Diagnosis and Treatment Trends in Pediatric Stone Disease: Preferences of Urologists in the Field

Nebil Akdogan[1], Mutlu Deger[1], Ismail Onder Yılmaz[1], Tunahan Ates[2], Ibrahim Atilla Arıdogan[1], Nihat Satar[1]

1 Department of Urology, Faculty of Medicine, Cukurova University, Adana, Türkiye
2 Department of Urology, Defne State Hospital, Hatay, Türkiye

Abstract

Aim: Many different treatment options exist for pediatric stone disease (PSD). We conducted a survey among urologists in Turkey to find out which diagnostic and therapeutic methods urologists choose for stones of different localization and size in pediatric patients of varying age groups.

Methods: A survey on treatment options in various PSD was developed for urologists working in hospitals of different status. The survey consisted of 42 multiple-choice questions, and the average response time was 5 minutes. The measure taken to avoid repetitive responses was that the survey could only be completed once from an internet protocol.

Results: The number of respondents was 95. 91.67%, 89.47%, and 80.21% of the participants preferred ultrasonography as the diagnostic method in the 0-2, 2-6, and 6-18 age ranges, respectively. In treating staghorn kidney stones between 0-2 and 2-6 years, mini percutaneous nephrolithotomy (PCNL) was preferred most frequently, followed by standard PCNL. In all age groups, shockwave lithotripsy was the most common procedure for symptomatic pelvic stones smaller than 10 mm, followed by retrograde intrarenal surgery in the second frequency. Endoscopic surgery was the most preferred method for bladder stones smaller than 2 cm in all age groups.

Conclusion: The management of urinary tract stones in pediatric patients involves a complex set of processes. The sole aim is not to achieve stone-free management. Urologists in Turkey act following the guidelines. However, this is not always possible due to the lack of facilities. The necessary facilities for urologists need to be improved.

***Keywords**: Pediatric; stone disease; trend; urologist; survey*

1. Introduction

Pediatric stone disease (PSD) is a major problem in urology practice today. The incidence and characteristics of stones show wide geographical variation in children.[1] PSD is endemic in Turkey, Pakistan, and some South Asian, African, and South American countries. However, epidemiological studies have shown that the incidence of pediatric stone disease is also increasing in the Western world.[2–4] A major contributor to the morbidity associated with nephrolithiasis is disease recurrence. Stone recurrence increases the morbidity of nephrolithiasis. Pediatric patients constitute a high-risk patient population that because of followed carefully due to the risk of stone recurrence for many years.[5]

Therefore, postoperative follow-up and treatment management are also of great importance. It is known that 25-50% of children with nephrolithiasis undergo surgical intervention.[6,7] Common procedures for nephrolithiasis include extracorporeal shockwave lithotripsy (SWL), retrograde intrarenal surgery (RIRS) with ureteroscopy (URS), and percutaneous nephrolithotomy (PCNL). Open, laparoscopic, and robot-assisted laparoscopic surgery are rare and performed in selected patient groups.[1] With the advancement of technology, stone management has shifted from open surgical approaches to less invasive endoscopic techniques. Treatment depends on the number, size, location, type, and anatomy of the urinary tract.[8,9]

There are many different treatment options for urinary tract stones. The majority of urologists intervene in urinary tract stones in adult patients. However, this may differ in pediatric patients. Therefore, we conducted a survey among urologists in Turkey to find out which diagnostic and therapeutic methods urologists choose for stones of different localization and size in pediatric patients of varying age groups.

Corresponding Author: Tunahan Ates, drtunahanates0101@gmail.com, Received: 06.10.2024, Accepted: 18.12.2024, Available Online Date: 15.03.2025 Cite this article as: Akdogan T, Deger M, Yılmaz IO, Ates T, Arıdogan IA, Satar N. Diagnosis and Treatment Trends In Pediatric Stone Disease: Preferences of Urologists In The Field. J Cukurova Anesth Surg. 2025; 8(1): 1-6. https://doi.org/10.36516/jocass.1562263

2. Materials and Methods

The study was conducted in compliance with the principles of the Declaration of Helsinki and additional approval was obtained from the Ethics Committee of Çukurova University, Medical Faculty, Adana, Turkey (2023-138/63).

Based on the EAU (European Association of Urology) 2023 guidelines [1,10] for various forms of PSD, a survey on treatment options in various PSD was developed for urologists working in hospitals of different status. The survey included the title and experience of the urologist in charge. The respondents were also asked about the imaging modalities used in different age groups and the treatment modalities for kidney stones (pelvis, lower pole calyx, staghorn), ureteral stones (upper and lower), and bladder stones.

