Hydronephrosis during pregnancy: how to make a decision about the time of intervention?

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ABSTRACT

Aim To evaluate the role of doppler ultrasonography in managing hydronephrosis during pregnancy.

Methods The study included 27 pregnant patients with unilateral symptomatic persistent hydronephrosis (group 1) and 38 pregnant patients with physiological hydronephrosis of pregnancy (group 2). All pregnant patients underwent Doppler Ultrasonography to determine the Resistive Index (RI) and the difference between the RI of the corresponding and contralateral kidney (Delta Resistive Index = ΔRI).

Results There were no statistical differences between the two groups in terms of age, mean gestational period, or number of pregnancies. The mean renal RI of the hydronephrosis side was 0.68±0.05 in group 1 and 0.60±0.05 in group 2 (p<0.001). The mean ΔRI of group 1 was significantly higher than the mean ΔRI of group 2 (0.07±0.03 versus 0.02±0.01, respectively, p<0.001). The RI and ΔRI were considered positive with values of ≥0.70 and ≥0.04, respectively, and the RI was sensitive in 44.4% and specific in 92.1% for intervention treatment. The corresponding values for ΔRI were 88.9% and 89.5%. The positive predictive value and negative predictive value of ΔRI for intervention were 85.7% and 91.9%, respectively.

Conclusion It is much better to consider ΔRI than RI when deciding on interventional treatment in hydronephrosis during pregnancy.

Key words: Doppler ultrasonography, Resistive Index, gravidity
INTRODUCTION

Radiologic diagnosis of urinary stones in pregnancy is complicated by the physiologic and hemodynamic changes of pregnancy (1-3). Because of potential adverse effects of radiation exposure to the fetus, conventional ultrasonography (US) is the first-line imaging tool for urolithiasis in pregnant patients (4,5). However, the use of US is limited in the diagnosis of obstructions in early pregnancy, and it may not actually show the stones because of dilatation of the upper urinary tract, which occurs in normal pregnant women who do not suffer from obstructive diseases (3,4).

In contrast to conventional renal US, the use of Doppler US (DUS) had produced excellent results in the diagnosis of ureteric obstructions in pregnant women (6,7). Conventional ultrasonography with Doppler studies allows for waveform tracings of the renal vasculature. Ureteric obstruction increases renal vascular resistance, resulting in diastolic blood flow and a rise in renal resistance (2). Based on waveform tracings, a renal resistive index (RI) value is calculated, providing improved sensitivity and specificity for differentiating obstructed from nonobstructed dilated collecting systems (6,8). Moreover, it was determined that the RIs of the kidneys of pregnant women were similar to those of non-pregnant women (9) and that an elevated RI should not be attributed to the normal physiological changes of pregnancy (10). Until now it has not been clarified how to differentiate pathological from physiological hydronephrosis of pregnancy in the best way.

In this prospective study, the RI of symptomatic persistent hydronephrosis was compared with physiological hydronephrosis of pregnancy in order to evaluate the role of renal DUS for managing hydronephrosis during pregnancy.

PATIENTS AND METHODS

Between December 2010 and January 2012, 65 pregnant women admitted to the Dicle University School of Medicine Department of Urology were included in this study. Of these, 27 pregnant patients had unilateral symptomatic persistent hydronephrosis (group 1) and 38 had physiological hydronephrosis of pregnancy which was incidentally found at the time of obstetric scan (group 2). In group 2, no patient had colic pain, hematuria, or any evidence of stone formation on US. Informed consent forms were obtained from all patients after approval from the local institutional review board of Dicle University was obtained.

At presentation, patients’ age, presenting symptoms, previous urological intervention, parity, and duration of pregnancy were recorded. Obstetric physical examinations and US were performed to determine gestational stage and exclude obstetric complications. All patients were then examined with conventional grey-scale US followed by DUS with a calculation of the intrarenal RI in both kidneys. Sonography was performed with a real-time multi-frequency (3.5–5-MHz) sector transducer (Logic P5, General Electric, USA). Renal size, echogenicity, and the presence of perinephric fluid or renal calculi were noted. The presence and position of a ureteric stone were documented. Renal RI was calculated as the average of three measurements in the arcuate arteries from the upper, middle, and lower third of the kidney. Continuous spectral wa-
Bodakci et al. Hydronephrosis during pregnancy

waveforms were optimized for measurements using the lowest pulse repetition frequency without aliasing, the highest gain without obscuring background noise, and the lowest wall filter. In each patient, the mean RI for the ipsilateral and contralateral normal kidney was obtained. The Delta Resistive Index (ΔRI) was determined as follows: ΔRI= RI of ipsilateral kidney-RI of contralateral kidney.

