An up-to-date overview of minimally invasive treatment methods in ureteropelvic junction obstruction

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Introduction

Over the last two decades, minimally invasive treatment options for ureteropelvic junction obstruction have been developed and are becoming more popular. Multiple series of laparoscopic pyeloplasty have demonstrated high success rates and low perioperative morbidity in pediatric and adult populations, for both the transperitoneal and retroperitoneal approaches. In this review, we aimed to analyze the current status of minimally invasive therapy of ureteropelvic junction obstruction.

Material and methods

A PubMed database search was conducted to examine minimally invasive treatments of ureteropelvic junction obstruction.

Results

A large number of cases have been reported for adult patients, confirming that robotic pyeloplasty represents a viable option for either primary or secondary repair. Comparative studies demonstrate similar success and complication rates between minimally invasive and open pyeloplasty in both the adult and pediatric populations. A clear advantage, in terms of hospital stay, of minimally invasive over open pyeloplasty was observed only in the adult population.

Conclusions

Studies have shown that minimally invasive pyeloplasty techniques are a safe, effective, and feasible in adult and pediatric populations.

Key Words: ureteropelvic junction • laparoscopy • robotic surgery
of hydronephrosis in renal ultrasonography and intravenous pyelogram may yield different results. Renal scintigraphy is the gold standard non-invasive test in evaluation of the upper urinary system obstruction.

Laparoscopic pyeloplasty

a) Pediatric group

The first series of laparoscopic pyeloplasty were described in the 1990s [3] and reported high success rate (92-100%) with low perioperative morbidity. There were concerns over technical difficulties, complication risk and superiority over open surgery in the pediatric group. Tan et al. detected anastomosis stenosis in two patients of three-month-age group who underwent LP [8]. Kutikov et al. stated that LP was technically 100% successful in those younger than six months [9]. Metzelder et al. divided the patients into three groups according to their age (1-12 months; 2-7 years; 7-18 years) and they found no difference in operation duration between these three groups [10]. In a study conducted by Tanaka et al., 5261 pediatric patients who underwent LP were analysed in multivariate linear regression and decreased hospitalization duration and administration of parenteral narcotics was detected in pre-adolescents and adolescents in comparison with younger age groups [11].

b) Adult group

When the major LP series (>100 cases) in literature were evaluated, low perioperative morbidity and high success rate were detected both in transperitoneal and retroperitoneal methods. Three studies used renal scintigraphy in postoperative assessment of LP success, and Lopes-Pujals et al. reported 95.6% success rate, while Maynes et al. reported 92% success rate [12, 13]. In a study conducted by Pouliot et al., half-life T1/2 < 10 min. was stated as a definitive success; T1/2 <20 min. as non-obstructive; recovered T1/2 as a technical success. Of the patients having undergone LP: 61% was definitive success, 86% was non-obstructive, 93% was technical success. Clinical success (disappearance of symptoms) was detected to be 95%. Interestingly, renal scintigraphic obstruction remained in 75% of the patients, but they were asymptomatic. They stated that the degree of renal scintigraphic obstruction and symptoms were not correlated [14]. Laparoscopic pyeloplasty studies are summarized in Table 1.

Robot-assisted laparoscopic pyeloplasty

a) Pediatric group

Compared to classical laparoscopy, RP reduced the perioperative morbidity and appears to be a more viable option, with its shorter learning-curve, superior manipulation and enhanced visualization [15, 16]. In the recent studies, success rates of transperitoneal and retroperitoneal approaches have been detected to be similar to open surgery. According to Olsen et al., who have five years of pediatric RP experience, the retroperitoneoscopic approach provides direct access to UPJO with a shorter operation duration, and its results and complications are similar to that of the transperitoneal approach [17].

b) Adult group

The first series (50 cases) in the adult population were reported by Patel. Patel defined their technique and emphasized its minimal morbidity and short and easy learning process [18]. Mufarrij et al. published the first multicenter study results (140 cases) and included patients with primary and secondary UPJO, those who underwent concurrent stone extraction, and those with a solitary kidney [19]. In a study conducted by Casteri et al., criteria set for transperitoneal approach included: previous renal surgery (except for endopyelotomy), a wide renal pelvis (> 6 cm), large or multiple kidney stones, pelvic or horseshoe kidneys and potentially crossing vessels [20]. For retroperitoneoscopic RP approach, Etafy et al. stated that the robot should approach anteriorly and from the patient’s head in order to provide enough space for an assistant and thus increase the success rate [20]. Robot-assisted laparoscopic pyeloplasty studies are summarized in Table 2.

