

Laparoscopic Dismembered Pyeloplasty—The Method of Choice in the Presence of an Enlarged Renal Pelvis and Crossing Vessels

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Abstract

Objective: Herein we report our experience of 49 consecutive pyeloplasties that were all laparoscopically performed with an intracorporeally sutured anastomosis. We describe the operative technique, complications and outcomes during a follow-up period of 1–53 months (mean 23.2 months).

Patients and Methods: Forty-nine patients (28 women and 21 men) with a mean age of 34 years (range 6–65 years) underwent a laparoscopic dismembered pyeloplasty because of primary ureteropelvic junction (UPJ) obstruction with hydronephrosis in each case. The preoperative evaluation included an evaluation for pain, an excretory urography (IVP), renal scan and sometimes CT angiography to evaluate for crossing vessels. Follow-up studies included an IVP, renal scan and renal ultrasound 4 weeks postoperatively and every 3 months thereafter. Success was considered as improvement of the pain score and IVP (less hydronephrosis, visible UPJ and/or normalization of drainage) or absence of an obstructive pattern during the washout phase of a renal scan.

Results: There was no conversion to open surgery. The mean operative time was 165 min (range 90–240 min). Blood loss was negligible. Crossing vessels were noted in 57.1% of the patients (28/49). Postoperative hospital stay was 3.7 days (range 3–6 days). One patient had a leakage of the anastomosis on postoperative day 1 and needed to undergo laparoscopic repair. The mean follow-up is 23.2 months (range 1–53 months). There was one single late failure. This patient later underwent an open revision of the laparoscopic pyeloplasty. In all other patients (48/49), the obstruction was resolved or significantly improved. The long-term success rate is 97.7%.

Conclusions: The results of dismembered laparoscopic pyeloplasties compare favorably with those achieved by open pyeloplasties with less perioperative morbidity and discomfort. We do believe that laparoscopic dismembered pyeloplasty with an intracorporeal anastomosis is the method of choice in the treatment of the UPJ obstruction in the presence of an enlarged renal pelvis and crossing vessels.

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1. Introduction

Anderson–Hynes pyeloplasty is an excellent procedure for treating ureteropelvic junction (UPJ) obstruction and produces a lasting improvement in function

and drainage in most patients. It is the “gold standard” against which newer techniques should be compared [1].

If we are going to minimize morbidity for our patients, we should consider minimal invasive techniques which were developed and established in the last few years. The treatment of UPJ has evolved over the past several years with the implementation of endopyelotomy techniques and, more recently, laparoscopic pyeloplasty [2–6].

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In fact, several endoscopically and fluoroscopically controlled methods of incising the obstructed UPJ are now available that are significantly less invasive and morbid in comparison to open pyeloplasty. However, the long-term success rates of these incisional techniques are less than the rates reported for open pyeloplasty [7,8]. Two potential reasons for the inferior success rates of incisional methods in comparison with open pyeloplasty are hydronephrosis and crossing vessels. The presence of hydronephrosis lowers the success rate of these procedures from 86% to 50%. Similarly crossing vessels reduced the success rate from 85% to 54% [9,10]. An additional disadvantage of incisional techniques is the significant risk of hemorrhage following incision of UPJ, with as many as 3–11% of patients requiring blood transfusion and 3% who had to undergo postoperative embolization or nephrectomy [11].

Laparoscopic pyeloplasty might be the bridge between the open and endoscopic approaches. Laparoscopic pyeloplasty is less invasive than open surgery and addresses all potential causes of obstruction. Particularly in cases of enlarged renal pelvis and crossing vessels, laparoscopic dismembered pyeloplasty promises to be a minimally invasive alternative with excellent success rates.

