

# Urolithiasis in pregnancy

Stavros Charalambous · Asterios Fotas · D. E. E. Rizk

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**Abstract** Urolithiasis is the most common cause of urological-related abdominal pain in pregnant women after urinary tract infection. The disease is not uncommon during pregnancy occurring in 1/200 to 1/2,000 women, which is not different from the incidence reported in the nonpregnant female population of reproductive age. During pregnancy, the frequency of stone localization is twice as higher in the ureter than in the renal pelvis or calyx, but there is no difference between the left and right kidney or ureter. Urinary stones during pregnancy are composed mainly of calcium phosphate (hydroxyapatite) in 74% of cases and calcium oxalate in the remaining 26% (Ross et al., *Urol Res* 36:99–102, 2008). In conclusion, urolithiasis during pregnancy can be serious, causing preterm labor in up to 40% of affected women. The pathogenesis, diagnosis, and management are analyzed.

**Keywords** Pregnancy · Ureteroscopy · Urolithiasis

## Introduction

Urolithiasis is a prevalent disease in women that is commonly encountered in urological practice. The current

evolution of medical technology has greatly assisted both in the diagnosis and treatment of this condition in nonpregnant women. In pregnancy, however, the physio-anatomical changes that normally occur in the urinary tract and the presence of the fetus, respectively, may complicate the clinical presentation and subsequent management of urolithiasis. Since most subspecialty curricula and training programs of urogynecology/female urology now include urinary tract disorders during pregnancy as a core component, an updated presentation of urolithiasis during pregnancy is important.

Urolithiasis is the most common cause of urological-related abdominal pain in pregnant women after urinary tract infection [1, 2]. The disease is not uncommon during pregnancy occurring in 1/200 to 1/2,000 women, which is not different from the incidence reported in the nonpregnant female population of reproductive age [3]. During pregnancy, the frequency of stone localization is twice as higher in the ureter than in the renal pelvis or calyx, but there is no difference between the left and right kidney or ureter. Urinary stones during pregnancy are composed mainly of calcium phosphate (hydroxyapatite) in 74% of cases and calcium oxalate in the remaining 26% [4]. Urolithiasis during pregnancy can be serious causing preterm labor in up to 40% of affected women [5].

## Pathophysiology

During pregnancy, there are physiological and anatomical changes in the urinary tract mainly affecting the upper compartment. Gestational hydronephrosis occurs in 90% of pregnant women beginning from 6 to 11 weeks of pregnancy and resolving by 4 to 6 weeks after delivery [5]. Hydronephrosis of pregnancy results from both

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S. Charalambous (✉) · A. Fotas  
Department of Urology, Ippokratia General Hospital,  
49 Konstantinoupoloes Street,  
Thessaloniki 54642, Greece  
e-mail: st.charalambous@ippokratia.gr

D. E. E. Rizk  
Department of Obstetrics and Gynecology, Faculty of Medicine,  
Ain Shams University,  
Cairo, Egypt

hormonal and mechanical factors. It is traditionally believed that the high levels of serum progesterone during pregnancy is mainly responsible by causing relaxation of the ureteric smooth muscles, thereby decreasing the peristalsis and producing dilatation of the ureter. Recent studies, however, suggest that gestational hydronephrosis is primarily caused by mechanical compression of the ureters by the growing uterus and/or congested right ovarian vein, thus, explaining the occurrence of hydronephrosis mainly in the right kidney during pregnancy [1].

The glomerular filtration rate (GFR) and renal plasma flow (RPF) are both increased by 20–25% during pregnancy [2]. These changes are attributed to the hemodynamic effects of increased cardiac output and decreased vascular resistance during pregnancy as well as increased circulating levels of natriuretic hormones like progesterone, aldosterone, deoxycortizone, and human chorionic gonadotrophin and raised urinary excretion of osmotically active metabolites like glucose, amino acids, proteins, and vitamins. This results in a net increase in renal volume of up to 30% during the 9th to 11th week of gestation. Increased production of prolactin in pregnancy also contributes to this gestational nephromegaly via its growth hormone-like action.