The study inclusion criteria included pregnant patients with normal blood pressure in their second or third trimester. Those with high blood pressure, bilateral hydronephrosis, passed spontaneously stones, or systemic diseases were excluded from the study. In group 1, the diagnosis of ureteral obstruction in pregnancy was made based on the clinical presentation of transabdominal US and DUS (Figure 2). Complete blood count, creatinine, urea, and urine culture tests were also performed to all patients, and blood cultures were obtained when needed. The US findings were diagnostic for obstructive ureteral calculi in 11 of 27 (40.7%) patients. In the remaining 16 patients, the clinical findings and observations of progressive hydronephrosis during ultrasound examinations were used for diagnosis and intervention. Conservative treatments such as intravenous fluids and analgesics were given to all patients in group 1 following admission to hospital. Patients whose symptoms improved and did not persist with conservative treatment were discharged and followed in the outpatient clinic. Moreover, these patients were excluded from the study. The patients whose symptoms persisted or whose stones were not cleared spontaneously following the medical treatment period were advised to receive either a minor intervention (percutaneous nephrostomy (PCN) tube, ureteral double J (JJ stent) or ureterorenoscopy (URS)).

All patients undergoing interventional treatment had antibiotic prophylaxis. Each of them took one dose of second or third generation cephalosporines intravenously one hour before the intervention, and medication was continued seven days after the operation.

URS was performed with a 9.5-F semi-rigid ureteroscope after confirming that the urinary infection was treated and the urinary culture was sterile. Under local anesthesia, the PCN was inserted in the flank position with ultrasonographic guidance, and a JJ stent was inserted with a 22-F cystoscope. Pearson correlation analysis was used to reveal the correlations. The Mann–Whitney U test and the Chi-square test were used to determine the differences between the groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

There were no statistical differences between group 1 and group 2 in terms of age, mean gestational period, or number of pregnancies (Table 1). However, the mean renal RI on the hydronephrosis side was significantly different: 0.68±0.05 in group 1 and 0.60±0.05 in group 2 (p<0.001). The mean ΔRI were 0.07±0.03 in group 1 and 0.02±0.01 in group 2 (p<0.001). The kidneys with ureteral obstruction had a mean RI of 0.68±0.05, and contralateral normal kidneys had a mean RI of 0.58±0.04 in group 1 (p<0.001; r=0.760). The mean diameter (mm) of the renal pelvis of group 1 was statistically higher than the mean diameter of the renal pelvis of group 2 (p<0.001).

Table 1. Baseline characteristics of the two groups

<table>
<thead>
<tr>
<th></th>
<th>Symptomatic persistent hydronephrosis of pregnancy (Group 1, N=27)</th>
<th>Physiological hydronephrosis of pregnancy (Group 2, N=38)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (year)</td>
<td>26.25±5.93</td>
<td>23.28±4.58</td>
<td>0.06</td>
</tr>
<tr>
<td>Mean gestational period</td>
<td>25.96±6.40</td>
<td>27.66±6.01</td>
<td>0.28</td>
</tr>
<tr>
<td>The number of pregnancies</td>
<td>3.0±2.28</td>
<td>2.0±1.23</td>
<td>0.08</td>
</tr>
<tr>
<td>Mean RI at the side of hydronephrosis</td>
<td>0.68±0.046</td>
<td>0.60±0.047</td>
<td>0.000</td>
</tr>
<tr>
<td>Mean ΔRI</td>
<td>0.07±0.03</td>
<td>0.02±0.01</td>
<td>0.000</td>
</tr>
<tr>
<td>The mean diameter of renal pelvis (cm)</td>
<td>29.14±11.00</td>
<td>15.94±5.85</td>
<td>0.000</td>
</tr>
</tbody>
</table>

ΔRI, inter-renal difference in RI
The RI was considered positive as a cut-off for intervention in pregnancy with a value of 0.70 or greater, and it was sensitive in 44.4% and specific in 92.1% for intervention. In addition, its positive predictive value (PPV) was 80% and negative predictive value (NPV) was 70%. While 0.04 or greater was considered positive as a cut-off for ΔRI, sensitivity and specificity were 88.9% and 89.5%, respectively. In addition, PPV and NPV for ΔRI were 85.7% and 91.9%, respectively.

The symptoms were renal colic in 17 patients, fever/chills in four patients, and hematuria in 15 patients, in group 1. Percutaneous nephrostomy tubes were inserted in three patients, and ureteral JJ stents were inserted in five patients under local anesthesia. However, in three patients, attempts to insert JJ stents were not successful, and they underwent URS, so 22 patients underwent the URS procedure. Spinal anesthesia was performed in 21 (95.4%) patients, while general anesthesia was performed in 1 patient. Endoscopically, ureteric stones were found in 17 (77.2%) patients. The stones were fragmented by holmium laser and a ureteral JJ stent was inserted in 8 of 17 (47%) patients with ureteral stones. All of JJ stents were removed by cystoscopy under local anesthesia two weeks after the initial procedure.

