



# COMPARISON OF LAPAROSCOPIC AND OPEN PYELOPLASTY IMPACT ON COMFORT AND SUCCESS: A RETROSPECTIVE, SINGLE CENTER STUDY

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**SUMMARY** – Ureteropelvic junction obstruction causes hydronephrosis and may lead to renal parenchymal damage unless timely diagnosed and treated. Although open pyeloplasty is still the gold standard, it needs to be compared with new techniques. In this study, we compared laparoscopic and open pyeloplasty. Data on 113 patients who had undergone surgery between 2008 and 2014 were evaluated retrospectively. Thirty-nine patients had undergone laparoscopic pyeloplasty, and 74 had undergone open pyeloplasty. Ultrasonography was performed at 3 months and scintigraphy at 6 months postoperatively. Parameters such as the length of surgery, need for analgesics, length of hospital stay, complications, and success rates were compared. When compared to open pyeloplasty (mean 9.8 dextropropofol 50 mg IV dose), the need for an analgesic was significantly lower in the laparoscopic pyeloplasty (mean 4.5, paracetamol 15 mg/kg IV dose) group ( $p < 0.05$ ). The length of hospital stay was also shorter in the laparoscopic pyeloplasty group (mean 4.0 days) than in the open pyeloplasty group (mean 7.3 days) ( $p < 0.05$ ). This study demonstrated that laparoscopic pyeloplasty could be safely used in the treatment of ureteropelvic junction obstruction with a lower need for analgesics and a shorter length of hospital stay than with open pyeloplasty.

**Key words:** *Hydronephrosis; Laparoscopic pyeloplasty; Open pyeloplasty; Ureteropelvic junction obstruction*

## Introduction

Ureteropelvic junction obstruction (UPJO) is the most common cause of upper urinary tract obstruction<sup>1</sup>. It can occur in all age groups and accounts for 50% of collecting system dilatations in children<sup>2</sup>. Although two-thirds of the cases regress during the follow-up, cases with no regression may lead to renal pa-

renchymal damage and permanent dysfunction<sup>3</sup>. The goal of treatment is to prevent parenchymal damage and preserve kidney functions<sup>4</sup>.

While nephrectomy used to be common, Ernest Küster performed the first successful pyeloplasty in 1891. Since then, various pyeloplasty methods have been developed to date. Currently, the dismembered pyeloplasty technique defined by Anderson and Hynes in 1949 remains the gold standard<sup>5</sup>. In recent years, minimally invasive surgical techniques have emerged in the treatment of UPJO and have become widely accepted<sup>6,7</sup>. The effectiveness and safety of laparoscopic pyeloplasty (LP) first reported in 1993 by Schuessler

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*et al.* have also been reported by various authors<sup>8</sup>. This procedure has emerged mainly to provide lower patient morbidity and similar success rates as open surgery. Today, LP can be performed safely in centers experienced in laparoscopy with less morbidity than open pyeloplasty (OP)<sup>9</sup>.

In this study, we compared the results of patients who had been followed up with the diagnosis of UPJO and undergone OP and LP during their treatment. The need for analgesics, length of hospital stay, and surgical success were compared between the groups.

## Patients and Methods

Data on 113 patients who had undergone surgery for UPJO between January 2008 and November 2014 in our department were retrospectively reviewed and evaluated. These 113 patients having undergone pyeloplasty for UPJO were divided into two groups LP and OP. The patients were also evaluated separately as groups of children (patients aged  $\leq 16$ ) and adults (patients aged  $>16$ ). The age, gender, surgery side, length of surgery, type of stenosis, removal of the ureteropelvic junction (UPJ), analgesic dose, complication and success rates, and length of hospital stay were evaluated retrospectively.

When deciding on surgery during the follow-ups, we prioritized patients with stage 3-4 pelvicaliectasis, those with  $T_{1/2}$  on diethylenetriamine pentaacetate (DTPA) renogram longer than 20 minutes, and/or split kidney function of lower than 40% on renal scintigraphy, reduction of  $>10\%$  on follow-up DTPA renogram, and those who were symptomatic. All patients were initially designated to undergo LP but a part had to be converted to OP due to lack of surgical experience.