2. Materials and methods

From August 1997 to January 2002, 49 patients (28 women and 21 men) with a mean age of 34 years (range 6–65 years) underwent laparoscopic pyeloplasty at the authors' centers for left- and right-sided UPJ obstruction in 26 and 23 patients, respectively. All patients had a primary UPJ obstruction and a significant hydronephrosis with an enlarged renal pelvis. Two patients had a 1.5–2 cm calculus in the renal pelvis at the time of diagnosis. The preopera-

tive evaluation included a detailed history focused on the nature of pain and activity, a physical examination, an excretory urography (IVP), DTPA-renal scans and retrograde pyelography just before the procedure. Because of the hydronephrosis in every patient, we did consider the primary pyeloplasty as the treatment option and a CT angiography was occasionally performed for evaluation of crossing vessels.

Follow-up studies were performed with an evaluation for pain and activity, an IVP (4 weeks postoperatively), DTPA-renal scans and renal ultrasound. These studies were compared with the preoperative findings and were performed 4 weeks postoperatively and every 3 months thereafter. Success was considered as improvement of the pain score, improvement of the IVP (less hydronephrosis, visible UPJ and/or normalization of drainage) or absence of obstruction during the washout phase of a DTPA-renal scan.

The UPJ obstruction was repaired with a dismembered Anderson–Hynes pyeloplasty in all cases.

3. Laparoscopic technique

After induction with general endotracheal anesthesia and administration of a prophylactic intravenous antibiotic, cystoscopy and retrograde pyelography were performed in each patient. Thereby, the diagnosis was confirmed and an indwelling ureteral stent was passed. A Foley catheter and nasogastric tube were inserted. The patient was placed in a 45° lateral position and secured to the operating table.

We prefer a 4-trocar transperitoneal approach. Insufflation is performed through a Veress needle. Four laparoscopic ports are inserted in the peritoneal cavity (Fig. 1). The ipsilateral colon is reflected and the proximal ureter and renal pelvis are identified.

The cause of UPJ obstruction (crossing vessels, stenosis) is evaluated and the proximal ureter and the renal pelvis including the UPJ are fully mobilized. The renal pelvis is dismembered with the proximal ureter. The stenotic segment is excised and the ureter is

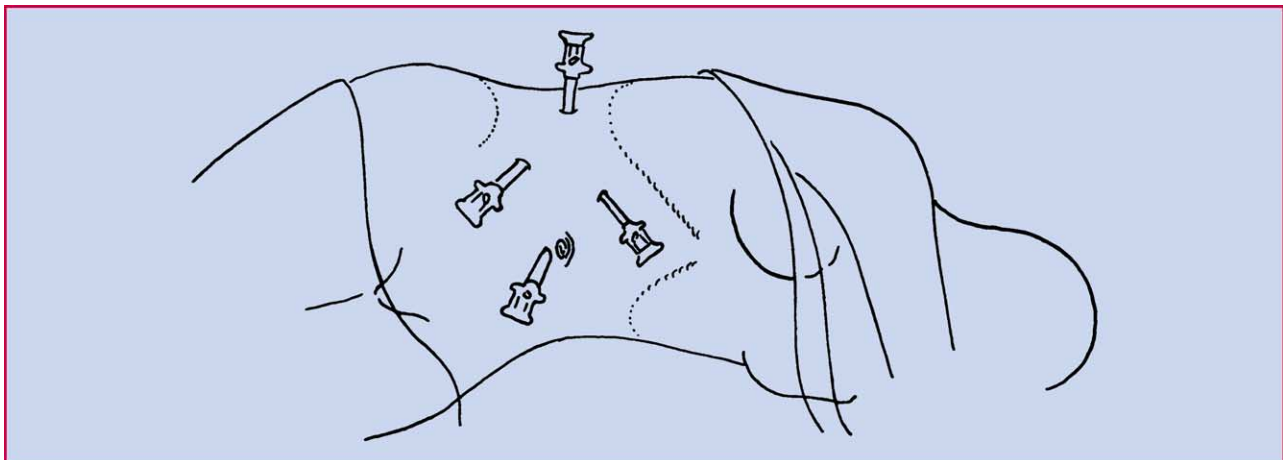


Fig. 1. Patient and trocar positions for laparoscopic transperitoneal pyeloplasty.

