Safety and Efficiency of Pyeloplasty in The First Six Weeks of Infants' Life

Serdar Moralıoğlu*, Aysenur Cerrah Celayir, Oktav Bosnalı, Osman Zeki Pektas

Purpose: The aim of this study was to assess the safety and the efficiency of pyeloplasty in infants with ureteropelvic junction obstruction (UPJO) in the first six weeks of their life.

Materials and Methods: Clinical records of the patients who had surgery during first six weeks of life for UPJO between June 2009 and June 2014 were analysed retrospectively.

Results: In this period, twenty-six dismembered pyeloplasties were performed in twenty-four patients on mean operation age of 27.3 ± 10.2 days (range 8-42 days). On the first postnatal ultrasound all twenty-six renal units had SFU-4 hydronephrosis. Mean preoperative and postoperative anterior-posterior pelvic diameter and parenchymal thickness were 33.1 ± 8.9mm (range 14-49mm), 3.2 ± 1mm (range 1-4,6mm) and 14.7 ± 6.6mm (range 6-27mm) and 7.8 ± 1.9mm (range 3.0-10.4mm), respectively. The differences between preoperative and postoperative parenchymal thickness and anterior-posterior pelvic diameter were statistically significant ($P < 0.0001$). Preoperative MAG3 dynamic renal scintigraphy showed obstructive pattern on the diuretic renogram in 26 units. Mean preoperative and postoperative differential renal function on dynamic renal scintigraphy of the affected renal units were 46 ± 15 and 44 ± 15, respectively. Postoperative drainage was normal on dynamic renal scintigraphy in 25 (96.2%) of the 26 units, redo-pyeloplasty was needed in only one unit (3.8%).

Conclusion: In conclusion, patient selection and timing of surgery are very important in the protection of renal function in newborn with UPJO. In our opinion, if there is indication for surgery, early surgical intervention should not postpone in this period. Surgical treatment of UPJO during first six weeks of life is safe and effective.

Keywords: newborn; pyeloplasty; ureteropelvic junction obstruction

INTRODUCTION

Ureteropelvic junction obstruction (UPJO) is still the most common antenatally diagnosed surgical anomaly in pediatric urology. Antenatal hydronephrosis is detected on prenatal ultrasonography in 1-5% of all pregnancies.[1] The reasons of antenatal hydronephrosis are transient hydronephrosis, ureteropelvic junction obstruction, vesicoureteral reflux, megaureters, multicystic dysplastic kidney, posterior urethral valve and other less common diseases. Typical ultrasonographic findings of UPJO are commonly unilateral pelvicalyceal dilatation without ureteral dilatation. In the postnatal management of these patients, non-operative follow-up is widely accepted, especially unilateral mild to moderate hydronephrosis. Most of these patients' hydronephrosis resolve spontaneously, this benign situation is named as transient hydronephrosis. Surgical treatment is indicated when progression of hydronephrosis and/or deterioration of renal function are detected, on the follow-up period.

Although, vast majority of the cases with antenatally detected hydronephrosis resolve spontaneously, some of these required early intervention during early infancy. In the patients with severe hydronephrosis, indications of early surgical intervention, type and the timing of the intervention are still controversy. In here, indications and experiences of surgical treatment in patients with severe hydronephrosis with UPJO in the first six weeks of life were reported. The aim of this study was to assess the safety and efficiency of pyeloplasty in infants with UPJO in this period.

MATERIALS AND METHODS

Study population

This retrospective study was carried out at University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Health Training and Research Center, Department of the Pediatric Surgery, Istanbul. Clinical records of the patients who had surgery during first six weeks of life for UPJO between June 2009 and June 2014 were analysed retrospectively. Demographic, diagnostic, operative findings and outcomes were analysed. Age, gender, side of hydronephrosis, type of presentations, results of the preoperative imaging studies, additional urological anomalies, indications of surgery, details of operations, and status on the follow-ups were recorded. The patients who had less than 1 year follow-up period were excluded from the study.

