Transperitoneal Laparoscopic Repair of Retrocaval Ureter: Two Case Reports and A Review of Recent Literature

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Abstract

A retrocaval ureter is an unusual congenital anomaly that results in outer ureteral compression by the inferior vena cava. Open pyelopyelostomy or ureteroureterostomy procedures are done with good results. In the present era of minimal invasive access surgery, a laparoscopic technique is being used with the same good results with all advantages, like minimal analgesic, short hospital stay and with better cosmetic results.

Key words: Retrocaval ureter, ureteroureterostomy, laparoscopy

Introduction

The retrocaval ureter (RCU), also known as the circumcaval ureter, is an uncommon congenital anomaly that becomes symptomatic in the third or fourth decade of life [1,2]. Since its first description by Hochstetler in 1893[3], approximately 212 cases have been reported worldwide. The incidence of a retrocaval ureter is one in 1500 cadavers. The male to female ratio is 3 or 4:1. A retrocaval ureter almost invariably involves the right side, but Brookes has reported one case of a left-sided retrocaval ureter accompanying situs inversus [4]. This mostly occurs at a late age but a number of cases have been reported in children [5]. A bilateral retrocaval ureter in an acardiac fetus has been reported [6]. Two types of RCU have been described. Type I (low loop) is the most common type, where the dilated proximal ureter assumes a reverse J or fishhook-shape. Type II (high loop) is rarer and the ureter courses behind IVC at the level of the ureteropelvic junction. The open ureteroureterostomy remained the gold standard surgical procedure for many years. Nowadays, a laparoscopic procedure is being used more commonly as intracorporeal suturing has become quiet easy [7]. The minimally invasive approach has led to comparable results to open surgery, with decreased convalescence and analgesic requirements [8,9]. We present here two cases of this uncommon anomaly treated with transperitoneal laparoscopic ureteroureterostomy.
Case Report

Case 1. A 24-year-old female presented with dull, intermittent pain in the right flank along with urinary tract infection for the last 3 months. Blood investigations and renal function tests were normal. Urine microscopic examination revealed pus cells. Ultrasonography revealed a right hydronephrotic kidney with dilatation of the proximal ureter. IVP showed a reverse-J deformity of the right proximal ureter with right hydronephrosis (Figure 1). Retrograde stenting was done with a 5F double-J stent in the lithotomy position for easy identification of the ureter (Figure 3). The patient was operated on with a transperitoneal three ports approach and ureteroureterostomy was done over a 5F double-J stent. Wide dissection was done on both the lateral and medial of the inferior vena cava. The dilated pelvis and upper ureter were mobilized. The lower part of the ureter, which was lying in the interaortocaval region, was dissected caudally. The pelvis was transected and transposed anterior to the inferior vena cava. Reconstruction was carried out with an intracorporeally sutured anastomosis over the double-J stent that was placed in an antegrade manner. Care was taken to avoid spiraling of the ureter. The proximal

Figure 1. Intravenous pyelogram showing reverse-J deformity of right proximal ureter with dilatation along with hydronephrosis.

Figure 2. Intravenous pyelogram showing reverse-J deformity of right proximal ureter with dilatation along with hydronephrosis.

Figure 3. Showing retrograde stenting.

Figure 4. Showing spatulation of ureter.
and distal ureteral lengths were spatulated with the help of an atraumatic grasper and scissors, and the stent was advanced into the proximal ureter and pelvis. A watertight and tension-free anastomosis was done with a 4-0 polyglactin interrupted suture placed at the 6, 12, 9 and 3 o’clock positions of the proximal and distal ureteral edges (Figure 4-6). Anastomosis was completed in 30 minutes. A closed suction drain was kept for 48 h. The operative time was 110 min. Blood loss was minimal. The patient was discharged on the 3rd day and the stent was removed after 4 weeks postoperatively. The patient was followed up after a 6-month period and she was free of pain and pus cells in her urine. Renal function tests were normal preoperatively as well as postoperatively.

