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Hand-Assisted Retroperitoneoscopic Nephroureterectomy With Bladder Cuffing After Preperitoneal and Retroperitoneal Perivesical Ballooning

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Purpose: We aimed to describe the surgical technique of hand-assisted retroperitoneoscopic nephroureterectomy (HARNU) with bladder cuffing after preperitoneal and retroperitoneal perivesical ballooning.

Materials and Methods: From March 2008 to September 2012, we performed HARNU and open bladder cuffing in 28 consecutive series of patients with upper urinary tract urothelial carcinoma. We performed HARNU according to the following procedure: (1) a camera port incision was made on the posterior axillary line; (2) multiple, repeated, preperitoneal and retroperitoneal ballooning was performed on both the posterior axillary line and in the umbilicus; (3) a 7.0 cm skin incision was made from the suprapubic to the lower inguinal with the balloon present in the extraperitoneal area; (4) hand-assisted laparoscopic retroperitoneal nephroureterectomy; (5) cessation of gas insufflation; and (6) extravesical cuffing as an open surgical procedure.

Results: The mean estimated blood loss was 250 mL. The mean operation time was 240 minutes. The mean time to oral intake and ambulation was 1.0 day and two days, respectively. As for postoperative complications due to the hand-assisted device, one patient developed febrile urinary tract infection within three weeks postoperatively and was hospitalized again to receive parenteral antibiotics.

Conclusions: We made a low Gibson incision for a route for the hand-assisted procedure as well as a window for open surgery in dissecting the distal ureter and extracting the surgical specimens. Thus, our results indicate that the HARNU might be a feasible surgical modality.

Keywords: *Endoscopy; Hand-assisted laparoscopy; Nephrectomy; Transitional cell carcinoma; Ureteral neoplasms*

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INTRODUCTION

Currently, nephroureterectomy with bladder cuff excision is the standard treatment regimen for patients with upper urinary tract urothelial carcinoma. Various open, laparoscopic, and endoscopic techniques have been developed to excise the distal ureter with bladder cuffing. To date, however, there are no established treatment guidelines in this series [1-5]. It has also been reported that there is no significant difference in oncologic outcomes between endoscopic and open surgeries [6-10]. Pure or hand-assisted laparoscopic nephroureterectomy with a bladder cuff excision is a minimally invasive surgical option in patients with upper tract urothelial cancer, which is beneficial in that early recovery can be achieved. An incision for a hand-assisted laparoscopic nephroureterectomy is a feasible option when it is performed for pathologic diagnosis or functional (for subsequent open surgery) purposes. Hand-assisted retroperitoneoscopic nephroureterectomy (HARNU) is an easier procedure than pure laparoscopic surgery, and there is

no significant difference in short-term recovery between the two surgical modalities. It has also been reported that there is no significant difference in the long-term cancer-specific survival between the two surgical modalities in patients with upper tract urothelial cancer [11-13].

We hypothesized that it would be easier to perform a bladder cuffing incision based on bidirectional dissection after repeatedly performing preperitoneal and retroperitoneal ballooning. Here, we describe our surgical technique of HARNU with bladder cuffing after preperitoneal and retroperitoneal perivesical ballooning.

MATERIALS AND METHODS

1. Patients

From March 2008 to September 2012, we performed HARNU and open bladder cuffing in 28 consecutive patients with upper urinary tract urothelial carcinoma. We obtained approval from the Institutional Review Board (IRB) of Gachon University Medical Center (IRB No: GCIRB2013-137) and retrospectively analyzed the clinical and pathological data on the basis of the medical records of eligible patients.

We evaluated the demographic data of the patients, including age, gender, body mass index (BMI), and tumor location. In addition, we classified the histologic subtype of the patients according to the American Joint Committee on Cancer staging system [14].

Statistical analysis was done by using PASW ver. 18.0 (SPSS Inc., Chicago, IL, USA). All data were expressed as mean±standard deviation.

2. Technique

The patients were placed in the lateral decubitus position with lumbar flexion under general anesthesia. Then, they were fixed to the operation table with a 3-inch tape, which permitted tilting motion. To maintain the orientation in relation to the bony landmarks, we marked the mid- and posterior axillary line and port sites before draping (Fig. 1). The surgeon and assistant faced each other in order to obtain sufficient work space (Fig. 1).