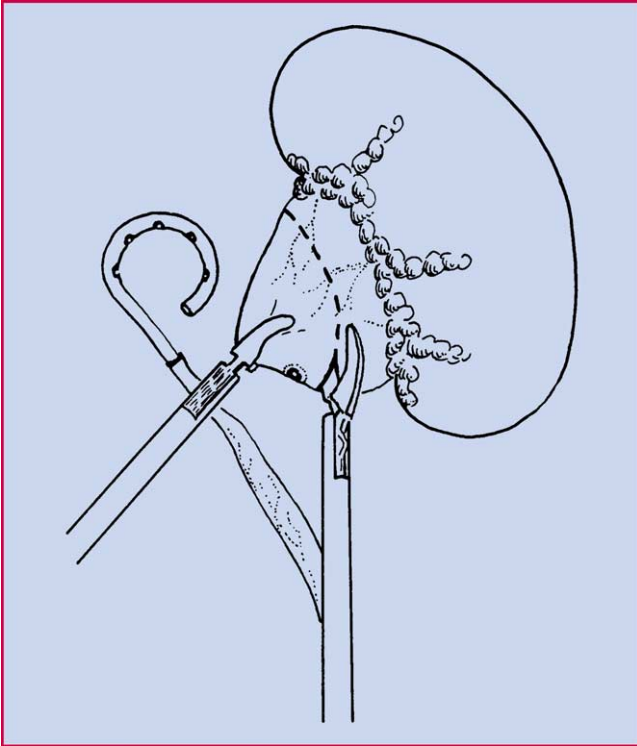


Fig. 2. Resection of the renal pelvis to improve the urodynamic function.

spatulated. The enlarged renal pelvis is resected to reduce the size of the pelvis and improve the urodynamics of the ureteropelvic complex (Fig. 2). At this point, in cases of calculi in the collecting system, the

stones were removed by grasping with a forceps. In one case, a flexible cystoscope is introduced through a laparoscopic port in the renal pelvis. With the use of normal saline irrigation, the calculus is identified in the lower calix, grasped with a grasper and extracted through the laparoscopic port.

If anterior crossing vessels are present (57.1%), in the majority of the cases the ureter and the renal pelvis are transposed ventrally to the vessels for completion of the anastomosis.

After spatulating a sufficient length of ureter, a wide anastomosis to the renal pelvis is created. Freehand laparoscopic suturing and in situ tying techniques are used exclusively. The preferred suturing material by the authors is 4-0 Vicryl with a straight needle. The anastomosis is started with three corner stitches to attach the ureter to the renal pelvis (deepest point of the spatulation and both flap corners of the end of the ureter with the corresponding sites of the renal pelvis) (Fig. 3). The anastomosis is performed over the previously passed 7 F stent. After the three-point fixation of the ureter, the pelvis is closed using a running suture 4-0 Vicryl with a straight needle (Fig. 4). This needle has the advantage that it is easier to achieve a correct orientation of the angle of the needle tip. The use of a straight needle facilitates this maneuver compared to a curved needle. The last step is the anterior and posterior anastomosis between ureter and renal pelvis using a running technique again (Fig. 5). Following completion of the anastomosis, the colon is replaced and the

