

Primary Ureteropelvic Junction Obstruction: Surgical Treatment with Antegrade/Retrograde Endopyelotomy and Laparoscopic Pyeloplasty (Effectiveness Analysis)

Alexei Suchshenko*, Yerbol Iskakov, Daniyar Akhmetov, Ravil Sherkhanov, Ulan Zhaparov, Fatima Suleimenova

ABSTRACT

The proposed research aimed to compare two surgical methods (laparoscopic pyeloplasty and both antegrade and retrograde endopyelotomies), their results and post-surgical complications prospectively. Within the scope of the study, surgeons performed 48 endopyelotomies (including 14 antegrade and 34 retrograde) and 65 laparoscopic pyeloplasties in patients with primary ureteropelvic junction obstruction (UPJO). The diagnosis of UPJO was based on complete medical history, ultrasonography, intravenous urography (IVU), and/or contrast-enhanced computed tomography. The mean follow-up period for patients in two groups was 12 months. The successful result was defined as the absence of any clinical symptoms combined with the significant reduction of hydronephrosis on IVU and ultrasonography. The successful result was observed in 84.8% of patients after endopyelotomy, and in 93.8% of patients after laparoscopy. Irrespective of the degree of hydronephrosis, laparoscopic procedures yield better therapeutic results than endopyelotomy for patients with primary UPJO. The number of complications was comparable in both groups. We conclude that laparoscopic pyeloplasty should be the procedure of choice in the treatment of primary UPJO.

KEY WORDS: Endopyelotomy, Laparoscopic pyeloplasty, Success rate, Ureteropelvic junction obstruction

INTRODUCTION

Historically, urologists preferred to use open pyeloplasty as the gold standard to treat hydronephrosis caused by ureteropelvic junction obstruction (UPJO). The effectiveness of the indicated procedure was proved to be over 90%.^[1] Endoscopic methods, including antegrade and retrograde endopyelotomy, are less painful for the patients and shorten their hospital stay and the recovery, but the success rate for these procedures is 10–25% lower when compared to open surgery.^[2] Laparoscopic pyeloplasty of the UPJO combines the success rate of open surgery with the benefits of minimally invasive procedures.^[3,4]

Scientists continue conducting studies that compare the effectiveness of endoscopic and laparoscopic procedures in the treatment of UPJO.^[5-7] Published reports are usually based on a small number of cases.

As an exception, only Rassweiler *et al.* as well as Ost *et al.* provide studies that are based on the series of more than 50 cases.^[8] In the provided research, authors compare two surgical procedures used in the treatment of primary UPJO: Antegrade and retrograde endopyelotomies and laparoscopic pyeloplasty. The material of the provided research is reasonably substantial as compared to the studies published so far.

MATERIALS AND METHODS

Patients

Antegrade/retrograde endopyelotomy

From March, 2012, to April, 2017, surgeons at our center (City Center of Urology, City Hospital #2, Astana, Kazakhstan) performed 14 antegrade and 34 retrograde endopyelotomies in patients with primary UPJO. All procedures were collectively carried out by the same two surgeons (Y.P. and T.M.).

Hydronephrosis was diagnosed by intravenous urography (IVU), or contrast-enhanced computed tomography using four-grade system scale.^[9] Like in the work of Van Cangh *et al.* (1994), Grades 1 and

Access this article online

Website: jpr.solutions.info

ISSN: 0975-7619

Department of Urology and Andrology, Astana Medical University, Astana, Kazakhstan

*Corresponding author: Alexei Suchshenko, Department of Urology and Andrology, Astana Medical University, 49A Beibitshilik str., Astana, Kazakhstan. E-mail: Yersain52@gmail.com

Received on: 17-02-2018; Revised on: 23-03-2018; Accepted on: 28-05-2018

2 (mild and moderate) and Grades 3 and 4 (severe and extreme) were combined for the purposes of analysis. Hydronephrosis Grade 1–2 was recognized in 45 patients, hydronephrosis Grade 3–4 in the remaining three patients. Nephrolithiasis was diagnosed in nine cases. All patients were stone free after the procedure.^[10]

Laparoscopy: Laparoscopic pyeloplasty was performed on 65 patients with primary UPJO. The first laparoscopic surgery for a patient with UPJO was performed at our center in January 2012, the latest one - in August 2017. Surgeries for all patients were performed by the same two surgeons (Y.P. and T.M.).

