

# Urolithiasis in infants

Jallouli Mohamed · Mhiri Riadh · Nouri Abdellatif

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**Abstract** There are few publications about urolithiasis of the new born baby and infant (UNI). The UNI represents 20% of the pediatric urolithiasis. The etiologies in this age group are chiefly dominated by the urinary-tract infections and metabolic abnormalities. The purpose of this paper was to investigate the epidemiological and clinical characteristics of infant urolithiasis and to define the various treatment modalities adapted to this age group.

**Keywords** New born baby · Pediatric · Extra-corporeal lithotripsy · Ureteroscopy

## Introduction

There are few publications about urolithiasis of the new born baby and infant (UNI). UNI is the out product of different metabolic, genetic, nutritional, and anatomic disorders. The UNI is to be distinguished from that of older patients by a special physiology of the kidney and the phosphocalcic and acidobasic

metabolism. The etiologies are chiefly dominated in this age group by the urinary-tract infections and metabolic abnormalities. These particularities as well as the occurrence of the lithiasis at a very early age explain the difficulty of the etiological investigation, which is essential to prevent recurrences. The treatment of this pathology has largely benefited from the extension of application of the extra-corporeal lithotripsy (ESL) and lately of the ureteroscopy among infants.

## Epidemiological and clinical characteristic

The UNI represents 20% of the sum total of pediatric lithiasis in the literature [1–3]. A clear masculine preponderance is observed among infants. The sex ratio varies from 2 to 8 [3–5]. In the absence of prematurity or hospitalization in the intensive care unit, the UNI was very rare before the age of 5 months. Only two prenatal diagnoses of the nephrocalcinosis was reported in the literature [6, 7]. The major symptom is the urinary-tract infection. The urine culture was positive in 94% in Lottmann's group [5] and positive in 75% in our group [3]. The germ that has so frequently been met in both groups is *Proteus mirabilis*. The other circumstances of the discovery are hematuria, anuria, sharp retention of urine, dysuria, and spontaneous elimination of the calculus. In the western reviews, the urolithiasis is frequently observed in the upper urinary tract and the proportion of the vesical lithiasis does not exceed 10% [1, 4]. In the developing countries, however, the upper lithiasis is as frequent as the lower one. This shows that the UNI profile in these countries is in an

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J. Mohamed (✉) · M. Riadh  
Department of pediatric surgery, Hedi Chaker Hospital,  
3029 Sfax, Tunisia  
e-mail: mohamed.jallouli@rns.tn

N. Abdellatif  
Department of pediatric surgery,  
Fattouma Bourguiba Hospital,  
5000 Monastir, Tunisia

J. Mohamed · N. Abdellatif  
Tunisian Research Group of Pediatric Urolithiasis,  
Research unit: 02/UR/08-26, Sfax, Tunisia

intermediary situation between the developed and the under developing countries [3].

### Radiological exploration

The simple X-ray remains the first examination to realize if the calculus is radiopaque in 90% of the cases [4]. Ultrasound is apt to confirm the renal seat of the unprepared urinary arbor opacities, to detect urinary tract lithiasis or nephrocalcinosis among the patients at risk (premature, metabolic diseases, digestive derivation), to follow up the lithiasic patients (mensuration, number, and seat of the calculus), to evaluate the reflux on the upper urinary tract, and to help a better pre-operative localization of the renal calculi. Ultrasound is quite limited in the case of lumbarureter calculi. It is particularly useful in the detection and follow up of the radio-transparent calculi [8]. In spite of the considerable contribution of ultrasound, the intravenous pyelography remains useful in identifying the different anatomic anomalies behind the urinary stasis and calculi formation. Yet, their indication and interpretation among infants are not always easy. Recently, unenhanced computerized tomography CT has been proposed as the method of choice in diagnosing urinary tract calculi due to its high sensitivity, specificity, and detail [9, 10]. Its most important disadvantage is the high radiation dose and high cost [11], which limits this utilization in the developing countries. However, two important advantages of CT are short duration of examination and the absence of contrast medium administration [10]. Additionally, by measuring the density of detected stones, CT provides information useful in treatment planning. Cystographic indications in the lithiasic pathology do not make the consensus [12]. It mainly enhances the detection of a vesico-ureteral reflux, which can either be a cause or a consequence of lithiasis. This cystography is justified whenever there are frequent infectious complications or huge ureteral or uretero-pyelocalic dilatation in the absence of a visible obstacle in the lower ureter.