A 2-cm incision was made below the tip of the 12th rib on the posterior axillary line. After finger dissection of the abdominal muscle, a 12-mm blunt-tip port with an inflatable balloon-tip cannula was placed and withdrawn with the balloon inflated such that it abutted the abdominal wall. Thus, we minimized the chances of inadvertent peritoneal entry. This was followed by the insertion of a 10-mm, 30-degree telescope. Then, pneumoretroperitoneum was created by blunt dissection by moving the telescope along the psoas muscle in a cranial-to-caudal fashion at an insufflation pressure of 14 mmHg. We repeated this maneuver more than five times and thereby dissected and then obtained sufficient retroperitoneal space. By moving the telescope from the inferior edge of the kidney to the pelvic brim and thereby medially sweeping the peritoneal

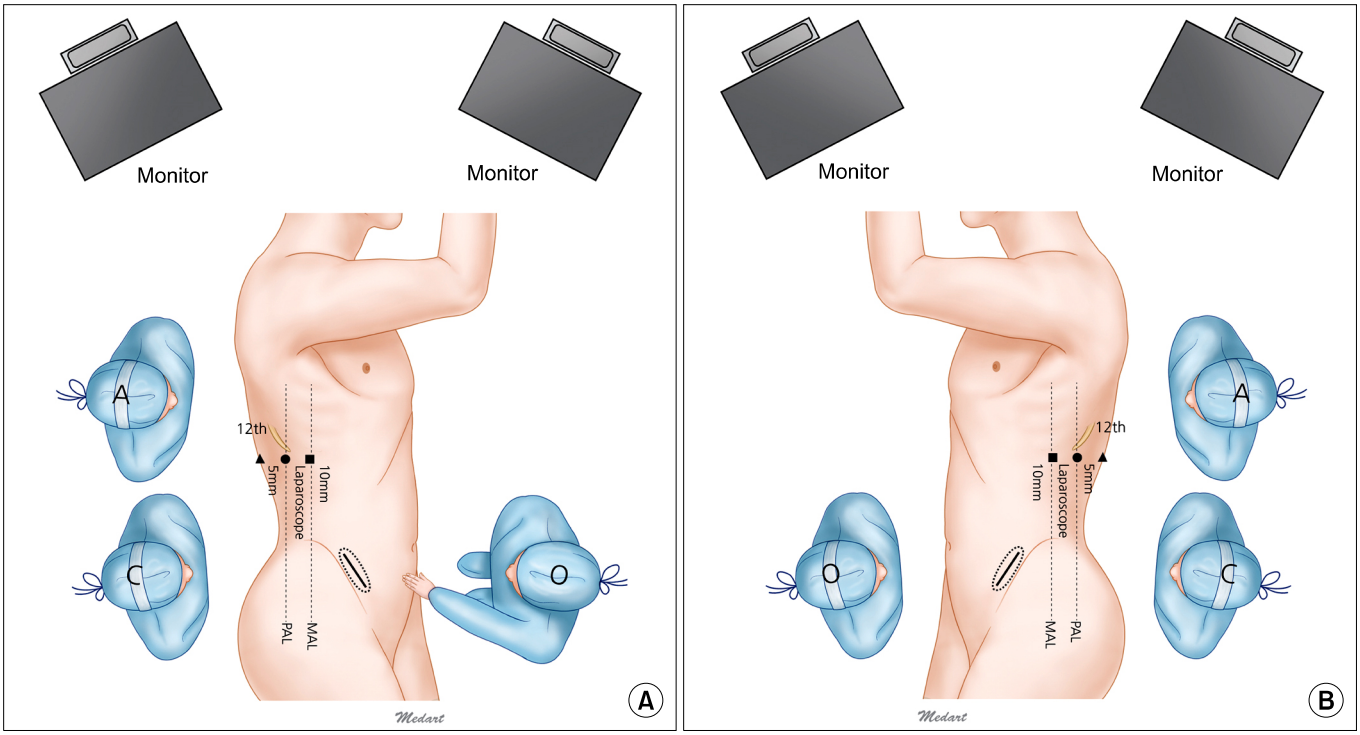

FIG. 1. Port arrangement and position of surgeon and assistant during hand-assisted retroperitoneoscopic nephroureterectomy for a right-handed surgeon. (A) For right-sided nephroureterectomy. (B) For left-sided nephroureterectomy. The solid line shows the lower Gibson incision for the hand port. O, operator; C, camera assistant; A, additional assistant; MAL, midaxillary line; PAL, posterior axillary line; 12th, 12th rib.

membrane, we created pneumoretroperitoneum externally to the Gerota's fascia.

