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Outcomes of Ureteroscopy for Stone Disease in Pregnancy: Results from a Systematic Review of the Literature

Key Words

Pregnancy · Stones · Lithotripsy · Laser · Urolithiasis

Abstract

Introduction: Our aim was to evaluate the clinical efficacy and safety of ureteroscopy as a primary treatment for pregnant women with symptomatic ureteric stones who have failed conservative management. **Materials and Methods:** A systematic review of the literature from January 1990 to June 2011 was performed, including all English language articles. Outcome measures were clinical efficacy, in terms of stone clearance and need for additional procedures, and safety in terms of complications. **Results:** A total of 239 abstracts were screened and 15 studies were identified reporting on 116 procedures. The surgical methods of stone management employed were stone extraction with basket only (n = 55, 47%), laser fragmentation (n = 27, 23%; holmium, n = 20, pulse dye, n = 7), impact lithotripsy (n = 21, 18%), ureteroscopic lithotripsy (n = 6, 5%) and a combination of methods (n = 6, 5%). A post-operative stent was inserted in 64 of 116 procedures (55%). Complete stone clearance was seen in 100 of the 116 procedures (86%). There were 2 major complications (1 ureteral perforation and 1 case of premature uterine contraction) and 7 minor complications (5 urinary tract infections and 2 cases of post-operative pain). **Conclusion:** This review suggests that stone clearance using ureteroscopy is a relatively safe option in pregnancy with a high success rate.

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Introduction

Urolithiasis can complicate up to 1 in 200 pregnancies [1–3]. It is the second most common cause of abdominal pain in pregnant women after urinary tract infection (UTI) [1–3] and is the commonest non-obstetric reason for admission to hospital during pregnancy. Within this group, 80–90% of pregnant women are in the 2nd or 3rd trimester of their pregnancy. Multiparous women are also more commonly affected [4–7].

During pregnancy, there is physiologic dilatation of the collecting systems, allowing for migration of renal stones into the ureter, leading to obstruction and/or pain. This could explain the reason for the observation that during pregnancy, stones are twice as likely to be found in the ureter than in the renal pelvis or calyces. Physiologic hydronephrosis caused by the enlarging uterus is present in 90% of pregnancies by the 3rd trimester [8–11]. This can make it more difficult to diagnose intramural obstruction during pregnancy. However, hydronephrosis due to pregnancy does not usually extend below the pelvic brim, and hence dilatation below this level is more likely to be due to an intraluminal cause such as ureteric stones.

Renal colic, infection and obstruction are a source of significant morbidity and potentially mortality to mother and child. The main risks are pre-term labour, which can occur in up to 40% of women [8], pre-term delivery and premature rupture of membranes.

The management of urolithiasis in pregnancy is mainly conservative in the first instance, with spontaneous stone passage in approximately 70–80% of patients [9]. Expectant management includes hydration and analgesia. The use of oral calcium channel blockers, α -blockers and corticosteroids remains unproven in pregnant women, predominately due to safety concerns within this population. Approximately 20–30% of pregnant women will require therapeutic intervention. Indications for operative intervention are renal colic refractory to conservative treatment, sepsis and renal tract obstruction in a solitary kidney [3, 10–14].

The European Association of Urology guidelines [15] state that pregnant women with renal colic who have failed conservative management should be treated with temporising measures such as a stent or nephrostomy. Ureteroscopy (URS) can be considered, but only in specialist centres.

Temporising measures such as ureteric stenting or nephrostomy insertion can be performed under local anaesthetic with ultrasound scanning or minimal radiographic screening; however, during pregnancy there is accelerated encrustation and plugging which may result in frequent replacement of stents or nephrostomy tubes. With continued advancements in endoscopic technology and endourological techniques, URS has become less invasive and less traumatic such that it may be considered as first-line treatment in the management of ureteric stones in pregnancy.

We conducted a systematic review to assess the relative merits and harms of URS in the treatment of urolithiasis in pregnancy.

Materials and Methods

Search Strategy

This systematic review was performed according to the Cochrane diagnostic accuracy review guidelines. The search strategy was conducted to find relevant studies from MEDLINE (1966 to June 2011), EMBASE (1980 to June 2011), the Cochrane Central Register of Controlled Trials (in *The Cochrane Library*, Issue 1, 2011), CINAHL (1872 to June 2011), Google Scholar and individual urological journals.

