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Surgical Treatment Methods For Pediatric Urinary Tract Stone Disease

Çocukluk Çağı Üriner Sistem Taş Hastalığının Cerrahi Tedavi Yöntemleri

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ABSTRACT

Objective: Stones of the urinary system occur in children at varying prevalence depending on the changing environment, diet, and genetic factors. The aim of this study was to evaluate patients with urinary tract stones in terms of surgical treatment indications, treatment methods and outcomes, and complications.

Material and Methods: Patients who were treated for urinary tract stones between January 2009 and December 2013 were retrospectively evaluated. Patients' age,sex,etiology, size, location, and number of their existing stones,the treatment method,stone-free rates, and postoperative complications were recorded.

Results: A total of 505 patients were evaluated. The mean age of the patients at the time of diagnosis was 55.8±52.2 (0–216) months. Of the 505 cases, 157 (31%) underwent surgery. The mean age of the patients was 63.6±55.2 (0–216) months. There was a statistically significant difference between the sizes of the stones found in patients receiving medical treatment and those who underwent surgery ($p<0.05$). There was no statistically significant difference between the surgical method and the number of patients with residual stones ($p>0.05$). In postoperative checks, there was no statistically significant difference between the size and location of the existing residual stone and the surgical method ($p>0.05$).

Conclusion: Stone disease of the urinary system is an important health concern in children. Determining the etiology, identifying surgical indications, and performing surgery using appropriate procedures play a key role in the treatment of the disease.

Key Words: Children, Surgery, Urinary tract stones

ÖZ

Amaç: Üriner system taşları çocuklarda değişen çevre, diyet ve genetik faktörlere bağlı olarak farklı prevelansta görülür. Bu çalışma ile üriner system taşı olgularının cerrahi tedavi endikasyonları, tedavi şekli ve sonuçları, ve komplikasyonları açısından değerlendirilmesi amaçlandı.

Gereç ve Yöntemler: Ocak 2009- Aralık 2013 tarihleri arasında üriner system taşı nedeniyle tedavi gören hastalar retrospektif olarak değerlendirildi. Hastaların yaşı, cinsiyeti, taşın etyolojisi, taşın boyutu, lokalizasyonu ve sayısı, tedavi şekli, taşsızlık oranları ve ameliyat sonrası komplikasyonları kaydedildi.

Bulgular: Toplam 505 hasta değerlendirildi. Hastaların ortalama tanı yaşı 55.8±52.2 ay (0 -216 ay)'dı. Çalışmaya alınan 505 olgudan 157'si (%31) opera edildi. Opere edilen hastaların yaş ortalaması 63.6 ± 55.2 ay (0-216 ay) olarak bulundu.

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Medikal tedavi alan hastalar ile opera edilen hastalarda bulunan taşların boyutları arasında istatistiksel anlamlı fark olduğu görüldü (p<0.05). Operasyon şekli ve rezidü taş kalan hasta sayısı arasında istatistiksel anlamlı fark olmadığı görüldü (p>0.05). Operasyon sonrası yapılan kontrollerde mevcut rezidü taşın lokalizasyonu boyutu ile operasyon şekli arasında istatistiksel anlamlı fark olmadığı görüldü (p>0.05).

Sonuç: Üriner sistem taş hastalığı çocukluk çağının önemli bir sağlık sorunudur. Etiyolojiyi aydınlatmak , cerrahi endikasyonları belirlemek ve uygun prosedürü kullanarak ameliyat etmek hastalığın tedavisinde önemli bir yer tutar.

Anahtar Sözcükler: Çocuk, Cerrahi, Üriner sistem taşı

INTRODUCTION and PURPOSE

The prevalence of urinary tract stone disease is gradually increasing in children (1). The number of patients requiring surgical intervention in addition to medical treatment is gradually increasing. Anatomical site shrinking with age in infants, comorbid diseases and congenital anatomical defects limit the options of surgical intervention. Therefore, the algorithm for the surgical method to be selected for treatment remains to be developed. In this study, the etiology of patients with urinary tract stones, their demographic data, treatment indications, treatment methods and outcomes, and complications were evaluated. The aim of this study was to evaluate patients with urinary tract stones in terms of surgical treatment indications, treatment methods and outcomes, and complications.

MATERIALS METHODS

In this study, 505 patients who were diagnosed with urinary tract stone disease between January 2009 and December 2013 were retrospectively assessed. Patients with stones of <3 mm in the urinary tract were excluded from the study.