All patients were operated under general anesthesia. An experienced senior surgeon team led all surgeries. The Anderson-Hynes dismembered pyeloplasty technique was used in all patients who had undergone pyeloplasty. The retroperitoneal approach was chosen for both open surgery and laparoscopic surgery. In the open approach, the patient was placed in a lateral decubitus position, and a subcostal incision was performed. Having separated abdominal muscles and pushed the peritoneum back, the Gerota fascia was opened, the ureter on the psoas muscle was identified, and the pelvis was approached. In the laparoscopic approach, three ports were placed on the anterior, medial, and posterior axillary lines between the subcostal line and the iliac protuberance. In all patients, a urethral

catheter, ureteral J catheter, and surgical drainage catheter were placed. After surgery, pediatric patients were treated with IV 15 mg/kg paracetamol as an analgesic, while adults were administered IV dexketoprofen 50 mg. Analgesics were administered on demand. Paracetamol was preferred to avoid children's exposure to nephrotoxicity. A Foley catheter was removed on days 1-2, and the drain was removed on days 3-10 after surgery. Patients were followed up upon discharge from the hospital.

Four to six weeks after surgery, a cystoscopy was performed and double J catheters were removed. A check-up and ultrasonography (US) were performed three months after surgery. Follow-up scintigraphy was performed in the sixth month. Patients were followed up for at least 2 years in total. In diagnostic and follow-up scintigraphy studies, Tc-99m MAG3 (mercaptoacetyltriglycine) was preferred in children and Tc-99m DTPA in adults. Analgesics were dosed as 15 mg/kg paracetamol IV for children and 50 mg dexketoprofen IV for adults. Success was defined as the relief of symptoms along with improvements in the imaging results. Failure was defined as the persistence or recurrence of symptoms and/or obstructive drainage pattern in the US, intravenous urography, or diuretic renography during the follow-up period.

All procedures in human participants were performed per ethical standards of the institutional and/or national research committee and the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. This study was conducted under the approval of the Ethics Council of Erciyes University, Faculty of Medicine (20.02.2015/2015-92). All patients gave informed written consent for participation in this clinical research and its publication.

The mean, standard deviation, median, minimum, maximum, frequency, and ratio values were used in the descriptive statistics of data. Kolmogorov Smirnov test was used to measure the distribution of data. Mann-Whitney U test was used in the analysis of quantitative data. The  $\chi^2$ -test was used in the analysis of qualitative data. Fisher's exact test was used when the  $\chi^2$ -test conditions were not met. IBM SPSS version 22.0 was utilized in the analyses.

## Results

Out of the 113 patients included in our study who had undergone LP or OP, 57 were children and 56 were adults. LP was performed in 21 and OP in 36

pediatric patients. LP was performed in 18 and OP in 38 adult patients. Pyeloplasty was performed on the right and left sides in 44 and 69 patients, respectively. The retroperitoneal approach was used in all patients.

The main complaint at the presentation was pain in 81 patients. Eight patients were diagnosed while investigating the etiology of a urinary tract infection (UTI). Three patients presented with hematuria and one patient with incontinence. Seventeen patients were diagnosed in the prenatal period and were taken into on follow-up. Eighty patients had primary UPJO and 33 had crossing vessels. The UPJ was removed in 92 patients, and 21 patients underwent V-Y-plasty. While

91 patients had no complications, 22 patients developed complications (urinary wetting of drain due to imperfect anastomosis, infection or fever, bleeding more than expected through the drain). Pyeloplasty was considered successful in 96 patients and failed in 17 patients.

The patients in our study were divided into two groups those who underwent LP and those who underwent OP. These two groups were compared according to gender, age group, presentation, stenosis side, stenosis type, UPJ removal, complication, success, length of hospital stay, and analgesic need. There was no significant difference between the groups according to gender, age group, presentation complaint, stenosis

*Table 1. Comparison of patients who underwent open pyeloplasty and laparoscopic pyeloplasty according to gender, age group, complaint, side, stenosis type, UPJ removal, complications, and success rate*