As a result of increased GFR and RPF, urinary excretion of both stone-forming substances such as sodium and uric acid and inhibiting factors such as citrate, magnesium, glycosaminoglycans, and acidic glucoproteins is increased during pregnancy. There is also a two- to threefold increase in urinary calcium excretion caused by absorptive hypercalciuria and serum oxalate super-saturation as a result of increased production of 1,25-dihydroxycholecalciferol by the placenta [6]. The risk of urolithiasis is not increased during pregnancy, however, because these metabolic changes are counter-balanced by the forced diuresis induced by increased GFR and RPF and by the raised urinary excretion of stone inhibiting factors. This finding may explain why the incidence of urolithiasis in pregnancy is not increased compared to nonpregnant women [2]. The relative frequency of calcium phosphate stones in pregnant women is, nevertheless, much higher than in nonpregnant women because of the pregnancy-induced alterations in calcium homeostasis [4].

## Diagnosis

Urinary stones in pregnant women become clinically manifested during the second and third trimester of pregnancy in 80–90% of patients, but the associated symptoms are not specific [4, 5]. In the largest retrospective series of 80 pregnant women with urolithiasis, the main presentation was gross or microscopic hematuria in 95%

and flank pain in 89% with misdiagnosis of acute appendicitis, diverticulitis, and placental abruption in 28% [5]. Hence, the diagnosis of urolithiasis during pregnancy is mainly established after detection of the stone by imaging. Several imaging modalities have been used in nonpregnant women like conventional KUB radiography, intravenous urography (IVU), ultrasound scan, computed tomography (CT) scan, and magnetic resonance imaging (MRI). Until recently, IVU was the most commonly used imaging procedure in nonpregnant women, but this has been largely replaced by unenhanced spiral CT scan because of greater accuracy [7]. The use of imaging in pregnant women to investigate nonpregnancy-related conditions such as urinary stones remains controversial because of the potential teratogenic, carcinogenic, and mutagenic risks to the fetus [8]. Therefore, any decision to perform these studies during pregnancy should be made after careful counseling of the individual woman about the risks versus the benefits of each imaging technique.

At present, renal ultrasound scan is considered the imaging method of choice for routine evaluation of suspected urinary stones in pregnant women because of absence of radiation exposure and reasonable sensitivity and specificity for stone detection of 34% and 86%, respectively [2, 6–8]. Several measurements have been introduced to increase the sensitivity of ultrasound assessment of urolithiasis during pregnancy. These include measuring the renal pelvic diameter with a cutoff value of 17 mm for both kidneys or of 27 mm for the right kidney and 18 mm for the left kidney during the second and third trimester of pregnancy [5]. Another parameter is the intrarenal resistive index (RI) measured by Doppler ultrasound and calculated as peak systolic velocity/peak diastolic velocity/peak systolic velocity. A RI of one kidney above 0.7 is indicative of upper urinary tract obstruction [9]. Alternatively, if the difference in the RI between the two kidneys is above 0.04, the kidney with the higher RI is considered to be obstructed [2]. In 72 nonpregnant patients with acute renal colic, the affected kidney had a significantly higher RI than that of the normal kidney 6–48 h after obstruction, but there was no statistically significant difference between the RI of both kidneys within the first 6 h [10]. Despite these promising results, the role of renal RI in pregnant women with acute stone disease is still not proven because of the low sensitivity (only 45%) albeit its high specificity and accuracy of 91% and 87%, respectively [11].

Several studies have suggested using a modified or limited IVU in pregnant women with suspected urolithiasis in order to decrease the risk of radiation exposure to the fetus. However, the data available to date do not support the safety of this technique in pregnancy, and there is also limited information on the effect of different contrast agents used during the procedure on the fetus [12]. Therefore, the

use of limited or modified IVU in pregnant women with urolithiasis should be discouraged. Likewise, the use of radioisotopes at radionuclide renography for the diagnosis of urinary stones during pregnancy is not yet established. Although there is sufficient data about the safety and diagnostic accuracy of this procedure in pregnant women, high fluid intake is indicated after examination to decrease the risk of radiation exposure by inducing diuresis and frequent voiding for rapid excretion of the radioisotopes [13]. MRI urography is increasingly used to evaluate the urinary tract during pregnancy without any reported teratogenic effects and with a diagnostic sensitivity of 100% in urolithiasis [14]. The only limitation is the service cost; therefore, this procedure should be reserved for patients with equivocal results at renal ultrasound scan. Retrograde pyelography and CT scan may be additional diagnostic aids but cannot be used as routine investigations of urolithiasis during pregnancy because of the theoretical possibility of fetal exposure to high doses of ionizing radiation. In a retrospective review of the use of low-dose CT scan in the evaluation of 20 pregnant women with suspected urolithiasis over 2.5 years, the risk of fetal adverse effects was, however, very low and the sensitivity and specificity for detecting renal calculi were extremely high [15].