Secondary Minimally Invasive Pyeloplasty (Redo-pyeloplasty)

Redo-pyeloplasty affects the success rate of adhesion and fibrosis depending on previous UPJO surgery. Sundaram et al. suggested a redo-pyeloplasty approach for patients with crossing vessels, grade 3-4 hydronephrosis or 15-25% kidney function [21]. They reported a high success rate despite the longer operation duration compared to primary patients [21]. In their study, Eden et al. stated that operation duration of retroperitoneoscopic redo-pyeloplasty takes 29 minutes longer compared to primary cases (173.3 min. & 144 min.), but they show no difference in terms of hospitalization duration, conversion and complications [22]. Piaggio et al. compared (4 open, 6 laparoscopic) redo-laparoscopic pyeloplasty (redo-LP) with redo open pyeloplasty in the pediatric group. They stated that operation duration was higher in redo-LP (290 min. & 203 min), success rate was similar, and redo-LP resulted in a shorter hospital stay along with decreased use of parenteral or oral narcotics [23].
Robotic redo-pyeloplasty (redo-RP) cases are present in literature only in short series (<10) for pediatric group. Hemal et al. performed redo-RP on 9 patients with mean age of 16.4 years and they stated that all patients showed symptomatic recovery and scintigraphic non-obstructive drainage [24]. Lindgren et al. emphasized the reliability and success of redo-RP in the treatment of persistent and recurring UPJO in their pediatric redo-RP series (13 RP, 3 robotic ureterocalicostomy) with 16 patients [25].

Wickam and Kellet reported full-thickness incision of UPJO with a cold knife inserted through a percutaneous nephrostomy track in 1983 [26]. Retrograde and anterograde approaches can be used. Although the role of endopyelotomy may get smaller, it will still have a role in redo treatment during management of UPJO. The anterograde endopyelotomy should be considered if there are concomitant kidney stones, which can be managed simultaneously. After a failed primary procedure, endopyelotomy allows for direct visualization free from adhesions. In addition, any crossing vessel will have been mobilized in the primary procedure [27]. The success rate of endopyelotomy for secondary UPJO is around 70% [27]. When patients have a tendency for endopyelotomy, they should be warned of the need for a third treatment.

### An approach for stent implantation (anterograde, retrograde, external, stentless)

Providing an anastomosis through use of a stent is general practice both in LP and RP operations. The type of stent, as well as its method of placement (retrograde or anterograde), has been a matter of debate for years. Cystoscopic retrograde stenting with concurrent retrograde pyelography allows for detection of any ureteric anomalies. However, this approach has three major disadvantages. Firstly repositioning of the patient is needed. The second disadvantage is that stent insertion causes pelvic collapse, thus hampering the determination of the obstruction point between a non-dilated pelvis and a normal ureter. The third disadvantage is the prevention of intracorporeal suturing by the proximal edge of the stent. Therefore, an anterograde stenting approach is more commonly preferred [28].

Eichel et al. described an anterograde approach of insertion of a 5 Fr Kumpe catheter to the ureter from a superior port with the help of a 8 / 10 Fr Amplatz Sheath [29]. Andreoni et al. described the catheter’s placement inside the ureter by sending a cholangiogram guide through a 5 mm trocar and stenting through this path [30]. Whether the distal edge of