Ethics approval was obtained from the ethics committee with number 208. (Ministry of Health Ankara Pediatric Hematology Oncology, Training and Research Hospital, Training Planning Board, date 27.12.2012).

Patients' history, physical examinations, and laboratory examinations were evaluated. In medicalhistory, the factors that cause a predisposition to the formation of stones such as age at which stone was first detected, history of stone disease in the family, kinship, concomitant disease, previous surgical interventions, immobilization, passing of a stone, urinary tract infection, and use of medications were questioned.

Patients' complaints about pain, vomiting, dysuria, hematuria, urination disorder, urinary tract infection, and history of passing a stone were recorded. Pathological findings detected during physical examinations of patients were recorded. Blood and urine analyses were biochemically evaluated.

Findings of direct urinary tract radiography, ultrasound (US), intravenous pyelography (IVP), voiding cystoureterography (VCUG), Dimercaptosuccinic acid (DMSA) static kidney scintigraphy, and computed tomography (CT), if any, were examined and recorded. Location, number and size of the stones, concomitant urinary system anomalies, stone-related anatomical disorders (hydronephrosis and caliectasis), nephrocalcinosis, and vesicoureteral reflux (VUR)were evaluatedby imaging. Stones in the kidney and ureter were considered stones of the upper urinary tract, whereas those in the bladder and urethra were considered stones of the lower urinary tract.

Medical treatments and surgical interventions applied to the patients owing to urinary tract stone disease were listed. A surgical procedure was selected by evaluating age as well as location and size of stone, anatomical disorders that are congenital or that develop due to stone formation, and metabolic diseases of patients requiring surgical treatment were evaluated. RIRS was preferred for those with concomitant kidney and ureteral stones. In cases where hydrodilatation is insufficient for passing an ureteroscope, a JJ catheter appropriate for the patient's age was inserted to provide passive dilatation. ESWL was preferred in patients with one stone in the renal pelvis, and patients were referred to another center for the procedure. PCNL was used for kidney stones with anatomical accessibility. Open surgical procedure was usually preferred in patients with staghorn stones or complications owing to endourological procedures. Holmium YAG laser or pneumaticlithotomy method was used for lithotomy.

All surgical interventions were performed under general anesthesia. All patients who underwent surgery were administered ampicillin/sulbactam and the therapeutic dose was continued for one week after surgery. It was administered at a prophylactic dose until the JJ catheter was removed.

Complications that occur during surgery and cause a change in the procedure (mucosal damage, contrast agent extravasation, ureteral perforation, ureterovesical junction damage, and avulsion) were recorded and rated according to Clavien–Dindo classification (2).

Stones eliminated those removed using surgical methods were analyzed in the laboratory, and patients were given appropriate diet and medical treatment.

Patients' postoperative follow-up period was between 12 and 50 (mean: 25) months. After the procedure, ultrasound was performed at months 1 and 6 to assess stone recurrence and hydronephrosis.

Statistical Package for Social SciencesforWindows 20 software was used for statistical analyses for evaluating the findings obtained in the study. Descriptive statistics were presented as mean ± standard deviation or median (minimum-maximum) for continuous variables, whereas categorical variables were

presented as the number and (%) of the cases. The Shapiro–Wilktest was used to investigate whether the distribution of continuous variables is close to normal and the Student t test was used for comparison. Significancewas evaluated at p<0.05 with 95% confidence interval.

RESULTS

Of the 505 patients included in the study, 157 (31%) underwent surgery for stone disease. The mean age was 63.6±55.2 months. Of these, 98 (62.2%) were boys and 59 (37.8%) were girls. Male to female ratio was 1.66.

The mean age at the time of diagnosis was 63.6±57.6 months in men and 64.8±50.4 months in girls. There was no statistically significant difference for the mean age at the time of diagnosis in both sexes (p >0.05).

The number of patients who received medical treatment was 135 (26.7%). Nine (1.7%) patients were treated with ESWL and 157 (31%) were treated with other surgical methods.

There was a statistically significant difference between the sizes of stones found in patients receiving medical treatment and patients who underwent surgery (p<0.05)

The most common complaint at admission was abdominal pain (16.6%). In addition, symptoms associated with urinary tract infection (UTI) (12.8%), hematuria (15.6%), and voiding dysfunction (2.5%) were among the causes of admission. Most patients (34.3%) presented with other complaints (vomiting, fever, passing stones, etc.). Overall, 17.9% patients were asymptomatic, and the diagnosis of urinary tract stones was accidental during assessmentsmade for various reasons. Although hematuria was the most common symptom in patients aged <1 year and those between 1 and 5 years, abdominal pain was found to be the most common complaint in those aged >5 years.

