Original Article

Transperitoneal laparoscopic repair of retrocaval ureter: Our experience and review of literature

Ashwin S. Tamhankar, Abhishek J. Savalia, Ajit S. Sawant, Prakash W. Pawar, Gaurav V. Kasat, Sunil R. Patil

Department of Urology, Lokmanya Tilak Municipal Medical College and General Hospital, Mumbai, Maharashtra, India

Abstract

Context and Aim: Retrocaval ureter (RCU), also known as circumcaval ureter, occurs due to anomalous development of inferior vena cava (IVC) and not ureter. The surgical approach for this entity has shifted from open to laparoscopic and robotic surgery. This is a relatively new line of management with very few case reports. Herein, we describe the etiopathology, our experience with six cases of transperitoneal laparoscopic repair of RCU operated at tertiary care center in India and have reviewed different management options.

Methods: From 2013 to 2016, we operated total six cases of transperitoneal laparoscopic repair of RCU. All were male patients with average age of 29.6 years (14–50). Pain was their only complaint with normal renal function and no complications. After diagnosis with CT Urography, they underwent radionuclide scan and were operated on. Postoperative follow-up was done with ultrasonography every 3 months and repeat radionuclide scan at 6 months. The maximum follow-up was for 2.5 years.

Results: All cases were completed laparoscopically. Average operating time was 163.2 min. Blood loss varied from 50 to 100 cc. Ureteroureterostomy was done in all patients. None developed urinary leak or recurrent obstruction postoperatively. Maximum time for the requirement of external drainage was for 4 days (2-4 days). Average postoperative time for hospitalization was 3.8 days. Follow-up ultrasound and renal scan showed unobstructed drainage.

Conclusions: Transperitoneal or retroperitoneal approach can be considered equivalent as parameters like operative time, results are comparable for these two modalities. We preferred transperitoneal approach as it provides good working space for intracorporeal suturing.

Keywords: Laparoscopic repair, preureteral vena cava, retrocaval ureter, transperitoneal, ureteroureterostomy

Address for correspondence: Dr. Abhishek Jaysukh Savalia, Department of Urology, Room No. 219, 2nd Floor, College Building, Lokmanya Tilak Municipal General Hospital, Sion, Mumbai - 400 022, Maharashtra, India.
E-mail: abhisheksavalia@gmail.com

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INTRODUCTION

Retrocaval ureter (RCU), also known as circumcaval ureter, occurs due to anomalous development of inferior vena cava (IVC) and not ureter. The surgical approach for this entity has shifted from open to laparoscopic and robotic surgery. This is a relatively new line of management with very few case reports. Herein, we describe the etiopathology, our experience with six cases of transperitoneal laparoscopic repair of RCU operated at tertiary care center in India from 2013 till date and have reviewed different management options.

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METHODS

From 2013 to 2016, we operated total six cases of transperitoneal laparoscopic repair of RCU. All were male patients with the average age of 29.6 years (14–50). Patients had right side flank pain for a period varying from 4 months to 3 years. None had developed episodes of fever and pyonephrosis. All had serum creatinine levels within normal range (0.7–1.2 mg/dl). Patients underwent investigation protocol in the form of ultrasonography followed by contrast enhanced computed tomography (CT) with reconstruction. All had moderate hydronephrosis with upper hydroureter. In CT, delayed films were taken in these patients to evaluate for the course of ureter. All of them had an RCU with segment traversing downward and crossing the IVC at L3-L4 vertebral level. All six had classical "Shepherd's crook" appearance [Figure 1] on CT (Type 1 according to Bateson and Atkinson classification). After CT diagnosis of RCU, patients underwent diethylenetriamine pentaacetic acid renogram. Glomerular filtration rate varied from 18.4 to 31.6 ml/min. All had obstructed drainage on diuretic study.