### Etiological investigation

The etiological investigation in search of a causal disease is essential in determining the rationale behind a preventive treatment adapted for each patient. In the case of infants, this investigation should include three stages:

1. An anamnestic investigation targeting the familial and personal antecedents and the genetic and environmental risk factors.
2. A radiological stage.
3. A biological stage and a study of the cristalluria and a chemical analysis of the calculus [13–16].

This investigation should be multidisciplinary with the collaboration of the pediatric nephrologist, pediatric radiologist, pediatric surgeon, and the biochemist. The perinatal antecedents have a special value among infants (prematurity, hypotrophy, and materno-fetal infection). Prematurity is an important risk factor of urolithiasis or nephrocalcinosis. In the case of prematurity, 16% of the new born premature develop a nephrocalcinosis or a urolithiasis. This seems to have multifarious origins: the association of a severe prematurity, a major respiratory distress and the administration of gentamycin, and/or of furosemide, and/or of vancomycin [17]. The masculine sex is another risk factor in the case of the premature new born [17]. A series of the gastroenteritis and dehydration should be tracked. Dehydration leads to the crystallization of the ammonium urate owing to a tendency towards a secondary hyperammoniuria amplified by a phosphorus deficiency and a hyperuricosuria, which can be transitory due to a tubular immaturity [15, 16, 18]. The antecedents of urinary tract infection must be investigated. However, the relationship between urinary tract infection and urolithiasis is not always evident. The question is whether the urinary tract infection is the cause or the consequence of urolithiasis [14]. In the pediatric literature, the frequency of the metabolic anomalies varies from 15 to 90% of cases. This huge variation can mainly be explained by the lack of agreement on the worth of the urinary biology among children and chiefly among infants [19]. Unquestionably, the best results in the identification of the causes of the lithiasic diseases are those which derive from the physical analysis of the calculus and the study of the cristalluria in the etiological approach [18, 20]. The simple execution, the quick results, and the high sensitivity make infrared spectrophotometry the best technique in the analysis of lithiasis. The small quantity required for the analysis is a valuable advantage particularly for the very calculi spontaneously eliminated [16]. The spectrophotometric data in the literature shows that the nucleus of the calculi is essentially phosphatic among infants [4]; in our group [3], however, its composition is basically uratic. The high proportion of the vesical endemic lithiasis in the developing countries can explain the discordance between these results and the recent findings of the western literature.

## Treatment

Up until the beginning of the 1990s, surgery was the only available modality for the treatment of the UNI. From 1990 onwards, two minimally invasive techniques were developed, leading to a real revolution in the management of these patients. The first and most spectacular breakthrough was extension of the application of ESL to this age group, and the second breakthrough was ureteroscopy following the enormous technological progress in the manufacture of endoscopes. The ESL is nowadays the best treatment to control child and infant urolithiasis from hemostasis troubles [5, 21]. The majority of authors agree that the effective fragmentation among infants is, in part, due to the recent and thus less hard lithiasis and to the good compliance with the urinary tract, which enhances the elimination of the calculous fragments [19, 22, 23]. Many studies have shown that ESL is an effective treatment, which can be safely applied to the pediatric population and even to the developing kidneys [5, 21, 24–26]. Some technical specificities are essential in the case of the infant: a pre, per, and post- ESL hyperhydration, a necessity of general anaesthesia to decrease the respiratory movements, and the ultrasound fix to prevent irradiation and to protect the lungs. The size of the calculus is not a contraindication of the ESL. The negative indications of the ESL are: the cystine calculi, the uric acid calculi, the nephrocalcinosis, the lithiasis associated with the obstructive malformative uropathy, the vesical calculi, and untreated urinary infection. Ureteroscopy for the treatment of urolithiasis in the pediatric population has become more common with the advent of smaller instruments and video equipment. Although availability of smaller caliber semirigid or flexible ureteroscopes (4,5 Fr) has made access of the ureteral orifice easier, it can still be a challenge because of the smaller size of the pediatric orifice compared to that in adults [27].

