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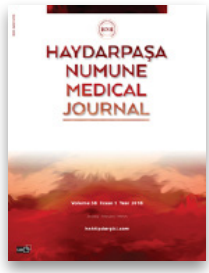

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ORIGINAL ARTICLE

Transperitoneal Laparoscopic Repair of Retrocaval Ureter: A Single Center Experience

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Abstract

Introduction: We aimed to describe our experience in transperitoneal laparoscopic repair of retrocaval ureter (RCU).

Methods: Between February 2010 and February 2017, five patients (1 female and 4 males) who underwent laparoscopic repair with the diagnosis of RCU in our department were included into the study. Patients mean age was 27.4 (range 20– 32 years). All patients were pre-operatively evaluated with ultrasonography (US) followed by contrast enhanced computed tomography (CT) intravenous pyelography (IVP). After CT diagnosis of RCU, all patients underwent diuretic renography examination with 99mTc-DTPA. Laparoscopic surgery was performed by transperitoneal approach using three-dimensional (3D) vision system in two and two-dimensional vision system (2D) in three patients.

Results: All operations were completed laparoscopically without conversion to open surgery. Mean operative time was 190±46.36 minutes. Operation time of two patients in whom 3D a vision system was used was shorter (150 and 170 minutes) comparing to others in whom 2D vision systems used. Median estimated blood loss was 105.7 mL. Obliterated ureteric segments were excised in 4 patients. Four patients were symptom-free after surgery and had regression of hydronephrosis in their kidney. In one of the cases there was no resolution of hydronephrosis postoperatively.

Discussion and Conclusion: Careful dissection along the planes with good tissue respect, and good hemostasis during each step are the key to success for laparoscopic repair of RCU. Pure laparoscopic treatment of RCU seems feasible and technically reliable. At the same time using 3D vision system if available would be preferable because of the dissection and intracorporeal suturing advantages.

Keywords: Laparoscopy; minimal invasive surgery; retrocaval ureter.

Retrocaval ureter (RCU) is a rare congenital disease, which can cause obstruction and related symptoms. Firstly, retrocaval ureter is reported by Hochstetter in 1893 [1]. RCU, also known as circumcaval ureter, occurs due to anomalous development of inferior vena cava (IVC) and not ureter. Open surgery was the classic treatment of this pathology with excision of the retrocaval segment, anteposition, and ureteroureteral or ureteropelvic reanastomosis [2, 3]. Development of laparoscopic techniques and performing skills for urologists have permitted enlargement of indications for this procedure. Laparoscopic dismembered pyeloplasty became the treatment of choice of ureteropelvic junction obstruction (UPJO) with equivalent results compared to open surgery, with less postoperative pain

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and shorter hospital stay [4, 5]. Therefore the surgical approach for this entity has shifted from open to laparoscopic and robotic surgery.

Rarity of this congenital disease and incidence added to the vascular risk with the dissection of the vena cava and the technical difficulty to perform laparoscopic ureteral sutures explains the few reported cases of laparoscopic repair of this anomaly. Herein, we describe our experience with five cases of transperitoneal laparoscopic repair of RCU.