In the remaining five patients, no stones were found, but there was an important obstruction due to ureteral invagination at the pelvic brim in three patients, ureteral stricture in one patient, and excessive uterine compression in one patient. In the last five patients, only JJ stents were inserted and the stents were removed two weeks after the successful completion of their pregnancies. No serious obstetric complications were observed in pregnant patients who underwent the URS procedure and all babies were born normally.

**DISCUSSION**

Conventional US is the first-line imaging tool for urolithiasis in pregnant patients because of the potential adverse effects of radiation exposure to the fetus (11). However, the use of US is limited in diagnosis, and it may not actually detect the stones because of dilatation of the upper urinary tract, which occurs in normal pregnant women who do not suffer from obstructive illnesses (12). It has been found that renal US provides a sensitivity of 34% and a specificity of 86% and that sonograms may not reveal the stones (4). In the present study, conventional grey-scale US detected obstructed ureteric calculus in 50% of our patients, and all symptomatic kidneys had pyelocaliectasis. Renal resistive index provides increased sensitivity and specificity for distinguishing obstructed from nonobstructed dilated collecting systems. Hertzberg et al (9) found no statistically significant difference between the RI of 156 pregnant women without renal disease and 25 non-pregnant women of childbearing age. Moreover, no important difference was detected between the RI of kidneys with and without pyelocaliectasis. Furthermore, Shokeir et al (7) found that the mean RI of kidneys with acute unilateral ureteric obstruction due to the stone disease was significantly higher than the mean RI of contralateral normal kidneys suggesting that RI is a sensitive and specific test for pregnant patients who suffer from acute unilateral ureteric obstruction. In our study, a higher mean RI in all 27 obstructed kidneys than the normal mean RI in the contralateral normal kidneys was found. In the study mentioned above (7), it was found that the mean RI of the obstructed kidneys in pregnant patients was significantly higher than the mean RI of the non-hydronephrosis kidneys of pregnant women and non-pregnant women of child-bearing age. Similarly, in the present study, a mean renal RI on the hydroureteric side was 0.68±0.05 in patients with symptomatic persistent hydronephrosis (group 1) and 0.60±0.05 in patients with physiological hydronephrosis (group 2). Moreover, our study revealed a mean ΔRI of symptomatic persistent hydronephrosis of pregnancy that was significantly higher than the mean ΔRI of physiological hydronephrosis of pregnancy.

One study showed that the mean renal RI in 61 asymptomatic pregnant women with at least unilateral pyelocaliectasis was 0.61±0.05 with no correlation between trimester or degree of pyelocaliectasis (13). Thus, an abnormal RI in the kidney of a pregnant patient cannot be explained on the basis of pregnancy alone; other disorders should be considered as potential etiological factors (13).

One study showed that an elevated RI increased sensitivity 88% and specificity 98% in diagnosing ureteral obstruction (6). When the RI and ΔRI were considered positive (with a value of 0.70 or greater and 0.04 or greater, respectively), the RI was found to be sensitive in 45% and specific in
91% of cases (7). The corresponding values for ΔRI were 95% and 100% of cases. In our study, based on the same cut-off values, the RI was sensitive in 44.4% and specific in 92.1% of hydronephrosis cases during pregnancy. In addition, we confirmed our previous observation that it is much better to consider the sensitivity and specificity of ΔRI than those of RI for diagnosis and therapeutic decisions in hydronephrosis during pregnancy.

Treatment modalities for urolithiasis during pregnancy range from conservative treatments to more invasive procedures (14). Recently, URS has become a first-line approach to urinary calculi requiring intervention during pregnancy (15, 16). It has been found that URS is a safe and effective treatment for urolithiasis in pregnancy (15-19). We prefer URS instead of a JJ stent or PCN tube because of the above complications. After lithotripsy, the ureteral JJ stent was inserted in 47% patients, and all of them were removed by cystoscopy under local anesthesia two weeks after the initial procedure. In the remaining five patients, no stones were found, and ureteral JJ stents were inserted. The JJ stents were removed two weeks after the post-natal period, and no complications related to the JJ stents were observed. General anesthesia is rarely used in pregnant patients. Most URS procedures are carried out with spinal or epidural anaesthesia (18, 20). In this study, we used semi-rigid URS, and spinal anesthesia was performed on 21 (95.5%) patients, while general anesthesia was performed for one patient.

In conclusion, both RI and ΔRI increase in unilateral symptomatic persistent hydronephrosis during pregnancy, but it is better to consider ΔRI than RI in deciding about interventional treatment. Conservative methods are advised for the initial treatment of ureteral stones and renal colic in pregnancy. However, if symptoms persist or complications develop either intervention with temporary drainage or URS is the most suitable next step.

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TRANSPARENCY DECLARATIONS

Competing interests: none to declare.

REFERENCES