Surgical technique

After giving antibiotic prophylaxis all patients underwent retrograde pyelography (RGP) on the table for confirmation of diagnosis and evaluation of lower ureter, followed by placement of ureteric catheter just below the level of kink, and the lower end was then kept in a sterile field. Patients were placed in the right lateral decubitus position at 45° angle. Once pneumoperitoneum was created, a 10 mm port was placed in the semilunar line just above the umbilicus level. A 5 mm port was placed subcostally in midclavicular line and another 5 mm on the spinoumbilical line midway. Liver retraction port (5 mm) below xiphisternum was placed in three of our patients depending on the intraoperative findings. Colon mobilization was done to expose the ureter. Ureter was traced near ureteropelvic junction and dissected lower down till the lateral aspect of IVC [Figure 2]. Ureter was then dissected from pelviureteric junction till the retrocaval portion and from the level of iliac vessels to the interaortocaval region. Then, the proximal ureter was transected at the point where it went retrocaval [Figure 3]. The lower end was dissected out from the posterior aspect of IVC. Thus, the ureter ends were brought anterior to the vena cava [Figure 4]. Utmost care was taken to preserve the vascularity of ureter. The segment was inspected for patency and vascularity. If found atretic, it was excised till the healthy margin. As the dilated ureter above had adequate length because of tortuosity, both the segments could be approximated without undue tension. The two ends were spatulated, and ureteroureterostomy was carried out with

Figure 1: Three dimensional reconstruction of computed tomography urography images show Type 1, low loop type of retrocaval ureter. There is gross hydronephrosis and upper hydroureter up to L4 level. Beyond L4 the ureter goes posterior to inferior vena cava and is atretic due to which its lumen is not opacified by contrast and proximal hydroureter and hydronephrosis results. The course of ureter produces a typical "S-" shaped/Fish-hook/Shepherd-crook deformity

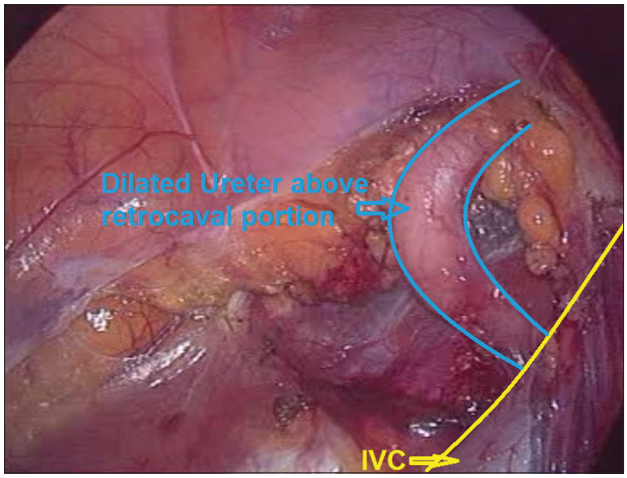

Figure 2: The right ureter (blue) runs posterior to the inferior vena cava (inferior vena cava – yellow)