		Type of surgery				p
		Open		Laparoscopy		
		n	%	n	%	
Gender	Male	47	64	23	59	0.636
	Female	27	36	16	41	
Age group	Child	36	49	21	54	0.599
	Adult	38	51	18	46	
Presentation	Prenatal	10	14	7	18	0.531
	Pain	54	73	27	69	0.675
	UTI	6	8	2	5	0.557
	Hematuria	2	3	1	3	1.000
	Incontinence	1	1	0	0	1.000
	Incidental	1	1	2	5	1.000
Side	Right	31	42	13	33	0.375
	Left	43	58	26	67	
Type of stenosis	Primary	51	69	29	74	0.545
	Crossing vessel	23	31	10	26	
UPJ	Removed	58	78	34	87	0.252
	Not removed	16	22	5	13	
Complication	None	61	82	30	77	0.482
	Bleeding	1	1	1	3	
	UTI	8	11	4	10	
	Stricture	4	5	4	10	
Outcome	Successful	62	84	34	87	0.631
	Failure	12	16	5	13	

UTI = urinary tract infection; UPJ = ureteropelvic junction

side, stenosis type, UPJ removal, complication, or success (Table 1).

The overall mean operation time was 141±11.3 minutes. The mean operation time was 143.6±40.4 (range: 80-260, median: 120) minutes in the OP group and 141.9±42.4 (range: 60-210, median: 120) minutes in the LP group. There was no significant difference between the groups according to the length of surgery (p=0.157). There was no significant difference between the pediatric (p=0.907) and adult (p=0.079) subgroups according to the length of surgery (Fig. 1).

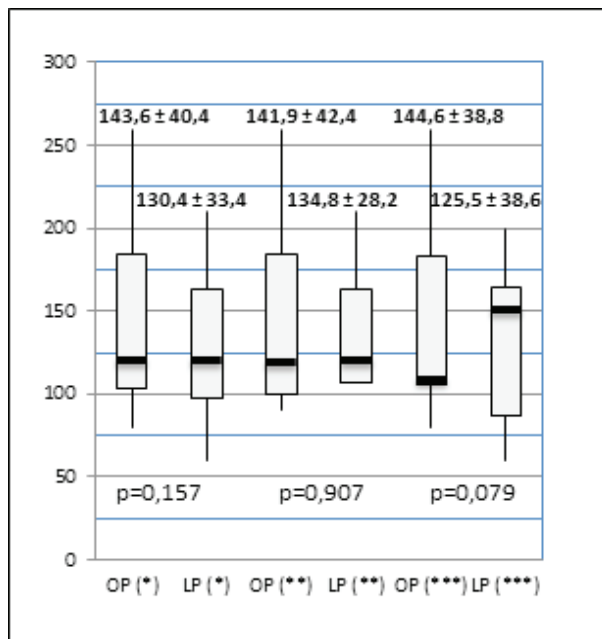


Fig. 1. Comparison of operation time (minutes) in all, pediatric\*\*, and adult\*\*\* patients.

The mean length of hospital stay was 7.3±3.2 (range: 2-22, median: 7) days in the OP group and 4.0±1.1 (range: 2-7, median: 4) days in the LP group. It was significantly longer in the OP group than in the LP group (p<0.05). In the pediatric (p<0.05) and adult (p<0.05) subgroups, the length of hospital stay was also significantly longer in the OP group than in the LP group (Fig. 2).

Evaluation of the groups in terms of analgesic needs showed that the mean analgesic need was 9.8±3.4 dose (range: 1-18, median: 9) in the OP group and 4.5±2.4 dose (range: 1-12, median: 4) in the LP group. The analgesic need was found to be significantly higher in the OP group than in the LP group (p<0.05). In the pediatric (p<0.05) and adult (p<0.05) subgroups,

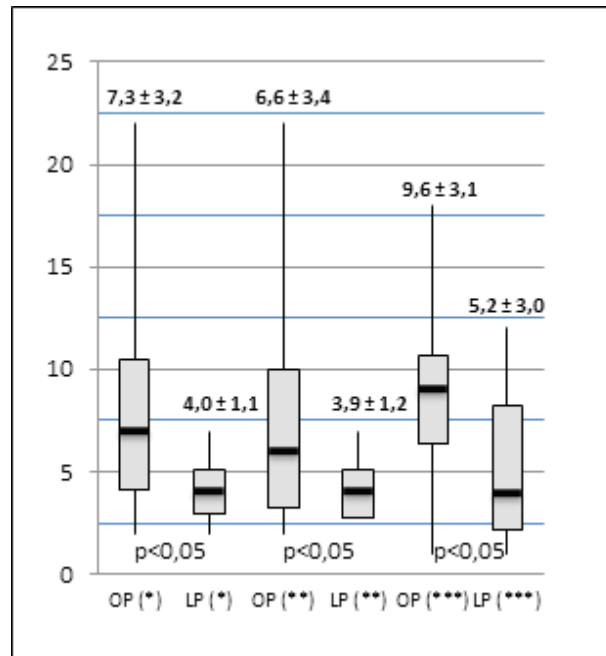


Fig. 2. Comparison of the length of hospital stay (days) in all\*, pediatric\*\*, and adult\*\*\* patients.

the analgesic dose administered was also found to be significantly higher in the OP group than in the LP group (Fig. 3).