Case 2. A 32-year-old female presented with intermittent pain in the right flank. On examination, the right renal angle was tender. Microscopic urine examination showed a field full of pus cells. Ultrasound revealed a hydronephrotic right kidney. IVP showed a reverse-J deformity of the right proximal ureter with right hydroureteronephrosis (Figure 2). Retrograde stenting was done with a 5F double-J stent and transperitoneal laparoscopic ureteroureterostomy was done. Anastomosis was completed in 40 minutes and the total operative time was 135 minutes. Blood loss was minimal and there was no complication during surgery. The patient was discharged. The follow-up was up to three months. Renal function tests were within normal limits preoperatively as well as postoperatively.

Discussion

A retrocaval ureter is a rare congenital abnormality. Though the abnormality is congenital, it does not present until the third or fourth decades of life.

The inferior vena cava normally develops from the posterior cardinal, subcardinal and supracardinal veins, which undergo sequential development, anastomosis and regression to become the inferior vena cava and azygous venous system. Normally the right subcardinal veins form the pre-renal inferior vena cava; the subcardinal - supracardinal anastomosis forms the renal segment and the right supracardinal vein forms the post-renal inferior vena cava. The left supracardinal and lumbar portion of the right posterior cardinal vein atrophy. If the subcardinal vein in the lumbar portion fails to atrophy and becomes a primary right side vein, the ureter is trapped dorsal to it. Variations of this include duplication of vena cava with the ureter lying beside or behind the vascular limbs. The various anomalies associated with the retrocaval ureter are a horse-shoe kidney, double IVC and a left retrocaval ureter with goldenhar syndrome, branchial arch syndrome, myelomeningocele, hypospadius, Turner’s syndrome, esophageal atresia, an abnormal left kidney (agenetic, ectopic or malrotated) and cardiovascular anomalies, such as situs inversus [10].

Right lumbar pain, dull aching or intermittent (renal colic), recurrent urinary tract infections and microscopic or gross haematuria are usual presenting symptoms. Usually, there is a high incidence of stone formation due to stasis.

For accurate diagnosis of the disease, radiological modalities are sufficient. Ultrasonography is a noninvasive method to demonstrate the anatomy of the ret-
rocaval ureter, hydro-nephrosis, parenchyma atrophy, and nephrolithiasis [11]. In the early stage of ureteral stenosis, an intravenous pyelogram will only show dilatation of the renal pelvis, calyces, as well as the upper ureter above the site of obstruction. Retrograde pyelography combined with inferior venocavography can clearly confirm the diagnosis but it is an invasive procedure [12]. An alone retrograde pyelogram demonstrates medial displacement of the ureter, usually beyond the midline and the un-dilated lower one-third of the ureter in its normal position. An enhanced CT scan with ureteral catheterization can demonstrate the opacified catheter posterior to IVC [13]. New imaging studies, such as a spiral CT scan and magnetic resonance imaging (MRI), are of great help in delineating the anatomy noninvasively. An isotope renal scan can reveal the degree of obstruction, and differential renal function can help. Bateson and Atkinson distinguished 2 types of retrocaval ureter according to the radiological appearance and site of ureteral narrowing. In type 1 (low loop), the ureter crosses behind the inferior vena cava at the level of the third lumbar vertebra and has a fish hook-shaped (S-shaped) deformity of the ureter. Marked hydronephrosis is seen in over 50% of patients. In type 2 (high loop), the renal pelvis and upper ureter lie horizontally, and the retrocaval segment of the ureter is at the same level as the renal pelvis. The retrograde pyelogram shows a “sickle shape” of the involved ureter, generally with mild hydronephrosis. Type 2 is less common in around 10% of all cases [14]. The main causes of hydronephrosis are lumen stenosis, torsion, and adhesion of the retrocaval segment. This segment is compressed by the psoas muscle, spinal column, and vena cava, which lead to inflammation and fibrosis.

