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Best Imaging Method for Detection of Renal Stones

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Abstract

The occurrence rate of nephrolithiasis has increased steadily. The development of stone in children depends on certain physicochemical factors. Kidney stones are one of the challenges of pediatric nephrology. We brief reviewed the current literature on the best diagnostic imaging to decrease the complication of nephrolithiasis, and we considered the areas that need future research.

Keywords: Nephrolithiasis, Children, Physicochemical Factors

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Introduction

The occurrence rate of nephrolithiasis has steadily increased (1, 2). The urolithiasis is a common, sever painful, and costly disease, with a high relapse probability (3-6). The global outbreak of the disease has been 1% to 15% (1). The reported prevalence of urolithiasis increases from 1% to 5% in Asia and 13% to 15% in the USA, although even some Asian countries have a very high reported prevalence of 20.1% (1, 4). Development of stone in children depends on certain physicochemical factors (5, 6). The suspected etiologies are anatomic abnormalities, urinary tract infection (UTI), metabolic disturbances, lifestyle, diet, and lack of adequate use of fluids and drugs (7-9). Kidney stones are one of the challenges of pediatric nephrology (1, 9). According to the literature, calcium stones are predominant renal stones comprising about 80% of all urinary calculi (1, 8). The recurrence rate of nephrolithiasis is not well defined in patients with kidney stones during childhood (1, 9), but the rate of recurrence is

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↑What is "already known" in this topic:
Urolithiasis in childhood and adolescence has been increasingly diagnosed. The reason for such an increase is not clear, but is associated to a high relapse probability. Appropriate assessment of the imaging way to diagnose kidney stones in children can improve the safety of patients by reducing side effect and long term complication.

→What this article adds:
We brief reviewed the current literature on the best diagnostic imaging to decrease the complication of nephrolithiasis. Although ultrasound is not as sensitive as the CT, it is usually a very good method for the diagnosis of urolithiasis in children, as it needs no radiation and no anesthesia, while providing detailed anatomic information in addition to being cost–effective and widely available. This study identified CT scan is choice method for the diagnosis of urolithiasis in children but effects of radiation, the risk may be higher in children compared to adults.

high (about 50% during 5 years) that is because of inefficacy of current methods in changing pathophysiology and course of stone formation (3, 8). We brief reviewed the current literature on the best diagnostic imaging to decrease the complication of nephrolithiasis, and we considered the areas that need future research.

Imaging Method to Detect Renal Stones in Children

Kidney stone imaging is a very important diagnostic method in children (8). It is an initial step in deciding on therapeutic options to use for the work up of kidney stones (7-11). First diagnostic examinations, significantly depending on imaging of the kidney and urinary tract should reveal obstruction or stasis, urinary tract infection (UTI), and abnormality of metabolic condition (8). The availability of imaging, such as ultrasound (US), cause stones to be incidentally diagnosed during the evaluation of nonspecific symptoms or unrelated problems. Individual clinical symptom and composition of the stone should be considered in making decisions on the best imaging modality. The imaging of urinary tract should sufficiently prevent urinary stream stasis or obstruction related to a stone in kidney and urinary tract (10-16). In children with suspected nephrolithiasis, US is a great diagnostic imaging, although more discussion is needed in this respect (11). KUB (kidney ureter bladder imaging), IVP (intravenous pyelography), and noncontrast spiral computerized scan (NSCT) are known as other imaging modalities (14). Although US is not as sensitive as the computed tomography (CT), it is usually a very good method for the diagnosis of urolithiasis in children, as it needs no radiation or anesthesia, while providing detailed anatomic information in addition to being cost-effective and widely available (9, 10). NSCT of the abdomen and pelvis consistently provides the most accurate diagnosis and a good standard method for detection of nephrolithiasis, and also exposes children to ionizing radiation (12). The measurement of the stone size by US is less reproducible compared with CT; thus, applying it for active monitoring of metabolic stone formation may be gradually reduced (14). In children with refractory urolithiasis symptoms but without clear evidence of a stone, NSCT scan is recommended (8, 15). Although the risk of cancer in a single CT imaging for kidney stones is not high, the cumulative risk is higher for the ones undergoing repeated research (12). Additionally, because of a longer life expectancy and the sensitivity of developing tissues to the effects of radiation, the risk may be higher in children compared with adults (16, 17). CT scan, while providing detailed anatomic information, is sensitive to very small stones (17). Recently, low-dose radiations CT techniques have been considered for the diagnosis of renal stones (16). The success of US depends on the observer's mastery (9, 16). Ultrasonography is sufficient in most cases; however, US may not diagnose urinary tract stones in up to 40% of patients (14). Some problems in the US include very small stones, thin papillary or calyceal stones, and lower ureteral stones, especially in neonate's preterm infants (15). Also, the Tamm-Horsfall protein deposits within the renal calyces may seem like nephrocalcinosis (15). Furthermore, in neonates, the high echogenicity of the renal cortex may occur; therefore, cortical nephrocalcinosis can be hard to detect (15). Although KUB may detect stones, it does not have high sensitivity and leads to diagnosis in 44% to 77% of cases (15). KUB accompanied with US helps clinicians detect and observe renal stones. Many stones include elements of compound calcium, and therefore are easily visible on x-ray. Small stones, ureteral stones, radiation exposure, and the need to preparation are some challenges of the KUB (8, 16). Calcium oxalate or calcium phosphate stones are very radio-dense, thus, they are readily seen by both U and CT. Their observability on imaging studies depends on the stone's composition. The stones composed of calcium oxalate or calcium phosphate result in a very dense image on x-ray and CT scans. Struvite and cystine stones have intermediate radiodensity. Uric acid, xanthine, 2, 8 dihydroxyadenine, and orotic acid stones are radiolucent by conventional radiography, but visible by ultrasonography or unenhanced CT (15, 17). Except for indinavir stones, the size and location of stones, CT scan is rapid and nearly 100% sensitive and specific (17).

