CASE REPORT

Robotic-Assisted Laparoscopic Nephroureterectomy and Bladder Cuff Excision

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ABSTRACT

Background and Objectives: Our aim was to show that bladder cuff excision and distal ureterectomy can be safely performed by using the LigaSure device during robotic-assisted laparoscopic nephroureterectomy.

Methods: A 60-year-old man presented with gross hematuria. He was diagnosed with upper urinary tract transitional cell carcinoma (TCC) on the left side and was scheduled for robot-assisted laparoscopic surgery. Without changing the patient's position, sealing with the LigaSure atlas for bladder cuff excision and distal ureterectomy was performed.

Results: The operating time was 140 minutes from the initial incision to skin closure of all incisions. The estimated blood loss during the surgery was 120mL. There were no intraoperative or postoperative complications. The Foley drain was removed on day 3 after normal cystographic findings, and the patient was discharged from the hospital on the fourth postoperative day.

Conclusion: Robot-assisted nephroureterectomy with distal ureterectomy in the same position using a LigaSure device is a safe alternative for upper tract transitional cell carcinoma.

Key Words: LigaSure, Nephroureterectomy, Robot.

INTRODUCTION

Upper tract transitional cell carcinoma (TCC) accounts for 5% of all urothelial tumors.[1] Standard management consists of nephroureterectomy with the removal of the bladder cuff, which usually requires 1 large or 2 separate abdominal incisions. Laparoscopic nephroureterectomy was first reported in 1991 by Clayman et al,[2–5] and the benefits of this procedure regarding perioperative morbidity, cosmesis, and convalescence have been established. Several methods for securing the distal ureter and bladder cuff have been suggested, but the best way to manage the distal ureter remains in dispute.[6,7] We present our technique of a purely robotic-assisted laparoscopic nephroureterectomy performed entirely through laparoscopic nephrectomy ports without changing patient positioning, and sealing with the LigaSure atlas for bladder cuff excision and distal ureterectomy.

METHODS

A 60-year-old presented with gross hematuria. The preoperative workup included upper tract imaging, flexible cystoscopy, ureteroscopy, and urine cytology. He was diagnosed with upper urinary tract TCC on the left side and was scheduled for robot-assisted laparoscopic surgery. His body mass index was 29, and he had not previously undergone abdominal surgery or received any radiotherapy or chemotherapy.

The patient was placed in a modified flank position (45° angle relative to the bed, kidney rest up, table in flex). The robot was docked at a 30° angle to the foot of the table. Pneumoperitoneum was achieved with a Veress needle, and the initial 12-mm port was placed supraumbilically for medial camera view. Another 12-mm port for lateral camera view was placed 8cm lateral to the peri-umbilical port. Two additional 8-mm robotic arm ports were then placed, again maintaining a minimum distance of 8cm, which was maintained between the robotic port sites. Another 5-mm port was placed in the midclavicular line in the ipsilateral upper quadrant, and a 12-mm assistant port was placed just caudal to the McBurney point on the ipsilateral side for suction-irrigation, retraction, and introduction and removal of suture material and the LigaSure.

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The white line of Toldt was incised as caudad as possible to reflect the colon medially. The ureter was then identified and dissected distally until the detrusor muscle fibers at the ureterovesical junction were identified. Next, the renal artery and vein were dissected and divided by Hemo-lock clips, and the kidney was mobilized, sparing the adrenal. Later the camera was inserted through the lateral 12-mm port. The ureter was then retracted gently upward with an atraumatic grasper, tenting up the bladder wall at the ureterovesical junction. A 1-cm margin of bladder cuff around the ureterovesical junction was cleared, and a bladder cuff was incised in the shape of a wedge with the use of a 10-mm LigaSure device (Valleylab, Tyco Healthcare UK Ltd, Gosport, UK). Because the LigaSure provided excellent dissection and hemostasis, and the bladder is a low-pressure organ, additional sutures in the bladder wall were not required. The specimen, including left kidney whole ureter and cuff of the bladder, at the end was contained within a 15-mm specimen bag. Thereafter, the bladder was filled with 120mL to assess for leakage. After entrapment of the specimen in the bag, one 16F Foley drain was placed through the 5-mm lateral port. A nearly 7-cm incision was made, extending the 10-mm port into the ipsilateral side, the thread of the bag was pulled out through the incision with the use of a grasper, and the dissected specimen was removed intact in the EndoCatch bag.

RESULTS

The operating time was 140 minutes from the initial incision to closure of all skin incisions, and the estimated blood loss during the surgery was 120mL. There were no intraoperative or postoperative complications. The Foley drain was removed on day 3 after normal cystographic findings, and the patient was discharged from the hospital on the fourth postoperative day.