After making a U-shaped (smile) incision in the subumbilical area, we created the preperitoneal, retropubic space. This is essential for obtaining sufficient perivesical space and preventing the occurrence of peritoneal injury (Fig. 2A).

After obtaining working space from bilateral directions, we made a hand port incision while asking the assistant to hold the telescope and to transilluminate the body wall. We made a Gibson incision 7.0 cm lower than the conventional one while adjusting its height depending on the height and body shape of the patients. In tall or obese patients, a more superior incision was made. In patients with an average body type, however, an incision was made proximal to the inguinal area. An incision of the fascia was made lateral to the rectus abdominis muscle. This was accompanied by finger dissection to make a tunnel between the muscle fibers in the transilluminated retroperitoneum. The insertion of the port into the correct space was confirmed by the outburst of insufflation gas (Fig. 2B, C). A LapDisc (Ethicon, Cincinnati, OH, USA) or Gelport (Applied Medical, Rancho Santa Margarita, CA, USA) was inserted according to the nondominant hand of the surgeon. We swept the insertion site along the psoas muscle with the hand. Meanwhile, we posteriorly moved the kidney toward the diaphragm by medially pushing the kidney and peritoneum, thus exposing the ureter and great vessels. With the completion of the procedure in the retroperitoneal space, we inserted a 10-mm port into the laparoscopic instruments on the midaxillary line with or without an additional 5-mm port for traction, 2-cm lateral to the camera port. Meanwhile, we lowered the pressure of the insufflation gas to 12 mmHg (Fig. 1).

The psoas muscle was visually examined intermittently throughout the procedure to make sure that it was placed parallel to the floor. This provided a visual landmark for spatial orientation. The surgeon examined the back of the patient from time to time and then exposed the renal hilum with the left hand in the hand port. The surgeon also manipulated a Harmonic scalpel with the right hand (Ethicon) via the port placed at the costovertebral angle for the left nephrectomy. The renal artery was immediately exposed and then divided with an endovascular stapler or surgical clips. The same maneuver was performed for the renal vein. In challenging cases, the hilar vessels were managed en bloc. This was followed by the superior, medial, and inferior mobilization of the kidney and, if applicable, the adrenal gland along the Gerota's fascia. Then, we divided the ureter and collected the specimens intact via the hand port. In collecting large specimens, we extended the skin incision inferiorly towards the pubis. This was followed by mobilization of the distal ureter by using a bladder cuff by making a lower Gibson incision as in open surgery. There was a similarity in the approach and the port sites between the left and the right side.

RESULTS

From September 2008 to October 2012, we performed HARNU and open bladder cuff excisions in 28 consecutive patients by use of a hand-assisted device. In our report, we examined the surgical cases since 2008 for which patient data were available. However, there have been more than 60 cases since 2000 for which the exact data were not available.

In the current study, we enrolled 28 patients (26 men and 2 women) whose mean age was 68.2 years (range, 51–81 years). Of these patients, 23 presented with gross hematuria and 3 were incidentally diagnosed on sonographic or computed tomography examinations. In our series, the mean height of the patients was 163 cm (range, 153–174 cm), the mean weight was 68 kg (range, 53–84 kg), and the mean BMI was 24.3±3.4 kg/m^2 (range, 21.7–28.4 kg/m^2)

