

Current approach for urinary system stone disease in pregnant women

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Summary *Urinary system stones can be classified according to size, location, X-ray characteristics, aetiology of formation, composition, and risk of recurrence. Especially urolithiasis during pregnancy is a diagnostic and therapeutic challenge. In most cases, it becomes symptomatic in the second or third trimester. Diagnostic options in pregnant women are limited due to the possible teratogenic, carcinogenic, and mutagenic risk of foetal radiation exposure. Clinical management of a pregnant urolithiasis patient is complex and demands close collaboration between patient, obstetrician and urologist. We would like to review current diagnosis and treatment modalities of stone disease of pregnant woman.*

KEY WORDS: *Urinary stone disease; Pregnancy; Hydronephrosis; Renal colic.*

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INTRODUCTION

Urinary system stone disease affects 10% of the population in a life time. The increase in this rate in the last decade is attributed to the developing imaging methods and more frequent use of imaging as well as to dietary habits, changing climate conditions, increasing obesity and diabetes mellitus (DM) (1-4). Although urinary stone disease used to be more widespread amongst men, the difference between genders disappeared with the increase of urinary system stone incidence in women (2, 5). Urinary stone disease is observed in one in 500 pregnant women, but there is no difference in prevalence when pregnant and non-pregnant groups of similar age are compared (6-13).

In pregnant women, the most noticeable cause of admission to hospital for non-obstetric purposes is urinary system stone disease (14, 15). The causes of this condition are the anatomical and physiological changes observed in pregnant women in the structure of urinary system and in the chemical properties of urine. These changes were summarized in the Table 1. Increasing progesterone causes dilatation in the smooth muscles of urinary system and dilation and stasis occur in the urinary system as a result of mechanical pressure from the fetus. Increasing glomerular filtration, calcium supple-

ment treatments and increased vitamin D level increase calcium excretion in the urine (13, 16-25). Furthermore, uric acid, sodium, oxalate and other lithogenic factors show increase during pregnancy (7, 19, 20). Calcium phosphate stones are observed in 75% of the pregnant women, whereas in general population usually calcium oxalate stones are prevalent (10, 14, 26-31).

Urinary stone disease involves some risks for the pregnant woman and her fetus. Though data are contradictory, preterm delivery, miscarriage, premature rupture of membrane, recurrent miscarriages and preeclampsia might be included among these risks (9, 11, 31-36). Importance of diagnosis and treatment of urinary stone disease is evident considering the complications that might be encountered.

DIAGNOSIS

The gold standard for the diagnosis of urinary stones in non-pregnant patients is computed tomography (37-42). However, its application in pregnant women is limited due to teratogenic effects of radiation. Therefore, the most appropriate first-choice diagnostic tool in pregnant women, despite its 60-78% sensitivity, is gray scale ultrasonography (USG) (43-46). Ureteral stones might be difficult to demonstrate with USG given to their localization; in this case, assessing resistive index (RI) (> 0.70) with Doppler USG (cDUSG), whose popularity has increased in recent years, will drive the sensitivity up to 90% in order to display the presence of obstruction (although the stone cannot be shown) (47, 48).

Although RI evaluation will not reveal the cause of obstruction, it is crucial in terms of showing the necessity of intervention. In pregnancy, dilation is observed three times more in the right kidney than it is in the left and it mostly occurs in the mid-trimester. Reasons for more frequent observation of dilation in the right kidney might be listed as: sigmoid colon's relative protection of the left ureter from pressure in the left side, high stress and pressure in the right ureter due to the more proximal intercrossing of iliac veins by right ureter and as the most important factor, dextro-rotation of growing uterus in midtrimester (49-50). Transvaginal USG might also be useful in distinguishing this physiological hydronephrosis, observed almost in 90% of the pregnant women, from

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ureter stones in the distal part of ureter (13, 23, 51). If the accuracy of diagnosis is doubted, then Magnetic Resonance Urography (MRU) can be used as a second option. MRU is comparable to CT and has the advantage of requiring safe and effective contrast media (52-55). At MRU, stones appear as storage defects and at the same time MRU may inform the physician of other causes that might lead to obstruction and about organs outside the urinary system. Popularity of low dose CT (0.97-1.9 mSv) with decreased radiation risk, as a last resort, has been increasing in the last years due to its high sensitivity (96.6%) and specificity (94.9%) (56-60). Their insufficiency in diagnosis and the risk of complications they trigger during pregnancy, limit the use of direct urinary system graphy (DUSG), intravenous urography (IVU), scintigraphic methods and magnetic resonance imaging (MRI) (31, 61-65). As above reported, the sensitivity and specificity of imaging methods that can be applied during pregnancy are inadequate and the risks of those with high sensitivity limit their use during pregnancy. Because of these reasons, urinary stone disease in pregnant women is already complicated at the stage of diagnosis. In a study, the rate of negative ureterorenoscopy (URS) in pregnant women was found to be 14% (66). Since the physiologic dilation (depending on fetal pressure especially in the right side) can be misdiagnosed as obstruction by a stone of the distal part of the ureter, the role of imaging methods become prominent to avoid invasive procedures based on false positive and the complications that could occur as a result.