Of the 157 patients who underwent surgery, 8 (5%) had a concomitant disease. Six patients (3.8%) had Cp-epilepsy, 3 patients (1.7%) had a history of surgery owing to renal stones in the external center, and 3 patients (1.7%) had atrophic kidney on the non-operated side. Thirty of the 157 patients (19.1%) had a positive family history for urinary tract stone disease. Twenty-two (14%) patients were treated for metabolic disorders (12 for cystinuria), whereas 14 (8.9%) were treated for frequent UTI. Locations of all existing urinary tract stones were determined using imaging tests. Stone locationsare presented in Table I for patients who underwent surgery and those who did not. In our sample, 100% bladder stones, 73.3% ureteral stones, and 23.6% kidney stones were operated.

Stone analysis could be performed in 68 patients who underwent surgery. The distribution of stone types is summarized in Table II. Overall, 77.5% calcium-oxalate stones were operated and 100% cystine stones were operated.

Various procedures were used for the surgical treatment of existing stones. Stone locations, surgical procedures performed,placement and size of residual stones after surgery, and postoperative stone-free rates are presented in Table III.

RIRS was more commonly preferred for patients aged ≤1 year, and PCNL was preferred in patients aged >5 years .

While open surgical procedure is mostly preferred in bladder stones, it has been observed that RIRS is primarily preferred in patients with both kidney and ureter stones. In bladder stones, open surgery was preferred at a rate of 80%, and endoscopic intervention at a rate of 20%; the stone-free rate was found to be 100%.

There was no statistically significant difference between the surgical method and the number of patients with residual stones (p>0.05)

In postoperative controls, there was no statistically significant difference between the location of the existing residual stone and the surgical method (p >0.05). After the surgery, there was no statistically significant difference between residual stone size and the surgical method (p>0.05).

Among the individuals in whom RIRSs was performed, 47 patients were diagnosed with physiological stenosis that does not allow the passage of the ureteroscope at the lower end of the ureter in the first RIRS; in 31 of these patients, a DJ catheter was inserted before surgery and the intervention was postponed. Six of the 12 patients in whom a transition was made to open surgery had staghorn stones.

Table I: Location of stones in patients who underwent surgery andthose who did not.

Location of the stone	All patients	%	Patients who underwent surgery	%
Bladder stone	20	4	20	100
Ureteral stone	45	9	33	73.3
Kidney stone	440	87	104(Lower Pole:24 Middle Pole:16 Upper Pole:1 Pelvic Stone:51 Staghorn Stone:12)	23.6
Total	505	100	157	

Table II: Distribution of stone types.

Stone type	In the whole group of patients	%	In the operated group	%
Calcium-oxalate	40	62.5	31	63.3
Cystine	13	20.3	13	26.5
Brushite	3	4.7	2	4.08
Struvite	4	6.25	2	4.08
Uric acid	4	6.25	1	2.04
Total	64	100	49	100

Table III: Stone locations, surgical procedures,location and size of residual stones after surgery, and postoperative stone-free rates.

	Rirs	Pcnl	Eswl	Rirs+Pcnl	Open Surgery After Rirs/Pcnl	Open Surgery
The location of the stone that was operated						18
Bladder	2				11	7
Single kidney	66	21	4	6		
Bilateral kidney	19	6	5	1		
Ureter	33				3	
Residual stone						
Pelvis, no	2	1		1		
Lower pole						
Lower pole	29	6		6		4
Residual stone size (mm)	4.4	4.5		5		3.5
Stone-free rate (%)	61.6	46		50	100	76.4

2 patients who underwent RIRS and 1 of the patients who underwent PCNL were not included in the table because they did not come to postoperative follow-up.

In all 31 patients with DJ catheter inserted for ureteral stenosis in the first RIRS, there was sufficient ureteral enlargement to reach the stone in the second session (4–6 weeks later). Balloon dilatation was performed in 2 patients to expand the ureter in the first RIRS, and co-axial dilatation was used. Postoperative follow-up showed that there were no patients who developed VUR.

During the endourological surgeries, the stone was crushed with holmium YAG laser in 175 procedures, and pneumatic lithotomy was performed during 23 procedures.A total of 12 patients (7.6%) developed early and late complications after surgery.