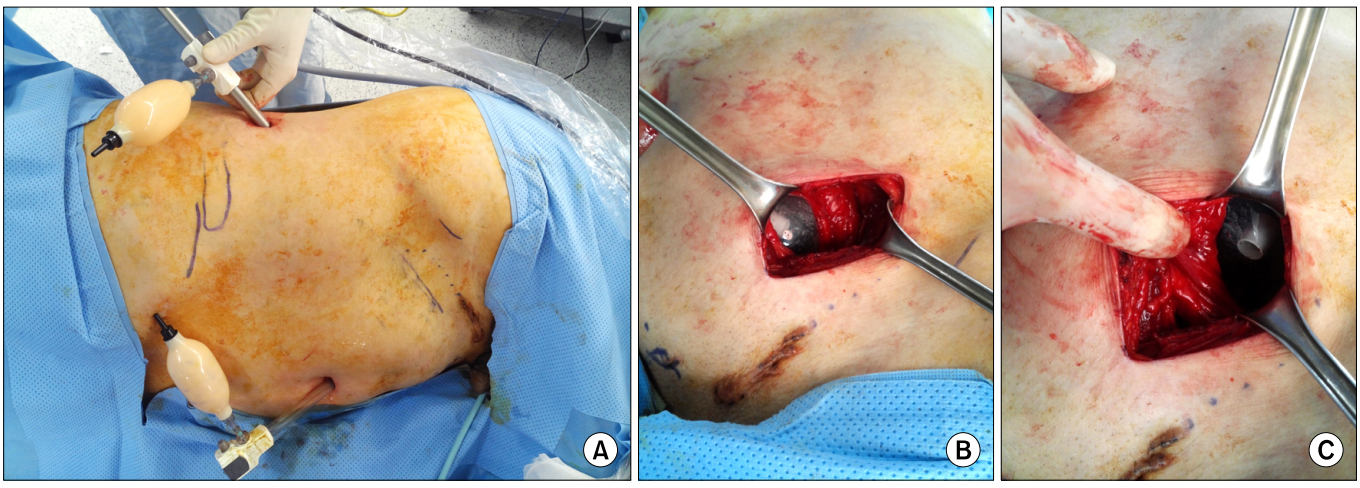

FIG. 2. Balloon dilation for the left nephroureterectomy. (A) Bidirectional balloon dilation. (B) The preperitoneal balloon dilator identified through a lower Gibson incision. (C) The retroperitoneal balloon dilator identified in the same patient.

TABLE 1. Patient characteristics

Variable	Value
No. of patients	28 (100)
Sex	
Male	26 (92.85)
Female	2 (7.14)
Age (y)	68±22 (51–81)
Body mass index (kg/m^2)	24.3±3.4 (21.7–28.4)
Tumor location	
Right	4 (14.28)
Left	24 (85.71)
Renal pelvis	12 (42.85)
Upper ureter	8 (28.57)
Mid ureter	2 (7.14)
Lower ureter	6 (21.42)
History of or concomitant bladder tumor	1 (7.14)

Values are presented as number (%) or mean±standard deviation (range).

TABLE 2. Perioperative and pathologic findings

Variable	Value
Operation time (min)	240±160 (100–420)
Bladder cuffing time (min)	31±5 (20–40)
Estimated blood loss (mL)	250±200 (50–1,400)
Time to oral intake (d)	1±1 (1–2)
Time to ambulation (d)	2±1 (2–4)
Hospital stay (d)	8±4 (5–10)
Time to remove Foley catheter (d)	7±2 (6–14)
Pain score: VAS (range)	
Postoperative 1 day	6±1 (5–6)
Postoperative 2 day	2±1 (2–6)
Time to use PCA	2±0 (1–4)
Complications	
Renal-vein injury	1
Blood loss > 1,000 mL	2 (14.28)
Wound infection	1
Febrile urinary tract infection	1
Pathologic stage	
Ta/T1	8 (28.57)
T2	4 (14.28)
T3	16 (57.14)
Tumor grade	
High	12 (85.71)
Low	1 (7.14)
Bladder recurrence	6 (21.4)

Values are presented as mean±standard deviation (range) or number (%).
VAS, visual analogue scale pain scores; PCA, patient-controlled analgesia.

(Table 1).

The mean operation time was 240 minutes (range, 100–420 minutes), the mean bladder cuffing time was 31 minutes (range, 20–40 minutes), and the mean estimated blood loss was 250 mL (range, 50–1,400 mL). The specimens were extracted easily from all patients either en bloc or via a lower Gibson incision. The mean time to oral intake and ambulation was 1.0 day irrespective of the method of specimen collection. The mean time to ambulation was 2 days (range, 1–4 days). Postoperatively, all patients underwent uneventful hospital courses. The mean length of hospital stay was 8.0 days (range, 5–10 days) (Table 2).

As for postoperative complications due to the hand-assisted device, one patient developed febrile urinary tract infection within 3 weeks postoperatively and was rehospitalized to receive parenteral antibiotics. Our clinical series of patients (n=28) showed 12 cases of renal pelvis transitional cell carcinoma, 16 cases of ureteral transitional cell carcinoma, and 3 cases of renal pelvis and ureteral transitional cell carcinoma. Histopathologically, our clinical series of patients had 8 cases of T1 carcinoma, 4 cases of T2 carcinoma, and 16 cases of T3 carcinoma according to the TNM staging system (Table 2). Five of 28 patients underwent transurethral resection of bladder for recurrence of bladder cancer.