## Management

The management of urolithiasis in pregnancy is mainly conservative. In fact, 70–80% of women with symptomatic calculi during pregnancy will be cured spontaneously if treated with hydration, analgesics and antibiotics if there is superimposed infection [1]. The remaining 20–30% of women will require more therapeutic measures. Aggressive medical treatment is tried initially and includes epidural block for pain relief and the use of beta-adrenoreceptor blockers [5]. The latter drug is thought to stimulate the contractility of the renal pelvis and ureter, thus, increasing the urine flow rate and assisting in spontaneous expulsion of the stone.

Indications for operative intervention are renal colic resistant to pharmacological treatment, sepsis, and obstruction in a solitary kidney. Percutaneous nephrostomy or ureteric stents had been used for removal of urinary stones since 1978 and remain the gold standard for surgical treatment. Both procedures are minimally invasive and can be performed under local or general anesthesia in pregnant women. The goal of treatment is to relieve obstruction and prevent further deterioration in renal function. Percutaneous nephrostomy is more cost-effective than ureteric stents and is successful in 90% of patients [1]. Complications include bleeding, dislocation of the tube,

and the need for using an external drainage system. Ureteric stents is equally effective but may be associated with infection necessitating the use of prophylactic antibiotics. Ureteric stents must be replaced regularly in order to avoid encrustation; therefore, the use of stents is preferable at a later stage of pregnancy to minimize anesthetic exposure to the growing fetus [16].

Ureteroscopy is a safe procedure during pregnancy and can be performed with a rigid, semi-rigid, or flexible instrument with good results [17]. The operation usually requires anesthesia, mainly general, and can be complicated by ureteric perforation or sepsis. Ureteroscopy is easier during pregnancy because preliminary dilatation of the ureteric orifices is not needed as a result of the muscle relaxing effects of progesterone and other pregnancy hormones. Fluoroscopy is not also indicated as part of the procedure in pregnancy to minimize radiation exposure. Stone baskets or lithotriptors (pneumatic or laser) can be used safely in pregnancy. Ureteroscopy is technically possible anytime during pregnancy but is better avoided during the third trimester because of the anatomical changes in the bladder secondary to compression by the gravid uterus [18]. The experience and training of the urologist is an important factor determining the outcome and complications of the procedure particularly in patients with a solitary or nonfunctioning kidney. In a recent meta-analysis of 14 reports about the use of ureteroscopy in 108 pregnant women with urolithiasis, there was no significant difference in the complication rate compared to nonpregnant women indicating that ureteroscopy should be considered a first-line treatment of stone disease during pregnancy [19]. Other endo-urological techniques such as extracorporeal shockwave lithotripsy (ESWL) or percutaneous nephrolithotomy should be avoided during pregnancy because of radiation risk associated with the prolonged operation time. In a previous study, however, six women had been treated with ESWL during the first trimester with good outcome and without any reported teratogenic effects in their children [20].

Open surgical treatment such as ureterolithotomy, pyelolithotomy, or nephrolithotomy should be considered in rare cases of urolithiasis during pregnancy with severe sepsis when other endourological procedures fail. In such cases, the woman should be informed about the postoperative risk of preterm labor because this is directly related to the duration of pregnancy at operation. The reported risk in one study was 6.5%, 8.6%, and 11.9% for the first, second, and third trimesters, respectively [5]. Finally, patients with urolithiasis during pregnancy should be referred to the urologist after delivery for further assessment and radical therapy. More importantly, women with known history of urolithiasis or metabolic diseases predisposing to urinary stone formation should be evaluated with a metabolic stone profile before planning pregnancy.

**Conflicts of interest** None.

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