Reviewing pregnancy outcomes in patients with or without urolithiasis, there was a higher percentage of preterm premature rupture of membranes in the urolithiasis cases (7.0% vs. 2.9%). Therefore serious attention must be given in the pregnant patients with suspected stone disease.

Diagnosis of urolithiasis in pregnancy is often difficult, as many of the presenting symptoms and signs may be masked. Potential adverse effects of anesthesia, X-ray examination, or invasive surgery on both mother and fetus have to be considered also.

Traditionally, the definite diagnosis of urolithiasis is based on image studies, such as KUB (kidney, ureter, bladder), intravenous pyelography (IVP), ultrasonography or spiral computed tomogram. However, risks of possible radiation hazard to the fetus and the adverse reaction of pregnant patient to contrast medium require special attention. Stewart suggested that the human embryo was sensitive to the leukaemogenic effects of radiation, and noted that an exposure as little as 10-20 mGY was associated a slight increase in childhood cancers, and the greatest risk of radiation for the fetus is in the first trimester, a period of rapid cell division. To avoid the risk of radiation, ultrasound has become the first-line diagnostic modality of urolithiasis in pregnancy.

Extracorporeal shock wave lithotripsy (ESWL), a less-invasive procedure of treatment nowadays, is contraindicated during pregnancy, since it may provoke miscarriage and unpredicted effect on the fetus. Urerorenoscopy (URS) is a semi-invasive procedure, but it is difficult to pass the endoscope beyond the pelvic brim during the third trimester of pregnancy. Therefore, the urologist has to make optimal use of some other alternative procedures (percutaneous nephrostomy (PCN), double J (DBJ) stenting and ureterorenoscopy (URS), if initial treatment failed.

All patients received conservative treatment at first, and 4 patients got well till delivery, another 5 patients needed further minimally invasive procedures; 1 of them received DBJ stenting, another 1 received PCN first and changed to DBJ stenting. The remaining 3 patients were treated by ureterorenoscopy with stone manipulation. All these 5 patients had full-term delivery without obstetric sequela, except 1 patient who received left salpingoophrectomy due to left ovarian abscess.

During pregnancy, urolithiasis is a diagnostic and therapeutic challenge. Clinical symptoms and signs are most important in establishing diagnosis, and ultrasound examination adds accuracy. Minimally invasive procedures (such as PCN, DBJ stenting, URS) can facilitate the successful management of patients requiring further intervention due to failure of conservative treatment.

Received: May 5, 2004.
Accepted: August 31, 2004.

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METHODS

From January 1990 to December 2001, about 15,300 deliveries were performed in our hospital. During that time, 9 pregnant women were admitted with symptoms suggestive of renal or ureteral stone. Clinical diagnosis was made by symptoms and signs, and was further confirmed by ultrasonographic studies. All patients were treated conservatively with hydration, analgesics and antibiotics initially, followed by minimally invasive procedures (such as PCN, DBJ stent, URS) if conservative treatment failed. The outcomes of the patients, including maternal and fetal status, were retrieved from medical records.

RESULTS

The incidence of urolithiasis in pregnancy in this study was 0.058% (9 in 15,300 deliveries). General information of the 9 patients is listed in Table 1. The mean age was 25.7 years (21-34 years). The patients were between the 11th and 32nd weeks of gestation at the time of presentation. Eight women were in gravida 2 and 1 in gravida 3 status. Clinically, all patients had flank pain, 3 (33%) on the left side, 6 (67%) on the right ride. Six (67%) of 9 cases had urinary tract infection (UTI) and fever. Ultrasonographic study was performed in all of the cases. Four patients were found to have renal stone, studies on the other patients revealed hydronephrosis over symptomatic sides as compared with opposite sides. These 5 cases were confirmed to have ureteral stone (3 were proved by URS during preganant period, 2 by postpartum KUB). None of the 9 cases took prepartum X-ray examinations. Initial conservative treatment with analgesics, spasmolytics, and antibiotics was given in all cases. Four cases (45%) got well after conservative treatment and had full-term delivery without any sequela, 3 of them received ESWL after delivery. One patient (case 2) did not receive definite management after delivery, but she had a similar episode the next year when she was pregnant again (cases 2 and 3 were the same patient at different time). Five (55%) of 9 cases underwent further intervention besides conservative treatment; 1 of them received DBJ stenting, another 1 received PCN first and changed to DBJ stenting. DBJ catheters were exchanged at 4 to 6-week intervals regularly in these 2 patients until their deliveries. ESWL and PCNL were performed after their deliveries. The remaining 3 cases were originally arranged for DBJ stenting. During the procedure, lower-third ureteral stones were found by ureteroscopy (in order to pass a guiding wire firstly), and retracted by stone basket or crushed with electrohydraulic lithotripter (EHL). All these 3 patients tolerated the procedure well under local anesthesia, and had full-term delivery without complication later. Renal function tests were routinely performed during hospital stay in all patients, but did not show significant change before and after treatments.