Materials and Methods

Between February 2010 and February 2017, five patients (1 female and 4 males) who underwent laparoscopic repair with the diagnosis of RCU in our department were included into the study. All operations were performed by the same surgeon experienced in laparoscopic urologic surgery. Patients mean age was 27.4 (range 20–32 years). All patients included in the study were symptomatic, all of them having history of intermittent moderate right-side flank pain. None of the patients had developed episodes of fever and pyonephrosis. All had serum creatinine levels within normal range (0.88±0.15 (0.7–1.1) mg/dl). All patients were evaluated with ultrasonography (US) followed by contrast enhanced computed tomography (CT)(with digital 3D reconstruction) and intravenous pyelography (IVP). Abdominal ultrasound demonstrated right renal hydronephrosis in all patients. All had moderate hydronephrosis with upper hydroureter. Additional findings were present in two patients, one had ureteral and the other patient had concomitant pelvis stone with a diameter of 5 mm. All of patients had RCU with segment traversing downward and crossing the IVC at L3-L4 vertebral level (Fig. 1). All five had classical "Shepherd's crook" appearance on CT (Fig. 2) (Type 1 according to Bateson and Atkinson classification) [6]. After CT diagnosis of RCU, all patients underwent diuretic renography examination with 99mTc-DTPA (Fig. 3). Laparoscopic surgery was performed by transperitoneal approach by using three-dimensional (3D) vision system in two and two-dimensional vision system (2D) in three patients. The 3D high definition (HD) Vision System (Viking Systems, La Jolla, CA) with 30° optic, and the 2D Full-HD Endoscopy System (Karl Storz, Tuttlingen, Germany) with 30° optic were used. Patients were followed up by ultrasonography at 3rd and 6th months, 1st year, and thereafter yearly or if symptomatic. Repeat renal diuretic renography scan or IVP or CT was done 6 months after surgery.

Surgical Technique

Operations were performed under general anesthesia. Antibiotic prophylaxis was given to all patients. Patients were firstly placed in the lithotomy position, cystoscopy and right ascending pyelography was performed to confirm the diagnosis (typical image in the form of a hook or S-shaped ureter) and evaluation of lower ureter, followed by placement of ureteric catheter just below the level of kink. The lower end of the catheter was then kept in a sterile field. In all patients, retrograde pyelography (RGP) showed the presence of RCU and whether additional stenosis was present (Fig. 4).

After endoscopic evaluation, patients were placed in the left lateral decubitus position at 45° angle for the transperitoneal laparoscopic approach. A pneumo-peritoneum was created using a Veress needle and ports were entered applying a 20 mm Hg intra-abdominal pressure. First, a 10-

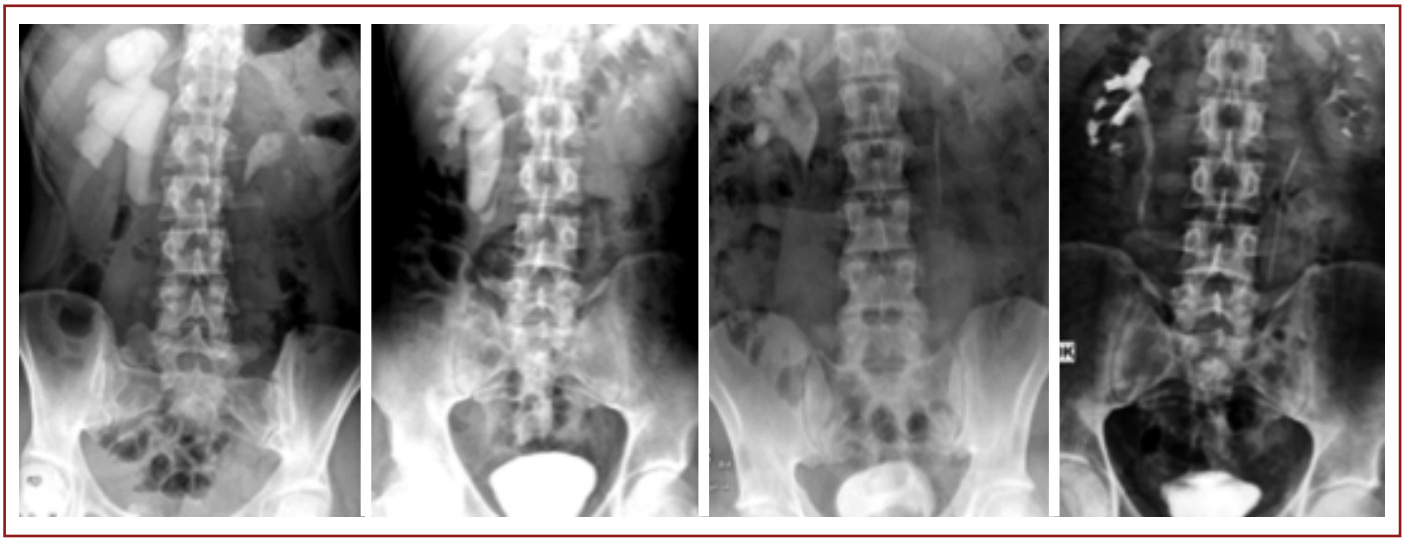

Figure 1. Intravenous pyelography images of patients with retrocaval ureter. Ureters crossing the inferior vena cava at L3-L4 vertebral level.