During surgery, there was extravasation during three PCNLs and transition was made to open surgery in 1 patient; and a JJ catheter was inserted and followed up in 2 other patients. The clinical presentation of the patients improved in the postoperative 48 h.

Four patients showed extravasation during RIRS, and a JJ catheter was inserted. The clinical presentation of the patients improved in the postoperative 48 h.

Despite insertion of a JJ catheter after extravasation during RIRS, one patient developed a perirenal abscess, and interventional abscess drainage was performed towing to the increase in the size of the abscess and septic findings in the first 48 h.

In 3 patients,because there was obstruction owing to ureteral lower end stone and ureteral rupture during cystoscopy, stones were removed and Politano–Leadbetter ureteroneocystostomy was performed in 2 patients, a stone was removed in 1 patient by ureterotomy, and the ureter was repaired.

In a patient, ureterocalicostomy was performed owing tothe development of UPJ obstruction after recurrent RIRS and PCNL.

DISCUSSION

Stones of the urinary tract occur in children at a varying prevalence, depending on various environmental, dietary, and genetic factors. Approximately 2%–3% of stones (10% in some regions) occur in children, and the incidence of this disease is gradually increasing in children (1).

A study conducted in Turkey showed that 17% patients with stones are aged <14 years (3).The mean age at the time of diagnosis in the study group was 63.6±55.2 months, which is consistent with the literature (4-6).

In many studies, it has been reported that urinary tract stone disease is more common in the male sex, and boys/girls ratio is between 4-1.2/1(4,6-8). It was found that 278 (54.8%) of the505 patients included in the present study were boys, 226 (45.2%) were girls, and the M/F ratio was 1.23. In a 24-year

series published by Onal et al. (9) in 2013, the M/F ratio was 1.36,close to the results of the present study.

It has been reported that metabolic disorders play a role in the etiology of urinary tract stone disease at a rate of 5.5%–96% (7,10-14). In the present study, 14% of the patients who underwent surgery also received medical treatment for metabolic disorders.The incidence of urinary tract stone disease associated with UTI in children ranges from 20%to 80.7% (11,13-16). In the present study, stone disease associated with UTI was found to be 44.5%. It was found that 8.9% of the patients received medical treatment for frequent UTIs.

In the present study, 58% of 505 patients had calcium-oxalate stones; 19.1% had cystine stones; 5.8% had struvite stones; 5.8% had uric acid stones, and 4.4% had burshite stones. It was observed that 77.5% calcium-oxalate stones and 100% cystine stones were operated.

In the present study, patients were referred to appropriate centers when there was not enough equipment to perform ESWL in our hospital. Nine patients (1.7%) were treated with ESWL. No residual stones were observed in 7 patients. In 2 patients, 3-mm residual stones wereobserved in the lower pole;after 3 months of follow-up, the stones were spontaneously passed, and the stone-free rate was 100%. A JJ stent was inserted in 3 patients before the procedure. There were no patients with renal damage during long-term follow-up. Three patients who were treated with ESWL were those receiving treatment for cystine stones.

PCNL is performed in prone position by entering the stone at an angle of 45° on the rear axillary line at a distance of 5–6 cm. Intervention with USG was primarily preferred at our center owing to the concern of less radiation. During percutaneous intervention, no intervention should be performed in those with thinned parenchyma anddilatedfunction of 10%. Because of thinned parenchyma, bleeding and extravasation are more common in dilatation. In a study by Sacid et al., nephrectomy was performed for kidneys with low function. During irrigation, one must necessarily pay attention to hydrostatic pressure. RIRS should be preferred in such patients (17,18).

Multiple entries with PNCL did not make a significant decrease in renal function compared with single way entry, and the hemodynamic response of PNCL is not related to the number of entries (19).

In a wider study conducted by Samad et al. (20), the stone-free rate was 59% after the first session in 169 children with a stone load of 3.1 cm. After recurrent PCNL and ESWL, this rate increased to 93.8%, and the requirement for preoperative or postoperative transfusion was 3.6%.

In the present study, 15 (9.5%) patients were treated using PCNL only. PCNL was usually performed in patients aged ≥5 years. Stone sizes ranged between 8 and 17 mm. During their follow-up, a stone-free rate of 46.6% was found in the first session. There were residues in the lower pole in 6 patients and in the pelvis in 1 patient, with a stone size of 4 mm on average, and one patient did not come for follow-up visit. During surgery, 3 patients had extravasation. The surgeons switched to open surgery in 1 patient, whereas a DJ catheter was inserted and followed up in 2 other patients. In the first 48 h, the patients' clinical presentations improved. There was no patient who needed blood transfusion.

