Review

Symptomatic urinary stone disease in pregnancy

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Background: Symptomatic urinary calculi are rare in pregnancy with an incidence of one per 1500 pregnant women. Calculi may cause ureteric obstruction that can be further complicated by sepsis. This may have a significant morbidity for mother and fetus.

Objective: To provide an update on the current investigations and management options for pregnant patients with symptomatic urinary calculi.

Discussion: We discuss the different imaging modalities available to investigate the renal tract in pregnant women and propose a management pathway. This topic is particularly pertinent to obstetricians in their roles as coordinators of prenatal care.

Key words: hydronephrosis, ureteric obstruction, pregnancy, renal calculi, urinary stones.

Introduction

Hydronephrosis and hydroureter are physiological changes that often occur in pregnancy. The process may begin as early as the sixth week of gestation and 90% of women will have some element of hydronephrosis by the 28th week.[1,2] The mechanism is unclear, but it may be the result of a combination of pressure on the ureters at the pelvic brim and smooth muscle relaxation secondary to the hormonal changes of pregnancy. It is more common on the right, possibly because of dextrorotation of the uterus and the sigmoid colon cushioning the ureter on the left.[1,3]

In most pregnancies, these changes remain asymptomatic and do not cause complications. They are therefore termed *physiological* changes. Five to 10% of pregnant women may develop flank pain requiring investigation and a urological opinion.[1] Hydronephrosis causes urinary stasis, which predisposes to urinary tract infections (UTI), pyelonephritis as a complication of bacteriuria and urolithiasis.[4,5] These complications have been associated with spontaneous abortion, hypertension, preterm labour and low birthweight.[5,6] In the clinical setting, it is often difficult to diagnose pathological obstruction, particularly due to ureteric calculi, as the symptoms of nausea, vomiting, back pain, urinary frequency and dysuria can all be present during the course of a normal pregnancy. In addition, it is difficult to image the ureters in pregnancy, as computed tomography (CT) is generally avoided.

In this paper, we hope to provide current information about symptomatic urinary calculi in pregnancy. Obstetricians are the coordinators of prenatal care and a clear knowledge of urinary stone disease in pregnancy can prevent unnecessary hospital visits while ensuring that patients who require urological intervention are identified.

Methods

We searched the published literature on the management of urolithiasis in pregnancy, by researching the MEDLINE database (from January 1966 to June 2006) and reviewed related literature regarding medical imaging in pregnancy and management

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Table 1 Presenting symptoms and signs of acute ureteric obstruction

- Pain – abdominal or flank,
- Haematuria – microscopic or macroscopic
- Nausea and vomiting
- Dysuria
- Pyuria
- Voiding symptoms
- Chills, fevers, sweats

procedures for acute ureteral obstruction. Based on relevance and the use of imaging, approximately 30 articles were identified.

Discussion

Hydronephrosis of pregnancy causes urinary stasis which may predispose to UTIs and pyelonephritis.[4,5] In pregnancy, a decrease in systemic vascular resistance also leads to a 30–50% rise in glomerular filtration rate (GFR), which elevates urinary sodium, uric acid and calcium concentrations.[2,7] Theoretically, these factors can predispose pregnant women to develop urinary calculi. However, studies demonstrate no significant difference in incidence compared to the non-pregnant population. The incidence of symptomatic urinary calculi in pregnancy is said to range from one per 1500 to one per 2500.[7–14]

The clinical significance of symptomatic hydronephrosis during pregnancy is the association with ureteral obstruction, ascending infection and bacteriuria which have the potential for life-threatening sepsis, threatened abortion or preterm labour. Up to 28% of cases of renal colic are misdiagnosed in pregnant women[14] as many clinical features are consistent with normal pregnancy or other conditions including appendicitis, diverticulitis and placental abruption and isolated UTI. We suggest that pregnant patients who present in the primary care setting with flank pain and signs of sepsis (see Table 1) should be referred to the emergency department for further evaluation. In addition, patients with pain and hydronephrosis should also be referred for a urological opinion. Asymptomatic hydronephrosis, however, can be monitored with serial ultrasound scans and the patient may be referred for a urological opinion if there is progression or symptoms develop.