The survey consisted of 42 multiple-choice questions (**Table 1)**, and the average response time was 5 minutes. The measure taken to avoid repetitive responses was that the survey could only be completed once from an internet protocol address.

After ethics committee approval the survey was sent to urologists nationwide via e-mail and mobile application. Participants' responses were then collected and analyzed. Categorical variables were expressed as numbers and percentages. The chi-square test was used to compare categorical variables between groups. All analyses were performed using IBM (Armonk, NY, USA) SPSS Statistics Version 20.0 statistical software. The level of statistical significance for all tests was set as $p < 0.05$.

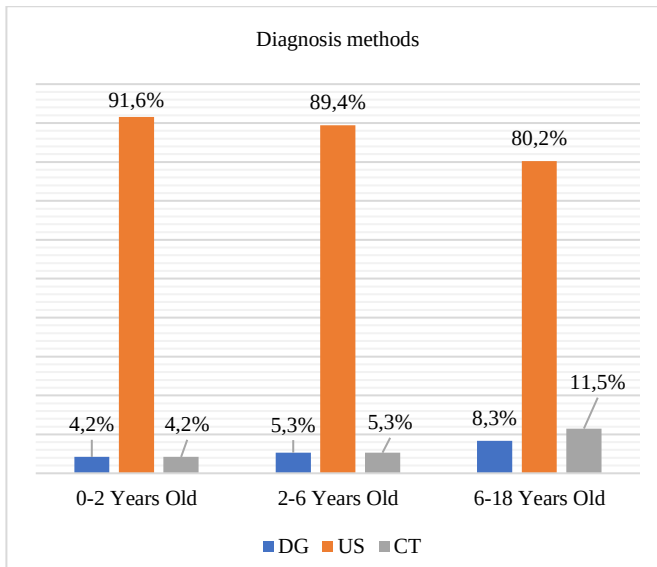
Table 1

The questions asked in the survey

1. What is your title?
2. Where do you work?
3. How many years are you in your profession?
4. Have you done a minor in pediatric urology?
5. In your daily practice, which imaging modality do you prefer first for diagnostic purposes in pediatric stone patients aged 0-2 years?
6. In your daily practice, which imaging method do you prefer first for diagnostic purposes in pediatric stone patients aged 2-6 years?
7. In your daily practice, which imaging method do you prefer first for diagnostic purposes in pediatric stone patients aged 6-18 years?
8. Which surgical methods do you use in pediatric stone disease between 0-2 years of age? (you can select more than one option in this question)
9. Which surgical methods do you use in pediatric stone disease between 2-6 years of age? (you can select more than one option in this question)
10. Which surgical methods do you use in pediatric stone disease between the ages of 6-18? (you can select more than one option in this question)
11. Which of the following treatment methods would you prefer for staghorn kidney stones in patients aged 0-2 years?
12. Which of the following treatment methods would you prefer for staghorn kidney stones in patients aged 2-6 years?
13. Which of the following treatment methods would you prefer for staghorn kidney stones in patients aged 6-18 years?
14. Which of the following treatment modalities would you prefer for <10 mm symptomatic pelvic stones in patients aged 0-2 years?
15. Which of the following treatment modalities would you prefer for symptomatic pelvic stones <10 mm in patients aged 2-6 years?
16. Which of the following treatment methods would you prefer for <10 mm symptomatic pelvic stones in patients aged 6-18 years?
17. Which of the following treatment methods would you prefer for symptomatic pelvic stones of 10 - 20 mm in patients aged 0-2 years?
18. Which of the following treatment methods would you prefer for 10 - 20 mm symptomatic pelvic stones in patients aged 2-6 years?
19. Which of the following treatment methods would you prefer for 10 - 20 mm symptomatic pelvic stones in patients aged 6-18 years?
20. Which of the following treatment methods would you prefer for > 20 mm symptomatic pelvic stones in patients aged 0-2 years?
21. Which of the following treatment methods would you prefer for symptomatic pelvic stones > 20 mm in patients aged 2-6 years?
22. Which of the following treatment methods would you prefer for > 20 mm symptomatic pelvic stones in patients aged 6-18 years?
23. Which of the following treatment modalities would you prefer for symptomatic 10-20 mm lower pol calyx stones in patients aged 0-2 years?
24. Which of the following treatment methods would you prefer for 10-20 mm symptomatic lower pol calyx stones in patients aged 2-6 years?
25. Which of the following treatment methods would you prefer for 10-20 mm symptomatic lower pol calyx stones in patients aged 6-18 years?
26. Which of the following treatment modalities would you prefer for symptomatic lower pol calyx stones <10 mm in patients aged 0-2 years?
27. Which of the following treatment modalities would you prefer for symptomatic lower pol calyx stones <10 mm in patients aged 2-6 years?
28. Which of the following treatment modalities would you prefer for symptomatic lower pol calyx stones <10 mm in patients aged 6-18 years?
29. Which of the following treatment modalities would you prefer for symptomatic upper ureter stones in patients aged 0-2 years?
30. Which of the following treatment modalities would you prefer for symptomatic upper ureteral stones in patients aged 2-6 years?
31. Which of the following treatment modalities would you prefer for symptomatic upper ureteral stones in patients aged 6-18 years?
32. Which of the following treatment modalities would you prefer for symptomatic lower ureteral stones in patients aged 0-2 years?
33. Which of the following treatment modalities would you prefer for symptomatic lower ureteral stones in patients aged 2-6 years?
34. Which of the following treatment modalities would you prefer for symptomatic lower ureteral stones in patients aged 6-18 years?
35. Which of the following treatment methods would you prefer for > 2 cm bladder stones in patients aged 0-2 years?
36. Which of the following treatment methods would you prefer for > 2 cm bladder stones in patients aged 2-6 years?
37. Which of the following treatment methods would you prefer for > 2 cm bladder stones in patients aged 6-18 years?
38. Which of the following treatment methods would you prefer for < 2 cm bladder stones in patients aged 0-2 years?
39. Which of the following treatment methods would you prefer for < 2 cm bladder stones in patients aged 2-6 years?
40. Which of the following treatment methods do you prefer for < 2 cm bladder stones in patients aged 6-18 years ?
41. Which of the following do you apply in pediatric stone patients in your daily practice? (you can select more than one option in this question)
42. In your daily practice, which imaging method do you prefer for the first postoperative control in pediatric stone patients?