Terms used included the following: 'ureteroscopy', 'pregnancy', 'calculi', 'stones', 'laser' and 'urolithiasis'. Mesh phrases included the following: ('Ureteroscopy' [Mesh]) AND 'Pregnancy' [Mesh], ('Calculi' [Mesh]) AND 'Ureteroscopy' [Mesh], ('Pregnancy' [Mesh]) AND 'Stones' [Mesh], ('Pregnancy' [Mesh]) AND ('Lasers' [Mesh] OR 'Laser Therapy' [Mesh]), (('Lasers' [Mesh]) AND 'Calculi' [Mesh]) AND (('Pregnancy' [Mesh]), and ('Ureteroscopy' [Mesh]) AND ('Calculi' [Mesh])). Reference lists

of selected papers and abstracts from the annual meetings of the American Urological Association, European Association of Urology and the World Congress of Endourology were also searched for further eligible studies. Finally, ongoing trials were searched using ClinicalTrials.gov. The search was performed by B.K.S. and K.A.L. and was limited to the English language. References of searched papers were evaluated for potential inclusion, and the more recently published version was included if the publication was duplicated. Authors of the included studies were contacted wherever data were not available or not clear. Disagreement between the reviewers was resolved by discussion. If agreement between the two reviewers could not be reached, a third author (T.B.L.L.) was consulted for arbitration and consensus.

The participants included pregnant women in all stages of pregnancy, who were 16 or over and who had failed conservative management for ureteric stones. The reasons for failure are outlined in the methodology section. They underwent URS \pm lithotripsy/stone extraction under local, regional or general anaesthetic. Comparisons were made between immediate versus delayed stone treatment. Immediate treatment included URS \pm lithotripsy \pm stenting and URS + stone extraction. Delayed treatment included stent + delayed URS, stent + delayed shock wave lithotripsy (SWL), nephrostomy + delayed URS and nephrostomy + delayed SWL. The outcomes measured were safety and adverse effects, graded using the Clavien criteria. Efficacy was defined by the stone clearance rate and the need for additional procedures such as ureteric stenting. Process and recovery outcomes were measured by length of hospital stay, analgesic requirements and quality of life measures.

Criteria for Inclusion

All studies published between January 1990 and June 2011 were eligible for evaluation. To satisfy the criteria for inclusion it was necessary that the study report on URS in a population of pregnant women of at least 3 patients and that the method of stone extraction, success rate and urological and obstetric complications be documented. Complications were graded in accordance with the Clavien criteria wherever possible or as defined by the study authors.

Quality Assessment of Included Studies

Risk of bias assessment and assessment of quality of evidence were planned, but since only retrospective case series were identified, formal risk of bias and quality assessments were not performed.

Data Extraction

Studies relevant to the ureteroscopic management of pregnant patients were included. The following variables were extracted from each study: period of the study; country of origin of the study; stone size and location; patient demographics such as age, gestation and type of anaesthetic; number of URS performed; method of anaesthesia; method of stone extraction; ureteric stent insertion; use of fluoroscopy; stone-free outcome, and urological, obstetric and other complications.

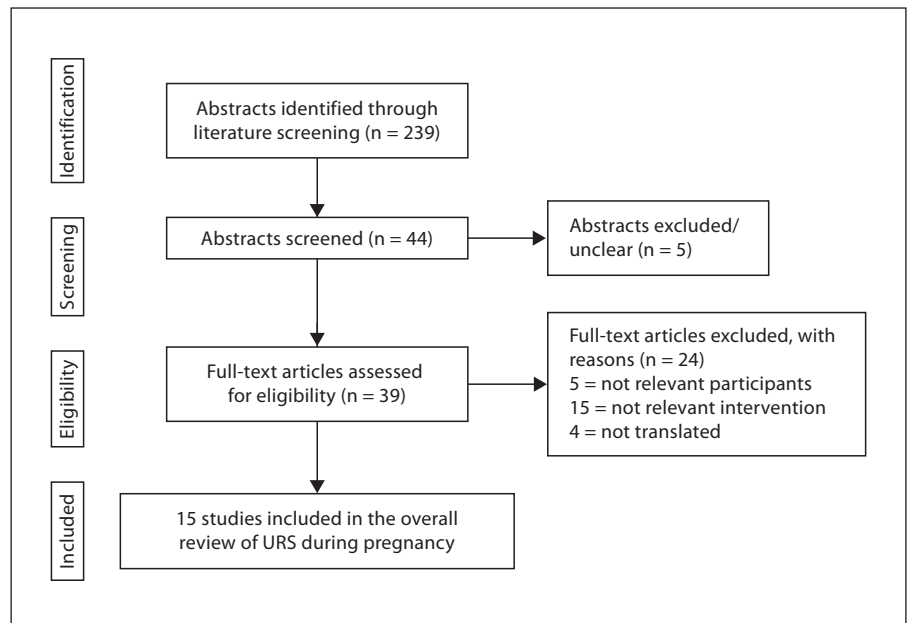


Fig. 1. Outcomes of the literature search.