All the patients were operated with the use of transabdominal access approach. A laparoscopic Hynes-Anderson pyeloplasty (H-A) was performed to 29 patients, whereas a laparoscopic Y-V pyeloplasty was performed in 10 cases. In five patients, a fenger pyeloplasty was carried out. In addition, laparoscopic vasopexia of the aberrant vessel was performed in nine cases, and laparoscopic pyelo ureterolysis was performed in 12 patients. Hydronephrosis was graded in the same way as in the endopyelotomy group according to the four-grade scale. Grade 1–2 was diagnosed in 35 cases, Grades 3–4 in 30 patients. In 14 patients, nephrolithiasis was recognized; therefore, the surgeries were extended to perform pyelolithotomies. Five cases were accompanied by nephroptos which is required additional laparoscopic nephropexy.

The patients' demographic and surgery information are presented in Table 1. The data of the two groups are comparable.

Diagnosis

The diagnosis of hydronephrosis in the course of UPJO was based on complete medical history, laboratory values, ultrasound, CT urography, and diuretic urography. If diuretic urography (IVU) indicated impaired renal function (three cases in endopyelotomy group and five cases in laparoscopy group), diuretic renography was performed. Both endopyelotomy and laparoscopy were carried out only in cases with the minimal split renal function above 15%. In the endopyelotomy group, a dynamic pressure perfusion study was additionally performed for nine patients.

Operative Techniques

In our study, endopyelotomy was performed in two methods: Antegrade endopyelotomy and retrograde endopyelotomy. The method was chosen individually and depended on the length of stricture of UPJ, hydronephrosys grade, and coexisting conditions.

Antegrade endopyelotomy: Patients were placed in the prone position. For retrograde pyelography cystoscopy with insertion of a 5- or 6-French open-ended ureteral catheter was performed. We have used upper- or middle-pole calix for the renal puncture. Tract dilation was performed with a stiff guidewire to 30-French using rigid Amplatz dilators. An incision was performed posterolaterally using a holmium laser and completed to the retroperitoneal fat. At the conclusion of the procedure patients was stented in an antegrade method with a 7-French stent (Balton, Warsaw, Poland), which was left unremoved for 4–8 weeks. A nephrostomy tube was inserted for up to 72 h, and a 16- or 18-French catheter was positioned in the bladder for 2 or 3 days. After that time, the tube was closed for 24 h. If the patient was asymptomatic and there was no paranephric fluid collection on ultrasound, the tube was displaced to the retroperitoneal space. If no urinary leakage was observed, the drain was removed in 24 h.

Retrograde Endopyelotomy

Patients were positioned for the perineal operations. Ureteroscopy was performed up to the ureteropelvic junction. A holmium laser was inserted, and the incision was performed through to the retroperitoneal fat. In contrast to antegrade endopyelothomy, the procedure finished with retrograde stenting with the same 7-French stent for 4–8 weeks. 16- or 18-French ureteral catheter was removed after 2 or 3 days. Ultrasound and urography were used to control the correctness of the drainage insertion.