Investigations

Table 1 lists the common signs and symptoms associated with acute obstruction or symptomatic hydronephrosis.[1,9,12,15,16] Once referred to the emergency department, initial investigations should include white cell count, serum electrolytes, urine microscopy and culture and ultrasonography. CT is the imaging modality of choice, but the radiation exposure renders this modality inappropriate in the pregnant patient. Ultrasound scans are the preferred first line imaging modality in pregnancy, being non-invasive and free of ionising radiation. However, ultrasonography is operator dependent and sensitivity ranges from 34 to 92.5%.[5,6,8,14] It is also often difficult to access acutely both in the primary care and in the hospital setting. Ultrasound may be enhanced by measuring the ureteric urine flow and vascular resistance of the kidney (resistive index) or analysing the ureteric jets but usage remains limited and controversial. A limited (three shot) intravenous pyelogram (IVP) can be useful. With lead shielding of the pelvis, a control film is taken followed by 15- and 30- or 60-min images postintravenous contrast administration. This limits radiation exposure and can diagnose obstruction or ureterolithiasis.[15–19] Magnetic resonance imaging (MRI) is safe in pregnancy and can diagnose obstruction but provides limited information about calculi. It is also expensive, not often available for routine use and difficult to access acutely.[16,20]

It is best to avoid ionising radiation in pregnancy, particularly during the first trimester when organogenesis takes place. However, it has been estimated that radiation doses below 50–150 mGy (5–15 rad) have no deleterious effects to the fetus.[6,8,19] Both the National Council on Radiation Protection and the American College of Obstetricians and Gynaecologists advise that exposure to less than 50 mGy (5 rad) has not been associated with an increase in fetal anomalies or pregnancy loss.[8,19] However, the International Commission on Radiological Protection recommends a lower threshold of 10 mGy (1 rad), below which no adverse fetal events have been noted.[21] The fetal radiation exposure from KUB radiograph, three-shot IVP, and CT scan is approximately 0.5, 5 and 22–49 mGy (0.05, 0.5 and 2.2–4.9 rad), respectively.[7,21,22] It is very difficult to estimate fetal radiation exposure from fluoroscopy as the dose is affected by multiple factors including the use of shielding, whether conventional or pulsed fluoroscopy was used, duration and location of the beam.[21] During pregnancy, the less exposure and risk to the fetus, the better, and the potential need to repeat testing over the course of a management plan needs to be carefully considered. Therefore, in this setting, the procedure of choice would be a three-shot IVP in order to maximise the chances of diagnosis
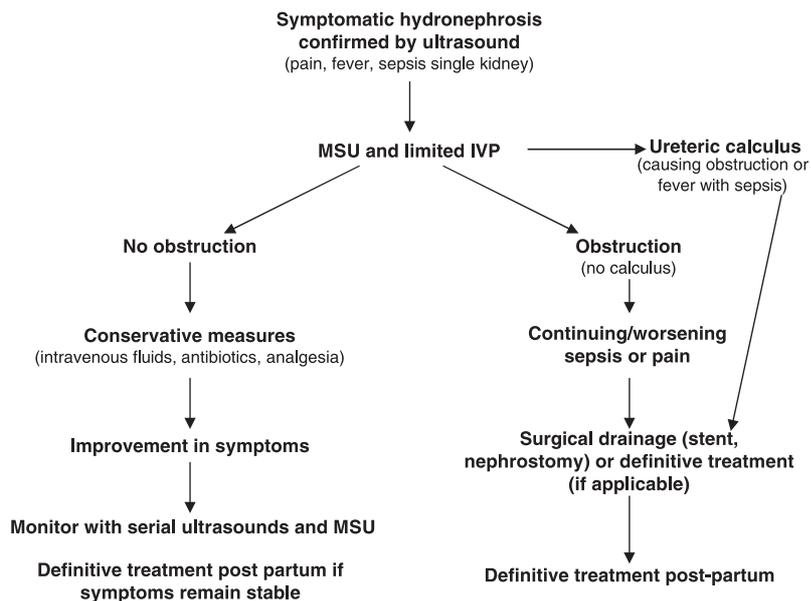
Figure 1 Management flow diagram. IVP, intravenous pyelogram; MSU, musculoskeletal ultrasound.

Table 2 Indications for surgical management (failed conservative therapy)

Absolute indications
    Solitary kidney and a ureteric calculus
    Obstructing calculus
    PUJ obstruction or ureterocele in the presence of sepsis
    UTI in the presence of a ureteric calculus
    Fever in the presence of a ureteric calculus
    Non-resolving signs of sepsis
    Complete ureteric obstruction
Relative indications
    Deteriorating renal function
    Chronic obstruction
    Intractable pain, not managed by analgesics

PUJ, pelvi-ureteric junction; UTI, urinary tract infection.

without the need for repeated or further testing and radiation exposure.