Preoperative evaluation

In all patients with antenatally diagnosed hydronephrosis, detailed ultrasounds of the urinary system were done in the first week of life. On ultrasound examination, hydronephrosis was graded according to the Society of Fetal Urology (SFU) guidelines, and antero-pos-

University of Health Sciences, Zeynep Kamil Maternity and Children's Diseases Health Training and Research Center, Department of the Pediatric Surgery, Istanbul, Turkey.
*Correspondence: Zeynep Kamil Mah. Op.Dr.Burhanettin Üstünel Cad. No:4/3 34668 Üsküdar, Istanbul,Turkey. Tel:+90 216 3910680. Fax:+90 216 3439251. key, E-mail: serdarmoralioglu@gmail.com
Received August 2019 & Accepted February 2020

Table 1. Classification of double-J stent related events according to Clavien Classification System.[3]

Total renal units	Grade 1, n (%)	Grade 2, n (%)	Grade 3, n (%)	Grade 4, n (%)	Grade 5, n (%)
26	8 (31)	0 (0)	0 (0)	0 (0)	0 (0)

terior diameter of renal pelvis, parenchymal thickness and caliectasis existence were determined.[2] If severe hydronephrosis (SFU-4) was present with thinning of the parenchyma, serial ultrasonography and dynamic renal scintigraphy were done. Dynamic renal scintigraphy was done as well-tempered diuretic mercaptoacetyltriglycine (MAG3) renogram. In this procedure, intravenous hydration and urethral catheterisation before the procedure and diuretic administration at the point of maximal uptake were done in all patients. Voiding cystourethrography was done in all patients.

When progressive hydronephrosis and severe parenchymal thinning were detected on ultrasonography and the obstructive pattern was present on MAG3 dynamic renal scintigraphy, pyeloplasty was performed. The obstructive pattern was defined as completely non-responsiveness to diuretic administration on the renography and completely persistence of pelvic accumulation on the 2 hours delayed images. In the patients who had not obstructive pattern or severe parenchymal thinning, non-operative follow-up were continued. In case of bilateral disease simultaneous operation was not done, worst side was operated first.

Operative technique

In the operating theater, urethral catheter was inserted and affected side was slightly elevated with towels in supine position. In all patients' operations, approximately 2cm length anterior subcostal incision was used and kidney was exposed via extraperitoneal approach. Anderson-Hynes dismembered pyeloplasty with pelvic reduction were done in all patients. Ureteropelvic anastomoses were done with 6-0 or 7-0 polydioxanone absorbable monofilament separated sutures. Antegrade placement of double-j stent or insertion of pyelostomy catheter was done during ureteropelvic anastomosis. At the end of the all procedures a Penrose drain was inserted to the perinephric area through the same incision (**Figure 1**).

Post-operative evaluation

Enteral feeding was started 4 hours after operation. Antibiotic treatment (Ampicillin/Sulbactam) was started preoperatively and this was continued until the patient was discharged from the hospital. Urethral catheter was removed in the first postoperative day. Penrose drain was removed when drainage ceased. Thereafter, patient was discharged with antibiotic prophylaxis (Amoxicillin, 20 mg/kg/day) until the double-J stent was removed on the 6th week after the operation. Postoperative follow-up consisted of serial ultrasonography and MAG3 dynamic renal scintigraphy.

Statistical analysis

Descriptive statistics were used and results were expressed as mean ± standard deviation, and median. A paired t-test was used to determine whether a statistically significant difference between preoperative and postoperative results of the patients. Statistical significance was considered at $P < 0.05$. Statistical analyses were performed with the SPSS Statistics for Windows version 15 package software (SPSS Inc., Chicago, IL, USA). Institutional ethical board approval was obtained for this study (5.09.2014-150).