Many ureteral orifices are too tight to allow advancement of the ureteroscope in infants and may require active dilation. According to Minevich [28], there is a belief (albeit unproved) that controlled dilation using the balloon dilator or a gradually dilating catheter may be less traumatic to the ureter than dilation with the ureteroscope itself. However, a caveat regarding the first approach is that there is a possibility (again unproved) that it may be associated with an increased risk of ureteral strictures and/or vesicoureteral reflux (VUR). Until definitive studies of any risks associated with ureteral dilation are undertaken, the decision to perform ureteral dilation will likely depend on surgeon preference and complication rate stemming

from the procedure. If dilation is necessary to advance the ureteroscope, gradual dilation is preferred using ureteral dilators, which we believe cause the least possible trauma to the intramural orifice. The dilation enables traumatic introduction of ureteroscopy and a quite safe extraction of the big fragments [29]. The calculi can be removed intact with a basket-catheter (Dormia type) or fragmented by the ballistic lithotripsy or vaporized by the YAG Homium Laser. The use of the YAG Homium Laser seems to be a good method as regards the small diameter of the laser fiber and its effectiveness on the uric acid calculi [29, 30]. The double J catheter is most often used and maintained from 1 to 4 weeks. This attitude does not make the compromise, however. Schuster, for instance, has resorted to the ureteral drainage only when the procedure lasted more than 90 min or when there were ureteral traumatic lesions in front of the seat of the lithiasis [29]. The success rate of the ureteroscopy varies from 77 to 100% [21, 31, 32]. The dilation of the ureteral intra-wall course does not seem to enhance the vesico-ureteral reflux. Once it appears, the reflux is transitory and asymptomatic for many writers [33, 34]. The early complications of the ureteroscopy are the ureteral perforation, which needs to be drained by the double J catheter and the acute post-operative pyelonephritis, which can be prevented by a systematic antibioprophyllaxis during the operation. Many recent publications report the application of the percutaneous nephrolithotomy to the UNI [35, 36]. Nevertheless, the percutaneous nephrolithotomy is an invasive technique for the young infant (hemorrhage, hypothermia, and irradiation), which requires an expensive technical plateau the equipment of which remains inadequate. The fragmentation and the extraction of the calculus are tedious with the use of very small instruments. Moreover, there is a decline in the frequency of use of this technique in the long-term treatment of infants. Surgery is still valuable in the case of the mini-invasive methods contraindications or their failure. It is the most suitable method for the vesical calculi [37–39]. The medical treatment or watchful waiting keeps precise indication including stone less than five millimeter size as well as the stone of the premature, at the cost of regular clinical and radiological follow-up of patients [19, 38, 39]. In our study, open surgical procedures were performed in 60 patients (94%), 2 were treated by ureteroscopy and 2 patients were treated medically [3]. The proportion of surgical procedure in our study was higher than that in other recent series. In our country, open surgery may remain important due to the prevalence of large stones and calculi, and essentially due to the rarity of equipment for lithotripsy and

endourology in most pediatric surgical units. We think also that the treatment options in infants, such as ESWL and ureteroscopy, require careful assessment and sound judgment that can only be gained through experience and a long learning curve, at a special referral unit developed to handle such cases.

## Conclusion

UNI is an important urological problem. An exhaustive etiologic investigation, including metabolic evaluation and stone analysis, should be obligatory. The control of the UNI should be carried in well-qualified multidisciplinary centers with an excellent mastery of the different therapeutic means. After stone removal, infants should be followed carefully with respect to stone recurrence and renal function. The prevention is intended to avoid the appearance of the lithiasis among the healthy subjects. It is chiefly applicable to the hereditary lithiasis or to the infants at risk (prematurity and digestive derivation)

## Notice

The majority of the references cited in the text included in their series infants and or new born.

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