

# Management of urolithiasis in pregnancy

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**Abstract:** Kidney stones are very common and unfortunately do not spare the pregnant population. Anatomical and pathophysiological changes occur in the pregnant female that alter the risk for development of nephrolithiasis. Acute renal colic during pregnancy is associated with significant potential risks to both mother and fetus. Diagnosis is often challenging because good imaging options without radiation use are limited. Management of diagnosed nephrolithiasis is unique in the pregnant population and requires multi-disciplinary care. Herein, we review the metabolic alterations during pregnancy that may promote kidney stone formation, the complications associated with acute renal colic in the pregnant state, and our proposed diagnostic and management algorithms when dealing with this clinical scenario.

**Keywords:** kidney stones, nephrolithiasis, pregnancy

## Introduction

Kidney stones afflict 10% of the population during their lifetime and over the past two decades this statistic has risen, thought to be caused by diet, climate changes, and a concurrent rise in comorbidities like diabetes and obesity.<sup>1-5</sup> This increase in stone events has been quite dramatic for women and incidence is now close to equal between sexes, while previously it was far more common in men.<sup>3,6</sup> While this rise has not necessarily been observed in pregnant females, this population is still affected by kidney stones, which occur in 1 in 200–1,500 pregnancies.<sup>7-13</sup>

The top cause for nonobstetric hospital admission during pregnancy is acute urolithiasis.<sup>14,15</sup> Anatomical and pathophysiological changes occur in the pregnant female to alter the urinary environment (Table 1). Elevated progesterone and mechanical compression cause urinary stasis. Increased glomerular filtration rate, calcium supplementation, and increased circulating Vitamin D levels lead to elevated urinary pH and hypercalciuria.<sup>16-27</sup> Uric acid, sodium, and oxalate, all lithogenic factors, also all have increased urinary excretion during pregnancy.<sup>8,19,20</sup> These changes promote calcium phosphate stone formation. Up to 75% of pregnant patients with kidney stones have calcium phosphate stones in contradistinction to the general population where calcium oxalate is the most common stone type.<sup>11,14,28-33</sup>

Renal colic has been associated with multiple potential risks to mother and fetus including preterm labor, preterm delivery, preterm premature rupture of membranes, recurrent pregnancy losses, and mild preeclampsia, but data are somewhat mixed.<sup>10,12,33-38</sup> These potential complications make accurate diagnosis crucial.

Renal ultrasound is considered first-line because the gold standard for diagnosis in the non-pregnant state, computed tomography (CT), involves radiation use, which

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**Table 1** Changes in pregnancy affecting stone risk

Stone promotion (mechanism)	Stone inhibition (mechanism)
Urinary stasis (mechanical compression, progesterone)	Hypercitraturia (increased GFR)
Lithogenic factors	
Hypercalciuria (increased GFR, increased vitamin D)	Increased excretion: magnesium, glycosaminoglycans, uromodulin, and nephrocalcin (increased GFR)
Elevated urine pH	
Increased excretion: uric acid, sodium, and oxalate (increased GFR)	

**Abbreviation:** GFR, glomerular filtration rate.

is avoided during pregnancy because of teratogenic risks and risk of childhood malignancy. Ultrasound has a poor sensitivity and one group only identified stones 60% of the time during pregnancy.<sup>39–41</sup> Transvaginal ultrasound can be helpful to evaluate distal ureter and distinguish obstruction from physiological hydronephrosis of pregnancy which can occur in up to 90% of patients.<sup>23–25,42</sup> When results are equivocal, half Fourier single shot turbo spin echo (HASTE) magnetic resonance urography (MRU) without contrast is safe, effective, comparable to CT accuracy, and now considered second-line during pregnancy when available.<sup>43–46</sup> It visualizes the stone as a filling defect, evaluates secondary findings of obstruction, and also gives information about non-urolitic organ systems. Low dose CT (fetal radiation dose 4 mGy versus 25 mGy) is highly sensitive and specific, increasing in popularity, but still is last-line given its use of radiation.<sup>47–49</sup> Plain radiography, intravenous urogram, nuclear medicine scans, and magnetic resonance imaging with contrast can be done but all have limitations and risks associated with them during pregnancy.<sup>33,50–56</sup> The need and importance for more accurate diagnosis is elucidated by White et al where they report a negative ureteroscopy rate of 14%.<sup>57</sup> This means that 1 in 7 patients who went to the operating room for assumed nephrolithiasis did not have a stone.