Table 1. Patient details

<table>
<thead>
<tr>
<th>Case No</th>
<th>Age (years)</th>
<th>Weeks (pregnancy)</th>
<th>Gravida</th>
<th>Presentations</th>
<th>Ultrasound finding</th>
<th>Treatment</th>
<th>Delivery</th>
<th>X-ray</th>
<th>Treatment (postpartum)</th>
<th>Stone size (mm)</th>
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<tbody>
<tr>
<td>1</td>
<td>34</td>
<td>14</td>
<td>G2</td>
<td>FP+Hematuria</td>
<td>Hydro</td>
<td>Conservative</td>
<td>CS</td>
<td>KUB</td>
<td>ESWL</td>
<td>10*12</td>
</tr>
<tr>
<td>2</td>
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<td>31</td>
<td>G2</td>
<td>APN+Hematuria</td>
<td>RS</td>
<td>Conservative</td>
<td>CS</td>
<td>KUB</td>
<td>None</td>
<td>15*12</td>
</tr>
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<td>32</td>
<td>G2</td>
<td>APN+Hematuria</td>
<td>Hydro</td>
<td>Conservative</td>
<td>CS</td>
<td>KUB</td>
<td>ESWL</td>
<td>15*12</td>
</tr>
<tr>
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<td>24</td>
<td>G2</td>
<td>APN+Hematuria</td>
<td>RS</td>
<td>Conservative</td>
<td>NSD</td>
<td>KUB</td>
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<td>30</td>
<td>G2</td>
<td>APN+Hematuria</td>
<td>RS</td>
<td>DBJ</td>
<td>CS+SP</td>
<td>KUB</td>
<td>ESWL+PCNL</td>
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</tr>
<tr>
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<td>18</td>
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<td>RS</td>
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<td>IVP</td>
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<td>Hydro</td>
<td>URS+EHL</td>
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<tr>
<td>8</td>
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<td>NSD</td>
<td>None</td>
<td>5*5</td>
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</tbody>
</table>

1. APN = acute pyelonephritis; FP = flank pain; Hematuria= microscopic hematuria.
2. Hydro = hydronephrosis, RS = renal stone.
3. DBJ = double J stent; EHL = electrohydraulic lithotripter; ESWL = extracorporeal shock wave lithotripsy; PCN = percutaneous nephrostomy; PCNL = percutaneous nephrolithotripsy; URS = ureteroscopy.
4. CS = Caesarean section; NSD = normal spontaneous delivery; SP = salpingoophorectomy.
DISCUSSION

The incidence of urolithiasis during pregnancy is rare (0.03 to 0.06%). Although the majority of series cite pregnancy outcomes similar to those without urolithiasis, others have found there were associated premature rupture of membrane or premature labor in the patients with renal colic. The effect of prostaglandin E₂ may play a role. Because symptoms of urolithiasis, including abdominal or flank pain, hematuria or unresolved bacteriuria, can be confused with other abdominopelvic disorders during pregnancy, attention must be taken in the establishment of this diagnosis. Based on observations from our study, the following conditions may be helpful to the diagnosis of urolithiasis in pregnancy: 1) symptoms and signs suggestive of calculi—all of our cases had unilateral flank pain, 90% demonstrating microhematuria; 2) severe symptomatic pyelonephritis—66% of our cases presented with acute pyelonephritis and half of them had poor response to antibiotics; 3) past history of urolithiasis—one (case 3) of our cases had a history of renal stone, some authors reported up to 30%. The imaging diagnosis of urolithiasis in pregnancy is further complicated by the physiologic and hemodynamic alterations in the maternal urinary tract. Physiologic hydronephrosis occurs in 90% of pregnant women, starting at 6th-10th week of gestation, and generally resolves within 4-6 weeks of partuition. This phenomenon is caused by a combination of hormonal and mechanical effects (ureteral compression by the enlarging gravid uterus). The right ureter is more frequently affected than the left one, because of compression from the engorged right ovarian vein and uterine dextro-rotation. Proximal ureteral dilatation may allow passage of previous asymptomatic renal calculi to distal ureter and result in symptomatic obstruction. It is true that most symptomatic urolithiasis occurs in the second or third trimester. Parity may also play an important role; multiparas have been reported to have higher incidence of symptomatic urolithiasis than nulliparas (ratio 3:1). To differentiate hydronephrosis caused by an obstructing calculus from physiologic hydronephrosis remains the most difficult task. In our series of ultrasonographic studies, there were significant pelvicaliectasis over affected sides comparing with the opposite sides. However, Laing et al. noted that conventional ultrasound also does not demonstrate hydronephrosis in 20% of patients with acute obstruction, because acutely obstructed kidneys may show only mild pyelocaliectasis or not at all. With the use of Doppler ultrasonogram, some studies depicted that normal pregnancy, with or without physiologic hydronephrosis, does not affect intra-renal resistive index (RI) (peak systolic velocity-peak diastolic velocity/peak velocity) in Doppler ultrasound, but an elevated RI (> 0.7) during pregnancy should alert us the possibility of ureteral obstruction. Ultrasound also has limitation in detecting ureteral calculi. Laing et al. detected stones in only 2 of 20 patients by trans-abdominal approach. Recent use of trans-vaginal ultrasound has improved the detection rate of calculi at the ureterovesical junction.

