfaction with cosmesis. However, there were no differences between the two procedures in the self-completed questionnaires. This led to the conclusion that the suprapubic wound had minimal effect on patient satisfaction with regard to cosmesis.

Table 1 shows the perioperative results of LESS-U performed at our institute. There was no difference in the results between the spLESS and uLESS groups, including the complication and recurrence rates. Perioperative results of LESS-U from other institutions reported that the mean operative time was 80–150 minutes and the mean estimated blood loss was 5–50 mL,<sup>4–12</sup> which was not different from the present study. Based on these results, we concluded that spLESS is a safe and feasible procedure.

This study had several limitations. This study is relatively large for LAP-U in a single institute; however, the small number of patients and retrospective analysis of perioperative results are limited. Although a larger, prospective randomized study is required, it would be difficult because UR is a rare congenital anomaly. In terms of cosmetic outcomes, there are some limitations. The low response rate for BIQ and the cross-sectional research, which was the time spent answering the questionnaire in each group, was imbalanced. Longitudinal research with a larger number of patients is required to better understand the cosmetic outcomes of spLESS.

In conclusion, the perioperative results and cosmetic outcomes for spLESS were not significantly different from those of uLESS. Thus, we consider spLESS as an effective and feasible procedure to overcome the problems associated with uLESS.

## AUTHORSHIP DECLARATION

Akio Hoshi designed this study. Akio Hoshi, Takashi Kawahara, Shuya Kandori, Hiromitsu Negoro, and

Hiroyuki Nishiyama analyzed the patient data. Ichiro Chihara, Masanobu Shiga, Satoshi Nitta, Yoshiyuki Nagumo, Shotaro Sakka, Kosuke Kojo, Atsushi Ikeda, Takayuki Yoshino, and Tomokazu Kimura performed data collection. Akio Hoshi drafted the manuscript. All authors read and approved the final version of the manuscript.

#### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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#### REFERENCE

- Berman SM, Tolia BM, Laor E, Reid RE, Schweizerhof SP, Freed SZ. Urachal remnants in adults. *Urology*. 1988;31:17-21.
- Ueno T, Hashimoto H, Yokoyama H, Ito M, Kouda K, Kanamaru H. Urachal anomalies: ultrasonography and management. *J Pediatr Surg*. 2003;38:1203-1207.
- Trondsen E, Reiertsen O, Rosseland AR. Laparoscopic excision of urachal sinus. *Eur J Surg*. 1993;159:127-128.
- Patrzyk M, Glitsch A, Schreiber A, von Bernstorff W, Heidecke CD. Single-incision laparoscopic surgery as an option for the laparoscopic resection of an urachal fistula: first description of the surgical technique. *Surg Endosc*. 2010;24:2339-2342.
- Patrzyk M, Wilhelm L, Ludwig K, Heidecke CD, von Bernstorff W. Improved laparoscopic treatment of symptomatic urachal anomalies. *World J Urol*. 2013;31:1475-1481.
- Yanishi M, Kinoshita H, Mishima T, et al. Influence of scars on body image consciousness with respect to gender following laparoendoscopic single-site versus conventional laparoscopic surgery. *Scand J Urol*. 2017;51:57-61.
- Yanishi M, Kinoshita H, Matsuzaki T, et al. Laparoendoscopic single-site surgery for Urachal remnants: a single-center experience. *Urol Int*. 2020;104:70-74.
- Garisto JD, Henriquez K, Pimentel MEE. Single-incision laparoscopy surgery excision of an infected Urachal cyst: description of the technique. *J Endourol Case Rep*. 2017;3:7-9.
- Iida T, Kawa G, Takizawa N, et al. Laparoendoscopic single-site surgery for urachal remnants. *Asian J Endosc Surg*. 2012;5:100-102.
- Sato F, Shin T, Yuki H, et al. Umbilical laparoendoscopic single-site technique for complete excision of urachal remnant. *J Laparoendosc Adv Surg Tech A*. 2012;22:899-903.
- Kim H, Nakajima S, Kawamura Y, et al. Three-flap umbilicoplasty: a novel and preliminary method of laparoendoscopic single-site transumbilical surgical approach for urachal remnants. *Int Urol Nephrol*. 2017;49:1965-1971.
- Nakamura H, Oshita A, Imamura Y, et al. Successful treatment of a patient with an infected urachal remnant via single-incision laparoscopic surgery: report of a case. *Asian J Endosc Surg*. 2016;9:86-88.
- Dunker MS, Stiggelbout AM, van Hogezaand RA, Ringers J, Griffioen G, Bemelman WA. Cosmesis and body image after laparoscopic-assisted and open ileocolic resection for Crohn's disease. *Surg Endosc*. 1998;12:1334-1340.
- Okegawa T, Odagane A, Nutahara K, Higashihara E. Laparoscopic management of urachal remnants in adulthood. *Int J Urol*. 2006;13:1466-1469.
- Cutting CW, Hindley RG, Poulsen J. Laparoscopic management of complicated urachal remnants. *BJU Int*. 2005;96:1417-1421.
- Araki M, Saika T, Araki D, et al. Laparoscopic management of complicated urachal remnants in adults. *World J Urol*. 2012;30:647-650.
- Cadeddu JA, Boyle KE, Fabrizio MD, Schulam PG, Kavoussi LR. Laparoscopic management of urachal cysts in adulthood. *J Urol*. 2000;164:1526-1528.
- Jeong HJ, Han DY, Kwon WA. Laparoscopic management of complicated urachal remnants. *Chonnam Med J*. 2013;49:43-47.
- Siow SL, Mahendran HA, Hardin M. Laparoscopic management of symptomatic urachal remnants in adulthood. *Asian J Surg*. 2015;38:85-90.
- Li Destri G, Schillaci D, Latino R, Castaing M, Scilletta B, Cataldo AD. The urachal pathology with umbilical manifestation: overview of laparoscopic technique. *J Laparoendosc Adv Surg Tech A*. 2011;21:809-814.
- Sasaki H, Kimura S, Shimada H, et al. Outcomes of laparoscopic resection of urachal remnants followed by novel umbilicoplasty. *Int Urol Nephrol*. 2018;50:2167-2172.
- Maemoto R, Matsuo S, Sugimoto S, Tokuka A. Umbilical resection during laparoscopic surgery for urachal remnants. *Asian J Endosc Surg*. 2019;12:101-106.
- Inoue S, Ikeda K, Kobayashi K, Kajiwara M, Teishima J, Matsubara A. Patient-reported satisfaction and cosmesis outcomes following laparoscopic adrenalectomy: Laparoendoscopic single-site adrenalectomy vs. conventional laparoscopic adrenalectomy. *Can Urol Assoc J*. 2014;8:E20-E25.
- Cilento BG Jr, Bauer SB, Retik AB, Peters CA, Atala A. Urachal anomalies: defining the best diagnostic modality. *Urology*. 1998;52:120-122.

**How to cite this article:** Hoshi A, Chihara I, Shiga M, et al. Laparoendoscopic single-site surgery for urachal remnant with extraperitoneal approach through a suprapubic port. *Asian J Endosc Surg*. 2022;15(3):569-576. doi:10.1111/ases.13056