Figure 1

Preferred diagnostic methods in different age groups



**DG: Direct Radiography, US: Ultrasonography, CT: Computed Tomography*

3. Results

The number of respondents was 95. Of the participants, 11.46% were assistants, 46.96% were specialists, 3.12% were lecturers, 11.46% were assistant professors, 19.79% were associate professors, and 5.21% were professors. A total of 39.58% of the participants worked in university hospitals, 25% in training and research hospitals, 17.71% in state hospitals, and 17.71% in private hospitals. 91.67%, 89.47%, and 80.21% of the participants preferred ultrasonography (US) as the diagnostic method in the 0-2, 2-6, and 6-18 age ranges, respectively. Intravenous pyelography (IVP) was not preferred by any participant **(Fig. 1)**. In response to the question "Which surgical methods do you use in pediatric stone disease?", URS was preferred most frequently between the ages of 0-2 and 2-6 years, followed by mini PCNL; between the ages of 6-18 years, URS was preferred most frequently, followed by RIRS and mini PCNL in equal proportions In treating staghorn kidney stones in the 0-2 and 2-6 age groups, mini PNL was preferred most frequently, followed by standard PCNL. In treating staghorn stones between the ages of 6 and 18, standard PCNL was preferred most frequently, followed by mini PCNL. Surgical treatment of staghorn kidney stones in different age groups was performed independently of both the place of duty and titles ($p > 0.05$) **(Table 2)**.

In all age groups, SWL was the most common procedure for symptomatic pelvic stones smaller than 10 mm, followed by RIRS, which was the second most frequently used. For symptomatic pelvic stones between 10-20 mm in all age groups, mini PCNL was the most commonly used method, followed by RIRS in second place. The most frequently used method for symptomatic pelvic stones larger than 2 cm was mini PCNL in all stone groups. For symptomatic lower pole calyx stones 10-20 mm, mini PCNL was the most frequently used method in all age groups.

