



# Safety and Efficacy of Ureteroscopic Laser Lithotripsy in the Management of Ureteric Calculi in Pregnancy—Experience of a Tertiary Care Center

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## Abstract

**Introduction** Ureteric colic in pregnancy is one of the common non-obstetric reasons for emergency department visits. Ureteric calculi present a significant threat to maternal and fetal health and definitive management often becomes necessary. Our aim is to assess the safety and efficacy of ureteroscopic laser lithotripsy in the management of ureteric stones in pregnancy.

**Material and methods** This is a prospective observational study of 3 years carried at a tertiary referral center. It includes all pregnant patients who underwent ureteroscopic laser lithotripsy for ureteric stones.

**Results** A total of 29 pregnant patients underwent ureteroscopic laser lithotripsy at our center in 3 years. The mean age of patients was  $33.5 \pm 6.2$  years, and the mean gestation age at the time of ureteroscopy was  $23.34 \pm 5.9$  weeks. The average stone size was  $8.3 \pm 3.6$  mm and was predominantly found in upper ureter (62%). The mean operative time was  $31 \pm 8.9$  min, and the average laser energy spent was  $4.3 \pm 1.1$  kJ/case. There was no major Intraoperative complication, and the average hospital stay was  $2.5 \pm 1.5$  days. Complete stone clearance was achieved in 93.1% of cases.

**Conclusion** Ureteroscopic laser lithotripsy is safe and effective treatment of ureteric stones in terms of obstetric outcome and stone clearance in pregnancy.

**Keywords** Pregnancy · Laser lithotripsy · Ureteroscopy · Ureteric calculi

## Abbreviations

CT	Computed tomography
DJ	Double J
MRU	Magnetic resonance urography
Ho:YAG	Holmium yttrium garnet
USG	Ultrasonography

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## Introduction

Ureteric calculi presenting as flank pain is one of the most common non-obstetric reasons for emergency department visit during pregnancy [1]. The incidence of urinary calculi in pregnancy ranges from 1:200 to 1:2000 with peak incidence found in second and third trimester [2]. Multiparous women have higher incidence of symptomatic ureterolithiasis compared to primiparous women. Progesterone induced relaxation of genitourinary smooth muscles and dilatation of ureter by extramural compression by gravid uterus predisposes to migration of renal calculi into ureter leading to ureteric colics [3]. Ureteric calculi are often difficult to diagnose and manage because of non-specific presenting symptoms, anatomical changes occurring during pregnancy and restricted use of imaging studies. Physiological hydronephrosis during pregnancy predominantly occurs on the right side (90%) compared to left side (67%). This often leads to delay in diagnosis and adversely affects fetal and maternal health. Ureteric calculi present a significant risk of preterm labor, miscarriage, premature rupture of the membranes, preeclampsia and obstructive uropathy [4]. Conservative

management is successful in 70–80% of patients and those failing conservative management require placement of double J (DJ) stent or percutaneous nephrostomy tube placement (PCN). With miniaturization of endoscopic equipment, better optics and efficient laser energy sources available for intracorporeal lithotripsy, definitive management of ureteric calculi is being promoted worldwide [5].

## Material and Methods

This is a prospective observational study carried out at a tertiary referral center. This study included all pregnant females who underwent ureteroscopic laser lithotripsy after failed medical expulsive therapy for ureteric calculi. Pregnant patients with ureteric colic were evaluated with ultrasound examination (USG) of abdomen. The size and location of stone as well as fetal wellbeing were documented. All patients except those with obstructive uropathy and urosepsis were initially managed conservatively with fluids, analgesics (paracetamol and drotaverine hydrochloride) and alpha blockers (Tamsulosin 04 mg). Follow-up USG was done after 2 weeks to look for grade of hydronephrosis and any stone. Patients who failed conservative management having persistent or worsening of hydronephrosis on follow-up USG, persistent flank pain requiring frequent analgesics were taken up for ureteroscopic laser lithotripsy. Written consent was taken, and patients were admitted 24 h before the procedure. Patients were started on tocolytics to reduce the risk of abortion or premature labor. Injection Hydroxyprogesterone 500 mg was given via intramuscular route half hour prior to surgery and then, given weekly for 4 weeks after procedure. Infusion of isoxsuprine (40 mg in 500 ml of 5% dextrose) was started half hour prior to surgery at the rate of 8–10 drops per minute and rate increased by 8 drops after every 30 min until there was maternal tachycardia, fall in blood pressure, nausea, vomiting or fetal tachycardia. The infusion was continued for 24 h after surgery and then, shifted to intramuscular route at the rate of 10 mg every 8 h for 3 days. Hydroxyprogesterone was used in all patients while as isoxsuprine was used only in patients in third trimester of pregnancy. The ureteroscopy was done under spinal anesthesia in lithotomy position with right flank raised about 25 degrees using 6/7.5Fr semi rigid ureteroscope with normal saline irrigation by pulsatile irrigation bulb. Once stone was identified, a 200  $\mu$ m fiber was used to deliver laser energy from Holmium:YAG laser generator. Lithotripsy was started with 0.4 J/6 Hz initially and gradually energy was increased if disintegration was ineffective. After lithotripsy bigger size stone fragments were removed with forceps, and a double J stent was deployed inside the ureter depending on the clearance and edema at impaction site. DJ stent placement was omitted in patients with complete stone clearance