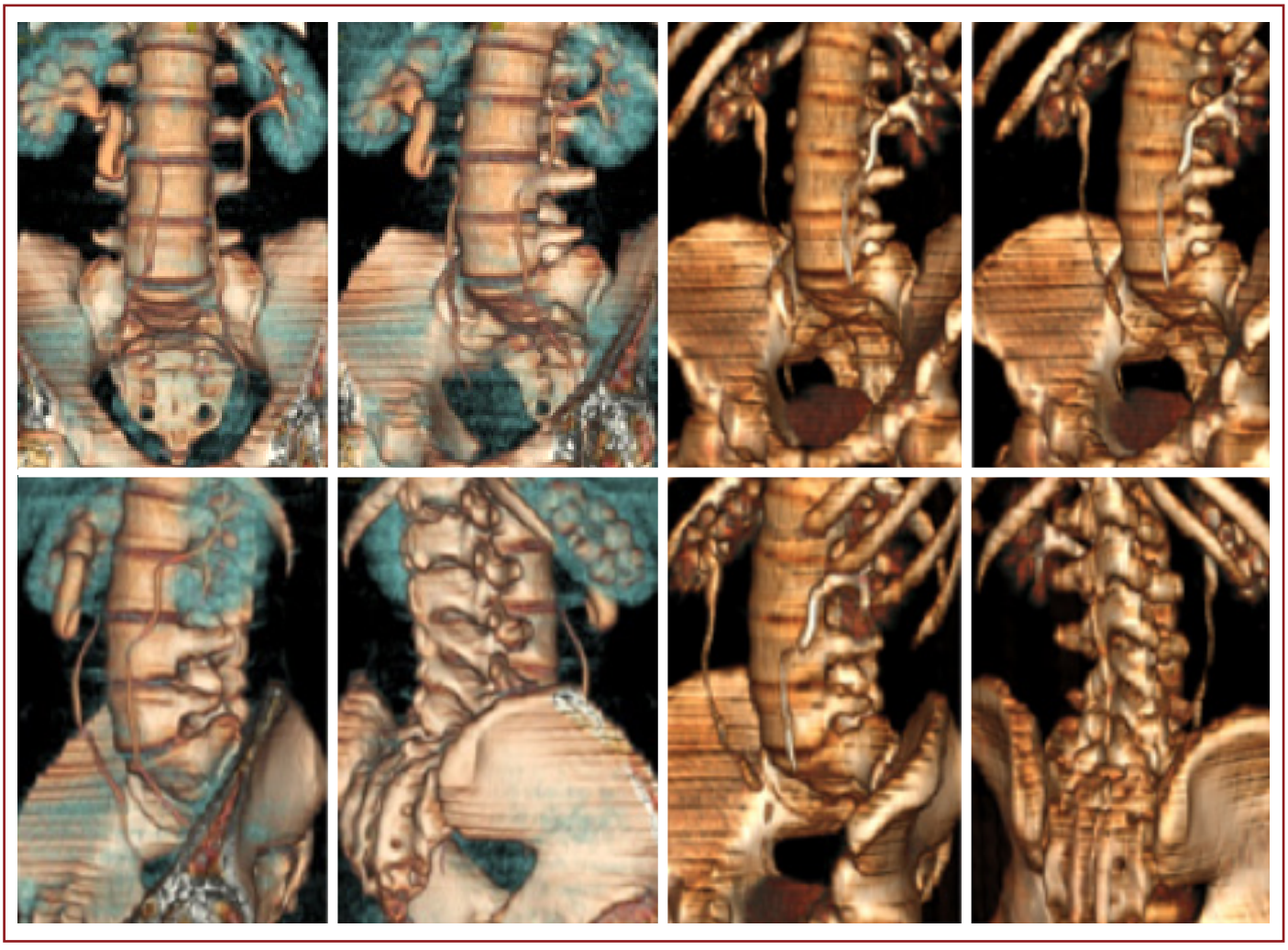

Figure 2. Classical "Shepherd's crook" appearance on computed tomography, 3D constructed.