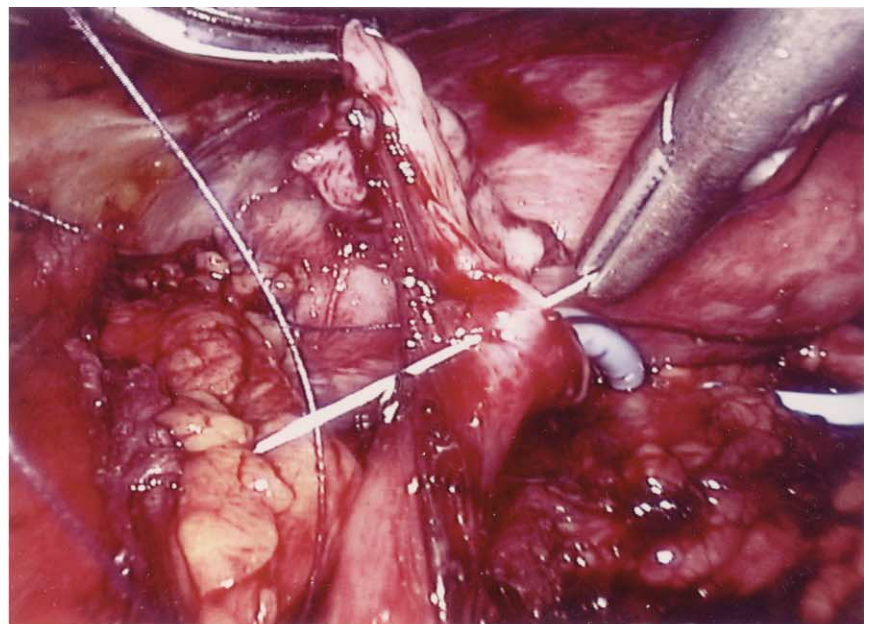
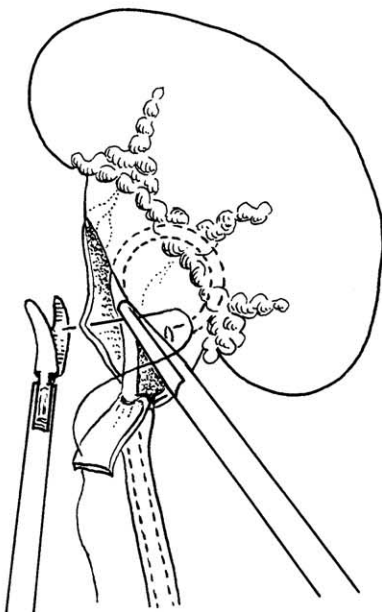


Fig. 3. Three-corner fixation of the ureter to the renal pelvis using a straight needle (DJ-stent in place).

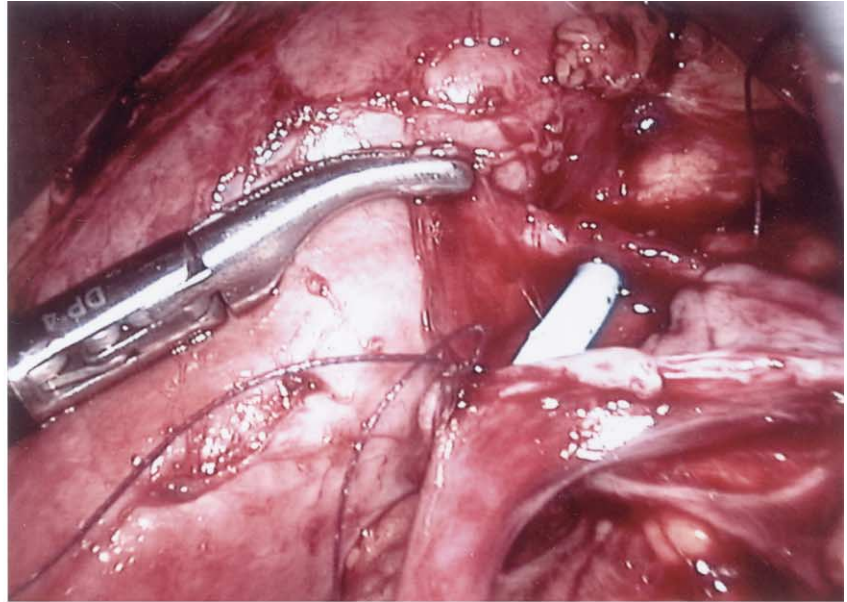
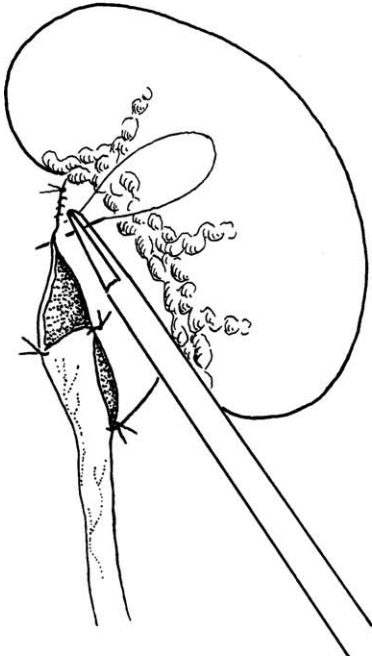


Fig. 4. Closure of the renal pelvis with running suture and a straight needle (DJ-stent in place).