Once the diagnosis of a stone is made during pregnancy, multi-disciplinary decision-making is required given the potential complications that can occur as discussed above (Figure 1). Urology and obstetrics should be in active communication with the patient outlining a plan with close follow-up and monitoring.

First choice, similar to the general population, is always conservative management and trial of passage with hydration and analgesia. Nonsteroidal anti-inflammatory drugs (NSAIDs) are usually avoided during pregnancy and narcotics are generally required. Requirements for this pathway are a

solitary stone less than 1 cm, absence of infection, adequate oral pain control, and ability to tolerate food and liquid. This will be successful 70%–80% of time and 50% of those without spontaneous passage during pregnancy will pass their stones after delivery.<sup>12,33,36,38,58–60</sup> While some have found spontaneous passage rate to be higher during pregnancy, thought to be due to physiological ureteral dilation, others believe the rate to be biased because of higher subject numbers for trial of passage, given surgeon reluctance to operate.<sup>11</sup> Additionally, the rate may be overestimated because of misdiagnosis and poor follow-up; a Mayo clinic series had 23% of patients misdiagnosed and only 48% passage rate.<sup>61</sup> The patient should be followed closely with physical exam, blood work, and ultrasound.

Medical expulsive therapy can be used as an adjunct to trial of passage. Alpha blockers are Category B drugs; they have not been studied in humans but have been shown to be safe in animal studies and are often used during pregnancy. Gestational hypertension and preterm labor are often treated with calcium channel blockers and these are also thought to be safe.<sup>62</sup>

Similar to the general population, some patients are not candidates for trial of passage and some fail conservative management. If fever, infection, or obstetric complications are present then intervention is indicated. Renal insufficiency and anatomical considerations such as solitary kidney or bilateral obstruction also require intervention. More minor indications for further management are refractory pain, intractable nausea and vomiting, stone greater than 1 cm, or non-diagnostic imaging.<sup>63</sup>

If a procedure is needed, experienced anesthesiologists, neonatologists, radiologists, urologists, and obstetricians should be involved. Cardiopulmonary changes during pregnancy make a pregnant woman's management more complex.<sup>17</sup> Temporary drainage versus definitive treatment of the stone is the next decision point in the management algorithm. Only over the last decade has definitive management become an accepted option.<sup>17,64</sup> Risks of surgery were previously thought to be too high and treatment too complex. However, over the last two decades endourology has expanded, and may be one of the most progressive fields within urology. Ureteroscopy is far more sophisticated with miniaturization, advanced visualization, improved deflection, and an immense armamentarium of instruments, baskets, and lasers available. Obstetrics care has also advanced and has improved monitoring technology. Shock wave lithotripsy and percutaneous nephrolithotomy are still contraindicated during pregnancy for a multitude of reasons.<sup>65–67</sup>

**Decision point 1 – conservative management versus intervention**

Option 1: Trial of passage

→ Preferred for all patients unless a criterion (below) exists for intervention

Option 2: Intervention (see decision point 2)

- |   |                           |
|---|---------------------------|
| → Poor pain control                               | → Persistent vomiting     |
| → Signs of infection                              | → Stone size >1 cm        |
| → Abnormal renal function                         | → Bilateral obstruction   |
| → Solitary kidney                                 | → Obstetric complications |
| → Failed conservative management/trial of passage |                           |

**Decision point 2 – temporary drainage versus ureteroscopy**

Option 1: Ureteroscopy

→ Preferred for all patients unless a criterion (below) exists for temporary drainage

Option 2: Temporary drainage with nephrostomy tube or ureteral stent

- |                           |                              |
|---------------------------|------------------------------|
| → Fever/infection         | → Large stone burden         |
| → Multiple stones         | → Altered anatomy            |
| → Bilateral disease       | → Transplant                 |
| → Pregnancy complications | → Inexperienced urologist    |
| → 1st trimester           | → Late 3rd trimester         |
| → Inadequate resources    | → Patient/surgeon preference |

**Figure 1** Algorithm for acute kidney stone event during pregnancy.

Multiple factors are considered when electing temporary drainage versus ureteroscopy. Infection is an absolute contraindication for ureteroscopy and urgent temporary drainage is required when fever is present. Experienced medical teams (surgeon, anesthesiologist, obstetrician, neonatologist), are required if stone treatment is elected. Adequate resources must be available as well (ie, laser, obstetric monitoring, etc).<sup>64</sup> Other reasons to potentially choose temporary drainage include large stone burden, complex anatomy, bilateral stone disease, obstetric complications, presentation in the first trimester, or presentation near full term.<sup>64</sup> Patient and surgeon preference are also important.