mm camera port was placed at the umbilicus level on the lateral rectus border. After the placement of the first port, the others were placed under direct vision. The intracorporeal pressure was decreased to 12 mm Hg after the placement of the ports.

After the medialization of the colon, ureter was traced near ureteropelvic junction and dissected lower down till the lateral aspect of IVC and from the level of iliac vessels to the interaortocaval region. In the interaortocaval area the ureter was identified and dissected caudally. Then, the proximal ureter was transected at the point where it went retrocaval. The lower end was dissected out from the posterior aspect of IVC. Thus, the ureter ends were brought anterior of the vena cava. By using sharp and blunt dissection, the retrocaval segment of ureter was then entirely mobilized and separated from the IVC. Utmost care was taken to preserve the vascularity of ureter. The segment was inspected for patency and vascularity. If an obliterated ureteral segment was detected, it was excised till to the healthy margin. Then the renal pelvis and the ureter were re-anastomosed with running 4-0 polyglactin sutures in a normal anatomic position.

Two patients had concomitant calculi, one had ureteral and the second had renal pelvis calculi. Stone removal was done in both cases during the same session. Because of the advanced dilatation in two patients, ureter was directly anastomosed to pelvis by using uretero-pyelostomy dismembered technique. In the other three cases, ureteroureterostomy was performed. The two ends were spatulated, and ureteroureterostomy was carried out with polyglactin 4–0 round body continuous sutures posteriorly. Having in consideration the probable risk of ureteral stenosis, suturing was done anterior and posteriorly with two separate stitches. After posterior wall anastomosis was completed, the JJ stent was inserted antegradely. The placement of JJ stent's lower end was confirmed by fluoro-