Table 1. Summary of study information and patient demographics in the studies included

First author	Year	Country	Journal	Level of evidence	Patient age range, years	Trimester
Scarpa [16]	1996	Italy	J Urol	3	16–30	2, 3
Carringer [17]	1996	Sweden	Br J Urol	3	27–35	3
Ulvik [18]	1995	Norway	J Urol	3	20–41	1, 3
Juan [19]	2007	Taiwan	Kaohsiung J Med Sci	3	23–39	3
Akpinar [20]	2006	Turkey	J Endourol	3	24–33	1, 3
Yang [21]	2004	Taiwan	J Chin Med Assoc	3	not known	1, 2
Lemos [22]	2002	Brazil	Int Braz J Urol	3	20–34	1, 3
Lifshitz [23]	2002	USA	J Endourol	3	17–31	1, 2, 3
Watterson [24]	2002	Canada	Urology	3	21–36	1, 2, 3
Shokeir [25]	1998	Saudi Arabia	Br J Urol	3	22–33	2, 3
Parulkar [26]	1998	USA	J Urol	3	18–40	2
Denstedt [27]	1992	Canada	J Urol	3	not known	3
Rana [28]	2009	Pakistan	Urology	3	18–27	2, 3
Travassos [29]	2009	Brazil	J Endourol	3	not known	1, 2, 3
Cocuzza [30]	2010	Brazil	Urology	3	29.9 (mean)	2, 3

Results

A total of 15 reports of URS in pregnant women were identified in the literature search (fig. 1). All of these were retrospective case series. These reports included 116 pregnant women undergoing URS for ureteric stone disease (tables 1, 2). The mean age was 28 years (range 16–

41); the majority of patients were in the 2nd or 3rd trimester of pregnancy. Most patients underwent the procedure under local anaesthetic or spinal/epidural anaesthesia. Ten procedures were performed under local anaesthetic, 46 under epidural/spinal anaesthesia and 44 under general anaesthetic, and the type of anaesthesia was not documented in 6 cases.