RIRS is becoming more popular with the development of appropriate equipment for the treatment of renal stones in children. It is considered a safe method, particularly in prepubertal children. However, it should be known that additional procedures may be required, particularly in case of stones of >6 mm (21).

In particular, it is an advantageous method with higher stone-free rates in a single session for lower pole stones; however, there are disadvantages such as morbidity (surgery, perforation, avulsion, etc.), technology dependence, and stent requirement. Spontaneous passage of asymptomatic and non-obstructive stones of <4 mm can be expected (22).

In the literature, RIRS is not very preferable because of its potential for causing an increased incidence of ureteral ischemia, perforation,and ureteral orifice enlargement that may cause ureteral stricture reflux in upper urinary tract stones. However, the fact that endoscopic instruments can be sufficiently miniaturized, and the holmium YAG laser has been recognized for use in children caused RIRS to be more effective and preferable in the pediatric age group. Complications were minimal (23). In the present study, stone-free rate was 100% in distal ureteral stones. In 3 patients, complications developed owing to ureteral rupture. One patient underwent ureterotomy and ureteral repair, whereas 2 patients underwent stone removal and Politano–Leadbetter ureteroneocystostomy.

In a larger series of 221 patients, 2 patients were reported to have developed ureteral stricture and VUR at a low incidence after RIRS was performed in distal ureteral stones (24).

In the present study, of the 47 patients who underwent RIRS, a JJ catheter was inserted and interventions were postponed in 31 patients, whereas a transition was made to open surgery in 15 patients because of stenosis at the lower end of the ureter in the first RIRS. In the second session, it was observed that there was sufficient enlargement of the ureter to access the stone. Balloon dilatation was performed in 2 patients to expand the ureter in the first RIRS, and no rigid dilatation was used. Postoperative follow-up showed that no patients developed VUR.

In the literature, stone-free rates in individuals who underwent RIRS were reported to be 76%–98% (25-27). In the present series, the stone-free rate was 61.6% after the RIRS procedure was performed for upper urinary tract stones and ureteral stones.

In another study conducted by Onal et al. (9), 768 patients who were operated within 24 years were examined in four periods. A total of 686 endourological procedures and 97 open surgeries were performed. With the improvement in endourological methods, open surgical methods are less frequently used; in cases of anatomical disorders, failure to achieve sufficient stone-free rate by recurrent endourological methods, large stone load and concomitant infection and the inter-period stone-free rate ranged between 86% and 100% (9). In the present study, the stone-free rate ranged between 50% and 100% in 157 patients who were operated over a period of 3 years with repeated endourological methods, followed by open surgery.

CONCLUSIONS

Correction of underlying causes, control of urinary tract infections, preservation of renal functions and prevention of relapses should be aimed in the treatment of pediatric urinary tract stone disease. Symptomatic stones that cause infection or obstruction should be treated. Diet and medical treatment should be preferentially employed. The decision to remove the stone in a child with kidney or ureteral stones should be made according to the location, size and composition of the stone, as well as whether it is accompanied by infection and/or obstruction. The type of surgery should be determined based on the presence of concomitant diseases, skeletal deformities, anatomical disorders and stone size and location. Endourological methods should be preferred because they are less invasive. A sufficient stone-free rate can be achieved by using multiple procedures.