Medical management

Once referred to the emergency department, up to 90% of patients will respond to conservative management.[1,6–10,22–24] If patients respond to intravenous fluids, prophylactic antibiotics and analgesia, it is possible to monitor them and plan definitive therapy post-partum. Amenable conditions include pelvi-ureteric junction (PUJ) obstruction or ureterocele. However, those with signs of sepsis and obstruction require prompt surgical intervention (see Table 2).

Surgical management

In the small number of patients who have any of the indications listed in Table 2, it is important to drain the affected kidney. Figure 1 demonstrates a management pathway which can be applied to patients with symptomatic hydronephrosis. Ureteric stents are relatively easy to insert in a *retrograde* fashion (via cystoscopy). This can be done with pelvic lead shielding and judicious use of fluoroscopy, although some groups are now using ultrasound guidance as an alternative.[9,15] Calculi and stents can be removed post-partum.

Ureteric stents can encrust and obstruct and hence, may need to be changed periodically. Patients who require stents early in their pregnancy may need more than one stent change prior to delivery. Other disadvantages include the risk of ascending pyelonephritis due to vesico-ureteric reflux and lower urinary tract symptoms due to stent irritation.[9,15,17,22–24] Stents may migrate and or encrust and in 5% of patients hydronephrosis may develop or worsen.[25,26] It is therefore necessary to closely follow up patients with ureteral stents as these complications can be managed simply with early stent replacement.

Insertion of a percutaneous nephrostomy tube is an alternative method of obtaining immediate drainage of the obstructed system.[9,27] This procedure is performed under local anaesthetic with ultrasound guidance, and can be performed in any patient with severe sepsis who is unfit for the general anaesthetic required for cystoscopic stent placement.[9,27,28] If

fluoroscopy is required, lead shielding can be used over the abdomen and pelvis with radiation directed to a targeted area of approximately 4 cm^2 to minimise exposure to the foetus.[27] A major disadvantage of the percutaneous nephrostomy is the presence of an external drainage tube which may be dislodged, cause discomfort or require replacement.[27–29] The complication rate of the procedure is reported to be 3–5% with a rate of 1.3–1.6% for major sepsis and haematuria requiring transfusion in 2–4% of patients.[30] Several studies have demonstrated successful nephrostomy placement in pregnant patients.[27,28] The percutaneous nephrostomy tract can be used to place an *antegrade* stent, often as a two-stage procedure.

Ureteroscope technology continues to improve and the new instruments have a smaller diameter. Some centres offer primary ureteroscopy to treat calculi in pregnancy.[31–35] They report several small series demonstrating successful treatment using primary ureteroscopy with no urological or obstetric complications. The advantages are definitive treatment without the need for long-term stents or nephrostomy tubes. It is also possible to perform ureteroscopy without the use of fluoroscopy or radiation. Ureteroscopy is generally safe; however, complications can include ureteral perforation, tears, stricture formation and pain.[36,37] However, with advancing technology and the availability and use of smaller calibre ureteroscopes, the complication rates associated with ureteroscopy have fallen to less than 2% for minor complications such as perforation, false passage, and 5% for minor abrasions and pain. Major complications such as avulsion, intussusception and stricture formation are very rare, occurring in less than 1% of cases.[36,37] There is also an increased risk of preterm labour or delivery if procedures are performed in first or the third trimester associated with general anaesthesia risk.

The commonly used energy source for intracorporeal stone fragmentation is ultrasound generated high-frequency vibratory energy (lithoclast), which may be harmful to fetal hearing.[35] However, Holmium laser has been reported to be safe to use in pregnancy.[31,35] In Australia, primary flexible ureteroscopy with laser is seldom performed in pregnant patients but its use may become more prevalent in the future. A review by the *British Journal of Urology International* advised that ureteroscopy should be performed by an experienced urologist with a single calculus less than 10 mm. It should not be performed in the setting of sepsis or multiple calculi.[9,11]

Extracorporeal shock wave lithotripsy is absolutely contraindicated in pregnancy as the vibrational effects of the procedure may adversely affect the fetus, increasing the risk of spontaneous abortion and hearing difficulties. Open surgery is a viable option in selected patients where sepsis is involved and stent or percutaneous nephrostomy insertion has failed. However, there are significant risks associated with general anaesthesia and open surgery in pregnant women.[7,11]