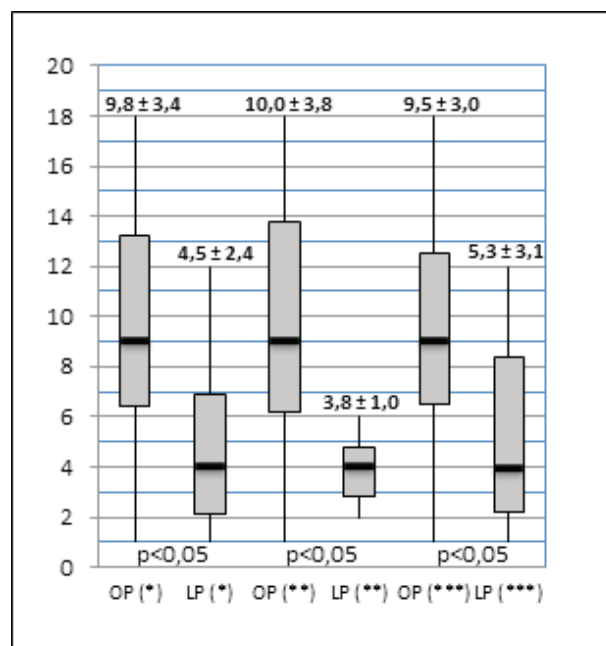


Fig. 3. Comparison of analgesic need (doses) in all\*, pediatric\*\*, and adult\*\*\* patients.

## Discussion

Hydronephrosis (HN) refers to enlargement of the kidney collecting system, and obstruction is a urinary flow deficiency severe enough to prevent kidney development or cause damage to the kidney<sup>10,11</sup>. Therefore, the definition of HN does not always express obstruction. Although we can diagnose HN prenatally by the US, it defines dilatation and not obstruction<sup>12</sup>. Prenatal US examined during pregnancy indicates a 1%-2% rate of transient or moderate HN and approximately 20% of these require long-term follow-up<sup>13</sup>. Furthermore, it is impossible to distinguish non-obstructive from obstructive dilatation or to identify the kidney in which damage will develop. Nevertheless, the severity of dilatation does not correlate with the course of the disease<sup>2</sup>. Since the most common cause of HN and urinary system obstructions in children is UPJO, HN should be monitored carefully and operated on when needed. It is crucial to make decision about the operation when the appropriate criteria are met to prevent renal function loss. Several techniques have been described to eliminate the obstructive pathology of UPJ in these patients. Recent developments have revealed a trend from classic open surgery towards modern minimally invasive techniques such as laparoscopy or robotic surgery. Thus, LP was compared to OP in this study.

In our study, 17 (30%) pediatric patients were infants diagnosed with HN prenatally, and UPJO was diagnosed on examinations performed after birth. Of the pediatric patients, 31 (55%) presented with flank pain, 3 (6%) had febrile UTI, one (2%) had hematuria, one (2%) had urinary incontinence, and two (4%) had been diagnosed incidentally. Among the adult patients, 50 (89%) had flank pain, three (5%) had recurrent UTIs, two (4%) had hematuria, and one (2%) had been diagnosed incidentally.

Ureteropelvic junction obstruction is the most common cause of HN in children and is more common in males; two-thirds of the cases occur on the left side. In our study, of the 113 patients, 69 (61%) were treated on the left side and the distribution of gender showed male predominance with 70 men and boys (62%), compatible with the literature.

Open pyeloplasty is currently the gold standard in the treatment of UPJO with a success rate higher than 90%<sup>14</sup>. However, OP requires wide incisions and longer hospital stays *versus* other methods<sup>15</sup>. In this study, patients who had undergone OP had a prolonged hospital stay, similar to the literature data.