with minimal ureteric edema. Intraoperative fetal monitoring was done, and any adverse event was recorded. Any perioperative complication was documented, and USG was done in postoperative period for fetal wellbeing and stone clearance. Patients were discharged 24–48 h after the procedure. DJ stent was removed after 4 weeks.

## Results

29 regnant patients underwent ureteroscopic laser lithotripsy at our center over a period of 3 years from January 2019 to January 2022. The mean age of patients was  $33.5 \pm 6.2$  years. 7 (24%) patients were presented in first trimester, 14 (48%) in second trimester and 8 (28%) in third trimester of pregnancy. The mean gestational age at the time of URSL was  $23.34 \pm 5.9$  weeks. The predominant symptom at presentation was flank pain in 25 patients (86%). 3 patients (10.34%) were presented with fever and flank pain while as one patient presented with vomiting and obstructive uropathy because of impacted stone in a solitary functional kidney. Symptomatic calculi were present on right side in 19 (65%) patients and on left side in 9 (31%) patients. One patient had bilateral ureteric calculi. The average stone size estimated on transabdominal ultrasound was  $8.3 \pm 3.6$  mm (Range 7.5–13 mm) and was predominantly found in upper ureter (62%). Definitive management of ureteric stones was undertaken because of persistent pain in 26 patients (89%), progressive hydronephrosis in 2(6.8%) and obstructive uropathy in 1 (3.4%) patient. The demographic profile and stone characteristics of patients are shown in Table 1.

All the patients were operated under spinal anesthesia. The mean operative time was  $31 \pm 8.9$  min. Mean laser time was  $11.5 \pm 3.5$  min, and the average laser energy spent was  $4.3 \pm 1.1$  kJ/case. Only 4 (13.7%) patients had adverse events recorded intraoperatively that included bleeding impairing vision (2 patients) and visible mucosal ablation (2 patients). DJ stent was placed at the end of procedure in 24 (82.7%) patients, while as no stent was required in 5 (17.2%) patients. Complete clearance of stone was achieved in 27(93.1%) patients, and only 2 patients had visible proximal migration of stone fragments that was confirmed by postoperative ultrasound examination of abdomen.

There was no major maternal or fetal complication recorded in postoperative period. Only 2 (6.8%) patients had fever that responded to intravenous antibiotics. One patient had accidental removal of DJ stent because of its entanglement with foley catheter. The average hospital stay was  $2.5 \pm 1.5$  days. There was no need of any ancillary procedure apart from removal of DJ stent after 4 weeks in 27 (93.1%) of patients, while as 2 (6.8%) patients with proximal migration of stone required extracorporeal shockwave lithotripsy (ESWL) after completion of pregnancy. The obstetric outcome of all patients was

**Table 1** Demographic profile and stone characteristics of patients

Variables	Value
Age	33.5 ± 6.2 years
Gestational age	23.34 ± 5.9 weeks
<i>Symptoms</i>	
Flank pain	25 (86%)
Fever with pain	3 (10.3%)
Vomiting with obstructive uropathy	1 (3.4%)
<i>Side of stone</i>	
Right	19 (65.5%)
Left	9 (31%)
Bilateral	1 (3.4%)
<i>Location of stone</i>	
Upper ureter	18 (62%)
Lower ureter	11 (38%)
Size of stone	8.3 ± 3.6 mm
<i>Reason for intervention</i>	
Persistent flank pain	26 (89.6%)
Progressive hydronephrosis	2 (6.8%)
Obstructive uropathy	1 (3.4%)

**Table 2** Perioperative data of patients

Parameters	Values
Mean operative time	31 ± 8.9 min
Mean laser time	11.5 ± 3.5 min
Mean laser energy spent/case	4.3 ± 1.1 kJ/case
<i>Intraoperative adverse events</i>	
Bleeding impairing vision	2 (6.8%)
Visible mucosal ablation	2 (6.8%)
Complete stone clearance	27 (93.1%)
Placement of DJ stent	24 (82.7%)
<i>Complications</i>	
Fever	2 (6.8%)
Accidental removal of DJ stent	1 (3.4%)
Hospital stay	2.5 ± 1.5 days
<i>Ancillary procedure required</i>	
ESWL (After completion of pregnancy)	2 (6.8%)

uneventful. 11 (38%) had normal vaginal delivery while as 18 (62%) underwent lower segment cesarean section at term. There was no premature labor recorded in any patient. The perioperative data of patients are compiled in Table 2.