Laparoscopic Pyeloplasty

The patient was placed in a 45-degree flank position. After the creation of pneumoperitoneum in a standard manner, the first 10-mm umbilical trocar was inserted blindly. Two or three additional trocars (two 5-mm and one 10-mm) were inserted under direct vision with a 5-mm trocar halfway between the umbilicus and xiphoid, a 10-mm trocar at the level of the

Table 1: Patient demographic and surgical data

Characteristics	Endopyelotomy	Laparoscopicpyeloplasty
Number of patients	48	65
Number of male/female	26/22	29/36
Mean patient age, y (range)	38.3 (17–66)	32.3 (17–63)
Number of patients according to the degree of hydronephrosis		
Grade 1–2	45	35
Grade 3–4	3	30
Number of patients with concomitant nephrolithiasis	9	5

umbilicus laterally to the rectus muscle, and the fourth, 5-mm trocar in the midclavicular line below the costal margin. After the medial dislocation of colon, the proximal ureter and renal pelvis were fully mobilized. In cases with aberrant vessels, they were completely isolated. A dismembered pyeloplasty was performed with excision of the stenotic segment and reduction of the renal pelvis. After the spatulation of the ureter, a wide anastomosis to the renal pelvis was created. In all the cases stent (double J, 6- to 7-French, 26–28 cm) were placed intraoperatively during anastomosis completion. For this purpose, we preferred 4–0 Vicryl (Johnson and Johnson Intl., St. Stevens–Woluwe, Belgium) with a curved needle as the suturing material. All anastomoses were completed with interrupted sutures over a ureteric stent using a freehand suturing technique. In the case of nondismembered Y-V pyeloplasty, two horizontal incisions of the pelvis were made and then the ureter was spatulated. The apex of the pelvic flap was brought to the most inferior part of the ureterotomy incision. The anastomosis was completed with interrupted 4–0 Vicryl sutures. In cases of anterior crossing vessels, the vein was divided, and an attempt was always made to displace the artery cephalad rather than posteriorly to the newly created ureteropelvic junction. A dorsally crossing vessel was displaced to the ventral side. At the end of the procedure, a 14-French drain was positioned close to the anastomosis and a 16-French urethral catheter was left indwelling. The abdominal drain was removed when the output was below 50 mL over 72 h. The urethral catheter was removed the next day.

Follow-up

Within the first 24 h after the surgery and before discharge, ultrasound was performed to control the presence of paranephric fluid collection. We used the same follow-up protocol for both groups of patients. 8 weeks after surgery, ultrasound was performed with the following cystoscopy, following the removal of the stent. 24 h after that excretion urography was performed and symptoms were assessed with the use of analog pain scale. Follow-up period included 18 months after the surgery and included examinations every 6 months. With the presence of indications (continuous pain syndrome), IVU was recommended in 18 months after the surgery. Subsequently, a yearly visit to a specialist was recommended.

In November 2017, the results for patients after antegrade and retrograde endopyelotomy and laparoscopic pyeloplasty were reviewed and summed up. The mean follow-up was 18 months.

Definition of Success

Complete success of the surgery was defined as the absence of any clinical symptoms combined with the

significant reduction of hydronephrosis on IVU and ultrasonography.

Statistical Analysis

For comparison of categorical values we used Chi-square analysis, and for comparison of numerical variables, we used student *t*-test. $P < 0.05$ was considered to be statistically significant.

RESULTS

Endopyelotomy was performed in 48 cases. Laparoscopic pyeloplasty was performed in 65 patients. The success rate was evaluated in all the cases.

Operative Duration, Blood Loss, and Hospital Stay

Endopyelotomy was performed on the left kidney in 30 patients, and in 17 patients - on the right kidney, and in one patient the surgery was performed on both kidneys simultaneously. Similarly, laparoscopic pyeloplasty was performed on the left kidney in 34 patients, and in 31 patients - on the right kidney. Overall hospital stay (including both pre- and post-operative hospital stay) was, on average, 11.6 days for endopyelotomy patients (ranged from 6 to 25) and 12.9 days for laparoscopy patients (ranged from 7 to 27). In particular, the mean hospital stay for patients after surgery was as follows after endopyelotomy - 9.0 days (ranged from 3 to 23) and 10.0 days (ranged from 5 to 20) - after laparoscopic pyeloplasty. The difference between the average length of stay was not statistically significant (P value is not significant). The mean operative time for endopyelotomy was 65.0 min, whereas for laparoscopic pyeloplasty it was 178.6 min. The difference between the average operative duration for the two types of surgery is statistically significant ($P < 0.0001$). The mean extent of blood loss composed 64.4 ml during endopyelotomy (0–300) and 153.5 ml during laparoscopic pyeloplasty (0–400).