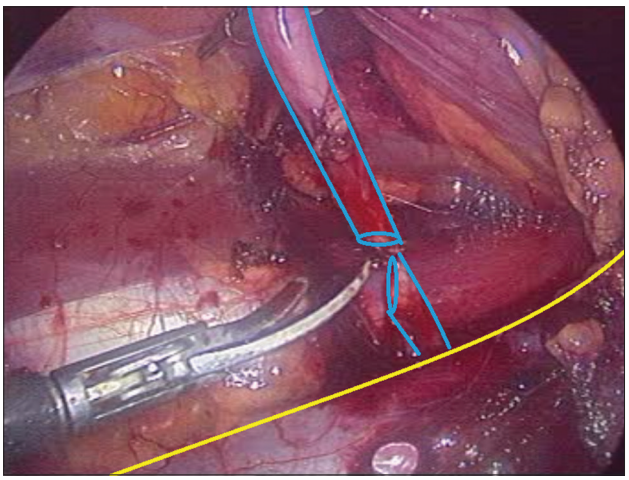

Figure 3: Ureter (blue) being cut just lateral to the inferior vena cava

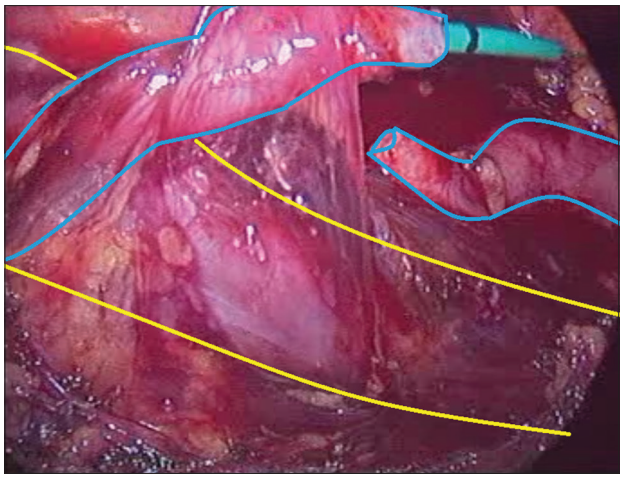

Figure 4: The two ends of mobilized ureter (blue), lateral to the inferior vena cava (yellow). Note the ureteric catheter coming out from the lower end

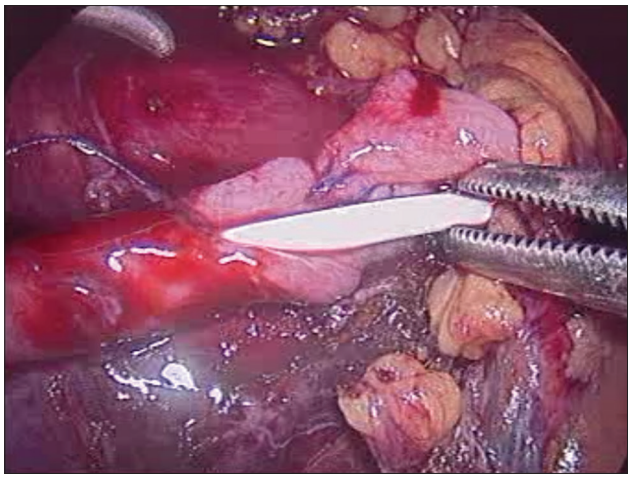

Figure 5: Double J stent placed across the anastomosis

polyglactin 4–0 round body continuous sutures posteriorly. Next, retrograde double-J stent was placed over guide wire and interrupted sutures were taken anteriorly [Figure 5]. Abdominal drain was placed through one of the ports and were removed when the drain output was <40 ml/day. Patients were discharged with per urethral catheter on day 3 which was subsequently removed on day 7 after ruling out any urinary leak. Double-J stent was removed by 6 weeks. Patients were followed up by ultrasonography at 2 months, 6 months, 1 year, and thereafter yearly or if symptomatic. Repeat renal scan was done at 6 months.

RESULTS

All cases were completed laparoscopically without any conversion. Operative time in our cases varied from a minimum of 146 minutes to maximum of 178 minutes. Mean time was 163.2 min. Blood loss varied from 50 to 100 cc. There was not any intraoperative injury. In two patients, we had to excise the ureteric segment as it appeared atretic on the table. None developed urinary leak postoperatively. Maximum time for the requirement of external drainage was for 4 days (2–4 days). Average postoperative time for hospitalization was 3.8 days. None of the patients had significant symptoms related to stent placement. All patients were asymptomatic on follow-up. Ultrasound was suggestive of resolution of hydronephrosis in all. Drainage was unobstructed in follow-up renal scan. Maximum follow-up was for 2.5 years, and there were no long-term complications in our patients.

DISCUSSION

Anderson and Hynes originally described the necessity of dismembering of ureter in a patient with RCU in 1949.[1] They called the procedure as the "plastic operation." Embryologically, the developing metanephros lies between paired set of three venous channels on each side which is called periureteric ring or the "renal collar" by Huntington and McClure.[2] As shown in Figure 6, ureter becomes retrocaval when either subcardinal vein or posterior cardinal vein form infrarenal vena cava instead of the supracardinal vein. As the subcardinal vein is anterior to the developing ureter during embryogenesis, the fully developed ureter hooks around the IVC as it courses down. 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, there can be 15 different theoretical possibilities of preureteral vena cava as described by Huntington and McClure, twelve of which have been documented in animals.[2] Five different variants have been described in human beings.[3] First type is unilateral right-sided single preureteral vena cava. Second group is unilateral right-sided double IVC and ureter lies between the two veins. Third group consists of bilateral, single IVC of which right is preureteric and the left is postureteric. Fourth type is bilateral single preureteric IVC. Fifth group is double right vena cava, ureter between the two veins and single postureteric left vena cava. First one is caused because of the persistence of the right posterior cardinal vein and or disappearance or failure of development of the right supracardinal vein. Second is caused because of persistence of the right supracardinal vein and right posterior cardinal vein. Third is due to persistence of right posterior cardinal vein and left supracardinal vein. Fourth one arises because of the persistence of the right and left posterior cardinal veins. Last one occurs because of