## Discussion

Ureteric calculi in pregnancy are a frequent cause of flank pain and emergency department visits for non-obstetric causes second only to urinary tract infection. The condition

is often difficult to diagnose and easily missed because of physiological changes occurring in pregnancy. Most commonly ureteric calculi present with acute flank pain; however, fever, vomiting, hematuria or deterioration of renal function can be the presenting symptoms in many patients [6]. Acute flank pain was the most common presenting symptom in our study. Clinical signs and symptoms combined with ultrasound examination (USG) of abdomen are most often used to establish the diagnosis of ureteric calculi. Easy availability and safety of USG makes it the first radiological investigation to be used in pregnancy for evaluation of flank pain. USG gives details of pelvicalyceal system, ureteric dilation and sometimes stone itself. It also easily identifies alternate causes of acute abdomen like appendicitis, diverticulitis, bowel obstruction or placental abruption. The sensitivity and specificity of USG to identify ureteric calculi are 24% and 90%, respectively, [7]. USG cannot clearly differentiate physiological hydronephrosis from pathological hydronephrosis with absolute certainty. In our study, USG was sufficient to diagnose ureteric calculi in 24 (82%) of patients.

Magnetic resonance urography (MRU) utilizes non-ionizing electromagnetic radiation for imaging and is considered safe to fetus. With accuracy comparable to computed tomography (CT) and ability of rapid acquisition of images without use of contrast, MRU is considered second line investigation in pregnancy to diagnose ureteric calculi [8]. MRU was used in 5 (17.2%) of our patients in which USG was not sufficiently informative.

Most of the ureteric calculi in pregnancy respond to conservative management consisting of hydration, analgesics, antiemetic and alpha blockers. 60–80% of pregnant patients respond to conservative management and have higher success rate compared to non-pregnant females because of physiologic dilatation of ureter [9]. Active intervention is warranted in patients who do not respond to conservative management, have progressive increase in hydronephrosis, obstructive uropathy or urosepsis. In our study, conservative management was tried before proceeding to ureteroscopic laser lithotripsy. Persistent pain was the most common indication for intervention in our study. Active intervention for ureteric calculi in pregnancy includes placement of DJ stent or percutaneous nephrostomy (PCN) tube to temporary drain the obstructed system or definitive intervention in the form of ureteroscopic lithotripsy. Although DJ stent or PCN are safe and easy to place with minimal risk to mother and fetus, they have disadvantage of accidental removal, infection, frequent blocking requiring change and poor tolerability.

Technological advancements in endourologic armamentarium with availability of finer semirigid ureteroscopes, better optics, high-definition cameras/monitors and efficient laser lithotripters have made ureteroscopic removal of ureteric stones as first line of definitive management

in pregnancy [10]. Regional anesthesia is preferred over general anesthesia since it is safe to mother and fetus [11]. Spinal anesthesia was used in our patients, and URS was carried in lithotomy position with slightly elevated right flank to ease the uterine compression on inferior vena cava to preserve cardiac output and placental perfusion. URS is considered more safe and feasible in second trimester of pregnancy with risk of miscarriage in first trimester and premature labor in third trimester [12]. Although most of our patients were in second trimester, procedure was equally safe and effective in first and third trimester as well. The risk increases with more prolonged procedure, excessive manipulation in pregnant pelvis and adverse underlying condition of patient mainly sepsis. Tocolytics have a definitive role in patients with onset of premature labor. Prophylactic tocolytics have been advocated in third trimester for non-obstetric pelvic procedures [13]. We have used isoxsuprine prophylaxis in third trimester of pregnancy only and omitted in first and second trimester. Progesterone supplementation during pregnancy has been approved by FDA for prevention of preterm birth. Progesterone synthesized by corpus luteum plays an important role in the maintenance of early pregnancy until it is taken over by progesterone produced by placenta at 7–9 weeks of gestation. In fact, abortion can be induced by progesterone suppression or administration of antagonists, explaining its role in maintenance of pregnancy. Studies have revealed the role of progesterone in maintaining uterine quiescence in second and third trimester of pregnancy by suppressing the production of stimulatory prostaglandins and inhibiting the expression of contraction associated protein genes [14]. we used progesterone in our patients to prevent miscarriage and premature labor. In the follow-up, we did not report any adverse fetal outcome with the use of progesterone. We recorded safe conduction of procedure in all trimesters of pregnancy. Ureteroscopy in pregnancy does not require any ureteric dilation since there is good physiological dilation to allow easy access to ureter. The mean operative time in our study was  $31 \pm 8.9$  min. All the procedures were conducted without the use of fluoroscopy, and DJ stent position was confirmed by table USG. Both pneumatic and laser lithotripters are considered as safe for use inside ureter in gravid patients. But the stone free rate is higher with the use of laser lithotripsy. Ho:YAG laser is efficient lithotripter with minimal tissue penetration, less retro-pulsion and no reported adverse fetal effects. Studies has shown Ho:YAG lithotripsy to be safe for use inside ureter without any adverse effect on the fetal wellbeing and is now considered as first modality for surgical management of ureterolithiasis in pregnancy. Stone free rate of 60–92% has been reported with URS in pregnancy [15]. In our study, Ho:YAG laser generator (Lumenis pulse 100H Holmium laser) was used with energy delivered by 200  $\mu$ m fiber through 6/7.5Fr semi rigid ureteroscope. In our study, 93.1% of patients had