Intraoperative Complications

Endopyelotomy

The difficulties in inserting a stent catheter into the renal pelvis intraoperatively were the most common complication experienced by the surgeons - in five cases (10.4%). Bleeding was the second most frequent complication as it occurred in two cases.

Laparoscopy: There were two cases of bleeding (3.1%), two cases of difficulties in inserting a stent (3.1%), as well as one case of surgical emphysema.

Post-operative Complications

Endopyelotomy

Pyelonephritis, as the most common post-operative complication, was observed in seven cases (14.9%).

Table 2: Intra- and post-operative complications observed after endopyelotomy and laparoscopic pyeloplasty

Complications	n (%)	
	Endopyelotomy	Laparoscopic pyeloplasty
Intraoperative complications		
Bleeding	2 (4.2)	2 (3.1)
Surgical emphysema	0	1 (1.5)
Difficulties in inserting a ureteral stent	5 (10.4)	2 (3.1)
Post-operative complications		
Pyelonephritis	7 (14.9)	4 (6.2)
Urinoma	1 (2.1)	1 (1.5)
Stent obstruction	3 (6.3)	1 (1.5)

A substantial urinary leakage to a drain placed in the retroperitoneal space was indicated in three patients (6.3%) because of the obstruction of a double J catheter. In one patient (2.1%), urinoma was noted.

Laparoscopy: The most common post-operative complication was pyelonephritis. It was observed in four cases (6.2%). The obstruction of stent catheter was the main cause of urinary leakage in one patient (1.5%). Urinoma was also observed in one patient (1.5%).

Table 2 compares intra- and post-operative complications observed among all our patients. The number of complications after the two procedures was comparable. In the laparoscopy group, we observed complications that did not occur in the endopyelotomy group (surgical emphysema in one case).

Success Rate

The success rate in the laparoscopic group was 93.8% as compared to 84.7% for endopyelotomy. The difference is statistically significant ($P < 0.05$).

The therapeutic efficacy of endopyelotomy and laparoscopic pyeloplasty was compared in relation to the degree of hydronephrosis. In the first group (Grade 1–2 hydronephrosis), the therapeutic result was good in 84.4% of patients after endopyelotomy and in 97.1% of patients after laparoscopy. The difference is statistically significant ($P < 0.05$). In the second group (Grade 3–4 hydronephrosis), the result was successful in 33.3% of patients after antegrade endopyelotomy, and in 90.0% of cases of laparoscopy. The difference is not statistically significant (p value is not significant).

Table 3 presents the success rates in patients after both antegrade and retrograde endopyelotomies and laparoscopy.

Failures

Endopyelotomy: In three cases, failure was evident after removing the stent (pain, unchanged hydronephrosis on ultrasound). The stent was inserted again and, after a month, an attempt was made to remove it. However, it was ineffective. Repeat ultrasound

Table 3: Success rates in patients after endopyelotomy and laparoscopic pyeloplasty

Procedure	Number of patients	Success rate
Endopyelotomy		
HN Grade 1–2	45	84.4% (38/45)
HN Grade 3–4	3	33.3% (1/3)
Laparoscopic pyeloplasty		
HN Grade 1–2	35	97.1% (34/35)
HN Grade 3–4	30	90.0% (27/30)

revealed hydronephrosis to be unchanged, and IVU showed hydronephrosis with no patent ureteropelvic junction. Recurrences in initially successful patients were observed during 12 months after treatment in two cases, and in three cases - after 18 months.