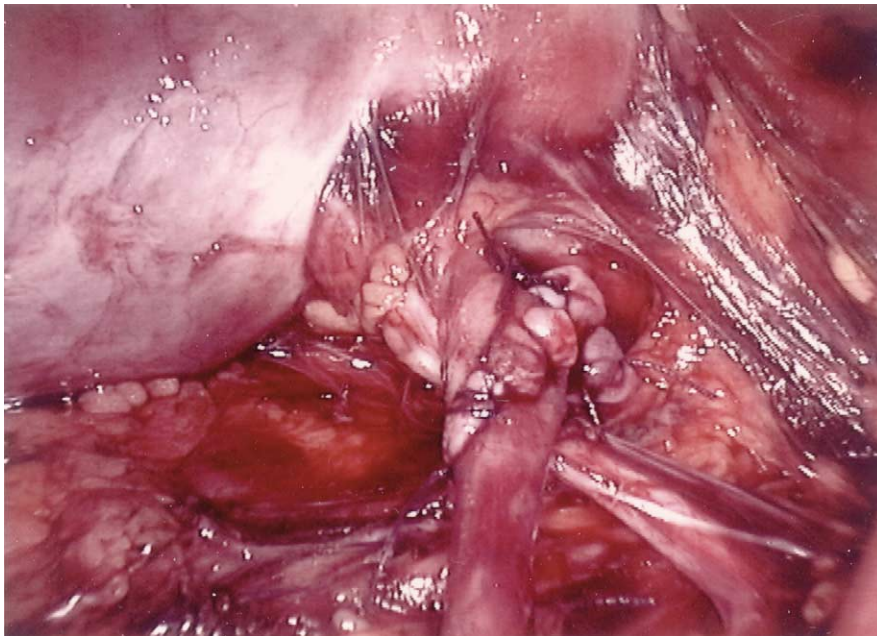


Fig. 5. Finished anastomosis with ventrally transposed ureter and renal pelvis.

peritoneum is closed along the line of Toldt with a running suture to close the peritoneal cavity and to avoid internal hernias. A Robinson drain is placed through a lateral port incision into the perinephric space adjacent to the UPJ. After hemostasis is confirmed, the CO₂ is evacuated and the port sites are closed.

4. Results

There was no conversion to open surgery. All operations were completed laparoscopically. The mean operative time was 165 min (range 90–240 min). Blood loss was negligible in all patients. Crossing vessel as reason of the UPJ obstruction were noted



Fig. 6. Pre- (a) and postoperative (b) IVP after laparoscopic Anderson–Hynes plasty with intracorporeally sutured anastomosis.

in 57.1% of the patients (28/49). In all cases, the vessels were crossing anterior of the UPJ. Postoperative hospital stay was 3.7 days (range 3–6 days). The Foley catheter was removed after 3 days and the ureteral stents were removed after 4–6 weeks in all patients.

One patient (the first procedure) had a leakage of the anastomosis on postoperative day 1 with a consecutive urinary ascitis, which was drained through the Robinson drain. This patient underwent a repeat laparoscopy with suturing of the insufficiently closed site. There were no other intra- or postoperative complications.

Postoperative evaluation included retrograde pyelography at the time of stent removal, clinical history, IVP (6–8 weeks postoperatively and every 3 months thereafter) and ultrasonography. The mean follow-up is 23.2 months (range 1–53 months). There was a late failure with an unresolved UPJ obstruction in one patient. The reason was a fibrotic scar around the UPJ caused by the earlier urine extravasation. This patient later underwent successful open surgery. In all other patients, the obstruction was resolved or significantly improved with an improved urodynamic function of the UPJ through the reduction of the size of the

renal pelvis (Fig. 6). Most of these patients are now symptom-free or improved (Table 1). The success rate is 48/49 (97.7%). No other late failure has been observed so far.