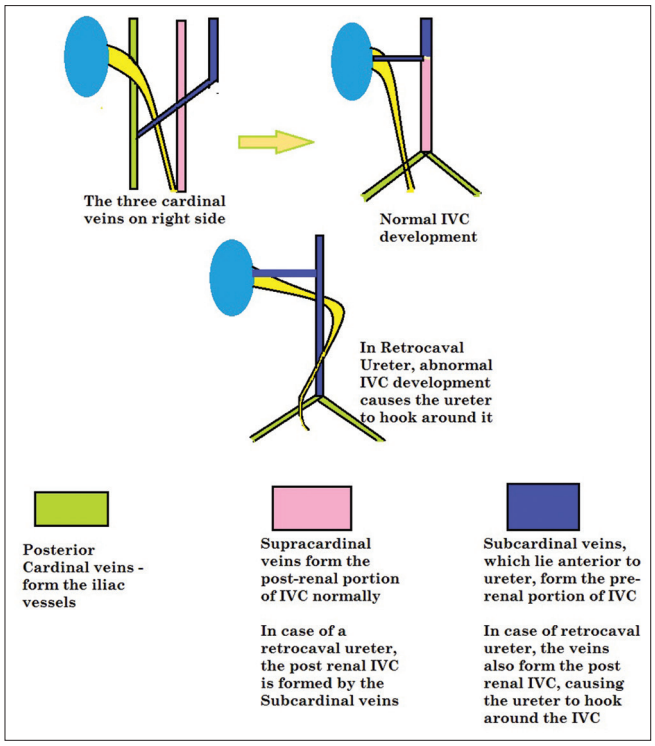

Figure 6: Embryological basis of retrocaval ureter (original, not borrowed)

persistence of the right supracardinal and posterior cardinal veins and left supracardinal vein. RCU has been associated with different anatomical abnormalities in 21% of cases.[4] These can be horseshoe kidney, absent or ectopic opposite kidney, agenesis of vas or uterus, cardiovascular anomalies, Turner syndrome, and imperforate anus.

Patients of RCU generally present clinically with symptoms in third or fourth decade of life with dull aching right flank pain. Although operative intervention is the standard of care in these patients there are certain reports of conservative management. Yen *et al*.[5] 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*.[6] 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 time and anastomosis time has significantly gone down. Regarding minimally invasive approaches, different authors have used either transperitoneal laparoscopic or retropertoneoscopic or robotic or minilaparotomy approach for RCU. All approaches have pros and cons with respect to each other. Ricciardulli *et al*.[7] have described vast experience of retroperitoneal laparoscopic approach in 27 cases of RCU. In this, 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. Proponents of transperitoneal[8] approach say that in transperitoneal space there is more working space and ease of intracorporeal suturing. In comparison, there is a risk of hemorrhage during the creation of working space in cases of retroperitoneoscopy. Ding *et al*.[9] commented that urologist is more familiar with transperitoneal approach and urine leak can be contained if peritoneum and Gerota's fascia are re-approximated after the procedure and fourth port is generally not required for procedure. Ji *et al*.[10] analyzed results of ten retroperitoneoscopic and eight transperitoneal 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. Different 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[11] have demonstrated the use of vessel loop around ureter for better dissection of interaortocaval portion. Fidalgo *et al*.[12] described technique of suspending the pelvis with monofilament suture from abdominal wall for the ease of suturing eliminating the need of extra hand. Ding *et al*.[9] modified the procedure by re-approximating the peritoneum and Gerota after the anastomosis so that urinary leak if occurs can be contained. El Harrech *et al*.[8] used RGP followed by JJ stenting on the table for better dissection of ureter which also ensured patency of ureter on the table. Regarding the excision of retrocaval portion Simforoosh *et al*.[13] for the first time demonstrated that retrocaval segment may not be excised without compromising on long-term patency rates. After that multiple studies have omitted excision of retrocaval portion.[8,9,14] For the anastomosis either pyeloplasty[8,11,12] or pyeloureterostomy[9,13] or ureteroureterostomy[9,12] can be done. All have shown good results in follow-up. Nayak *et al*.[14] shared experience on three cases of ureteroureterostomy and two cases of pyelopyelostomy which had comparable results. Fidalgo *et al*.[12] 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. Tobias-Machado *et al*.[15] used retroperitoneoscopy for dissection followed