Laparoscopy: All five failures occurred within 6 months of the surgery. In two cases (one after an H-A plasty, the other two after a Y-V plasty, and the other five after Fenger plasty), pain occurred immediately after the stent removal. In all these patients, the ultrasound indicated a dilated system unchanged from the pre-operative studies. We followed the same protocol as in the endopyelotomy group (the stent was inserted again for 4–6 weeks). After the stent removal, repeat ultrasound revealed hydronephrosis to be unchanged, and diuretic IVU showed hydronephrosis with no patent ureteropelvic junction. In four of the five cases, retrograde endopyelotomy was performed with a good therapeutic result. Our five failures were the patient after Y-V plasty who did not report pain but 6 months after the operation hydronephrosis worsened. Diuretic IVU confirmed hydronephrosis with no patent ureteropelvic junction, but the patient refused to continue the treatment.

DISCUSSION

UPJO is the most common congenital abnormality of the ureter. Its incidence is 5/100,000 annually.^[11] Indications for surgical treatment stay the same for many years already. They include loin pain, deteriorating renal function, urinary infection, stone formation, and hypertension. The goals for the surgery have also stayed the same for years. They include eliminating

the ailments, ensuring adequate urinary drainage, and restoring or improving renal function. Till the beginning of the 1980s, open pyeloplasty was the standard surgical method of treatment of UPJO. H-A plasty enjoyed particular popularity, yielding the success rate of 90–100%.^[12-14] However, the procedure also had a serious drawback such as the consequences of the loin incision used to perform open surgery. Attempts were made to find less invasive and minimal access alternatives.

In 1983, Wickham and Kellet described the technique of the incision of the ureteropelvic junction with a cold knife inserted into the renal pelvis through a percutaneous nephrostomy track.^[15] The technique, called by its authors “percutaneous pyelolysis,” is now better known as endopyelotomy. The therapeutic efficacy of the method ranges from 65% to 92% in different studies. The results of major series of endopyelotomy are listed in Table 4.

Since Schuessler *et al.* and Kavoussi and Peters first described laparoscopic pyeloplasty, numerous reports evaluating the procedure have been published.^[20,21] The therapeutic efficacy of laparoscopic plasties equals the success rate of open surgery, but they are less invasive. The results of major series of laparoscopic pyeloplasties are listed in Table 5.

The studies comparing the therapeutic results of endopyelotomy and laparoscopy in the treatment of UPJO are not so common. Pardalidis *et al.* (2002) as well as Ost *et al.* (2005) reported that the therapeutic results of the two procedures are comparable. Desai *et al.* (2004) observed significantly worse results of endopyelotomy as compared to laparoscopy (respective success rates: 88% and 100%).^[5] In all the above studies, however, endopyelotomy was performed in selected cases when the renal pelvis was small and obstruction short (Ost, Desai), and when there were no crossing vessels.

In our analysis, ultrasound and diuretic urography were the major procedures used to diagnose UPJO and to evaluate the success rate of the operation. We agree with Yurkanin and Fuchs (2004) that diuretic IVU is the best test for pre-operative and post-operative evaluation of patients with UPJO. It allows anatomic as well as a qualitative functional assessment of the affected kidney. Diuretic IVU will certainly unmask and document UPJO in patients with bilaterally equal time to the first excretion of contrast medium and unimpaired global renal function.^[24] Our study indicates that in such cases routine diuretic renography is not of any additional benefit. We are aware that IVU does not provide a quantitative measure of treatment outcome. Yet, it seems to us that this information is not dispensable in the evaluation of the operative procedures. However, equivocal IVU indicates that diuretic renography and/or Whitaker’s test should additionally be performed.

The analysis of our material indicates that laparoscopy is a more efficacious operative procedure than endopyelotomy (either antegrade or retrograde) in patients with primary UPJO (respective success rates: 93.8% and 84.7%). The divergence between our results and those reported by others may result from the fact that in our materials patients treated with endopyelotomy were not selected in any way.