RESULTS

In this five-year period, a total of 603 renal units in 499 newborns with antenatally diagnosed isolated hydronephrosis were followed and treated. 526 renal units (87.2%) were followed conservatively. In the 26 units (4.3%) early pyeloplasty were done before six-week of age. Afterward, 51 units (8.5%) which were initially treated conservatively eventually required pyeloplasty. Of the 24 patients whom had early pyeloplasty done before six-week of age, consisted of 16 male and 8 female. Twenty-three patients presented with antenatally detected hydronephrosis. Diagnosis was made incidentally in one patient following workup for etiology of simian line. UPJO was found in the left kidney in 21 patients (87.5%) and in the right in one patient. Two patients had bilateral disease. Two patients had (8.3%) additional urological anomalies. One patient had multicystic dysplastic kidney in contralateral kidney and the other patient had bilateral ureterovesical junction obstruction. On the first postnatal ultrasound all twenty-six renal units had SFU-4 hydronephrosis. Mean preoperative anterior-posterior pelvic diameter and parenchymal thickness were 33.1 ± 8.9 mm (range 14-49 mm, median 32 mm) and 3.2 ± 1 mm (range 1-4,6 mm, median 3.3 mm), respectively. MAG3 dynamic renal scintigraphy showed obstructive pattern on the diuretic renogram in 26 units. Mean preoperative differential renal function on dynamic renal scintigraphy of the affected 19 renal units (2 bilateral UPJO, 1 multicystic dysplastic kidney, 2 differential functions unavailable) was 46 ± 15% (range 4-64%, median 48%). Voiding cystourethrography results were normal in all patients.

Twenty-six dismembered pyeloplasties were performed on mean operation age of 27.3 ± 10.2 days (range 8-42 days, median 30 days). The mean operative time was 84 minutes (range 60-100 minutes, median 90 minutes). Double-J ureteral stent was used as internal drainage in 20 patients (22 units). In three patients, ureteral stent was used as pyelostomy tube. In one patient, operation was done without stent. There was no anesthesia related complication. Mean time of the Penrose drain removal was 2.3 ± 0.4 days (range 2-3 days). Average length of stay was 3.2 ± 0.7 days (range 2-5 days). In the intraoperative and postoperative period, double-J stent related events occurred in the 8 of 26 renal units. In the one patient, double-J stent did not pass through the ureterovesical junction and the operation was performed without internal and external stent. In the two girl patients double-J stents passed out through the urethra spontaneously in the early postoperative period. In these three patients no complication such as urinoma or

Table 2. Comparison of preoperative and postoperative anterior-posterior pelvic diameter, parenchymal thickness and differential renal function on MAG3.

Variables	Preoperative	Postoperative	*P*-value
Anterior-posterior pelvic diameter (mean ± SD)	33.1 ± 8.9 mm (range 14-49)	14.7 ± 6.6 mm (range 6-27)	< 0.0001
Parenchymal thickness (mean ± SD)	3.2 ± 1 mm (range 1-4,6)	7.8 ± 1.9 mm (range 3.0-10.4)	< 0.0001
Differential renal function on MAG3 (mean ± SD)	46 ± 15% (range 4-64%)	44 ± 15% (range 5-59%)	> 0.05

recurrent UPJO occurred. In the one renal unit, ureteroscopic intervention was required for ureteral migration of the double-J stent. In the last two renal units, double-J stents were removed during Politano-Leadbetter ureteroneocystostomy which was performed due to bilateral ureterovesical junction obstruction. When these events were classified according to Clavien Classification System stage 1, 2, 3, 4, 5, complication rate was observed in 31%, 0%, 0%, 0%, and 0% of renal units, respectively (**Table 1**).[3]

