Predictive Value of Current Imaging Modalities for the Detection of Urolithiasis During Pregnancy: a Multicenter, Longitudinal Study

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Purpose: We determined the optimal imaging study by which to diagnose and treat pregnant patients with suspected urolithiasis.

Materials and Methods: A retrospective, multicenter study was performed to determine the comparative accuracy of imaging modalities used before the surgical management of suspected urolithiasis in pregnant patients. Patients with a clinical suspicion of urolithiasis were evaluated with directed imaging including renal ultrasound alone, renal ultrasound and low dose computerized tomography, or renal ultrasound and magnetic resonance urography. When indicated, patients underwent therapeutic ureteroscopy. The rate of negative ureteroscopy was determined and the positive predictive values of the imaging modalities were calculated.

Results: A total of 51 pregnant patients underwent ureteroscopy. The mean age of the cohort was 27 years. Mean gestational age was 24.4 weeks. Of the women 24 (47%) underwent renal ultrasound and low dose computerized tomography, 22 (43%) underwent ultrasound alone, and 5 (10%) underwent renal ultrasound and magnetic resonance urography. Negative ureteroscopy occurred in 7 of the 51 patients (14%). The rate of negative ureteroscopy among patients who underwent renal ultrasound alone, renal ultrasound and low dose computerized tomography, and renal ultrasound and magnetic resonance urography was 23%, 4.2% and 20%, respectively. The positive predictive value of computerized tomography, magnetic resonance and ultrasound was 95.8%, 80% and 77%, respectively.

Conclusions: The rate of negative ureteroscopy was 14% among pregnant women undergoing intervention in our series. Of the group treated surgically after imaging with ultrasound alone, 23% had no ureteral stone, resulting in the lowest positive predictive value of the modalities used. Alternative imaging techniques, particularly low dose computerized tomography, offer improved diagnostic information that can optimize management and obviate unnecessary intervention.

Key Words: pregnancy, urinary calculi, diagnostic imaging, disease management, treatment outcome

Abbreviations and Acronyms

CT = computerized tomography

IVP = excretory urography

LDCT = low dose computerized tomography

MRU = magnetic resonance urography

PPV = positive predictive value

RUS = renal ultrasound

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THE management of pregnant patients with suspected urolithiasis can be challenging and fraught with diagnostic inaccuracies. Conventional and highly accurate imaging techniques (ie noncontrast CT) have largely been avoided in pregnancy due to concerns regarding exposure of the fetus to ionizing radiation.[1,2] Renal ultrasonography has traditionally been used to

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avoid radiation exposure but frequently offers only indirect clues of urinary tract obstruction (hydronephrosis).[3] As a result, urologists are often placed in the unenviable position of choosing observation, empiric stent or nephrostomy tube placement, or diagnostic and/or therapeutic ureteroscopy without the benefit of a definitive diagnosis. While selected patients can be treated conservatively, many pregnant patients will demonstrate refractory symptoms that demand some level of surgical intervention.[4,5] In an effort to effect prudent decision making in this situation, alternative advanced imaging techniques such as low dose CT and MRU have been proposed.[6,7] These newer imaging modalities offer the promise of improved diagnostic accuracy with a modicum of patient and fetal related harm. Ultimately these imaging techniques may yield critical diagnostic information that can help guide surgical decision making. Therefore, we evaluated the predictive value of these imaging techniques to determine the most appropriate diagnostic algorithm.

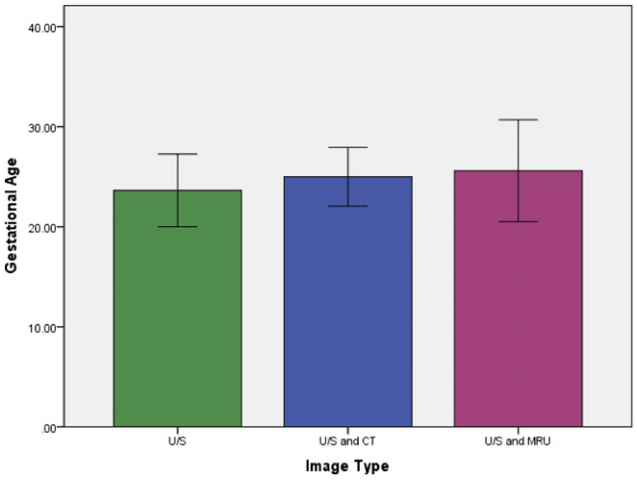
MATERIALS AND METHODS

A multicenter retrospective study was performed to define the risk of obstetric complications after ureteroscopy. The results of this study have been previously published.[8] Among the outcomes noted during this initial study was a negative ureteroscopy rate of 14%. To define risk factors for a negative ureteroscopy, a post hoc analysis was performed with specific attention to the correlative rate of negative ureteroscopy based on preoperative imaging type. Salient demographic information including patient age, gestational age, history of urinary stone disease, urinalysis results, preoperative imaging type and imaging results was obtained. Operative data including the presence or absence of an identifiable stone and any relevant operative complications were accrued. Fetal dosimetry was calculated when available.

SPSS®+ was used to perform all statistical analyses. Statistical significance was set at $p \leq 0.05$ a priori. Descriptive analyses were performed to describe the characteristics of the patient sample (mean, standard deviation, percentages and frequencies). PPV was calculated to evaluate reliability of imaging. A negative predictive value could not be calculated as patients with negative imaging findings, regardless of the type of imaging used, were not taken to the operating room.

RESULTS

Between April 1, 2004 and February 1, 2012, 51 patients with a mean age of 27 years (range 18 to 42) and a mean gestational age of 24.4 weeks (range 9 to 35) underwent diagnostic and/or therapeutic ureteroscopy for suspected urolithiasis at 1 of 5 tertiary academic centers. Of this cohort 22 patients (43%) underwent RUS alone. All patients who underwent RUS alone demonstrated direct (presence of an echogenic focus with acoustic shadowing) or indirect (hydronephrosis) evidence of urolithiasis. Transvaginal ultrasound was additionally used at 1 center to better visualize the distal ureter and/or the presence of a ureteral jet. An additional 24 patients (47%) underwent combined RUS and LDCT. In this subgroup all RUS findings were inconclusive. LDCT subsequently demonstrated the presence of a calculus in all patients. The remaining 5 patients (10%) underwent RUS and MRU. Indirect evidence of obstruction was identified on RUS with MRU confirming the presence of obstruction likely secondary to urolithiasis. The figure shows imaging type based on mean gestational age.



Average gestational age by image type. *U/S*, ultrasound.

At the time of ureteroscopy a stone was identified in 44 of 51 patients (86%). Conversely, no stone or other identifiable obstruction was identified in the remaining 7 patients (14%). Of those patients with a negative ureteroscopy 5 underwent RUS alone, 1 underwent combined RUS and LDCT, and 1 underwent RUS and MRU. Based on these findings the PPV of the preoperative imaging studies was 95.8% for RUS and LDCT, 80% for RUS and MRU, and 77% for RUS alone.

Surgical outcomes and adverse events have been previously reported.[8] The mean calculated radiation exposure to the fetus in the RUS/LDCT subgroup was 645.22 mrad. Before LDCT, all patients were jointly interviewed by the attending obstetrician, urologist and radiologist, and the risks of LDCT were fully explained. Consent was obtained for imaging in all cases in accordance with recommendations from the American College of Radiology.[9]

DISCUSSION

The treatment algorithm for pregnant patients with refractory flank pain concerning for urolithiasis is