### Table 1. Laparoscopic pyeloplasty series

| Authors, year | No. of cases | Population | Operation time (min) | Follow-up (months) | Success rate |
|---------------|--------------|------------|----------------------|--------------------|--------------|
| Metzelder, 2006 [45] | 46 | Pediatric | 175 | 29 | 96 |
| Romero, 2006 [46] | 170 | Adult | 176 | 22 | 94 |
| Moon, 2006 [47] | 170 | Adult | 140 | 12 | 96 |
| Lam, 2007 [48] | 29 | Pediatric | 255 | 28 | 100 |
| Vicentini, 2008 [49] | 23 | Pediatric | 175 | 2-47 | 100 |
| Rassweiler, 2008 [50] | 189 | Adult | 123 | X | 95 |
| Lopez, 2009 [51] | 32 | Pediatric | 152 | 22 | 100 |
| Chacko, 2009 [52] | 52 | Pediatric | 248 | 20 | 98 |
| Srivastava, 2009 [53] | 186 | Adult | 180 | 39 | 94 |
| Symons, 2009 [54] | 118 | Adult | 205 | 12 | 94.5 |
| Chuanu, 2009 [55] | 150 | Adult | 105 | 16 | 98 |
| Maheshwari, 2010 [56] | 82 | Pediatric | 151 | 41 | 91 |
| Szavay, 2010 [57] | 20 | Pediatric | 140 | 24 | 100 |
| Wagner, 2010 [58] | 105 | Adult | 150 | 51 | 96 |
| Singh, 2010 [59] | 142 | Adult | 145 | 30 | 96 |
| Sweeney, 2011 [60] | 112 | Pediatric | 254 | 15 | 97 |
| Shao, 2011 [61] | 105 | Adult | 96 | 42 | 100 |
| Juliano, 2011 [62] | 133 | Adult | 127 | 68 | 96 |
| Szydelko, 2012 [63] | 50 | Adult | 169 | 26 | 91 |
| Turner, 2013 [64] | 29 | Pediatric | 245 | 13 | 92 |
Also, Sethi et al. stated that operation duration was shortened and the amount of narcotics used as well as length of hospitalization were both lowered [38].

Comparative Studies

a) LP/RP & OP

In adult patient groups, only Bansal et al. presented a randomized controlled study (28 laparoscopic pyeloplasty; 34 open pyeloplasty). Scintigraphy in the third month post-op and IVP in the sixth month were used for control purposes. Median operation duration was detected to be shorter in the open pyeloplasty group and this was statistically significant (244 min. & 122 min.). Postoperative diclofenac requirement and hospitalization duration were detected to be significantly lower in the laparoscopic group (107.14 mg vs. 682.35 mg); (3.1 days vs. 8.3 days) [39].

There are more comparative studies conducted in the pediatric group. In their study, for instance, Bonnard et al. stated that operation duration for OP was significantly shorter also adding that postoperative analgesic intake and hospitalization duration were lower in retroperitoneoscopic LP [40]. Valla et al. stated that a retroperitoneoscopic minimally invasive approach was preferred over OP in the pediatric group, but OP is still the first-choice for the <4 months age group [41]. Sorensen et al. detected no difference in hospitalization duration, pain score, surgical success and complication rate in their comparative study between RP and OP in the pediatric group [42].

b) LP & RP

The first meta-analysis was conducted by Braga et al. in 2009. It was thought to be unreliable due to a low number of cases included in the study and its lack of statistical significance.
of assessment of randomized controlled studies. In recent years, five comparative (4 centric, 1 multicentric) studies were carried out. In a comparative study conducted by Bird et al. with 98 RP and 74 LP, it was stated that operation duration, preoperative complication rate and diuretic scintigraphy dependent success rate were detected to be similar between groups [43]. Riachy et al. reached similar conclusions in the pediatric group with 18 LP (mean age: 8.1) and 46 RP (mean age: 8.8). They stated that operation duration in RP was shorter (209 min. vs. 298 min.) [44]. When 277 RP and 196 LP were compared in an up-to-date meta-analysis; operation duration in the RP group was strikingly shorter. Preoperative complication rates, hospital stay and success rate were detected to be similar. Advantages of minimally invasive treatment methods are summarized in Table 3.

CONCLUSIONS

In the era of minimally invasive surgery, the ideal treatment method in UPJO treatment for adult and pediatric groups must be a method that is easy to learn, safe, effective, does not cause serious perioperative morbidity, and able to provide long-term stability. Despite the lack of randomized controlled studies and low evidence levels, a large database exists along with very important results. LP and/or RP can be used as an alternative of OP in adult group. These options still offer little advantage in the pediatric group due to length of postoperative recovery and hospitalization.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

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