Mean time of the follow-up period after the operation was 81.2 ± 17.4 months (range 53-110 months, median 84 months). Mean postoperative anterior-posterior pelvic diameter and parenchymal thickness on the third postoperative month were 14.7 ± 6.6 mm (range 6-27 mm, median 13 mm) and 7.8 ± 1.9 mm (range 3.0-10.4 mm, median 8.1 mm), respectively. The differences between preoperative and postoperative parenchymal thickness and anterior-posterior pelvic diameter were statistically significant ($P < 0.0001$). Mean postoperative differential renal function on dynamic renal scintigraphy of the affected 21 renal units (2 bilateral UPJO, 1 multicystic dysplastic kidney) was 44 ± 15% (range 5-59%, median 51%).(**Table 2**) Postoperative drainage was normal on dynamic renal scintigraphy in 25 of the 26 units (96.2%), redo-pyeloplasty was needed in only one unit (3.8%). In this patient, operation was performed for recurrent UPJO at 2-year old. Early and late postoperative period was uneventful. In the postoperative MAG3 dynamic renal scintigraphy, drainage was normal. In the 71st month of follow up after the reoperation, the patient had no symptoms and hydronephrosis had improved.

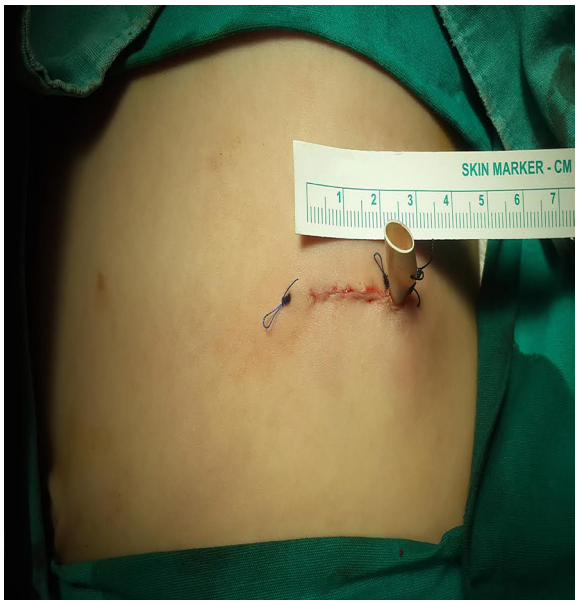

Fig1. Postoperative view of the pyeloplasty incision.

DISCUSSION

By the routine usage of prenatal ultrasonography, detection of asymptomatic severe UPJO is increased and these patients catch the early treatment of chance before the renal dysfunction and the failure. The main goal in the treatment of the UPJO is to preserve or to improve renal function. Although, antenatal hydronephrosis is common, severe hydronephrosis is relatively rare. In the literature, SFU grade 3 and 4 hydronephrosis rate in all hydronephrosis varies 21-25% and 15-21%, respectively.[4,5]

In order to assess severity of antenatal and postnatal hydronephrosis many grading system is being used. The anteroposterior diameter of the renal pelvis and Society for Fetal Urology grading systems most commonly used methods in the literature and practice. In 1993, Society for Fetal Urology proposed a grading system based on the postnatal ultrasonographic appearance of the renal pelvis, calyces and parenchyma. In this system SFU grade 4 is presence of distention of renal pelvis and calyces with parenchymal thinning. Severity of parenchymal thinning was not graded in SFU grading system. By this grading system standardisation was aimed, there was no treatment algorithm.[2] In Onen's alternative grading system parenchymal thinning was graded as less than half and more than half parenchymal thinning and named in the alternative grading system as grade 3 and 4, respectively. In this grading system, early intervention was recommended for the patients with grade 4.[4] In our series, all patients fell into grade 4 hydronephrosis according to both SFU and Onen's alternative grading system.