Pathological examination revealed transitional cell carcinoma in the renal pelvis of the left kidney. Pathologic stage was pT1, no tumors were found in the entire ureter, and the surgical margins were negative. Control cystoscopic examinations done at 1-, 3-, and 6-month follow-up revealed no tumor in the bladder or in the previous ipsilateral ureteral orifice.

DISCUSSION

Transitional cell carcinoma of the upper tract is less common than TCC of the lower tract and has fewer surgical options. Although endoscopic treatments have been described, the gold standard therapy is nephroureterectomy.[8] Laparoscopic and open nephroureterectomy techniques have been described, and both types also have similar recurrence rates.[9,10] Compared with the open technique, the laparoscopic approach has been shown to result in decreased blood loss, less postoperative pain, and shorter hospitalization. It is also associated with a faster recovery time and return to normal activities.[5,11,12] The open nephroureterectomy technique also has some potential disadvantages, such as contralateral ureteral orifice compromise, inadequate excision of the bladder cuff, and technical difficulty especially in obese patients.[13,14] We believe that the robot-assisted laparoscopic approach with good surgical vision, prevention of tremors, and accurate mobility is also a good alternative to open and to laparoscopic nephroureterectomy excision of the distal ureter and bladder cuff. Rose and colleagues[15] initially described the use of robot-assisted laparoscopic nephroureterectomy. Both patients underwent retroperitoneoscopic nephroureterectomy with a mean operative time of 182.5 minutes and mean blood loss of 75mL with no perioperative complications. In another series of Nanigian and colleagues,[16] 10 patients underwent laparoscopic nephroureterectomy and robot-assisted transvesical excision of the distal ureter and bladder cuff. Our approach differs in that the whole procedure (robot-assisted nephroureterectomy and extravesical distal ureterectomy) is performed transperitoneally, changing only the camera port from medial to lateral positions but without changing the position of the patient and the robot. We prefer to perform the renal part of the operation transperitoneally to dissect the ureter all the way to the bladder. Also the LigaSure device was used for en bloc resection of the bladder cuff, all of which allowed us to complete the procedure in a shorter period of time. Surgeons familiar with the retroperitoneal approach to radical nephrectomy can perform the renal part of the operation retroperitoneally, although access to the distal ureter is difficult with this approach. But the transperitoneal approach is suited to our case where the distal ureter was managed with the LigaSure device, avoiding the need to reposition and dock the robot in the flank position, which not only shortened operative time, but also improved exposure of the distal ureterectomy. Also intraoperative patient repositioning may be associated with potential urethral complications.[17]

The technique of distal ureterectomy and bladder cuff excision has not yet been standardized.[18] Adherence to the basic tenets of oncologic surgery mandate that the most important point is having a complete resection of the distal ureter with bladder cuff and avoiding tumor spillage. Multiple techniques have been described in the literature as mentioned earlier: an open technique, a transurethral resection of the ureteral orifice ("pluck" technique),

an intussusception technique, a transvesical laparoscopic detachment and ligation technique, and laparoscopic stapling of the distal ureter and bladder cuff.[6,12] Each technique has distinct advantages and disadvantages, and differs not only in the technical approach, but also in the observation of oncologic principles as well, but no single technique for the distal ureter and bladder cuff has become standard. The open technique does not necessarily guarantee adequate excision of the entire ureter and bladder cuff when performed blindly and has a risk of contralateral ureteric orifice compromise, because the contralateral trigone may be inadvertently included in a right-angle clamp or suture line and also may be difficult in obese patients.[12,19]

Aggressive transurethral resection of the intramural ureter during the pluck technique exposes the extravesical space to spillage of irrigant and urine during the procedure with possible development of tumor seeding and local tumor recurrence at the resection area.[6] Arango et al[6] reported a case of tumor implantation at the endoscopic resection area, and Laguna et al[20] in their review found bladder carcinoma recurrence of 19.3% and 24% for ureteral stripping and "pluck" technique, respectively. Shalhav et al[4] described the laparoscopic stapling of the distal ureter and bladder cuff, but Hattori et al[21] reported that stone formation occurred in 3 (5.7%) of 53 patients. Although to date there have been no reports of recurrences at the staple line, Venkatesh et al[22] have shown viable cells within the staple lines in a porcine model, and Matin and Gill[23] have shown that the stapling technique is associated with decreased overall survival, decreased recurrence free survival, and a higher positive surgical margin rate. As seen, oncologic safety of the laparoscopic stapler is not enough and has a potential risk of stone formation and staple migration.[21,24] Kurzer et al[25] reported their results after cystoscopic circumferential excision of the distal ureter without primary closure of the bladder cuff with simultaneous ureteral ligation. No cases of local pelvic or peritoneal recurrences were reported.