complete stone clearance without the need of any auxiliary procedures. Studies have reported a complication rate of 0–2.5% with urinary tract infection more common than ureteric perforation, miscarriage and preterm labor [16]. We did not report any major complication in our study. Intraoperatively, there was minor bleeding during lithotripsy impairing vision in 2 patients and minimal visible mucosal ablation in 2 patients. In postoperative period, 2 patients had fever and one patient had accidental removal of DJ stent.

The limitation of our study is that it is a single center study with relatively small sample size.

## Conclusion

Our study concludes that ureteric stone in pregnancy is a common cause of flank pain. Clinical history and examination combined with USG is sufficient to make diagnosis in most of the case. Ureteroscopy with laser lithotripsy is safe and effective in the management of ureteric stones in any stage of pregnancy and should be offered to patients failing conservative line of management.

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## Declarations

**Conflict of interest** There is no conflict of interest in the present study.

**Ethical Approval** This study has been approved by the institution ethical committee of our institute with IEC number #OA/212/2020. This study is designed and performed according to the Declaration of Helsinki.

**Informed Consent** Informed consent was taken from all the participants of this study.

## References

- Rodriguez PN, Klein AS. Management of urolithiasis in pregnancy. *Surg Gynecol Obstet.* 1988;166:103–6.
- Maikranz P, Lindheimer M, Coe F. Nephrolithiasis in pregnancy. *Baillieres Clin Obstet Gynaecol.* 1994;8:375–86.
- Sefa R, Cetin EH, Gurkan K, Metin K. Are changes in urinary parameters during pregnancy clinically significant? *Urol Res.* 2006;34(4):244–8.
- Somani BK, Dellis A, Liatsikos E, Skolarikos A. Review on diagnosis and management of urolithiasis in pregnancy: an ESUT practical guide for urologists. *World J Urol.* 2017;35(11):1637–49.
- Juan YS, Wu WJ, Chuang SM, Wang CJ, et al. Management of symptomatic urolithiasis during pregnancy. *Kaohsiung J Med Sci.* 2007;23:241–6.
- Andreoiu M, MacMahon R. Renal colic in pregnancy: lithiasis or physiological hydronephrosis? *Urology.* 2009;74(4):757–61.

7. Elgamasy A, Elsharif A. Use of Doppler ultrasonography and rigid ureteroscopy for managing symptomatic ureteric stones during pregnancy. *BJU Int.* 2010;106(2):262–6.
8. Mullins JK, Semins MJ, Hyams ES, et al. Half fourier single shot turbo spin echo magnetic resonance urography for the evaluation of suspected renal colic in pregnancy. *Urology.* 2012;79(6):1252–5.
9. Dellabella M, Milanese G, Muzzonigro G. Randomized trial of the efficacy of tamsulosin, nifedipine and phloroglucinol in medical expulsive therapy for distal ureteral calculi. *J Urol.* 2005;174:67.
10. Lifshitz DA, Lingeman JE. Ureteroscopy as a first line intervention for ureteral calculi in pregnancy. *J Endourol.* 2002;16:19–22.
11. Cheek TG, Baird E. Anesthesia for nonobstetric surgery: maternal and fetal considerations. *Clin Obstet Gynecol.* 2009;99:535–45.
12. Ulvik NM, Bakke A, Høisaeter PA. Ureterscopy in pregnancy. *J Urol.* 1995;154(5):1660–3.
13. Upadya M, Saneesh PJ. Anaesthesia for non-obstetric surgery during pregnancy. *Indian J Anaesth.* 2016;60(4):234–41.
14. Norwitz ER, Robinson JN, Challis JRG. The control of labor. *N Engl J Med.* 1999;341:660–6.
15. 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. *Urology.* 2002;60(3):383–7.
16. Bozkurt Y, Soylemez H, Atar M, et al. Effectiveness and safety of ureteroscopy in pregnant women: a comparative study. *Urolithiasis.* 2013;41(1):37–42.

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