In 1990 Ransley et al. advocated a conservative approach based on isotope imaging findings and surgery was reserved presence of significant loss of renal function.[6] Later, several publications have supported this approach even in patients with severe (SFU grade 3-4) hydronephrosis.[7-10] In that series, early pyeloplasty rate varies from 10% to 38% and final pyeloplasty rate when added the patients with operated after initially conservative treatment varies from 22% to 68% in the severe hydronephrosis.[7-10] On the other hand, criticisms of this conservative approach have been done in the literature. Subramaniam et al. concluded that conservative management of some patients with antenatally detected UPJO probably results in irreversible loss of function.[11] Hanna, in an editorial review paper, emphasised inaccuracy of diagnostic tests for the diagnosis of obstruction, sensitive nature of the infant kidneys and more significant improvement than older pyeloplasties of the renal function after surgery in all infants[12] Thus, he advocated early intervention in patients with increased pelvic dilation on ultrasound and prolongation of the diuretic nuclear renogram washout half-time. In their prospective study, Babu et al. found significant loss of renal function in patients; with SFU grade 3-4 hydronephrosis with obstructive renogram; who had been initially treated conservatively.[13] Defi-

nition of obstructive renogram in this study was type 2 O'Reilly curve with hold up at 2 hours delayed graphy.[14] In the literature, early and total pyeloplasty rates in all hydronephrosis grades varies from 0-10.1% and 11.8-15.2%, respectively.[4-6,9] In our series, early and total pyeloplasty rates in all hydronephrosis grades were 4.3% and 12.8%, respectively.

Actually, still there is no absolute indicator of accurate obstruction or early predictor of renal injury in the newborn hydronephrosis. Current methods are not sensitive or specific enough yet to differentiate an obstruction which has potential lead to renal deterioration. For that reason, indications and timing of surgery in newborns with severe hydronephrosis are still controversial. Previously, on the MAG3 dynamic renal scintigraphy, postdiuretic renal pelvis clearance half-time (T1/2) greater than 20 minutes is thought to indicate obstruction.[14] Afterward, Eskild-Jensen et al. stated that it could be affected by hydration, renal function, diuretic injection time, gravity, status of bladder filling and volume of renal pelvis.[16] In our practice, in the patients with half-time shorter than 20 minutes, non-operative follow-up was continued by intervals depending on severity of hydronephrosis. Prolonged half-time (> 20 minutes) was not used for indicator of obstruction in our series. Obstructive pattern was defined as completely non-responsiveness to diuretic administration on the renography and completely persistence of pelvic accumulation on the late images.

In the literature, there are many algorithms about management of antenatal hydronephrosis. The cornerstone of vast majority of these algorithms is estimated differential renal function on MAG3 dynamic renography.[5,9,10,17] Eskild-Jensen et al. stated that estimated differential renal function is not influenced by degree of hydronephrosis, status of hydration and bladder filling, gravity, diuretic usage and the level of renal function.[16] On the other hand, estimation of differential renal function is influenced by age, size of the affected kidney, time period of the calculation of differential renal function and size of the region of interest.[18,19]. In small children with severe hydronephrosis difficulties may arise in interpreting. Age-related disparity of differential renal function estimation in children with unilateral hydronephrosis is more common under 1 year of age. Especially, disagreement rate is much higher in the children age under 3 months.[18] In our series, mean preoperative and postoperative differential renal function on MAG3 dynamic renography was 46% and 43%, respectively. We think that, postoperative estimation of differential renal function is more realistic than preoperative differential renal function estimation because of higher age and normalised kidney size in postoperative period.

In the literature, surgical indications generally described as existence of urinary obstruction, renal deterioration, urinary tract infection and abdominal mass. Definitions of urinary obstruction and renal deterioration were specified as impaired differential renal function (<30-40%), worsening hydronephrosis on ultrasonography and parenchymal loss or reduction in differential renal function of more than 10% on follow up.[9,10,20,21] Onen recommends early intervention after a short period of follow up in patients with severe hydronephrosis plus severe parenchymal loss (more than half).[4] Babu et al. have operated patients with SFU grade 3-4 hydronephrosis with type 2 O'Reilly curve with hold up at 2 hours delayed graphy.[13,14] In our series, all renal units had severe hydronephrosis (SFU-4) and also they had severe parenchymal loss or progression of hydronephrosis or both. In our series, indication for surgery was, in the patients with initially grade 4 hydronephrosis, increased hydronephrosis with severe parenchymal thinning and obstructive pattern on the diuretic renogram. We think that, this kind of investigation and follow-up of the patients with severe hydronephrosis is helpful for the individualized decision-making process. In this instance each case should be evaluated individually and parents should be informed on the advantages and disadvantages of both early surgery and conservative approach.