DISCUSSION

This article is based on the technique reported in the video session of the American Urological Association in 2002 (abstract no. V-70). The method of bidirectional balloon dissection in HARNU is unique and has not been previously introduced in the literature. Because this was our first attempt, we may have tended to emphasize the advantages; however, we tried to fully examine both the advantages and the safety of this procedure. Our report emphasizes the introduction of a new technique rather than being an original article. Since 1998, various hybridization techniques (laparoscopy+minilaparotomy) have been used, and HARNU can be included in this classification.

We have described a novel technique, HARNU, to create the retroperitoneal, preperitoneal, and perivesical spaces for bladder cuffing. Although it is a feasible, effective, and easy method of bladder cuffing, it remains problematic. We aimed to completely and easily remove the total intramural ureter. This was based on the speculation that repeated retropubic preperitoneal and retroperitoneal ballooning would lead to excellent perivesical dissection. In addition, a low-positioned extraperitoneal hand port incision can be made near the bladder without peritoneal injury if an extraperitoneal ballooning state is maintained. As a result, bladder cuffing can be easily performed by the open surgical method.

We performed HARNU according to the following procedure:

(1) Camera port incision on the posterior axillary line; (2) multiple, repeated, preperitoneal and retroperitoneal ballooning, both on the posterior axillary line and in the umbilicus; (3) a 7.0-cm skin incision from the suprapubic to the lower inguinal area in the presence of extraperitoneal ballooning; (4) hand-assisted laparoscopic retroperitoneal nephroureterectomy; (5) cessation of gas insufflation; and (6) extravesical cuffing as performed in open surgery.

We hypothesized that the removal of a screw (the distal ureter) might be promoted by beating on both sides of the screw (the distal ureter). If the screw is removed by rotation in a single direction, excessive force is used, and the process can be time-consuming. However, if the screw receives force from several directions, removal is much easier. Thus, we tried to dissect the perivesical space around the ureterovesical junction from the retroperitoneal and preperitoneal directions and the distal ureter to thereby reduce the bladder cuffing time.

In our technique, balloon dissection, which is commonly used in retroperitoneal or extraperitoneal laparoscopic surgery, is performed repeatedly for at least 5 times. Such a procedure reduces the laparoscopic instrument use time and makes bidirectional dissection possible. Such a procedure makes dissection near the distal ureter less difficult and shortens operation time. Because the bladder is dropped below the preperitoneal ballooning area, and the retroperitoneal ballooning is pushed to the side, mobilization of the bladder can be easily performed.

Bladder cuffing is easy in open surgery because of the facility of bladder mobilization. Without using a balloon, bladder cuffing is possible by using the hand port incision similarly to the previous open procedure. However, the method we are introducing is different from previous methods in the location of the hand port and in the size of the hand port. The incision is 2 to 3 cm lower and shorter than previously reported Gibson incisions. Because the hand port incision is low, it can be concealed by undergarments, which results in excellent cosmesis. Because both the preperitoneal space and the retroperitoneal space are dissected, mobilization can be easily performed, and the cuffing length is shorter than with previous techniques. Because preperitoneal space was acquired with balloon dilatation, we considered that damage to the peritoneum is quite minimal. In addition, during blunt balloon dissection, most of the distal ureter is dissected, which allows early ligation of the distal ureter.

Pure or hand-assisted laparoscopic nephroureterectomy with a bladder cuff excision is a minimally invasive modality in patients with upper tract urothelial carcinoma and is beneficial in achieving early recovery and providing comparable disease control. The hand-assisted procedure is a rational option when an extraction incision is required for pathological purposes. It is a convenient procedure and its short-term recovery parameters are comparable to those of a pure laparoscopic surgery [15].

There are several reasons we prefer the use of a retroperitoneal approach by making a lower Gibson incision for laparoscopic surgery, as follows [5,16]:

(1) The bowel does not interfere with the operation field because it is present in the peritoneum. The pneumoretroperitoneum pushes the peritoneum medially and allows the peritoneum to serve as a natural bowel retractor. If it is possible to keep the bowel and abdominal contents remote from the operation field, this lowers the risk of injuring the bowels and abdominal contents. Compared with an intra-abdominal approach, a retroperitoneal approach is useful for the peritoneal retraction of the adjacent organs (the descending colon, spleen, and pancreas on the left side and the ascending colon and duodenum on the right side). It is not necessary to strip them from their original attachments, and the risk of incidental bowel injuries is lowered.

(2) From a theoretical perspective, this approach prevents urinary extravasation (infection or tumor cells) into the peritoneal cavity.