To avoid fetal exposure to radiation is another diagnostic consideration. Some authors reported the dosage required to double the baseline mutation rate was 500-1000 mGY, but measuring the genetic effects is difficult clinically. Theoretically, a KUB delivers about 0.5 mGY to the fetus, and a standard IVP about 3 mGY, whereas a limited IVP delivers down to about 2 mGY. Therefore, some authors suggest the following diagnostic protocols: (1) a KUB and (2) a limited IVP study under the circumstances of: (a) persistent fever after 48 hours of antibiotic coverage; (b) elevation of BUN and creatinine levels; (C) significant hydronephrosis demonstrated by ultrasound; and (d) persistent vomiting resulting in dehydration. A limited IVP means that the first film is taken 30-60 minutes after injection of contrast medium. A second and third exposure, if required, may be taken at 90-minute interval. If still non-diagnostic, a fourth film may be taken 3 hours later. In our cases, no further X-ray study was applied after ultrasound examination, since clinical condition did not deteriorate after initial treatment.

The following modalities have been advocated for the treatment of urolithiasis in pregnancy: (1) conservative treatment - a high rate of spontaneous stone passage has been reported in 45-80% of cases, (2) minimal intervention - PCN is an accepted mode for the decompression of obstructed upper urinary tract, especially when retrograde endoscopic manipulation is technically difficult. The procedure can be performed under ultrasound guidance and...
local anesthesia. It was applied in Case 6 of our series to abort an episode of urosepsis. However, for the patient’s comfort and to avoid the chance of infection associated with external drainage device, the nephrostomy was exchanged with an internal stent. Internal DBJ stent can be inserted at any stage of gestation using local anesthesia. In our cases, we placed the guiding wire firstly under the direct vision of ureterorenoscope. In 3 of 5 cases, we could visualize distal ureteral stones, and removed them by stone basket or crushed them with lithotriptor, and the patients tolerated the procedures well under local anesthesia. However, ureteral stents are not without complications in that encrustation has been mentioned, but clinically significant stone formation has been described only by case report. Definite guideline for replacement of ureteral stents is still not well established. It has been suggested stents may be left in place safely for 3 to 9 months. Based on experience of stenting during pregnancy, others recommend exchanging ureteral stent every 4 to 8 weeks.

Today, most simple renal stones can be managed easily and safely with either ESWL or endourological procedures in the non-pregnant female. It is reasonable to remove potentially symptomatic stones prior to conception and avoid any possible risk to pregnancy.

Urolithiasis during pregnancy is an unusual occurrence, but it is also a major cause of non-obstetric acute abdominal pain requiring hospitalization. Ultrasound is a valuable tool for the detection of renal calculi or ureteral obstruction without taking the risk of radiation hazard to fetus. The goals of various treatment modalities are to lessen maternal discomfort, avoid renal damage and sepsis due to obstruction, and minimize risks to the fetus. With conservative treatment, urolithiasis usually pass out in most of pregnant women. The remaining of the patients require further urological intervention, includes PCN, DBJ stenting and URS, which could facilitate the successful management of patients after failure of conservative treatment.

REFERENCES