Treatment depends primarily on the clinical presentations, severity of the hydronephrosis, and impairment of renal function. When there is mild hydronephrosis without obvious symptoms, infection, worsening renal function, or stone formation, conservative treatment with periodic examination is then necessary. When a kidney is badly damaged or is severely infected, nephrectomy is the treatment of choice, provided that the other kidney is normal. In case of repeated attacks of colick pain along with persistent urinary tract infection, surgery (open/laparoscopic) is the treatment of choice.

In 1935, Kimbrough performed the first successful surgical correction [15,16]. For this obstructive lesion, sleeve resection in an elliptical fashion followed by ureteropelvic anastomosis is done. Theoretically, this location for anastomosis has a greater chance of success than ureteroureterostomy or ureteroneocystostomy, because at this site both ends of the anastomosis are dilated and have a good blood supply, while a normal caliber ureter has been shown to slough or develop stricture frequently when reimplanted [17]. In cases where a retrocaval portion of a ureter is stenosed, ureteroureteral anastomosis may be necessary but results are usually not good and also progressive stricture also develops. In a few cases, sections of the lower ureter and ureteroneocystostomy have been done. However, due to extensive dissection of the ureter and stripping of a large segment of its blood supply, infection and necrosis occur. Even transection of inferior vena cava and transposition of the retrocaval ureter anteriorly were done but with a complication of residual edema of the lower limbs [18]. If there is severe hydronephrosis, Anderson Hynes pyeloplasty with precaval transposition of the ureter has been advocated. Occasionally, nephrectomy may be required in the presence of a non-functional kidney. A ureteral stent may be helpful for stenting and drainage.

Recently, with the invent of minimal invasive access, laparoscopic pyelopyelostomy or ureteroureterostomy has become the procedure of choice in the hands of a trained laparoscopic surgeon, as there is better magnification, minimal blood loss, better cosmetic result and without any unusual complication. To date, approximately 51 cases have been reported in literature using a laparoscopic technique [19]. Laparoscopic repair of the retrocaval ureter is easier than laparoscopic standard dismembered pyeloplasty for non-retrocaval pelvi-ureteric obstruction (as there is availability of an abundant ureteric length for tension-free anastomosis) [7]. However, the performance of laparoscopic dismembered pyeloplasty is quite difficult, as extensive dissection is needed on both sides of inferior vena cava.

In spite of variable operative time, it is a safe and easy procedure. With better experience of an intracorporeal suturing technique, operative time has reduced from 560 minutes to 82 minutes, as shown in Table 1 [2,7,19-42].
Table 1. Table shows the documentation of the literatures which related to the repair of retrocaval ureter.