Conclusion

Acute ureteral obstruction may have potentially significant morbidity if left untreated. Pregnant patients who present with symptoms of acute urinary obstruction should be referred to the emergency department and be investigated with urinalysis and culture, serum electrolytes, blood count and urinary tract ultrasound. Drainage measures should be undertaken in patients who have UTI, fevers or a single kidney in the presence of a ureteric calculus, PUJ obstruction or ureterocele. In the absence of ureteric calculi, initial treatment should be conservative, given that the majority of patients will recover with analgesia, antibiotics and hydration. Drainage is again required in patients who have symptoms refractory to conservative measures, namely, ongoing sepsis despite antibiotics (> 48 h), and the worsening of any of renal function, pain, obstruction or hydronephrosis. Efforts should be made to minimise the radiation exposure of patient and fetus without delaying diagnosis or compromising early treatment. The choice of the investigations and surgical options available should be tailored to the individual patient's situation and discussed with a consultant urologist and obstetrician.

Key Points

- Up to 28% of cases of renal colic are misdiagnosed in pregnant women
- Hydronephrosis is a common physiological change in pregnancy; however, acute ureteric obstruction can result in significant morbidity if left untreated.
- Acute ureteric obstruction may be due to a ureteric calculus, ureterocele or PUJ obstruction.
- Radiological imaging can be used judiciously to provide early diagnosis and treatment without unnecessary fetal radiation exposure. Limited IVP is generally accepted as being safe in pregnancy.
- The majority of cases will resolve with conservative therapy, however, 10% of patients with acute ureteral obstruction may require a surgical procedure (ureteric stents, percutaneous nephrostomy tubes, ureteroscopy).

Acknowledgements

References

1 Gulmi F, Felsen D, Vaughan ED. Pathophysiology of urinary tract obstruction. *Campbell's Urology*, 8th edn. Philadelphia, PA: Saunders; 2002.

2 Stables D. The Renal Tract Section 2B. Pregnancy the mother. In: Cunningham FG, MacDonald PC, Gant NF *et al.* eds. *Physiology in Childbearing with Anatomy and Related Biosciences*. Edinburgh, UK: Hauscent Publishing Limited; 2000; 236–246.

3 Cunningham FG, MacDonald PC, Gant NF *et al.* Physiology of pregnancy: Maternal adaptations to pregnancy. In: Cunningham FG, MacDonald PC, Gant NF *et al.* eds. *William's Obstetrics*, 20th edn. London: Prentice Hall International; 1999; 2191–2265.

4 Beischer N, Mackay EV, Colditz PB. Medical and surgical disorders of pregnancy: The urinary system. *Obstetrics and the Newborn: An Illustrated Textbook*, 3rd edn. London: W.B. Saunders, 1997; 371–376.

5 Enkin M, Keirse MJ, Neillson JP *et al.* Infections in pregnancy. *A Guide to Effective Care in Pregnancy and Childbirth*, 3rd edn. Oxford, UK: Oxford University Press, 2000.

6 Lingeman J, Lifshitz DA, Evan AP. Surgical management of urinary lithiasis. *Campbell's Urology*, 8th edn. Philadelphia, PA: Saunders, 2002.

7 McAleer SJ, Loughlin KR. Nephrolithiasis and pregnancy. [Review] *Curr Opin Urol* 2004; **14**: 123–127.

8 Biyani CS, Joyce AD. Urolithiasis in pregnancy. I. Pathophysiology, fetal considerations and diagnosis. [Review] *Br J Urol Int* 2002; **89**: 811–818; quiz i–ii.

9 Biyani CS, Joyce AD. Urolithiasis in pregnancy. II. Management. [Review] *Br J Urol Int* 2002; **89**: 819–823.

10 Lewis DF, Robichaux AG III, Jaekle RK, Marcum NG, Stedman CM. Urolithiasis in pregnancy. Diagnosis, management and pregnancy outcome. *J Reprod Med* 2003; **48**: 28–32.

11 Butler EL, Cox SM, Eberts EG, Cunningham FG. Symptomatic nephrolithiasis complicating pregnancy. *Obstet Gynecol* 2000; **96**: 753–756.

12 Ferguson T, Bechtel W. Hydronephrosis of pregnancy. *Am Fam Physician* 1991; **43**: 2135–2137.

13 Meron MaR, M. Urinary lithiasis: Aetiology, diagnosis and medical management. *Campbell's Urology*, 8th edn. Philadelphia, PA: Saunders, 2002.

14 Stothers L, Lee LM. Renal colic in pregnancy. *J Urol* 1992; **148**: 1383–1387.

15 Jarrard DJ, Gerber GS, Lyon ES. Management of acute ureteral obstruction in pregnancy utilizing ultrasound-guided placement of ureteral stents. [See comment] *Urology* 1993; **42**: 263–267; discussion 267–268.