However, in case of obstruction and non-opaque or low-density stones requiring careful delineation, and a need to details of urinary contrast agents are necessary. The most common ureteral calcification is a stone that has moved down from the kidney. These stones typically become impacted at narrow anatomic sites and are hard to detect, when they create altitude with bony structures, such as the sacrum. Ultrasonography fails to detect a ureteral stone (8) but CT scan is a better method of diagnosis (16, 17). The color doppler twinkling artifact can be used when the results for stones in B mode ultrasonography are not sufficient (10, 13). IVP is rarely prescribed for patients with renal stone, but in some cases, it can contribute to determine the anatomy of calyces and pelvis before surgery. Some disadvantages of IVP in children with nephrolithiasis are contrast nephropathy, radiation exposure, unavailability, and the need to preparation (16).

Conflict of Interests

The authors declare that they have no competing interests.

References

1. Sharma AP, Filler G. Epidemiology of pediatric urolithiasis. Indian J Urol. 2010 Oct-Dec;26(4):516–522.
2. Issler N, Dufek S, Kleta R, Bockenhauer D, Smeulders N, Van't Hoff W. Epidemiology of paediatric renal stone disease: a 22-year single centre experience in the UK. BMC Nephrol. 2017;18(1):136.
3. Mehrabi S, Askarpour E, Mehrabi F, Jannesar R. Effects of hydrophilic extract of Nasturtium officinale on prevention of ethylene glycol induced renal stone in male Wistar rats. J Nephropathol. 2016;5(4):123-127.
4. Mehrabi S, Manzouri L, Kohzadi A, Mehrabi F. Efficacy of tamsulosin versus tamsulosin plus lithorex-B as medical expulsive therapy following extracorporeal shock-wave lithotripsy of renal and upper ureteric stones; a randomized clinical trial. J Nephropharmacol. 2017;6(2):79-84.
5. Mehrabi S, Behnam P, Manzouri L, Mehrabi A. Comparison efficacy and side effects of combined cystone and hydrochlorothiazide with cystone monotherapy in treatment and passage of upper urinary stones. J Renal Inj Prev. 2019;8(3):211-215.
6- Tanikawa C, Kamatani Y, Terao C, Usami M, Takahashi A, Momozawa Y, et al. Novel Risk Loci Identified in a Genome-Wide

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Association Study of Urolithiasis in a Japanese Population. J Am Soc Nephrol. 2019 May;30(5):855–864.
7- Elder JS. Urinary Lithiasis. in: Kleigman RM, Behrman RE, Stanton BF Geme St, Schor NF, editors. Nelson textbook of pediatrics 21th ed. Philadelphia: Saunders. 2020: p. 2835-2840.
8- Dawn S. Milliner. Urolithiasis. In: Avner ED, Harmon WE, Niaudet P, et al. Pediatric nephrology. 7th ed. Baltimore: Lippincott Williams & Wilkins. 2016: p.1405-30.
9. Miah T, Kamat D. Pediatric Nephrolithiasis: A Review. Pediatr Ann. 2017 Jun 1;46(6):e242-e244.
10. Roberson NP, Dillman JR, Reddy PO, DeFoor W Jr, Trout AT. Ultrasound versus computed tomography for the detection of ureteral calculi in the pediatricpopulation: a clinical effectiveness study. Abdom Radiol (NY). 2019 May;44(5):1858-1866.
11. Roberson NP, Dillman JR, O'Hara SM, DeFoor WR Jr, Reddy PP, Giordano RM, et al. Comparison of ultrasound versus computed tomography for the detection of kidney stones in the pediatric population: a clinical effectiveness study. Pediatr Radiol. 2018 Jul;48(7):962-972.
12. Dillman JR, Kappil M, Weadock WJ, Rubin JM, Platt JF, DiPietro MA, et al. Sonographic twinkling artifact for renal calculus detection: correlation with CT. Radiology. 2011 Jun;259(3):911-6.
13. Sim KC. Ultrasonography of acute flank pain: a focus on renal stones and acute pyelonephritis. Ultrasonography. 2018 Oct;37(4):345-354.
14. Khan SR, Pearle MS, Robertson WG, Gambaro G, Canales BK, Doizi S, et al. Kidney stones. Nat Rev Dis Primers. 2016 Feb 25;2:16008.
15. Hoppe B, Kemper MJ. Diagnostic examination of the child with urolithiasis or nephrocalcinosis. Pediatr Nephrol. 2010;25(3):403-413.
16. Kokorowski PJ, Hubert K, Nelson CP. Evaluation of pediatric nephrolithiasis. Indian J Urol. 2010;26(4):531-535.
17. Rajma J, Arun AC, Ganesapillai M. Clinical profile of urolithiasis among hospitalized children- a single center study. Int J Pediatr Res. May 2017;4(5):343-349.

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