by minilaparotomy for extracorporeal anastomosis which had comparable operative time and hospital stay.

In all published series [Table 1], JJ stent and external drainage were placed. All but one[8] series used antegrade approach for stenting. Recently, robotic surgery[14,15] is used for the repair of RCU which has significantly reduced the operative time (92 min – Nayak *et al*.[14]) but with significant cost for the procedure.

We find that doing an 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.

CONCLUSIONS

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. Transperitoneal or retroperitoneal approach can be considered equivalent, as parameters like operative time and results are comparable for these two modalities. We preferred transperitoneal approach as it provides good working space for intracorporeal suturing.

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Nil.

Table 1: Published reports of operative repair of retrocaval ureter

Author	Year	Patient number	Approach	Technique	Anastomosis	Time minimum	Excision of segment	Modifications used during procedure	Stay in days (mean)	Stenting and duration	Follow-up
Chung and Gill[11]	2008	1	Trans peritoneal laparoscopy (4 port)	Dismembered pyeloplasty	Running 4-0 polyglactin	180	Yes	Vessel loop at interaortocaval portion for traction	2	Antegrade 6 weeks	No obstruction
El Harrech *et al*.[8]	2016	3	Trans peritoneal laparoscopy	Pyelo-pyelostomy	Running 4-0 polyglactin	140	No (patency ensured)	RGP followed by JJ stent on table before laparoscopy	5	Antegrade 8-12 weeks	No obstruction
Fidalgo *et al*.[12]	2016	1	Trans peritoneal laparoscopy (4 port)	Dismembered pyeloplasty	Running 3-0 polyglactin	170	Yes	Pelvis suspended to abdominal wall before reconstructive part	3	Antegrade 6 weeks	No obstruction
Ding *et al*.[9]	2012	9	Trans peritoneal laparoscopy (3 port)	Pyelo-ureterostomy or ureteroureterostomy	Running 4-0 polyglactin	135	No (in 2 patients excised)	Peritoneum and Gerota's sutured back to contain urine leak if occurred	7.3	Antegrade 6 weeks	No obstruction
Nayak *et al*.[14]	2012	5	Robotic trans-peritoneal	Ureteroureterostomy 3 Pyelo-pyelostomy 2	Running 4-0 polyglactin	92	No	No fourth arm used in any of cases	2	Antegrade 6 weeks	No obstruction
Hemal *et al*.[16]	2008	1	Robotic trans-peritoneal	Pyelo-pyelostomy	Interrupted 4-0 polyglactin	-		No Fourth arm used docking time - 15 min only		Antegrade 6 weeks	No obstruction
Ricciardulli *et al*.[7]	2015	27	Retroperito neoscopic	Ureteroureterostomy	Running 4-0 polyglactin	131		Early access to urinary tract No requirement of colon reflection and liver retraction	3.8	Antegrade 6 weeks	
Simforoosh *et al*.[13]	2006	6	Trans peritoneal laparoscopy	Pyelo-ureter ostomy	Running 4-0 polyglactin	180	No		4	Antegrade 4 weeks	
Ji *et al*.[10]	2014	18	A) 8 - trans peritoneal laparoscopy B) 10 - retroperito neoscopic	Ureteroureterostomy	Running 4-0 polyglactin	A) 85 B) 98					

RGP: Retrograde pyelography

Conflicts of interest

There are no conflicts of interest.

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