Table 1

Outcome data of 49 dismembered laparoscopic pyeloplasties with an intracorporeal anastomosis during 1–53 months (mean 23.2 months) follow-up

Outcome parameter	Laparoscopic pyeloplasty (n = 49)
Operative results/complications	
Early technical failure	1/49 (2)
Late failure	1/49 (2)
Pain score evaluation	
Pain-free	40/49 (81.6)
Improvement of pain score	8/49 (16.4)
No change in pain score	1/49 (2)
IVP/retrograde pyelograms	
Absence of an anatomic obstruction	48/49 (97.7)
Lasix renogram (DTPA-renal scan)	
Absence of a functional obstruction	48/49 (97.7)

The values given in parenthesis are in percentage.

5. Discussion

The recent introduction of various endourological procedures (endopyelotomy, Acucise incision, balloon dilatation) have provided less invasive treatment alternatives to conventional open dismembered pyeloplasty in the management of UPJ obstruction [8–12]. These procedures cause less postoperative morbidity than open pyeloplasty but 10–20% lower success rate than for open surgery [10–12]. These procedures are also associated with a higher risk of perioperative hemorrhage with 3–11% of patients requiring blood transfusion [10–12].

There is no doubt that endopyelotomies are not well suited for patients with a dilated redundant renal pelvis and/or lower pole crossing vessels [10–12]. The length of stricture, high-grade hydronephrosis and crossing vessels are significant risk factors for failure or late recurrence after incisional techniques [10–12]. The long-term success rate is significantly decreased to 39% or 78%, if these risk factors are present [10,12]. Endopyelotomy techniques should be reserved for patients with a short intrinsic stenosis, no significant hydronephrosis and a low likelihood of crossing vessels [10,13].

The advances in image techniques allow today in a high percentage to detect crossing vessels which are involved in the UPJ obstruction. Either CT angiography or contrast-enhanced Doppler imaging are able to identify this problematic vascular structures and should be included in the standard work-up of the patients and may help to influence the choice of treatment modality [14,15].

The most common cause of extrinsic UPJ obstruction is an aberrant, accessory or early branching vessel to the lower pole of the kidney. More than 50% of cases of UPJ obstruction in adulthood are associated with anterior crossing vessels [16]. We found these vessels in 57.1% of our patients. Certainly not in every case, the vessels are the original reason for obstruction. However, a ballooned renal pelvis (because of intrinsic stricture) can drape over the anterior crossing vessels and the resulting angulations appears to worsen obstruction [17]. In either scenario, the vessels are important and can cause in surgical complications or procedure failure. If anterior crossing vessels are present, the dismembering of the ureter and his transpose ventrally to the vascular structures where he is anastomosed to the renal pelvis is suggested [14,18,19]. This maneuver prevents a potential compressive impact of the vessels to the new anastomosis. The laparoscopic transperitoneal approach facilitates either the evaluation of anterior crossing vessels and the ventrally displacement of ureter and renal pelvis [14].

Laparoscopic pyeloplasty is a minimally invasive alternative in the treatment of UPJ obstruction and was developed in the early 1990s to duplicate the high success rates achieved with open pyeloplasty [3,5,7]. Like open surgery, the repair is performed under direct vision and has a high success rate even with large dilated renal pelvis and lower pole crossing vessels. Long-term objective outcome analysis of laparoscopic pyeloplasty have shown that the results equal those of open surgery [2,3,15,20]. Laparoscopy is associated with lower morbidity, therefore, it is preferable to open surgery [21]. However, the major disadvantage of laparoscopic pyeloplasty is the need for proficiency in laparoscopic techniques, particular in suturing and tying techniques. Technologic advances, such as the EndoStich device, have facilitated reconstructive laparoscopic procedures, such as pyeloplasty. The EndoStich gives the surgeon the advantage of being able to easily pass the suture through the tissue. The device makes the placement of the needle considerably easier than using a needle driver. However, the problem with this device is its size. It seems too large for the vulnerable tissue of renal pelvis and especially for the ureter. Some investigators reported about stitch channel leakage because of the large diameter of the needle [20]. We would like to emphasize that laparoscopic dismembered pyeloplasty requires not only laparoscopic expertise, but also experience with intracorporeal suturing and tying. Our extensive experience with the laparoscopic prostatectomy and other reconstructive procedures enabled us to overcome the difficulties of intracorporeal suturing and knotting techniques. For a skilled surgeon, it is possible to perform a good anastomosis in a reasonable time by using of freehand technique. For a beginner in terms of intracorporeal suturing, we recommend the use of a straight needle. For a skilled surgeon, there is no difference in using either a straight or a curved needle and depends on the surgeon's preference.