REFERENCES

1. Srivastava T, Alon U.Urolithiazis in adelosan children. J Urol 2005;16:87-109.
2. Clavien PA, Barkun J, Oliviera L, Vauthey JN, Dindo D, Schulick RD, et al. The Clavien-Dindo classification of surgical complications: five-year experience. Ann Surg 2009;250:187-96.
3. Tellaloglu S, Ander H. Stones in children. Turk J Pediatr 1984;26:51-60.
4. Williams HE, Wandzilak TR. Oxalate synthesis, transport and the hyperoxaluric syndromes. J Urol 1989;141:742-9.
5. Cochat P, Pichault V, Bacchetta J, Dubourg L, Sabot JF, Saban C, et al Nephrolithiasis related to inborn metabolic diseases. Pediatr Nephrol 2010;25:415-24.
6. Boutros M, Vicanek C, Rozen R, Goodyer P. Transient neonatal cystinuria. Kidney Int 2005;67:443-8.
7. Bak M, Ural R, Agin H, Serdaroglu E, Calkavur S. The metabolic etiology of urolithiasis in Turkish children. Int Urol Nephrol 2009;41:453-60.
8. Hoppe B, von Unruh GE, Blank G, Rietschel E, Sidhu H, Laube N, et al. Absorptive hyperoxaluria leads to an increased risk for urolithiasis or nephrocalcinosis in cystic fibrosis. Am J Kidney Dis 2005;46:440-5.
9. Onal B, Citgez S, Tansu N, Emin G, Demirkesen O, Talat Z, et al. What changed in management of pediatric Stones after the introduction of minimally invasive procedures? Asingle centre experience over 24 years. J Urol 2013 ;9:910-4.
10. Edvardsson V, Elidottir H, Indridason OS, Palsson R. High incidence of kidney stones in Icelandic children. Pediatr Nephrol 2005;20:940-4.
11. Ali SH, Rifat UN. Etiological and clinical patterns of childhood urolithiasis in Iraq. Pediatr Nephrol 2005;20:1453-7.
12. Ece A, Ozdemir E, Gurkan F, Dokucu AI, Akdeniz O. Characteristics of pediatric urolithiasis in south-east Anatolia. Int J Urol 2000;7:330-4.
13. Oner A, Demircin G, Ipekcioglu H, Bulbul M, Ecin N. Etiological and clinical patterns of urolithiasis in Turkish children. Eur Urol 1997;31:453-8.
14. Borgmann V, Nagel R. Urolithiasis in childhood. A study of 181 cases. Urol Int1982;37:198-204.
15. Dursun I, Poyrazoglu HM, Dusunsel R, Gunduz Z, Gurgoze MK, Demirci D, et al. Pediatric urolithiasis: an 8-year experience of single centre. Int Urol Nephrol 2008;40:3-9.
16. Coward RJ, Peters CJ, Duffy PG, Corry D, Kellett MJ, Choong S, et al. Epidemiology of paediatric renal stone disease in the UK. Arch Dis Child 2003;88:962-5.
17. Dawaba MS, Shokeır AA, Hafez AT, Shoma AM, El-Sherbıny MT, Mokhtar A, et all Percutaneous Nephrolıthotomy In Chıldren: Early And Late Anatomıcal And Functıonal Results J Urol Vol 2004; 9:1078–81.
18. Morshed A. Salah Æ Csaba To´ th Æ A. Munim Khan Percutaneous nephrolithotomy in children: experience with 138 cases in a developing country. World J Urol 2004;22: 277–80.
19. Dawaba MS, Shokeir AA, Hafez A, Shoma AM, El-Sherbiny MT, Moktar A, et al. Percutaneus nephrotitotomy in children : early and late anatomical and functional results. BJU; 2004;172:1078-81.
20. Samad L, Aquil S, Zaidi Z. Pediatric percutaneus nephrolithotomy setting new frontiers. BJU Int 2006:97;359-63.
21. Tanaka ST, Makari JH, Pope JC, Adams MC, Brock JW, Thomas JC. Pediatric Ureteroscopic Management of Intrarenal Calculi. J Urol 2008;180:2150-4.
22. Van Savage JG, Palanca LG, R D Andersen, Rao SG, Slaughenhoupt BL. Treatment of distal ureteral stones in children: similarities to the american urological association guidelines in adults J Urol;2000;164:1089-93.
23. Schuster TG, Rusell KY, Bloom DA, Koa HP, Fearber GJ. Ureteroscopy for treatment of urolithiazis in children. J Urol 2002;167:1813.
24. Lesani OA, Palmer JS. Retrograde proximal rigid ureteroscopy and pyeloscopy in prepubertal children: safe and effective. J Urol 2006;176:1570-3.
25. Tan AH, Al-Omar M, Destedt JD, Razvi H. Ureteroscopy for pediatric ürolithiazis; an envolving first line terapyh. Urology 2005;65:153-6.
26. Minevich E, Defoor W, Reddy P, Nishinaka K, Wacksman J, Sheldon C, et al. Ureteroscopy is safe and effective in prepubertal children. J Urol 2005;174:276-9.
27. Cannon GM, Smaldone MC, Wu HY, Bassett JC, Bellinger MF, Docimo SG, et al. Ureteroscopic management of lower – pole stones in a pediatric population. J Endourol 2007;21:1179-82.