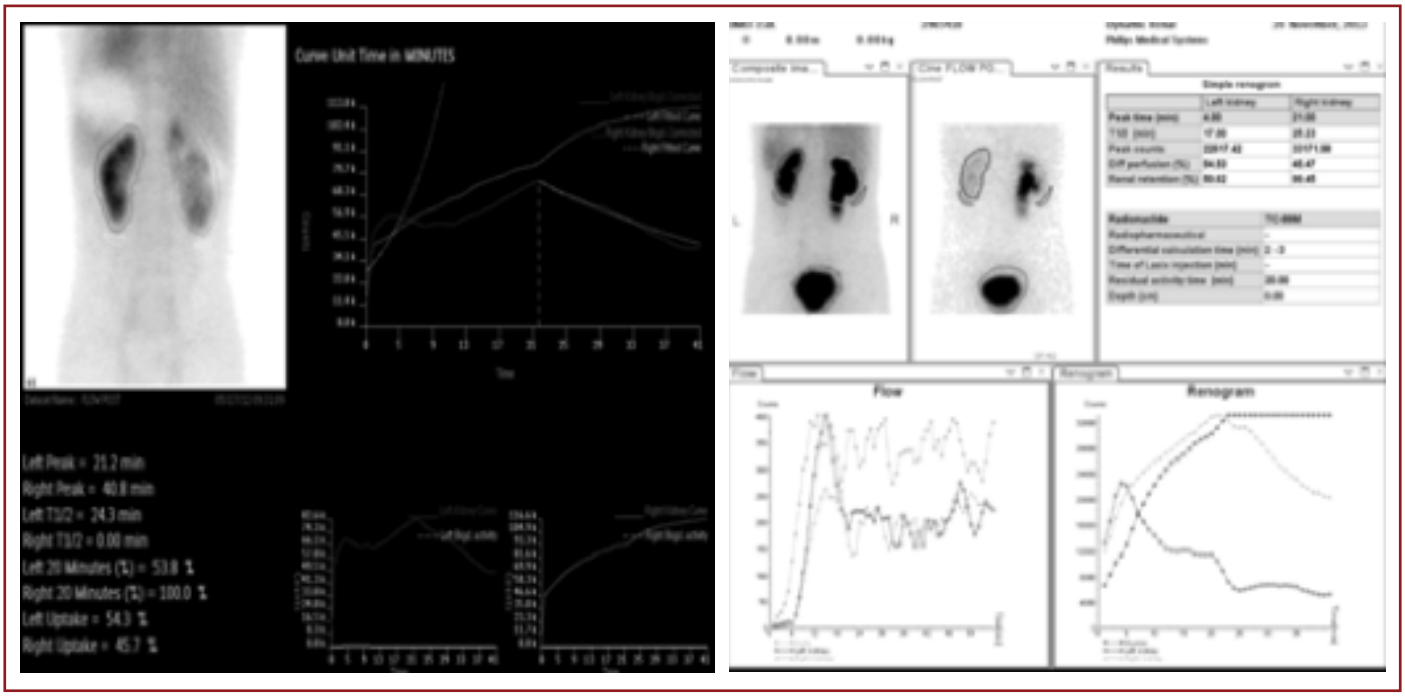

Figure 3. Diuretic renography examination with 99mTc-DTPA.

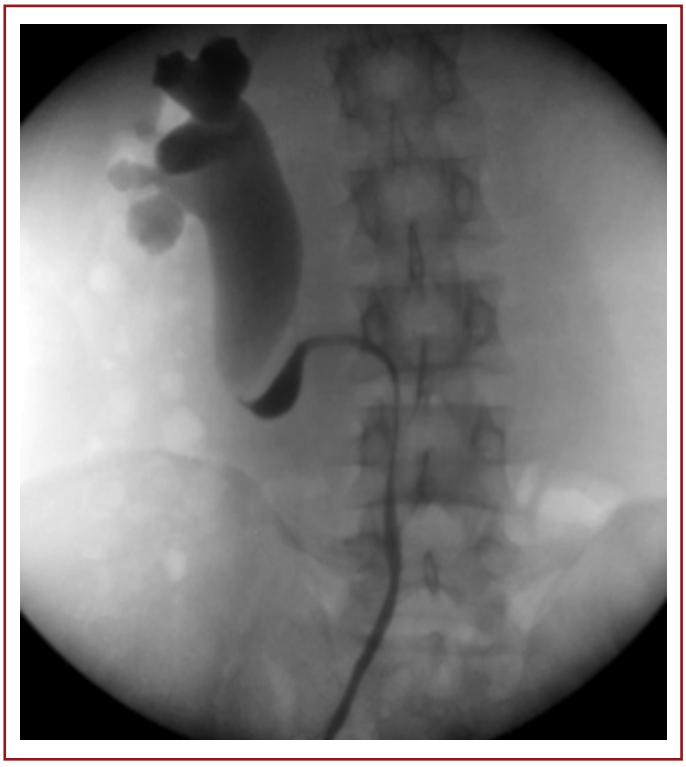

Figure 4. Intraoperative confirmation of the presence of retrocaval ureter and whether additional stenosis was present by retrograde pyelography.

scopic imaging. The upper curve of stent was placed into the renal pelvis and the anterior wall was anastomosed in a watertight manner. After the completion of anastomosis, a suction drain was placed in the operation area. Double-J stents were removed after 6 weeks after the surgery.