TREATMENT MODALITIES

Due to potential complications, diagnosis and treatment of urinary system stone disease in pregnant women should be closely followed with a multidisciplinary approach by an urologist, a neonatologist, an anesthetist and an obstetrician. In order to minimize the complications, the primary method should be the conservative treatment. In a study conducted by Skolarikos et al., conditions that make patients eligible for conservative treatment are listed as: single stone, smaller than 1 cm and with no infection; effective pain management and conserved oral intake (67). Most of the pregnant women with kidney stone can receive conservative treatment (17, 68, 69). Ureter stones become symptomatic mostly in the midtrimester and this necessitates an intervention (45, 70). In non-pregnant patients spontaneous passage is reported to be 68% in patients with < 5 mm stone size and 47% in those with > 5 mm stone size (71), whereas during pregnancy spontaneous passage rate is 70-80%, with some women experiencing spontaneous passage after delivery at a rate of 50% (17, 11, 31, 34, 36, 69, 72, 73). Although some authors argue that spontaneous passage during pregnancy would be higher due to physiologic ureteral dilatation, there are others who think otherwise (10). Because of the limitations in diagnostic methods, the rate of false positive results is high and is reported as high as 23% according to the results of a study (74). For this reason, they argued that the high rate of spontaneous passage is based on misdiagnosis. In conservative approach, patients must be attentively fol-

lowed with physical examination, vital findings, total blood count, blood biochemistry and USG.

a) MET (Medical Expulsive Therapy)

In addition to conservative treatment, spontaneous passage rate can be increased by medical expulsive therapy (MET) in these patients. As a part of MET, alpha blockers and calcium channel blockers can be safely used during pregnancy (75).

As some patients are not eligible for MET and conservative treatment, the treatment may also fail in others who fit. In particular, fever, infection and obstetric complications are indicative of intervention to the stone. Also solitary kidney or occurrence of bilateral obstruction necessitate immediate intervention. Finally, intervention must be taken into account in the case of intractable pain, oral intake problems and stones that are larger than 1 cm (76). Cardio-pulmonary changes during pregnancy and limitations in imaging further complicate treatment environment (17). Therefore, intervention team must be composed of an experienced urologist, an obstetrician, a neonatologist, a radiologist and an anesthetist and the patient should be closely followed and monitored.

Intervention is necessary in aforementioned conditions, however, another crucial point is whether it will be a temporary drainage or a definitive treatment. Moreover, the question of whether the percutaneous drainage or the retrograde ureteral stenting is more convenient needs to be answered. With the technological advances in recent years definitive treatment became more prominent and ureterorenoscopy (URS) too is more frequently preferred (17, 77). However, extracorporeal shock wave lithotripsy (ESWL) and percutaneous nephrolithotomy (PCNL) are still contraindicate in pregnant women (78-80).

b) URS (Ureterorenoscopy)+Lithotripsy

Endourologic intervention is being increasingly preferred in line with the fast development of endourology in concert with technological advances. With the miniaturization of URS and enhancement of imaging quality, use of baskets, stone cone and lasers to this process was accelerated. In addition to this, development of monitoring methods used in post-operative follow-up of the patient and fetus also contributes to the process. Besides all these developments, the risk of surgery and the complexity of the procedure should be kept in mind and shared explicitly with the patients. If the definitive treatment is decided, an experienced team, new equipment and post-operative monitoring must be provided.

URS, which is a definitive treatment method, can be applied under spinal or general anesthesia and is a successful procedure considering the results. In a meta-analysis of 14 studies, complication rates of 108 pregnant women who were administered URS were found similar with that of general population and as a consequence the safety and efficiency of URS during pregnancy was highlighted (81). In recent years, records of pregnant women who were administered URS were published and results were reported in Table 2 (26, 82-87). Furthermore, a study carried out by Johnson et al. involving 46 patients reported 2 premature labors, one resulting in delivery (86). If the patient suffers from an active infection or has

Table 1.
Physiologic changes in the kidney occurring during pregnancy.