Today, the number of studies that support the benefits of minimally invasive interventions in the diagnosis and treatment of many diseases and even consider these methods as the gold standard is gradually increasing<sup>16</sup>. Today, all principles applied in open surgery can be applied laparoscopically<sup>17</sup>. In line with the literature, our study found that the success of OP and LP was similar.

Laparoscopic pyeloplasty takes longer than OP due to the learning process and lack of experience with laparoscopic procedures. As the surgeon gains experience, laparoscopic surgeries become shorter with no incision or suturing<sup>18</sup>. In our study, the average surgery length was 143 minutes for OP and 130 minutes for LP, which is consistent with the literature.

The most common problem in the early period after pyeloplasty is prolonged urine leakage. The leakage is less common in patients with double J catheters inserted through the anastomosis line<sup>19</sup>. In this study, anastomosis leakage was not observed in any of the patients with ureteral double J catheters. They were removed 4-6 weeks after the surgery.

Fewer painkillers are required after laparoscopic surgeries than after open surgeries. The reasons for this are the shorter surgery time, smaller incision, briefer layers opened, less tissue mobilization during surgery, and less external contact with the surgical area. In our study, the need for analgesics was also lower in patients who had undergone laparoscopic surgery, both in the pediatric and adult subgroups.

Longer hospital stays increase the risk of hospital infections<sup>20</sup>. Prolonged hospital stay in children is also important because it increases the anxiety of the child and the mother<sup>21</sup>. In the literature, patients undergoing LP had shorter hospital stays than those who underwent OP<sup>22</sup>. In this study, in line with the literature, the patients who had undergone LP had shorter hospital stays than those who had undergone OP, which also held true for the pediatric and adult subgroups.

## Conclusion

In conclusion, patients who had undergone LP stayed in the hospital for a shorter time, and this period was more comfortable because fewer analgesics were required. The rates of complications and success were similar to open surgery. Recently, the minimally invasive technique of robotic pyeloplasty has also emerged<sup>23</sup>. However, LP with shorter hospital stays and fewer analgesic needs is still a reliable option for

centers not equipped with robotic technology. We conclude that with similar success and complication rates, lower analgesic requirements, and shorter hospital stays, LP can be performed as safely as OP in the treatment of UPJO.

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## Sažetak

## USPOREDBA UČINKA LAPAROSKOPSKE I OTVORENE PIJELOPLASTIKE NA UDOBNOST I USPJEŠNOST ZAHVATA: RETROSPEKTIVNO ISTRAŽIVANJE U JEDNOM CENTRU

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Opstrukcija ureteropelvičnog spoja uzrokuje hidronefrozu i ako se pravodobno ne dijagnosticira i liječi može dovesti do oštećenja bubrežnog parenhima. Iako otvorena pijeloplastika ostaje zlatnim standardom, treba ju usporediti s novim tehnikama. U ovom istraživanju usporedili smo laparoskopsku i otvorenu pijeloplastiku. Retrospektivno smo analizirali podatke za 113 bolesnika koji su operativno liječeni između 2008. i 2014. godine. Laparoskopna pijeloplastika primijenjena je u 39, a otvorena pijeloplastika u 74 bolesnika. Ultrasonografija je provedena 3 mjeseca, a scintigrafija 6 mjeseci nakon operacije. Uspoređivali smo sljedeće parametre: trajanje operacije, potrebu za analgeticima, trajanje hospitalizacije, komplikacije i stope uspješnosti zahvata. U usporedbi s otvorenom pijeloplastikom (srednja vrijednost 9,8, IV doza deksketoprofena 50 mg), potreba za analgeticima bila je značajno manja u skupini laparoskopne pijeloplastike (srednja vrijednost 4,5, IV doza paracetamola 15 mg/kg) ( $p < 0,05$ ). Duljina hospitalizacije također je bila kraća u skupini laparoskopne pijeloplastike (srednja vrijednost 4,0 dana) od one u skupini otvorene pijeloplastike (srednja vrijednost 7,3 dana) ( $p < 0,05$ ). Ovo istraživanje je pokazalo da se laparoskopna pijeloplastika može sigurno primijeniti u liječenju opstrukcije ureteropelvičnog spoja, uz manju potrebu za analgeticima i kraće trajanje hospitalizacije u usporedbi s otvorenom pijeloplastikom.

Ključne riječi: *Hidronefroza; Laparoskopna pijeloplastika; Otvorena pijeloplastika; Opstrukcija ureteropelvičnog spoja*