Results

All operations were completed laparoscopically without conversion to open surgery. Mean operative time was 190±46.36 minutes. Operation time of two patients in whom 3D vision system used was shorter comparing to others (150 and 170 minutes). The reason for this was thought to be the visual advantage of 3D system for making anastomosis and dissection procedure easier. No intraoperative vascular or digestive complications occurred. Median estimated blood loss was 105.7 (20-423.9) mL. Obliterated ureteric segments were excised in 4 patients. Four patients were symptom-free after surgery and had regression of hydronephrosis in their kidney. In one of the cases there was no resolution of hydronephrosis postoperatively. Further investigations were done due to anastomotic stricture suspicion. After diuretic renography and retrograde pyelography ureteral stricture of the anastomotic segment was diagnosed followed by laparoscopic excision and reanastomosis of the ureteric segment.

None developed urinary leak postoperatively. Intravenous paracetamol was administrated during the first postoperative day for pain control. No patient required opioid analgesia. All patients were discharged 2 to 4 days after the operation and the median hospital stay was 3 days. None of the patients had significant symptoms related to stent

placement. After removing the stent, patients were followed clinically and by ultrasound every 3 months. There after the same follow-up protocol was used. Maximum follow-up was 48 months, and there were no long-term complications in any of the patients.

Discussion

Retrocaval ureter is a rare congenital anomaly, with a reported incidence of 1/1000 live births [7, 8]. It mostly manifests itself in the third or fourth decade of life and occurs 3 times more frequently in men than women [9]. In normal embryologic development, the connection between the right subcardinal vein and the supracardinal vein regresses. The failure of the supracardinal vein to develop into the infrarenal inferior vena cava seems to be responsible for a retrocavally positioned right ureter [10].

Anderson and Hynes originally described the necessity of dismembering of ureter in a patient with RCU in1949 [3]. In true sense, as the ureter circumvents the vena cava, "circumcaval ureter" is the appropriate terminology to describe the course of ureter. Many authors use the term "preureteral vena cava," because, the root cause of the condition is actually developmental anomaly of IVC and not ureter. Embryologically, 15 different types of preuretral vena cava are described by Huntington and McClure, twelve of which have been documented in animals [11]. Five different variants have been described in human beings [12].

Retrocaval ureter has been associated with different anatomical abnormalities in 21% of cases. These can be horseshoe kidney, absent or ectopic opposite kidney, agenesis of vas or uterus, cardiovascular anomalies, Turner syndrome, and imperforate anus [13]. It mostly involves the right ureter. Two types of RCU were described. In type I (S-shaped), the ureter lies medial to lumbar vertebral process and the point of maximal obstruction is lateral to the lateral margin of inferior vena cava, whereas in type II (sickle-shaped), the ureter is less angulated, hydronephrosis is less severe, and the point of obstruction is the lateral border of inferior vena cava [9].

Surgery is indicated when the disease is associated with symptoms or related complications. Patients of RCU generally present clinically with symptoms in third or fourth decade of life with dull aching right flank pain [14]. RCU is not always associated with symptomatic obstruction. However, in our case series, all the patients presented with symptoms like flank pain or fever. The degree of hydronephrosis was of grade 3-4 in our case series. The diuretic renograms showed delayed excretion and decreased function in the affected kidney of all patients. Therefore, surgical treatment was offered.

Patients with RCU are mostly identified by IVP (sea-horse sign). In suspected cases, CT (preferably 3-dimension or reconstructed) or magnetic resonance imaging may be helpful. However, the diagnosis must be confirmed with an intraoperative RGP. The luminal obliteration or dysplasia of the ureteral segment beneath the inferior vena cava is not frequent. However, it can occur in some cases such as the case reported by Chung and Gill. RGP can reveal different areas of stenosis or obstruction that have not been shown by preoperative radiological studies [15]. We think that doing a RGP on table aids in ruling out concurrent pathology of lower ureter, ensures patency of the segment. Excision of retrocaval segment is unnecessary unless found atretic on table. Although operative intervention is the standard of care in these patients there are certain reports of conservative management. Yen et al.[16] have described two cases of RCU, which were managed conservatively as per patients' choice. Both had unobstructed drainage on renogram in spite of having certain degree of hydronephrosis. Both of them did well in the follow-up of 6–8 months.