In addition, it is important to standardize the suturing technique particularly in terms of geometric rules. The right angles and distances between the working ports are imperative to provide an optimal environment for laparoscopic reconstructive surgery [22].

Another way to simplify the technically demanding technique of dismembered pyeloplasty is to perform a non-dismembered reconstruction of the UPJ obstruction. Different techniques of non-dismembered pyeloplasty are described (Y-V plasty and Fenger plasty) and are performed by incising the UPJ longitudinally and closing the incision transversely [4,5]. Janetschek and co-workers prefer the laparoscopic Fenger plasty technique. They performed this procedure even in the

setting of anterior crossing vessels, because it can be achieved quickly with one to three sutures. After a mean follow-up from 27 months, they recently reported between 86% and 100% success depending from the grade of hydronephrosis before treatment [15].

The etiology of the obstruction seems to be important for the long-term outcome. The dismembered pyeloplasty involves the complete removal of both the anatomical and functional causes of obstruction (stenosis, adynamic junction). Another factor in the superior success of dismembered pyeloplasties is ampullar resection of the ureter and the resection of the renal pelvis, which may interfere with recovery of a normal peristalsis of the UPJ. These maneuver improves the urodynamics of the new UPJ and the transport of the urine down to the bladder [1].

Both problems addressed, resection of the adynamic ureter segment and reduction of the size of the renal pelvis, we were able to achieve a 97.7% success rate with the laparoscopic Anderson–Hynes technique. Conceptually, the flap techniques (Fenger plasty and Y-V plasty) do not eliminate the adynamic segment at the UPJ that causes the obstruction and do not resect the redundant renal pelvis. That may explain the lower success rate of 86% after laparoscopic Fenger plasty in cases with high-grade hydronephrosis [15].

Laparoscopic pyeloplasties have even been introduced in the field of pediatric urology [23,24]. Particularly, Tan was able to show the efficacy of laparoscopic pyeloplasty in infants [25]. The results seem promising compared to endourological techniques in this patient population [26]. However, the age limit of the author is 6 years. In younger patients, you

need special instruments and the benefit of the laparoscopic approach is questionable compared to the open procedure over a small flank incision.

Retroperitoneal modifications with respect to the optimal laparoscopic approach have been reported [27,28]. However, we prefer the transperitoneal route because it facilitates the recognition of anterior crossing vessels, the transpose of the ureter and renal pelvis ventrally to the vessels and provide more space for intracorporeal suturing of the anastomosis.

6. Conclusions

In the next few years, we can expect a significant increase in laparoscopic urological procedures for the treatment of malignancies as well as for reconstructive interventions. The ability to perform a safe laparoscopically sewn anastomosis in a reasonable time will determine the success of the laparoscopic surgeon and will expand the use of laparoscopic techniques in reconstructive procedures.

Particularly, the recent widespread interest in laparoscopically performed radical prostatectomy requires a familiarity with intracorporeal suturing techniques. A laparoscopic pyeloplasty will no longer be a challenge for those surgeons trained in intracorporeal suturing techniques.

Having mastered the technical aspects, we believe the laparoscopic dismembered pyeloplasty with an intracorporeal anastomosis is the method of choice in the treatment of the UPJ obstruction, particular with crossing vessels and excessively dilated renal pelvis.

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