Table 2. Management and outcomes of patients in the studies included

First author	URS type and size	Imaging methods	Anaesthetic type	Position of stone	Stone size, mm	Fluoroscopy	Method of stone extraction	Stent	Complications	Follow-up
Scarpa [16]	13 rigid, 7.5 Fr	renal tract USS	8 GA 5 LA	2 distal 3 middle 3 upper 5 NA	NA	no	3 pulse dye laser 3 holmium laser 2 pneumatic 2 basket 3 displaced	13/13	nil	renal tract USS 2 days post-operatively 13/13 healthy full-term infants removal of stent post partum ESWL for stone clearance in 3/13
Carringer [17]	4 mini, 7 Fr (Candela Co.)	IVU	4 LA	3 distal 0 middle 1 upper 0 NA	7, 7, 8 16	no	4 pulse dye laser	0/4	nil	KUB on first post-operative day 4/4 healthy full-term infants
Ulvik [18]	13 rigid, 11.5 Fr	KUB + renal tract USS	12 epidural 1 LA	NA	NA	no	2 USL 1 forceps 10 basket	7/13	3 UTI ¹ 1 premature uterine contractions (treated conservatively) 1 ureteric perforation (treated with stent and antibiotics)	IVU/USS 3 months post-operatively 1 neonate 7 weeks premature – not related to URS 1 neonate with cleft lip 11 healthy full-term infants
Juan [19]	3 semi-rigid, 6 Fr	renal tract USS	3 epidural	NA	NA	no	3 basket	0/3	nil	3/3 healthy full-term infants
Akpınar [20]	4 rigid, 8/9.8 Fr 2 FURS	renal tract USS	6 GA	3 distal 0 middle 3 upper 0 NA	7, 11, 9 8, 6, 6	no	6 holmium	4/6	2 prolonged admission due to pain (stayed 48 and 72 h post-operatively, respectively)	stents removed on 4th post-operative day 12/12 healthy full-term infants
Yang [21]	3 semi-rigid	renal tract USS	unknown	NA	NA	no	1 EHL 2 basket	0/3	nil	3/3 healthy full-term infants
Lemos [22]	13 rigid, 7/10 Fr	renal tract USS MRI	13 epidural	10 distal 2 middle 1 upper 0 NA	4–12 median 6	1/13	11 basket 2 USL	8/13	nil	13/13 healthy full-term infants
Lifshitz [23]	4 rigid (ACMI, 6.9 Fr) + FURS (Storz, 7.5 Fr; Olympus, 8 Fr)	renal tract USS limited IVU	4 epidural	3 distal 0 middle 1 upper 0 NA	4, 5, 3 0 5	4/4	4 basket	3/4	nil	4/4 healthy full-term infants removal of ureteric stent 1 day post-operatively
Watterson [24]	8 semi-rigid, 6.9 Fr	renal tract USS	8 GA	4 distal 1 middle 3 upper 0 NA	NA	4/8	8 holmium	4/8	nil	8/8 healthy full-term infants stent removal USS/IVU/KUB in post-partum period 2 ESWL post partum
Shokair [25]	8 rigid, 11/9.5 Fr	renal tract USS	8 epidural	4 distal 1 middle 3 proximal 0 NA	NA	no	3 basket 2 USL 3 displaced	3/8	UTI – treated conservatively	stents changed every 6 weeks until delivery USS every 2 months until delivery and then 6 months following delivery 8/8 healthy full-term infants 3 ESWL post partum
Parulkar [26]	4 rigid	renal tract USS	4 GA	NA	NA	4/4	4 basket	0/4	nil	out-patient review 2–60 weeks following delivery
Denstedt [27]	3 rigid		unknown	NA	NA	3/3	3 basket	0/3	nil	NA
Rana [28]	18 semi-rigid (Storz, 6.9 Fr/Wolf, 8 Fr)	renal tract USS 1 KUB	18 GA	8 distal 0 middle 10 proximal 0 NA	8–18 median 11	no	18 lithoclast	12/18	nil	18/18 healthy full-term infants renal tract USS, urine C+S post-operatively 3 ESWL post partum

Table 2 (continued)

First author	URS type and size	Imaging methods	Anaesthetic type	Position of stone	Stone size, mm	Fluoroscopy	Method of stone extraction	Stent	Complications	Follow-up
Travassos [29]	9 semi-rigid	renal tract USS	unknown	6 distal 0 middle 3 proximal 0 NA	6–10 median 8	no	9 basket	9/9	nil	removal of stent after 1 week 9/9 healthy full-term infants
Cocuzza [30]	6 semi-rigid (Wolf, 6.9 Fr), 1 FURS (Storz, 7.5 Fr)	renal tract USS	7 spinal	3 distal 2 middle 3 proximal 0 NA	mean 8.1 ± 4.8	7/7	4 basket 3 holmium	1/7	nil	7/7 healthy full-term infants stent removed 2 weeks following delivery USS 2 months following delivery

URS = Ureteroscopy; FURS = flexible ureteroscopy; GA = general anaesthetic; LA = local anaesthetic; USS = ultrasound scan; KUB = X-ray of kidneys, ureters, bladder; IVU = intravenous urogram; MRI = magnetic resonance imaging; NA = not available; EHL = electrohydraulic lithotripsy; SWL = shock wave lithotripsy; C+S = culture and sensitivity; UTI = urinary tract infection.

¹ Three patients with temperature <38.4 °C; of those 2 had documented UTI prior to URS (2 treated with antibiotics and discharged 3/7 days post-operatively, 1 re-admitted with pyelonephritis, which was treated conservatively).

Stone location was documented in 10 studies (86 patients). The stone location was in the proximal, middle and distal ureter in 31, 9 and 46 patients, respectively. Stone size was only documented in 7 studies (range: 3–11 mm for distal stones and 5–16 mm for proximal stones). The stone procedure was performed by rigid URS (n = 62, 53%), semi-rigid URS (n = 47, 45%), flexible URS (n = 3, 3%) or mini-ureteroscope (n = 4, 3%). During the procedure, fluoroscopy was used in 23 patients (20%). There were a number of methods used for stone extraction. The commonest method was basket extraction, which was used in 55 patients (47%). Laser and lithoclasts were popular for stone fragmentation, being used in 27 (23%) and 21 patients (18%), respectively. In a small proportion of patients, ultrasonic lithotripsy (USL) and a combination of techniques were required for stone extraction. The stone was extracted successfully in 100 patients (86%). In 6 patients, there was displacement of the stone into the renal pelvis necessitating SWL post partum. Sixty-four patients (55%) had a ureteric stent placed at the end of the procedure. The majority of procedures were performed without incident. There was 1 reported incidence of premature uterine contraction (Clavien criteria grade II), 5 UTIs (Clavien criteria grade I), 1 ureteral perforation (Clavien criteria grade III) and 2 cases of prolonged admission due to pain (Clavien criteria grade I). There were no maternal or foetal deaths reported.