Table 2

Preferred treatment methods for staghorn kidney stones in different age groups

Age groups	Treatment Methods	Title						p
		Resident (%)	Specialist (%)	Lecturer (%)	Assistant Professor (%)	Associate Professor (%)	Professor (%)	
0-2	Follow up	9.1	0	0	0	0	0	0.595
	SWL	0	4.3	0	0	0	0	
	Standard PCNL	18.2	8.5	0	20	10.5	20	
	Mini PCNL (<22 F)	54.5	70.2	100	70	78.9	80	
	Micro PCNL	9.1	12.8	0	10	5.3	0	
	Laparoscopic surgery	0	0	0	0	5.3	0	
	Open Surgery	9.1	4.3	0	0	0	0	
2-6	Follow up	9.1	0	0	0	0	0	0.762
	SWL	0	4.3	0	9.1	0	0	
	Standard PCNL	9.1	13	33.3	18.2	11.1	20	
	Mini PCNL (<22 F)	72.7	71.7	33.3	72.7	83.3	80	
	Micro PCNL	9.1	6.5	0	0.	5.6	0	
	Open Surgery	0	4.3	33.4	0	0	0	
6-18	Follow up	9.1	0	0.0	0	0	0	0.168
	Standard PCNL	63.66	53.2	66.7	81.8	31.6	40	
	Mini PCNL (<22 F)	18.2	44.7	33.3	18.2	68.4	60	
	Micro PCNL	9.1	2.1	0	0	0	0	

**SWL: Shock Wave Lithotripsy, PCNL: Percutaneous Nephrolithotomy*

Table 3

Rates of stone surgery according to title

	Age groups	Title						p
		Resident (%)	Specialist (%)	Lecturer (%)	Assistant Professor (%)	Associate Professor (%)	Professor (%)	
Those who perform stone surgery	0-2	27.3	42.6	0	36.4	15.8	0	0.007
	2-6	18.2	31.9	0	36.4	10.5	0	
	6-18	9.1	14.9	0	0	10.5	0	

Table 4

Rates of stone surgery according to place of duty

	Age groups	Place of Duty				p
		University Hospital (%)	Training and Research Hospital (%)	State Hospital (%)	Private Hospital (%)	
Those who perform stone surgery	0-2	23.7	33.3	41.2	35.3	0.364
	2-6	21.1	29.2	29.4	17.6	
	6-18	7.9	8.3	17.6	11.8	

Table 5

Proportions of those who perform metabolic screening and stone analysis and those who do neither, according to the title

	Title						p
	Resident (%)	Specialist (%)	Lecturer (%)	Assistant Professor (%)	Associate Professor (%)	Professor (%)	
Metabolic Screeners	54.5	61.7	66.7	63.6	73.7	60	0.392
Stone Analyzers	90.9	72.3	100	100	84.2	100	0.157
Those Who Do Neither	9.1	19.1	0	0	15.8	0	0.479

For symptomatic lower pole calyx stones smaller than 10 mm, RIRS was the most used method in the 0-2 and 6-18 age groups, whereas SWL was the most frequently used method in the 2-6 age group. URS was the most used method for symptomatic upper and lower ureteral stones in all age groups. For bladder stones larger than 2 cm, endoscopic surgery was the preferred method in the 0-2 and 2-6 age groups, while endoscopic surgery and percutaneous surgery were equally preferred in the 6-18 age group. Endoscopic surgery was the preferred method for bladder stones smaller than 2 cm in all age groups. In different age groups, performing stone surgery was related to title ($p = 0.007$) **(Table 3)** but not to place of duty ($p = 0.364$) **(Table 4)**. In daily practice, 82.29% of the participants recommended stone analysis and 63.54% recommended metabolic screening, while 13.54% did neither. When we looked at the rates of performing stone analysis according to the place of work, 92.1% of those working in university hospitals, 79.2% of those working in training and research hospitals, 52.9% of those working in state hospitals, and 94.1% of those working in the private hospital performed stone analysis ($p = 0.002$). On the other hand, performing metabolic screening and stone analysis did not depend on title ($p = 0.392$, $p = 0.157$, respectively) **(Table 5)**. At the first postoperative visit, 93.75% of the participants preferred US.

4. Discussion

In PSD, the guideline [11] strongly recommends direct radiography (DG) and US as primary for diagnosis and follow-up. In line with the guidelines, urologists preferred US the most. However, contrary to expectations, DG was less frequently preferred. IVP was not chosen, indicating that urologists had abandoned this diagnostic modality. We believe that non-contrast CT should be selected in preoperative patients. We know that CT provides excellent anatomical information and has high specificity. However, some studies [12,13] in the literature recommend CT as the first diagnostic method for PSD because it is the gold standard diagnostic method. Radiation is a major problem for pediatric patients. Therefore, US should be performed first, at least to determine urgent conditions such as hydronephrosis and pyonephrosis. This way, pediatric patients will be protect pediatric patients from unnecessary radiation exposure in non-emergency situations. For children for whom non-contrast CT is planned, it is also strongly recommended in the guideline [11] that CT should be low dose. Urologists should consider this recommendation and prefer low-dose, non-contrast CT in children.

