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Are small residual stone fragments really insignificant in children?

Nida Dincel[a], Berkan Resorlu[b,*], Ali Unsal[b], Abdulkadir Tepeler[c], Mesrur Selcuk Silay[c], Abdullah Armağan[c], Akif Diri[d], Ahmet Ali Sancaktutar[e], Tevfik Ziypak[f], Sevgi Mir[a]

[a]*Department of Pediatric Nephrology, Ege University, Faculty of Medicine, Izmir, Turkey*
[b]*Department of Urology, Kecioren Training and Research Hospital, Ankara, Turkey*
[c]*Department of Urology, Bezmialem Vakif University, Faculty of Medicine, Istanbul, Turkey*
[d]*Department of Urology, Ankara Training and Research Hospital, Ankara, Turkey*
[e]*Department of Urology, Dicle University, Faculty of Medicine, Diyarbakir, Turkey*
[f]*Department of Urology, Ataturk University, Faculty of Medicine, Erzurum, Turkey*

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Abstract

Objectives: To assess the significance of asymptomatic residual stone fragments of less than 4 mm (clinically insignificant residual fragments [CIRFs]) after shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PNL), and retrograde intrarenal surgery (RIRS) in children.

Patients and Methods: Eighty-five children were followed up for 6 to 50 months (median 22). Outcomes measured were fragment re-growth, stone events (emergency department visits, hospitalization, or additional interventions) and spontaneous fragment passage.

Results: During follow-up, 22 children (25.8%) passed residual fragments spontaneously. Highest spontaneous passage rate was found for renal pelvis stones and the lowest for the lower pole stones (57.1% vs. 16.1%; $p<0.001$). When the number of the fragments increased, the chance of the spontaneous passage decreased (30% vs 20%; $p<0.05$). Symptomatic episodes including renal colic, hematuria, or urinary tract infection were documented in 34 (40%) patients, and re-growth of fragments was observed in 18 (21.2%). Stone size had no significant effect on spontaneous passage ($p=0.079$), stone growth ($p=0.528$), and symptomatic episodes ($p=0.402$). Twenty-five patients (29.4%) required secondary intervention for stone re-growth or stone related events and the remaining 20 patients (23.5%) needed medical treatment for bothersome symptoms or complications.

Conclusions: Our results suggest that 40% of children with CIRFs will become symptomatic and 20% will develop stone re-growth over the following 6 months. Only one fifth of the fragments will pass spontaneously without any complications. Therefore, the use of the term "CIRF" is not appropriate for postoperative residual fragments in children.

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* Corresponding author. Tel.: +90 5055025743; fax: +90 3123569003.
E-mail addresses: drberkan79@gmail.com, drberkan@yahoo.com (B. Resorlu).

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The management of upper urinary stone disease in children has changed dramatically in the last two decades due to improvements and miniaturization of instruments [1-4]. Currently, the three minimally invasive approaches available for pediatric patients with intrarenal stones are shock wave lithotripsy (SWL), percutaneous nephrolithotomy (PNL) and retrograde intrarenal surgery (RIRS). SWL is a well-established treatment method and the majority of pediatric stone diseases can be managed effectively and safely with this technique. However, there are some stones that do not respond to SWL, and these can be managed by other treatment modalities such as PNL and RIRS.

These minimally invasive techniques have provided a new definition in reporting treatment results, that is clinically insignificant residual fragments (CIRFs) [5]. Residual fragments smaller than 5 mm which are asymptomatic, noninfectious and likely to pass spontaneously are termed CIRF [6]. However, this term has not been accepted by some authors because these fragments have the potential to cause ureteral obstruction and are important risk factors for stone re-growth and recurrence [7].

Although data are available regarding the outcomes of CIRFs in adults, no data is available for children and the fate of CIRFs is not known in the pediatric population. In this study, we evaluated the natural history of these fragments following SWL, PNL or RIRS in children.

1. Patients and methods

We retrospectively reviewed the medical records of 85 pediatric patients (1–17 years) who had CIRFs at 3 months after the last session of SWL (n=49) or 1–2 months after the RIRS (n=10) and PNL (n=26). CIRFs were defined as nonobstructive, noninfectious, asymptomatic residual fragments 4 mm or less in size [5]. Stone fragment size, location (upper-, middle-, lower-pole and renal pelvis) and presence of single or multiple fragments were assessed with the combination of ultrasonography (US) and plain radiography. Only patients with follow-up more than 6 months were included to study. The patients who had abnormal renal anatomy, musculoskeletal deformities, radiolucent stones and inadequate follow-up data were not included to study. Pretreatment evaluation included a careful medical history, physical examination, routine blood tests, urine analysis, urine culture, plain film, US and intravenous urography (IVU). Renal scintigraphy and computed tomography (CT) were not done routinely but they were performed whenever needed. Stone size was determined by measuring the longest axis on plain film; when multiple stones were present in the kidney stone size was reported as the sum of the diameters of each stone.

Stone-free status was determined in an outpatient clinic setting at 1–2 months postoperatively for PNL and RIRS, and at 3 months after SWL. Patients were evaluated by urinalysis, urine culture, renal function tests, plain abdominal radiography and urinary US every 3 months during the first year and every 6 months thereafter. Stone analyses were performed by X-ray diffraction crystallography. We routinely advised patients and their parents to maintain a high fluid intake and avoid excessive intake of salt and animal proteins. A primary metabolic evaluation included urine pH, stone analysis, serum calcium, phosphorus, uric acid and 24-hour urinary calcium, phosphorus, oxalate, citrate, uric acid, creatinine and electrolytes. Patients completing a metabolic evaluation were offered selective medical therapy. Medical therapy included potassium citrate for hypocitraturia, renal tubular acidosis, chronic diarrheal syndromes; thiazide diuretics for hypercalciuria; alpha-mercaptopropionylglycine for cystinuria; and allopurinol for hyperuricosuria [8]. However, some patients or their parents chose not to undergo selective medical therapy and opted for conservative measures alone.

Patients were followed for 6 to 50 months (median 22 months). During the follow-up, incidence of stone events (hospitalization, need for emergency room visit and additional interventions for removing the residual fragments or treat symptoms), growth in the size of fragments and spontaneous passage of these fragments were evaluated. For the developing complications, patients were treated conservatively or received appropriate ancillary treatment.

1.1. Statistical analyses

Data were processed using SPSS-16 for Windows (SPSS, Inc., Chicago, IL). Continuous variables were compared with the Mann–Whitney U test. The proportions of categorical variables were analyzed for statistical significance using the chi-square test. While the categorical variables were presented by frequency (percent), continuous variables were presented by median (range). Statistical significance was defined as $p<0.05$.

2. Results

The clinical and radiographic findings of the 85 children are summarized in Table 1. Forty-nine boys and 36 girls with a mean age of 9.2 years were included in the study. The median size of CIRFs was 3 mm (1–4 mm). The anatomical distribution of CIRFs was 36% lower pole, 31% middle or upper pole, 25% multiple caliceal and 8% renal pelvis. Most of the children had only one fragment (58.8%) followed by two and more than two fragments in 20% and 21.2% of the patients, respectively.

Stone analysis was available in 75 (88.2%) patients and showed that 41 patients had calcium oxalate or phosphate stones, 27 had mixed, 4 had cystine and 3 had uric acid stones. No patients with residual fragments had struvite calculi. Metabolic evaluation was performed in 66 patients

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