Discussion

Retrograde stone extraction during pregnancy is becoming more common. The findings of this systematic review suggest that it is a procedure with high efficacy, with 86% of cases achieving complete stone clearance. Fluoroscopy and radiation exposure should be limited during pregnancy due to the risks to the foetus, and this was only required in 23 patients (20%). A number of techniques were used for stone extraction, including USL, basket extraction and lithoclast. A ureteric stent was placed in 55% of patients, which is disappointing as although they can allow adequate drainage of an obstructed system they are more prone to encrustation due to the increased concentration of calcium and urate in urine during pregnancy [13]. This encrustation can necessitate frequent stent changes, which can be as often as every 4–6 weeks. These additional procedures are associated with morbidity such as UTI, stent migration and pain, which can have adverse effects on the pregnancy. Nephrostomy for obstruction secondary to urolithiasis in pregnancy

[14] has also been described but is subject to similar complications and is not well tolerated, with a third of patients requiring removal of the nephrostomy tube due to pain, fever or drain obstruction [14]. Both are only temporary measures and do not provide definitive management of the obstructing calculus. To their advantage, ureteric stent insertion and nephrostomy placement can be successfully performed under local anaesthetic, thus reducing the potential risks of a general anaesthetic for the pregnant women. However, many of the URS procedures reported in this systematic review were performed under local or regional anaesthetic.

Technological advancements in endourology such as the development of the semi-rigid or flexible ureteroscope could be one of the reasons why URS is increasingly being used in pregnancy. There have also been improvements in the design of baskets used for retrieval, and the availability of laser, SWL and USL enables the atraumatic fragmentation of stones.

Complications were infrequent in pregnant women undergoing URS, with only 2 patients (1.6%) suffering a major complication. There was no mortality reported either for mothers or unborn children.

The review had some inherent limitations. Firstly, the paucity of well-designed randomised trials or comparative prospective studies assessing the role of URS in pregnant women was a clear limitation. Virtually all studies were retrospective case series without a control arm, and this inevitably introduces selection bias, as various confounding variables such as stone size, stone location and type of stones were not accounted for. This limits the evidence base somewhat. However, given the relative rarity of urolithiasis in pregnancy, especially complicated cases requiring surgical intervention, coupled with the high efficacy of URS and the lack of therapeutic alternatives, it may not be feasible nor pragmatic to conduct comparative studies on such women, let alone randomised studies. However, future studies should be prospective at the very least, with clearly specified objectives, an assessment of confounding variables such as stone size and location, and the measurement of clinically meaningful outcome measures, including quality of life outcomes.

Secondly, it was also unclear in the majority of studies how patients were selected, as there were no inclusion criteria in the majority of studies. This limitation may affect the external validity of the review findings. Thirdly, performance bias may also have been an issue, as it was not clear in the majority of studies what was the grade of the surgeon performing the URS. URS and in situ lithotripsy or stone retrieval is a complex procedure with a relatively

long learning curve, and hence the surgical outcomes of experts and trainee surgeons are likely to be different. Finally, publication bias is also possible, as unfavourable results are less likely to have been reported or published. This assertion is supported by the apparent discrepancy between the relatively low number of patients in this review ($n = 116$ only) and the reported incidence of urolithiasis of up to 1 in 200 pregnancies, especially with 20–30% of patients failing expectant management. This observation suggests it is probable that more women are undergoing URS during pregnancy than is being reported, and our review was limited as only case series were included.

With these limitations in mind, the evidence base in regard to level 1–3 evidence for the role of URS in the treatment of urolithiasis in pregnancy is poor, and hence further well-designed, prospective studies which take into account selection bias, performance bias and the issue of confounding are required.

Conclusion

In spite of the various limitations, the findings from this systematic review suggest that URS appears to be a safe procedure during pregnancy, which can be performed under local or regional anaesthesia without the need of fluoroscopy. As such, it may be considered as a first-line treatment of ureteric calculi in those who have failed expectant management. To optimise outcomes in terms of efficacy and safety, URS in pregnancy should ideally be performed by experts in high-volume centres.

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