When intervention required in the six-week of life, treatment options could be definitive (i.e.pyeloplasty) or temporary (i.e.nephrostomy, double-J stent insertion). In the literature, there is no data about these methods' safety or efficiency for this period. In our series, we preferred open dismembered pyeloplasty through the approximately 2cm length anterior subcostal incision. This approach with that kind of a small incision is proper and suitable for newborns and small infants. Also, it has satisfactory cosmetic results.

In pediatric age group, using diversion in dismembered pyeloplasty is still controversial. Surgeon does make diversion or not according to clinical preferences. In the newborn period, diversion is usually recommended. In open dismembered pyeloplasty, diversion options are external drainage by nephrostomy, pyelostomy, ureteropyelostomy or internal drainage by double-J stent. Each of these has unique advantages and disadvantages; and none of these methods are free of complication. In our series, primarily, diversion by double-J stent was preferred. In three cases, pyelostomy was used due to surgeon preference and difficulties with antegrade passing of the stent. Pyelostomies were removed in 7 to 15 days the operation.

In our series, no perioperative and early postoperative complication was encountered and postoperative recovery was uneventful. In the literature, even though age groups and details of operative techniques are heterogeneous, failure and reoperation rates after open dismembered pyeloplasty varies from 0% and 12,5%.[20,22-26] In our series, which is the homogeneous age group of patients in the first six-week of life, recurrence rate was 3.8%.

Our study has some limitations. These were retrospective design of the study, the lack of comparison group in the study design and the low number of patients in the study group.

CONCLUSIONS

Patient selection and timing of surgery are very important in the protection of renal function in newborn with UPJO. In our opinion, if there is indication for surgery, early surgical intervention should not postpone in this period. Surgical treatment of UPJO during first six weeks of life is safe and effective.