(3) This approach avoids troublesome encounters with adhesion from previous intra-abdominal operations, as seen in six of our patients (21.4%). Such benefits are not shared by transperitoneal approaches. Furthermore, the hilar vascular dissection is facilitated because the renal artery is encountered before the vein.

However, these favorable outcomes can occur only after overcoming the steeper learning curve of the retroperitoneoscopic approach because of the relative lack of anatomical landmarks [5]. It is therefore likely that the retroperitoneal approach with the nondominant hand would not be beneficial. We believe that hand-assistance improves the learning curve. It would become possible to overcome difficulties in identifying the kidney and the limited surgical space in a pure retroperitoneoscopic approach by using the hand-assisted technique. Hand-assisted nephrectomy is advantageous for perceiving tactile feedback, enabling digital retraction, dissecting the kidney, and palpating the renal vessels. This hand-assisted procedure is so easy that only two or three trocar sites are needed for HARNU. Moreover, a lower Gibson incision provides direct vision of the distal ureter and bladder cuff, while lowering the risk of tumor seeding by careful manipulation of standard open maneuvers.

The assistant stands beside the patient facing the surgeon, thus allowing plenty of space in which the assistant can maneuver. In addition, the nondominant hand of the surgeon can reach the renal lesion on the unilateral side within the retroperitoneal space. This is helpful for flexible manipulation of the laparoscopic instruments with the dominant hand. Sometimes, the flexibility of the nondominant hand is limited in this position, and this may also cause neuromuscular strain to the surgeon's upper extremity or back muscles. In such cases, the surgeon is permitted to change hands to facilitate instrumentation for blunt dissection or traction.

According to a review of the literature, there are three types of hand port incisions for HARNU and open lower ureter and bladder cuff resection; these include the lower midline, the paramedian, and the Gibson incision [11,12,17]. Considering cosmetic outcomes, we tried to make a lower Gibson incision to ensure that the 7.0-cm scar could be hidden by undergarments. Our experience with laparoscopic nephroureterectomy and bladder cuff resection using two directional balloon dissections is comparable to that of other groups [7,18,19]. In the current study, an inexperienced surgeon showed that the mean operation time could be shortened from 240 to 180 minutes in the last five patients.

Ou et al. [15,16,19] placed their patients in a supine position (spread-eagle position, SEP) with both legs abducted. According to those authors, HARNU can be easily performed when patients are placed in a completely supine position, which is beneficial for HARNU. In addition, an SEP accelerates the operation without delay due to a positional change, thus providing better coordinated movements for both the surgeon and the assistant. Furthermore, it is also less cumbersome for the nondominant hand on either side of the body. According to their first and final reports, the mean operation time was 207.6 minutes [15] but was shortened to 103 minutes [19], respectively. Presumably, the shorter operation time might be due to increased familiarity with hand-assisted surgery.

Chen et al. [18] performed a hand-assisted transperitoneal laparoscopic nephrouretectomy on seven patients by using a Gibson incision for open bladder cuffing with a hand-assisted device. Thus, these authors minimized the potential for tumor cell spread or urine leakage. In addition, they first ligated the lower ureter at the level of the bladder cuff with an open technique only, which is different from our technique. Owing to a small series of patients (n=7), however, the oncologic outcomes of their technique remain inconclusive.

Our results showed that we can easily perform lower ureter and perivesical dissection via the hand port for the following reasons:

(1) The hand port is placed near the bladder; (2) The perivesical tissue is already dissected by the previous ballooning; and (3) In addition, an extremely low incision has the advantage that any possibly unfavorable cosmetic outcomes will be hidden by undergarments.

There are three limitations of the current study as follows:

(1) We enrolled a small number of patients (n=28); (2) Our clinical series of patients were followed up for a short period of time; and (3) There was no control group.

Further large-scale, randomized controlled studies with long-term follow-up are therefore warranted to evaluate the operation time, safety, and oncologic and cosmetic outcomes of HARNU.

CONCLUSIONS

We made a lower Gibson incision as both a route for the hand-assisted procedure and a window for open surgery in dissecting the distal ureter and extraction of the surgical specimens. Thus, our results indicate that HARNU might be a feasible surgical modality. We easily performed the lower ureter and perivesical dissection via the hand port, owing to the contiguity of the hand port and previous dissection of the perivesical tissue by previous ballooning. The procedure resulted in excellent cosmesis owing to the concealable location of the low incision.

CONFLICTS OF INTEREST

The authors have nothing to disclose.

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