In our material, the number of complications after the two procedures was comparable except for intraoperative difficulties in inserting a stent, which was more frequent for endopyelotomy patients. The complications that were not observed in the endopyelotomy groups such as surgical do not seem to be related in any way to the type of the operative procedure. As our trial has been nonrandomized, the conclusions are rather a specimen. Our findings indicate that the success rate in the endopyelotomy

Table 4: Results of major series of endopyelotomies

Investigators	Patients (n)	Primary success rate (%)	Secondary success rate (%)	Mean follow-up (mo)
Knudsen <i>et al.</i> ^[16]	80	65	74	55
Van Cangh <i>et al.</i> ^[10]	102	73	NS	60
Motola <i>et al.</i> ^[17]	212	85	86	NS
Shalhav <i>et al.</i> ^[18]	149	89	77	27
Kletscher <i>et al.</i> ^[19]	50	90	82	12
Ost <i>et al.</i> ^[3]	50	92	58	16
Present study	48	85	72	18

Table 5: Results of major series of laparoscopic pyeloplasties

Investigators	Patients (n)	Primary success rate (%)	Secondary success rate (%)	Mean follow-up (mo)
Moon <i>et al.</i> ^[22]	170	97	85	15
Inagaki <i>et al.</i> ^[23]	147	98	84	24
Rassweiler <i>et al.</i> ^[8]	143	94,4	NS	63
Present study	65	94	82	18

group after 18 months was 72%. Similarly, in the pyeloplasty group, the recurrence-free survival rate was 82% after the same follow-up period. As the length of the follow-up period was similar in the two groups, we conclude that the effectiveness depends on the type of procedure performed. We consider that the same selection criteria, as well as the same follow-up protocol, allow us to compare the results obtained in both groups of patients.

Based on our findings, we believe that laparoscopic pyeloplasty should be the first choice treatment in patients with primary UPJO. However, endopyelotomy should be the method of choice for patients with nonextended or relapsed stricture of UPJ.

CONCLUSION

In the result of the study, we concluded that laparoscopic pyeloplasty is the procedure of choice for patients with primary UPJO. However, this procedure requires special experience and surgical qualifications. Laparoscopic pyeloplasty is both effective and safe procedure to treat primary UPJO. On the contrary, endopyelotomy is usually associated with the shorter time of major stage of procedure and stenting.