<table>
<thead>
<tr>
<th>Study</th>
<th>Cases</th>
<th>Approach</th>
<th>Blood loss (ml)</th>
<th>Operative time (minutes)</th>
<th>Anastomosis (minutes)</th>
<th>Complication</th>
<th>Follow up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baba et al. [20]</td>
<td>1</td>
<td>TP</td>
<td>NR</td>
<td>560</td>
<td>150</td>
<td>none</td>
<td>2</td>
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<tr>
<td>Matsuda et al. [21]</td>
<td>1</td>
<td>TP</td>
<td>&lt; 30</td>
<td>450</td>
<td>-</td>
<td>none</td>
<td>NR</td>
</tr>
<tr>
<td>Amenda et al. [22]</td>
<td>1</td>
<td>TP</td>
<td>20</td>
<td>450</td>
<td>-</td>
<td>none</td>
<td>NR</td>
</tr>
<tr>
<td>Ishitoya et al. [23]</td>
<td>1</td>
<td>TP</td>
<td>NR</td>
<td>365</td>
<td>-</td>
<td>none</td>
<td>2</td>
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<tr>
<td>Gaur et al. [24]</td>
<td>1</td>
<td>RP</td>
<td>NR</td>
<td>200</td>
<td>-</td>
<td>none</td>
<td>NR</td>
</tr>
<tr>
<td>Mugiya et al. [25]</td>
<td>1</td>
<td>RP</td>
<td>50</td>
<td>300</td>
<td>-</td>
<td>none</td>
<td>6</td>
</tr>
<tr>
<td>Salomon et al. [26]</td>
<td>1</td>
<td>RP</td>
<td>&lt; 20</td>
<td>270</td>
<td>-</td>
<td>none</td>
<td>6</td>
</tr>
<tr>
<td>Polascik et al. [27]</td>
<td>1</td>
<td>TP</td>
<td>NR</td>
<td>225</td>
<td>45</td>
<td>none</td>
<td>NR</td>
</tr>
<tr>
<td>Miyazato et al. [28]</td>
<td>1</td>
<td>RP</td>
<td>&lt;50</td>
<td>180</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Bhandarkar et al. [29]</td>
<td>1</td>
<td>TP</td>
<td>NR</td>
<td>240</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Ramalingam et al. [30]</td>
<td>1</td>
<td>TP</td>
<td>minimal</td>
<td>240</td>
<td>-</td>
<td>none</td>
<td>6</td>
</tr>
<tr>
<td>Sinforoosh et al. [31]</td>
<td>6</td>
<td>TP</td>
<td>&lt;50</td>
<td>180</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Gundeti et al. [32]</td>
<td>1</td>
<td>TP</td>
<td>&lt;50</td>
<td>180</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Dogan et al. [33]</td>
<td>4</td>
<td>TP</td>
<td>NR</td>
<td>210</td>
<td>-</td>
<td>none</td>
<td>3</td>
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<tr>
<td>Gupta et al. [34]</td>
<td>1</td>
<td>RP</td>
<td>NR</td>
<td>210</td>
<td>-</td>
<td>none</td>
<td>3</td>
</tr>
<tr>
<td>Chung &amp; Gill et al. [7]</td>
<td>1</td>
<td>TP</td>
<td>minimal</td>
<td>180</td>
<td>30</td>
<td>none</td>
<td>6</td>
</tr>
<tr>
<td>Xu et al. [35]</td>
<td>7</td>
<td>RP</td>
<td>20</td>
<td>128</td>
<td>36</td>
<td>none</td>
<td>16</td>
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<tr>
<td>Singh O et al. [36]</td>
<td>1</td>
<td>TP</td>
<td>NR</td>
<td>120</td>
<td>-</td>
<td>none</td>
<td>NR</td>
</tr>
<tr>
<td>Nagraj et al. [37]</td>
<td>1</td>
<td>TP</td>
<td>NR</td>
<td>110</td>
<td>-</td>
<td>none</td>
<td>NR</td>
</tr>
<tr>
<td>Li HZ et al. [38]</td>
<td>7</td>
<td>RP</td>
<td>&lt;10</td>
<td>82 (60-110)</td>
<td>-</td>
<td>none</td>
<td>52</td>
</tr>
<tr>
<td>Tobias-Machado et al. [2]</td>
<td>4</td>
<td>Laparoscopic assisted Extracorporeal anastomosis</td>
<td>50</td>
<td>130</td>
<td>-</td>
<td>none</td>
<td>3</td>
</tr>
<tr>
<td>Fernandez-Fernandez et al. [39]</td>
<td>1</td>
<td>TP</td>
<td>NR</td>
<td>60</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Smith et al. [40]</td>
<td>1</td>
<td>TP</td>
<td>NR</td>
<td>294</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Autorino et al. [41]</td>
<td>1</td>
<td>TP</td>
<td>minimal</td>
<td>180</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Hemal et al. [42]</td>
<td>4</td>
<td>TP</td>
<td>98</td>
<td>138</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Singh V et al. [19]</td>
<td>1</td>
<td>TP</td>
<td>50</td>
<td>180</td>
<td>60</td>
<td>NR</td>
<td>6month</td>
</tr>
<tr>
<td>Present study</td>
<td>1</td>
<td>TP</td>
<td>minimal</td>
<td>110</td>
<td>30</td>
<td>none</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>TP</td>
<td>minimal</td>
<td>135</td>
<td>40</td>
<td>none</td>
<td>-</td>
</tr>
</tbody>
</table>