In general, URS is the most commonly used surgical method in PSD because it is easily accessible to most urologists and minimally invasive. EAU guidelines [11] recommend PCNL for kidney stones larger than 2 cm. Participants in the study generally follow the guideline recommendations. In staghorn kidney stones, mini PCNL is performed more frequently in patients aged 0-2 and 2-6 years because the kidney is relatively smaller. Between the ages of 6 and 18, standard PCNL is preferred more frequently as the kidney approaches adult size. In addition, although AUA (American Urology Association) guidelines [10] states that SWL can be performed in pediatric patients for stones larger than 20 mm, a ureteral catheter (Double J) or percutaneous nephrostomy should be placed before the procedure. Since this method requires extra intervention in pediatric patients, it has not been a preferred treatment method. The fact that the surgical treatment of staghorn kidney stones can be performed independently of both the place of duty and title suggests that the experience of urologists in Turkey is similar.

In the literature, stone-free rates ranging from 57% to 97% in

the short term and 57-92% in the long term after SWL are available. [9,14,15] Following the guideline [11] recommendations, symptomatic pelvic stones smaller than 10 mm in diameter are treated with SWL in all age groups, with the endourological methods (RIRS and PCNL) being the second most common treatment modality. We can conclude that urologists who prefer RIRS as the first treatment method may not have the opportunity to perform SWL or may be unable to perform SWL due to contraindications. The fact that SWL requires anesthesia in pediatric patients is a relative disadvantage.

Recent guidelines [11] recommend SWL / PCNL / RIRS as the first choice of surgical treatment for 10-20 mm pelvic stones. SWL is more likely to require more than one session. For this reason, we believe that mini PCNL is the first preferred method among the participants. RIRS was chosen as the second method of choice. The aim is to make patients stone-free with the minimum number of sessions possible.

Although observation or SWL is recommended as the first choice for lower pol stones smaller than 10 mm in the recently published guideline [11] the participants used SWL as the first choice and RIRS as the second choice only for patients between 2 and 6 years of age. In other age groups, RIRS was preferred most frequently. We know that the success of SWL is lower pole stones than for stones in other localizations due to the location. For this reason, the participants may prefer RIRS over SWL.

In previous studies, the stone-free rate with URS ranged between 82% to 100%. [16,17] However, endoscopic surgery via the retrograde route is relatively more complex for upper ureteral stones. Middle and lower ureteral stones can be removed more easily with URS. Participants reported URS as their first choice for symptomatic ureteral calculi in all age groups. However, guideline [11] recommends SWL as the first-line treatment for upper ureteral stones.

There are three different methods for the surgical treatment of bladder stones: endoscopic (transurethral/percutaneous), SWL, and open surgery. Guidelines [11] recommends that endoscopic methods should be preferred primarily. Participants frequently preferred endoscopic methods, following guideline recommendations and in their daily practice.

The statistical difference in stone analysis according to the place of duty is likely due to the inadequacy of facilities in state hospitals. The conditions of state hospitals should be improved. The fact that stone analysis and metabolic screening are independent of the title shows that urologists perform stone analysis when they have sufficient facilities.

US, which is not as effective as computed tomography in stone detection, is preferred as a postoperative control imaging method because it is easily accessible to urologists, does not involve radiation, and provides reliable information about the condition of the collecting system.

5. Conclusion

The management of urinary tract stones in pediatric patients involves a complex set of processes. The sole aim is not just to achieve stone-free management. Since children are in a high-risk group, prevention of recurrence is equally important, along with stone analysis and metabolic evaluation. Urologists in Turkey generally following the guidelines. However, this is not always possible due to a lack of facilities. The necessary facilities for urologists need to be improved.

Statement of ethics

This study was approved by the Ethics Committee of Çukurova University, Medical Faculty, Adana, Turkey (2023-138/63)

Source of Finance

The authors declare that they have received no financial support for this study

Conflict of interest statement

The authors declare that they have no conflict of interest.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Author contributions

NA: Conception, Data Collection, Design, MD: Conception, Materials, Analysis, IOY: Analysis, Writing, Design, TA: Data collection, Writing, Critical Review, IAA: Data collection, Supervision, Materials, NS: Critical Review, Literature Review

Acknowledgment

We would like to thank Sevinc Puren Yucel for the statistical analysis of our study.

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