Vardi et al[26] proposed using a flexible cystoscope and an electrode for en bloc excision of the bladder cuff during hand-assisted laparoscopic nephroureterectomy without repositioning the patient. Mean follow-up was 31 months (range, 5 to 44), and none of the 6 patients experienced a local recurrence. Agarwal et al[27] performed a circumscribed incision in the ureteric orifice with a bladder cuff using a Collins knife. The ureter stump was ligated with an Endoloop via a cystoscope to avoid urine leakage from the upper tract. Complete excision was achieved in all 13 patients, but 5 patients had bladder recurrence, 2 close to the ureteral scar. Recently, Nanigian et al[28] reported using robotic assistance in an attempt to decrease the technical challenge of excision of the distal ureter in 11 patients. As part of the procedure, they filled the bladder with a saline solution before opening it, and aspirated all the fluid to avoid dissemination of cancer cells. Because most studies do not show any difference between different methods of handling the distal ureter, the best option is to follow the individual surgeon's preference, as long as the fundamental oncological concepts are preserved. Our experience with the LigaSure device was satisfactory. Our hypothesis was that the use of the LigaSure device in robotic surgery for a sealant tissue effect of the device might provide a simple method of distal ureteral and cuff management, avoiding the need to reposition and dock the robot in the flank position. This would not only shorten operative time but would also improve exposure for the distal ureterectomy. Also, intraoperative patient repositioning may be associated with potential urethral complications.

The LigaSure device is a computer-controlled bipolar diathermy system and is routinely used for hemostasis. It is designed to seal vessels up to 7mm in diameter.[29] It creates a permanent seal by melting the collagen and elastin and effectively seals and cuts tissue, such as blood vessels, lymphatic tissue, and connective tissue. This unique energy output results in virtually no sticking, and the seals can withstand 3 times the normal systolic blood pressure.[30] Its effects in urologic procedures have been studied by Sengupta and Webb.[29] They used it to seal all the vessels and other structures <7mm and concluded that the LigaSure device is safe and easy to use in major urologic procedures in 32 consecutive open surgical cases, including 25 radical prostatectomies, 5 radical nephrectomies, 1 partial nephrectomy, and 1 nephroureterectomy. There were no postoperative hemorrhages, lymph leakage, or lymphoceles. And its effects in the urinary tract-urothelium, such as in the ureter and bladder, have been examined. In the study of Lambert and colleagues,[31] laboratory and clinical studies demonstrate that the device adequately seals and ablates both porcine and human urothelial tissue, without leaving any viable cells behind. In the porcine model, they showed that enough strain on the bladder can be obtained with the LigaSure device. The mean estimated volume of saline instillation required for rupture of the ablated porcine bladder was between 150cc and 200cc, and for the nonablated bladder it was approximately 1100cc. The mean burst pressure was 14mm Hg (range, 10 to 17). The mean nonablated bladder burst pressure was 70mm Hg. The seal was strong enough to withstand pressures above the resting pressure of the catheterized bladder.[31] And in the human model,[31] the LigaSure device reliably sealed the bladder acutely

without urine leakage in 82% (18/22) of patients without suturing, and 21/22 patients had the catheter removed on postoperative day 10. The bladder urothelium seal created with the LigaSure is not as strong as the normal bladder. Decompressing the bladder with transurethral catheterization theoretically provides zero pressure in the bladder.

We present our technique of a purely robotic-assisted laparoscopic nephroureterectomy performed entirely through laparoscopic ports for nephrectomy without changing patient position, sealing with the LigaSure atlas for bladder cuff excision and distal ureterectomy, which allowed us to complete the procedure in a shorter period of time. Our approach differs in that the whole procedure is performed transperitoneally with only of the camera port being changed from medial to lateral positions but without docking. And also the use of the LigaSure device in robotic surgery for the sealant tissue effect of the device may allow for a simpler method of distal ureteral and cuff management preventing spillage and enabling the removal of the entire specimen en bloc that may contain malignant cells. This theoretically decreases the risk of local recurrence. Early clinical experience and results with this method are encouraging, although with short-term follow-up. As with any new technique, additional larger series and potential modifications comparing long-term outcomes are necessary.

CONCLUSION

Robot-assisted nephroureterectomy with distal ureterectomy in the same position using the LigaSure device is a safe alternative for upper tract transitional cell carcinoma. Removal of the kidney, ureter, and bladder cuff en bloc strictly adheres to oncologic principles (removal of the affected renal unit without opening the urinary tract), and obviates the need for transurethral and intraureteral instrumentation as well as intraoperative repositioning of the patient, all of which result in shorter operative time.

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