While once the preferred and only acceptable method of management, there are many disadvantages to temporary drainage. First and foremost, it is temporary and requires definitive management at a later date post-partum, often during a time that is hectic and focused on a new child. Additionally, multiple procedures may be required during pregnancy, as the physiological variations induce rapid encrustation and exchanges are required every 4–6 weeks.<sup>68–70</sup> This is expensive and each exchange incurs a risk on the pregnancy. Temporary drainage is often not tolerated well. Tubes and stents dislodge, migrate, are uncomfortable, and become colonized with bacteria increasing risk for urinary

infection; patients are often miserable. The advantages of temporary drainage are that it can be done very quickly, with minimal anesthesia and no radiation exposure. Stent versus nephrostomy tube is always the subject of a debate. With regards to infection, study has shown them to be equivalent in outcome.<sup>71</sup> In general though, stent is preferred because it does not require an external tube which can be quite burdensome to the patient. Stents do cause lower urinary tract symptoms, whereas nephrostomy tubes do not. If a large stone burden is present, nephrostomy tubes can assist with future access for definitive treatment.<sup>17,72</sup>

Because of the above-mentioned disadvantages of temporary drainage, definitive treatment with ureteroscopy is often considered and is now accepted as a reasonable and sometimes ideal option (Table 2).<sup>17,64</sup> Patient selection is critical and guided by the contraindications mentioned above. Ureteroscopy can be done under spinal or general anesthesia. Radiation is not required and good outcomes can be achieved using ultrasound alone.<sup>73</sup> An experienced radiologist and/or technician can be involved in the operating room. In 2009 Semins et al performed a systematic review and meta-analysis of 14 reports of ureteroscopy during pregnancy in over 100 patients.<sup>74</sup> Complication rates between the general female population and pregnancy were similar and ureteroscopy was deemed to be safe and effective in the properly selected patient. It is important to remember that these reports are by experienced endourologists with excellent available resources. Over the past 5 years, more groups have published case series reporting acceptable safety profiles and good efficacy for ureteroscopy during pregnancy.<sup>28,75–80</sup> Johnson et al also stresses that a multi-disciplinary approach is critical as they did have 2 patients go into pre-term labor, 1 of which delivered early.<sup>79</sup> Experience, patient selection, and available resources are vital to a good outcome.

**Table 2** Complication rates of ureteroscopy during pregnancy

Literature	Patients (N)	Complications N (%)
Semins et al <sup>74</sup> Meta-analysis 14 studies	108	9 (8.3) – ureteral perforation (1), premature contractions (1), postoperative pain (2), UTI (5)
Travassos et al <sup>76</sup>	9	0 (0)
Rana et al <sup>77</sup>	19	0 (0)
Polat et al <sup>75</sup>	8	0 (0)
Ross et al <sup>28</sup>	21	0 (0)
Bozkurt et al <sup>78</sup>	41	15 (36) – ureteral injury (4), sepsis (1), UTI (4), pain (6)
Johnson et al <sup>79</sup>	46	2 (4) – preterm labor (1), preterm delivery (2)
Hoscan et al <sup>80</sup>	34	12 (35) – uterine contraction (1), UTI (3), other minor (8)

**Abbreviation:** UTI, urinary tract infection.

In conclusion, urolithiasis during pregnancy is more complex than when it occurs in the general population and diagnosis can sometimes be quite challenging. Expectant management is first-line, but if not an option or if it fails, then both temporary drainage and definitive treatment are acceptable secondary management alternatives. Patient and surgeon preference, along with clinical variables and available resources, guide decision-making.

## Disclosure

The authors report no conflicts of interest in this work.

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