**TP:** Transperitoneal; **RP:** Retroperitoneal; **NR:** Not Reported
Which approach, whether transperitoneal or retroperitoneal, is better for entering retroperitoneum is still arguable. Pure retroperitoneal laparoscopic repair of a circumcaval ureter is a more direct approach to the urinary tract. The operative time was significantly shorter than with the previously reported transabdominal laparoscopic approach. Salomon hypothesized that the shorter time was obtained because dissection of the retroperitoneal space was not hindered by intraabdominal organs. Mugiya et al. confirmed that the retroperitoneoscopic treatment could be superior to the conventional transabdominal approach to perform the laparoscopic transposition and reanastomosis of a circumcaval ureter. An automatic suture device was used retroperitoneoscopically to correct a circumcaval ureter. [43]

The main limiting factor for laparoscopic management of RCU has been the intracorporeal suturing of the ureter. In the first case mentioned in the literature, Baba et al. [20] performed this procedure that required 9.3 hours, including 2.5 hours for intracorporeal suturing. Polascik and Chen [27] performed laparoscopic ureteroureterostomy for a RCU in 3 hours and 45 minutes using an automatic suture device. The first case of a retroperitoneoscopic approach was reported by Mugiya et al. and by Salomon et al. [26], where the authors indicated shorter operative time than that of the transperitoneal approach. Li HZ et al. [38] operated on 7 cases with a retroperitoneal approach and finished in an average 1 hour and 22 minutes. Meanwhile, Nagraj et al. [37] reported 1 case supporting that transperitoneal intracorporeal suturing is less time consuming and easier than retroperitoneal suturing. In our cases, the mean anastomosis time was 35 min, revealing that intracorporeal suturing is probably much easier in a transperitoneal approach.

Chung and Gill [7] reported a resection of the segment that was found to be atretic and stenotic. Dogan et al. [33] presented 4 cases managed without resection. Despite transaction and spatulation of the dilated proximal ureter in most studies, resection has been rarely applied.

Similarly, in our cases the RCU was neither dysplastic nor atretic. Thus, end-to-end anastomosis was performed without resection of the retrocaval segment. However, it is mandatory to verify the patency of the distal ureter intraoperatively before proceeding to definitive repair in order to avoid areas of potential stenosis.

A remarkable point in this surgery is the insertion of a double-J stent before starting laparoscopy. Cystoscopic placement of a double-J stent or a ureteral catheter before the procedure shorten operative time significantly, as it helps in the identification and dissection of the ureter. Performing the anastomosis is easier, safer and more rapid with a ureteral stent in situ, as the ureter is generally fragile. In our series, the intracorporeal anastomosis was completed in 30 and 40 min with a 6 Fr double-J stent in situ. Thus, we advocate the use of a ureteral catheter/stent beforehand if possible.

Another point to argue is concerned with retrograde pyelography (RGP), which is used preoperatively or intraoperatively by some authors. Nevertheless, preoperative stenting deletes the necessity of RGP but Dogan et al. recommends intraoperative RGP to avoid missing coexisting pathologies [33].

Both laparoscopic pyelopyelostomy and ureteroureterostomy are safe and equally effective but pyelopyelostomy, which is similar to standard pyeloplasty, has got a lower stricture rate and even stones can also be removed if present [36]. Ureteroureterostomy is the procedure of choice in case of a grossly atretic ureter [36]. Recently, extracorporeal uretero ureteral anastomosis has also been done in 130 mts [2].

Usually, antegrade stenting of the ureter is done because retrograde stenting is very difficult due to a tortuous ureter, but retrograde stenting helps in the identification and dissection of a ureter, as in our case.

There is feasibility of pure robotic repair with the advantage of ergonomic ease and simple intracorporeal suturing [44].

**Conclusion**

Laparoscopic surgery is technically simple and is a safe procedure in trained hands. In the management of a retrocaval ureter, laparoscopic ureteroureterostomy and pyelopyelostomy can be done effectively with minimal blood loss and a better cosmetic result with short hospital stay.

**Conflict of interest statement**

The authors have no conflicts of interest to declare.
References