16 Murthy LN. Urinary tract obstruction during pregnancy: Recent developments in imaging. [Review] *Br J Urol* 1997; **80** (Suppl. 1): 1–3.

17 Hellawell GO, Cowan NC, Holt SJ, Mutch SJ. A radiation perspective for treating loin pain in pregnancy by double-pigtail stents. *Br J Urol Int* 2002; **90**: 801–808.

18 Irving SO, Burgess NA. Managing severe loin pain in pregnancy. *BJOG: Int J Obstet Gynaecol* 2002; **109**: 1025–1029.

19 Practice ACoO. ACOG Committee Opinion. Number 299, September 2004 (replaces No. 158, September 1995). Guidelines for diagnostic imaging during pregnancy. *Obstet Gynecol* 2004; **104**: 647–651.

20 Spencer JA, Chahal R., Kelly A, Taylor K, Eardley I, Lloyd SN. Evaluation of painful hydronephrosis in pregnancy: Magnetic resonance urographic patterns in physiological dilatation versus calculus obstruction. *J Urol* 2004; **171**: 256–260.

21 Valentin J. Pregnancy and medical radiation. ICRP Publication 84. *Ann ICRP* 2000; **30**: 1–43.

22 Puskar D, Balagovic I, Filipovic A *et al.* Symptomatic physiologic hydronephrosis in pregnancy: Incidence, complications and treatment. *Eur Urol* 2001; **39**: 260–263.

23 Fainaru O, Almog B, Gamzu R, Lessing JB, Kupferminc M. The management of symptomatic hydronephrosis in pregnancy. *BJOG: Int J Obstet Gynaecol* 2002; **109**: 1385–1387.

24 Zwergel T, Lindenmeir T, Wullich B. Management of acute hydronephrosis in pregnancy by ureteral stenting. *Eur Urol* 1996; **29**: 292–297.

25 Damiano R, Oliva A, Esposito C, De Sio M, Autorino R, D'Armiento M. Early and late complications of double pigtail ureteral stent. *Urologia Intis* 2002; **69**: 136–140.

26 Ringel A, Richet S, Shalev M, Nissenkorn I. Late complications of ureteral stents. *Eur Urol* 2000; **38**: 41–44.

27 Khoo L, Anson K, Patel U. Success and short-term complication rates of percutaneous nephrostomy during pregnancy. *J Vasc Int Radiol* 2004; **15**: 1469–1473.

28 Kavoussi LR, Albala DM, Basler JW, Apte S, Clayman RV. Percutaneous management of urolithiasis during pregnancy. [See comment] *J Urol* 1992; **148**: 1069–1071.

29 Peer A, Strauss S, Witz E, Manor H, Eidelman A. Use of percutaneous nephrostomy in hydronephrosis of pregnancy. *Eur J Radiol* 1992; **15**: 220–223.

30 Hausegger K, Portugaller H. Percutaneous nephrostomy and antegrade ureteral stenting: Technique, indications, complications. *Eur Radiol* 2006; **16**: 2016–2030.

31 Akpinar H, Tufek I, Alici B, Kural AR. Ureteroscopy and holmium laser lithotripsy in pregnancy: Stents must be used postoperatively. *J Endourol* 2006; **20**: 107–110.

32 Carringer M, Swartz R, Johansson JE. Management of ureteric calculi during pregnancy by ureteroscopy and laser lithotripsy. [See comment] *Br J Urol* 1996; **77**: 17–20.

33 Lifshitz DA, Lingeman JE. Ureteroscopy as a first-line intervention for ureteral calculi in pregnancy. *J Endourol* 2002; **16**: 19–22.

34 Ulvik NM, Bakke A, Hoisaeter PA. Ureteroscopy in pregnancy. [See comment] *J Urol* 1995; **154**: 1660–1663.

35 Watterson JD, Girvan AR, Beiko DT *et al.* Ureteroscopy and holmium: YAG laser lithotripsy: An emerging definitive management strategy for symptomatic ureteral calculi in pregnancy. [See comment] *Urology* 2002; **60**: 383–387.

36 Carter SS, Cox R, Wickham JE. Complications associated with ureteroscopy. *Br J Urol* 1986; **58**: 625–628.

37 Johnson DB, Pearle MS. Complications of ureteroscopy. [Review] *Urol Clin North Am* 2004; **31**: 157–171.