Operative intervention progressed from open surgery done for the first time by Anderson and Hynes followed by laparoscopic surgery done for the first time by Baba et al.[17] That operation took 9.3 h with 2.5 h for anastomosis. This pioneering work has given the direction to current approach for RCU. Due to the improvements in techniques of hemostasis, intracorporeal suturing, and availability of newer energy sources the operative and anastomosis time have significantly gone down. Regarding minimally invasive approaches, different authors have used either transperitoneal laparoscopic or retroperitoneoscopic or robotic or minilaparotomy approach for RCU. All approaches have pros and cons with respect to each other. Both the transperitoneal and the retroperitoneal approach can be used[18]. Taking in consideration the very few series of RCU reported we aimed to compare our cases with the reported ones. Therefore, the numbers of patients involved in our series were considerable when compared with the other series.

Dogan et al.[19] operated on 4 patients by using the transperitoneal approach. Mean operation time was 210 minutes. No intraoperative complications occurred. Simforoosh et al. reported a series of 6 cases of RCU that were successfully treated with a transperitoneal laparoscopic approach. Mean operative time was 180 minutes (range 150 to 210) and patients were discharged home at a mean of 4 days (range 3 to 5) [14]. Ding et al. [20] reported the largest series of transperitoneal approach in 2012. Nine patients underwent pure laparoscopic pyelopyelostomy or ureter-

oureterostomy. The mean operative time was 135 minutes (range, 70–250 minutes). No intraoperative complications or significant bleeding occurred. Some authors preferred retroperitoneal approach. Xu et al. used this way to treat RCU. In their series, 7 patients underwent retroperitoneal repair. The mean operating time was 128 minutes. The mean blood loss was 20 mL. Li et al. [22] operated a total of 10 patients with retroperitoneal approach. All operations were completed laparoscopically. The mean operative time was 82 minutes and the blood loss was minimal. Chen et al. reported the largest series of retroperitoneal laparoscopic ureteroureterostomy for RCU with 12 patients. No open surgery conversion was needed. The mean operating time was 112 minutes, and the mean anastomosis time was 42 minutes [23]. Ricciardulli et al. have described vast experience of retroperitoneal laparoscopic approach in 27 cases of RCU. In this approach, operative time is reduced as there is no need for colon mobilization and liver retraction. One can get early access to urinary tract. They have mean operative time of 131 min in 27 cases [24]. Ji et al. analyzed results of 10 retroperitoneal and 8 transperitoneal laparoscopic RCU repairs from the same center. Operative time was comparable (98 vs. 85 min). Both groups were comparable in terms of success and complications related to surgery [25].

The approach performed frequently is the transperitoneal one because of a larger operation field and because of the fact that urologists are more familiar with this approach [14, 26, 27]. In comparison, there is a risk of hemorrhage during the creation of working space in cases of retroperitoneoscopy [28]. The retroperitoneal approach was also described earlier because of the concerns of urine leaking into the peritoneum [29-31]. However, the surgical field is narrower in this approach, and we believe that a transperitoneal watertight anastomosis over an internal stent is straightforward and does not pose any postoperative problems. We believe that each technique (transperitoneal and retroperitoneal) has advantages and drawbacks.

Our results are comparable to these series. All operations were achieved with transperitoneal approach and laparoscopically without conversion to open surgery. The mean operative time was 190±46.36 min. No intraoperative vascular or digestive complication occured and the median estimated blood loss was 105.7 mL.

Authors have modified certain techniques for a successful outcome. Expertise is required in the critical step of mobilization of retrocaval segment in the interaortocaval region. Chung and Gill have demonstrated the use of vessel loop around ureter for better dissection of interaortocaval portion [16]. Fidalgo et al. [32] described technique of suspending the pelvis with monofilament suture from abdominal wall for the ease of suturing eliminating the need of extra hand. Unnecessary dissection can be avoided. After opening the peritoneum and Gerota's fascia, dissecting the anteromedial lower pole of the kidney is sufficient to expose the renal pelvis and upper ureter. In two of our cases we used suture to lift up the pelvis and make manipulations comfortable as reported by Fidalgo et al.