REFERENCES

- Notley RG, Beaugie JM. The long-term follow-up of Anderson-Hynes pyeloplasty for hydronephrosis. *Br J Urol* 1973;45:464-7.
- Szydelko T, Kopeć R, Kasprzak J, Apoznański W, Kołodziej A, Zdrojowy R, *et al.* Antegrade endopyelotomy versus laparoscopic pyeloplasty for primary ureteropelvic junction obstruction. *J Laparoendosc Adv Surg Tech A* 2009;19:45-51.
- Ost MC, Kaye JD, Guttman MJ, Lee BR, Smith AD. Laparoscopic pyeloplasty versus antegrade endopyelotomy: Comparison in 100 patients and a new algorithm for the minimally invasive treatment of ureteropelvic junction obstruction. *Urology* 2005;66 Suppl 5A:47-51.
- Fallon E, Ercole B, Lee C, Best S, Skenazy J, Monga M, *et al.* Contemporary management of ureteropelvic junction obstruction: Practice patterns in Minnesota. *J Endourol* 2005;19:41-4.
- Pardalidis NP, Papatsoris AG, Kosmaoglou EV. Endoscopic and laparoscopic treatment of ureteropelvic junction obstruction. *J Urol* 2002;168:1937-40.
- Desai MM, Desai MR, Gill IS. Endopyeloplasty versus endopyelotomy versus laparoscopic pyeloplasty for primary ureteropelvic junction obstruction. *Urology* 2004;64:16-21.
- Baldwin DD, Dunbar JA, Wells N, McDougall EM. Single-center comparison of laparoscopic pyeloplasty, acucise endopyelotomy, and open pyeloplasty. *J Urol* 2003;17:155-60.
- Rassweiler JJ, Subotic S, Feist-Schwenk M, Sugiono M, Schulze M, Teber D, *et al.* Minimally invasive treatment of ureteropelvic junction obstruction: Long-term experience with an algorithm for laser endopyelotomy and laparoscopic retroperitoneal pyeloplasty. *J Urol* 2007;177:1000-5.
- Talner LB. Urinary Obstruction. In: Pollack HM, editor. *Clinical Urography: An Atlas and Textbook of Urological Imaging*. Vol. 2. Ch. 5. Philadelphia, PA: W.B. Saunders; 1990. p. 1535-628.
- Van Cangh PJ, Wilmart JF, Opsomer RJ, Abi-Aad A, Wese FX, Lorge F, *et al.* Long-term results and late recurrence after endoureteropyelotomy: A critical analysis of prognostic factors. *J Urol* 1994;151:934-7.
- Eden CG. Minimally invasive treatment of ureteropelvic junction obstruction: A critical analysis of results. *Eur Urol* 2007;52:983-9.
- Nguyen DH, Aliabadi H, Ercole CJ, Gonzales R. Nonintubated Anderson-Hynes repair of ureteropelvic junction obstruction in 60 patients. *J Urol* 1989;142:704-6.
- O'Reilly PH, Brooman PJ, Mak S, Jones M, Pickup C, Atkinson C, *et al.* The long-term results of anderson-hynes pyeloplasty. *BJU Int* 2001;87:287-9.
- Bauer JJ, Bishoff JT, Moore RG, Chen RN, Iverson AJ, Kavoussi LR. Laparoscopic versus open pyeloplasty: Assessment of objective and subjective outcome. *J Urol* 1999;162:692-5.
- Wickham JE, Kellet MJ. Percutaneous pyelolysis. *Eur Urol* 1983;9:122-4.
- Knudsen BE, Cook AJ, Watterson JD, Beiko DT, Nott L, Razvi H, *et al.* Percutaneous antegrade endopyelotomy: Long-term results from one institution. *Urology* 2004;63:230-4.
- Motola JA, Badlani GH, Smith AD. Results of 212 consecutive endopyelotomies: An 8-year follow-up. *J Urol* 1993;149:453-6.
- Shalhav AL, Giusti G, Elbahnasy AM, Hoenig DM, McDougall EM, Smith DS, *et al.* Adult endopyelotomy: Impact of etiology and antegrade versus retrograde approach on outcome. *J Urol* 1998;160:685-9.
- Kletscher BA, Segura JW, LeRoy AJ, Patterson DE. Percutaneous antegrade endopyelotomy: Review of 50 consecutive cases. *J Urol* 1995;153:701-3.
- Schuessler WW, Grune MT, Tecuanhuey LV, Preminger GM. Laparoscopic dismembered pyeloplasty. *J Urol* 1993;150:1795-9.
- Kavoussi LR, Peters CA. Laparoscopic pyeloplasty. *J Urol* 1993;150:1891-4.
- Moon DA, El-Shazly MA, Chang CM, Gianduzzo TR, Eden CG. Laparoscopic pyeloplasty: Evolution of a new gold standard. *Urology* 2006;67:932-6.
- Inagaki T, Rha KH, Ong AM, Kavoussi LR, Jarrett TW. Laparoscopic pyeloplasty: Current status. *BJU Int* 2005;95:102-5.
- Yurkanin JP, Fuchs GJ. Laparoscopic dismembered pyeloureteroplasty: A single institution's 3-year experience. *J Endourol* 2004;18:765-9.

Source of support: Nil; Conflict of interest: None Declared