CONFLICT OF INTEREST

The authors declare no conflict of interest

REFERENCES

1. Nguyen HT, Herndon CD, Cooper C, et al. The Society for Fetal Urology consensus

statement on the evaluation and management of antenatal hydronephrosis. J Pediatr Urol 2010; 6: 212-31.
2. Fernbach SK, Maizels M, Conway JJ. Ultrasound grading of hydronephrosis: Introduction to the system used by the Society for Fetal Urology. Pediatr Radiol 1993; 23: 478- 80.
3. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004; 240: 205–13.
4. Onen A. An alternative grading system to refine the criteria for severity of hydronephrosis and optimal treatment guidelines in neonates with primary UPJ-type hydronephrosis. J Pediatr Urol 2007; 3: 200-5.
5. Karnak I, Woo LL, Shah SN, Sirajuddin A, Ross JH. Results of a practical protocol for management of prenatally detected hydronephrosis due to ureteropelvic junction obstruction. Pediatr Surg Int 2009; 25: 61-7.
6. Ransley PG, Dhillon HK, Gordon I, Duffy PG, Dillon MJ, Barratt TM. The postnatal management of hydronephrosis diagnosed by prenatal ultrasound. J Urol 1990; 144: 584-7.
7. Arnold AJ, Rickwood AM. Natural history of pelviureteric obstruction detected by prenatal sonography. Br J Urol 1990; 65: 91-6.
8. Madden NP, Thomas DF, Gordon AC, Arthur RJ, Irving HC, Smith SE. Antenatally detected pelviureteric junction obstruction. Is non-operation safe? Br J Urol 1991; 68: 305-10.
9. Ulman I, Jayanthi VR, Koff SA. The long-term followup of newborns with severe unilateral hydronephrosis initially treated nonoperatively. J Urol 2000; 164: 1101-5.
10. Heinlen JE, Manatt CS, Bright BC, Kropp BP, Campbell JB, Frimberger D. Operative versus nonoperative management of ureteropelvic junction obstruction in children. Urology 2009; 73: 521-5.
11. Subramaniam R, Kouriefs C, Dickson AP. Antenatally detected pelvi-ureteric junction obstruction: concerns about conservative management. BJU Int 1999; 84: 335-8.
12. Hanna MK. Antenatal hydronephrosis and ureteropelvic junction obstruction: the case for early intervention. Urology 2000; 55: 612-5.
13. Babu R, Rathish VR, Sai V. Functional outcomes of early versus delayed pyeloplasty in prenatally diagnosed pelvi-ureteric junction obstruction. J Pediatr Urol 2015; 11: 63.e1-5.
14. O'Reilly PH, Consensus Committee of the Society of Radionuclides in Nephrourology. Standardization of the renogram technique for investigating the dilated upper urinary tract and assessing the results of surgery. BJU Int 2003; 91: 239-43.
15. Lupton EW, Testa HJ, O'Reilly PH, et al. Diuresis renography and morphology in upper urinary tract obstruction. Br J Urol 1979; 51: 10-14.
16. Eskild-Jensen A, Gordon I, Piepsz A, Frøkiaer J. Interpretation of the renogram: problems and pitfalls in hydronephrosis in children. BJU Int 2004; 94: 887-92.
17. Palmer LS, Maizels M, Cartwright PC, Fernbach SK, Conway JJ. Surgery versus observation for managing obstructive grade 3 to 4 unilateral hydronephrosis: a report from the Society for Fetal Urology. J Urol 1998; 159: 222-8.
18. Ozcan Z, Anderson PJ, Gordon I. Robustness of estimation of differential renal function in infants and children with unilateral prenatal diagnosis of a hydronephrotic kidney on dynamic renography: How real is the supranormal kidney? Eur J Nucl Med Mol Imaging 2006; 33: 738-44.
19. Gungor F, Anderson P, Gordon I. Effect of the size of regions of interest on the estimation of differential renal function in children with congenital hydronephrosis. Nucl Med Commun 2002; 23: 147-51.
20. Kajbafzadeh AM, Tourchi A, Nezami BG, Khakpour M, Mousavian AA, Talab SS. Miniature pyeloplasty as a minimally invasive surgery with less than 1 day admission in infants. J Pediatr Urol 2011; 7: 283-8.
21. Turner RM 2nd, Fox JA, Tomaszewski JJ, Schneck FX, Docimo SG, Ost MC. Laparoscopic pyeloplasty for ureteropelvic junction obstruction in infants. J Urol 2013; 189: 1503-7.
22. Braga LH, Lorenzo AJ, Bägli DJ, et al. Risk factors for recurrent ureteropelvic junction obstruction after open pyeloplasty in a large pediatric cohort. J Urol 2008; 180: 1684-7.
23. Morsi HA, Mursi K, Abdelaziz AY, Elsheemy MS, Salah M, Eissa MA. Renal pelvis reduction during dismembered pyeloplasty: is it necessary? J Pediatr Urol 2013; 9: 303-6.
24. Almodhen F, Jednak R, Capolicchio JP, Eassa W, Brzezinski A, El-Sherbiny M. Is routine renography required after pyeloplasty? J Urol 2010; 184: 1128-33.
25. Scuderi MG, Arena S, Di Benedetto V. One-trocar-assisted pyeloplasty. J Laparoendosc Adv Surg Tech A. 2011; 21: 651-4.
26. Masieri L, Sforza S, Cini C, et al. Minilaparoscopic Versus Open Pyeloplasty in Children Less Than 1 Year. J Laparoendosc Adv Surg Tech A. 2019; 29: 970-5.