Regarding the excision of retrocaval segment, Simforoosh et al. demonstrated that retrocaval segment might not be excised without compromising on long-term patency rates. After that multiple studies have omitted excision of retrocaval segment [14, 21, 28, 33]. El Harrech et al. didn't excise the ureter in all of their cases. The reason was the posterior part of the ureter that was behind the cava not being atretic. Also they thought that probable excision would apply high tension on the anastomosis [28]. Regarding the anastomosis type, either pyeloplasty [15, 28, 32] or pyeloureterostomy [14, 21] or uretero-ureterostomy [21, 32] can be done. All have shown good results in follow-up. Nayak et al. shared their experience on three cases of uretero-ureterostomy and two cases of pyelopyelostomy, which had comparable results [33]. Fidalgo et al. have stated that dilated ureter has long redundant segment. Hence, the ureteroureterostomy if done, would require excision of a longer segment of normal ureter to give more functional and anatomical outcomes [32]. Pyelopyelostomy is easier because it enables more space for grasping and passing the needle. However, this approach is not compatible with the aim and principle of laparoscopy. In our series ureteric excision was performed after the ureteric dissection in all of the cases. We share the opinion that the length of the ureter and the excision of the ureteric segment are of crucial importance for the healthy ureter. We performed tension-free uretero-ureterostomy in three and pyelo-ureterostomy in two of our patients. In one of uretero-ureterostomy patient postoperative stricture occured. Second laparoscopic session with excision of the narrow fibrotic segment and re-uretero-ureterostomy was done.

Many authors consider laparoscopic suture as the most difficult and time-consuming step of the procedure. Ishitoya et al. [34] and Tobias-Machado et al. [35] proposed retroperitoneoscopy for dissection followed by minilaparotomy for extracorporeal anastomosis, which had comparable operative time and hospital stay. 3D vision system can be of use for making easier the laparoscopic suture. In many laparoscopic series including ours also, the 3D vision system was associated with shorter operation time and shorter learn-

ing curve for the surgeons [36]. To our knowledge, no previous results reported on the 3D vison system used in RCU repair. We used 3D vision system in two of our patients. Operation times of these two cases were shorter than the other group, which 2D vision system was used. This system was found to have advantage on dissection and anastomosis part of the operation making it's time shorter. Because of the small number of cases we were not able to do comparable statistical analysis of the two systems.

Kang et al. used the laparoendoscopic single-site surgery (LESS) procedure with retroperitoneal approach to operate 4 patients with RCU [37]. The single-port device was made with a surgical glove and Foley catheter and allowed the introduction of three trocars. The mean operating time was 105 min (range, 90–135 min). None of the patients required blood transfusion. These results are encouraging but the real place of LEES remains debated. Also, no benefit in terms of recovery has been demonstrated when comparing LESS nephrectomy and LESS pyeloplasty with the classic laparoscopy [38, 39].

More recently, some observations reported the application of robotic laparoscopy to the management of RCU. Obviously, due to ergonomic benefit and 3D vision, this technology may improve surgeon dexterity and quality of dissection, but the problem of high procedure cost may be an obstacle especially in emerging countries [40, 41]. The authors stated that robotic assistance eases the dissection and intracorporeal suturing. However, it is not available in every institute, and robotic technology is not widely used in our country.

Conclusion

Careful dissection along the planes with good tissue respect, and good hemostasis during each step are the key to success for minimally invasive surgery for RCU repair. Pure laparoscopic treatment of RCU seems feasible and technically reliable. It should be proposed as a first-line treatment for RCU. Transperitoneal or retroperitoneal approach can be considered equivalent, as parameters like operative time and results are comparable for these two modalities. The choice of transperitoneal or retroperitoneal approach depends on the preferences of the surgeon. At the same time using 3D vision system if available would be preferable because of the dissection and intracorporeal suturing advantages. We preferred transperitoneal approach as it provides good working space for intracorporeal suturing. Especially we suggest transperitoneal approach together with 3D vision system for surgeons with less experience.

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