Physiologic changes in the kidney occurring during pregnancy Stone-inducing factors	Physiologic changes in the kidney occurring during pregnancy Stone inhibitors factors
<ul style="list-style-type: none"> * Renal blood flow increases, leading to a 30% to 50% rise in glomerular filtration rate * Increases the filtered loads of calcium, sodium, and uric acid (McAleer and Loughlin, 2004) * Hypercalciuria is further enhanced by placental production of 1,25 (OH) 2D3, which increases intestinal calcium absorption and secondarily suppresses PTH (Gertner et al, 1986; Biyani et al, 2002) * Hyperuricosuria has also been reported as a result of increased filtered load of uric acid (Swanson et al, 1995) 	<ul style="list-style-type: none"> * Increased excretion of citrate, magnesium, glycoproteins, uromodulin, and nephrocalcin (increased GFR) (Maikranz et al, 1987; Smith et al, 2001).

Table 2.
Complication rates of ureteroscopy during pregnancy.

Literature	Patients (N)	Complications N (%)
Semins et al. (81) Meta-analysis of 14 studies	108	9 (8.3) – ureteral perforation (1), premature contractions (1), postoperative pain (2), UTI (5)
Travassos et al. (83)	9	0 (0)
Rana et al. (84)	19	0 (0)
Polat et al. (82)	8	0 (0)

fever, URS is contraindicate because in this case applying a procedure that would drive up the pressure in collecting tubules would aid to infection's progress, and therefore the obstructed system must be immediately drained. Temporary drainage methods should also be applied in case of oversized stone, complex anatomy, bilateral obstruction, obstetric complications, first trimester and being close to delivery (77, 88). In deciding the method, experience of the physician, preference of the patient and the available options are to be considered.

c) Temporary Drainage: Percutaneous Nephrostomy (PCN) or Double J Stenting (DJS)

DJS and USG with PCN are the most frequently employed methods in the treatment of urinary obstructions (89, 90). Despite its advantages such as only requiring quick and minimal anesthesia, temporary drainage also has many disadvantages. In addition to inadequacy of temporary drainage in comparison to definitive treatment, disruption of the treatment, as the family focuses on the child, may also result in forgotten stent cases. Physiologic changes during pregnancy involve the necessity of multiple procedures because encrustation of the catheter is accelerated requiring substitution every 4-6 weeks (91-93). This drives up the cost and endangers both the mother and the fetus.

Inability to tolerate temporary drainage, catheter migration and bacterial colonization makes it sometimes unbearable for the patient.

Percutaneous nephrostomy is a procedure first described by Goodwin et al. in 1955 (94). Up to today, it is effectively used under local anesthesia with 98-100% success rate in obstructed systems (95). Major complication rate of PCN is 6% whereas minor complication rate is about 28% (96). According to these rates, it is not at all an harmless procedure. Therefore, patients that will undergo this procedure must be chosen with caution. If PCN has to be placed in an obstructed and infected system, a wide spectrum antibiotic treatment (ampiciline-sulbactam) is mandatory, in other cases a prophylaxis with first-generation cephalosporin is indicated (97, 98).

Important advantages of PCN are the absence of lower urinary system complaints and provides access for later definitive treatment (17, 99).

DJS can be applied with 94.2% success rate with local anesthesia (100). General opinion is that DJS would be more tolerated since it cannot be viewed outside the body by the patient, however it is disadvantageous in terms of causing lower urinary system complaints. Because it could be blocked and bacterial colonization could occur, DJS must be changed every 4-6 weeks (91-93). In fact DJS encrustation and stone formation are

Table 3.
Advantages of DJS and PCN.

DJS	PCN
<ol style="list-style-type: none"> 1. Catheters cannot be observed outside the body 2. Lesser risk of hemorrhage (5C) 3. Interventional radiologist is not needed, any urologist can apply 4. No need for anesthesia 	<ol style="list-style-type: none"> 1. Catheters can be placed in different sizes (8-12 Fr) 2. Catheter can be irrigated 3. Urine can be followed from the implanted kidney 4. Ureteral complications can be avoided 5. Placement can be made with local anesthesia

usually seen in patients that had the stent for more than 3 months (89).

Similar results were reported in studies that compare the success of DSJ and PCN (101) and advantages of DSJ and PCN were listed in Table 3.

Disadvantages of temporary drainage methods emphasize the importance of definitive treatment. However, the most important factors in deciding the treatment are assessing the patient, considering the contraindications, experience of the physician and patient's decision on treatment made in full awareness of the risks (77).

CONCLUSION

Both the diagnosis and the treatment of urinary system stone disease is difficult during pregnancy. In deciding the treatment, success of the method, its convenience and the risks that the mother and fetus may suffer from must be considered. After these considerations, patients must be informed of all possible risks, and decision should be made by taking into account the experience of the physician, available equipment and preference of the patient. Even when all the conditions are favorable, natural complications of patient population must be regarded and attentively followed.

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