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ORIGINAL ARTICLE

# Comparison of electrocautery versus holmium laser energy source for transurethral ureterocele incision: an outcome analysis from a tertiary care institute

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## Abstract

Transurethral endoscopic incision is an established treatment option for management of obstructing ureterocele. It can be performed using monopolar electrocautery or holmium laser as an energy source. The present study was carried out to evaluate outcomes of transurethral ureterocele incision (TUI) by two different energy sources, i.e., monopolar electrocautery versus holmium laser. A retrospective review of the data of all patients who underwent endoscopic TUI from 2007–2017 was performed. Preoperative clinical, biochemical, and radiological characteristics and operative parameters were reviewed and compared between the two groups. Associated stone in the ureterocele was fragmented using pneumatic lithotripter or Mauermeyer stone punch forceps in the electrocautery group and holmium laser in the laser group. Statistical analysis was performed using IBM SPSS version 21.0. Chi-squared test was used for categorical/dichotomous variables. Unpaired *t* test was used for continuous variables. Out of total 44 patients, 28 patients had duplex system ureterocele and 16 patients had single system ureterocele. Mean age was 18.5 ± 7.4 years (range 14–26 years). Six patients had associated stones in the ureterocele. Most common presentation was flank pain followed by urinary infections and bladder outlet obstruction. Preoperative vesico-ureteric reflux was seen in 18% patients. Monopolar TUI was performed in 20 patients and laser-TUI in 24 patients. Three patients had associated stone in ureterocele in each group. Fragmentation of stone was successfully done with holmium laser without changing the instrument and with less associated surgical morbidity in the laser group. Postoperative successful decompression was evident in 38 (90%) patients. Renal parenchyma thickness was improved on ultrasound scan and renal scan showed non-obstructed system in all patients at follow-up. Both laser and monopolar incision have similar efficacy in decompressing the ureterocele in long-term follow-up. However, laser has added advantage of stone lithotripsy with the same instruments with lesser morbidity and lower incidence of persistent reflux.

**Keywords** Transurethral ureterocele incision · TUI · Laser · Monopolar electrocautery, Surgical outcomes

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## Introduction

Ureterocele is defined as cystic dilation of intra-vesical part of the ureter. It may be intra-vesical or extra-vesical (at bladder neck or urethra) [1]. It is not an uncommon presentation in adults despite widespread use of ultrasound. Transurethral endoscopic approach (either incision or puncture) is a minimally invasive initial treatment for obstructing ureterocele [2]. The purpose of treating ureterocele is to decompress upper tract obstruction, to prevent recurrent urinary tract infection (UTI), and to reduce operative morbidity and vesico-ureteric reflux (VUR). Different techniques of incision and puncture have been described in the literature with success rate ranging from 0 to 100% [3]. Traditionally, monopolar electrocautery is

being used for making transurethral ureterocele incision (TUI) but with the introduction of holmium laser energy source in clinical practice, it is also being used frequently at many health care centers. Holmium laser is a versatile energy source in the urological armamentarium with its broad spectrum use in prostate, stone, and stricture urethra management. There is a paucity of studies in the current literature comparing the efficacy and safety of electrocautery with holmium laser for ureterocele incision as an energy source. The present study is a comparison on performing endoscopic incision of ureterocele by monopolar electrcautery versus holmium laser.

## Methods and methodology

We retrospectively reviewed prospectively maintained database of patients who underwent endoscopic incision of ureterocele from 2007 to 2017 at a larger tertiary care center. Ethical approval was obtained from institutional ethical committee. Forty-four patients were included in the present study. Patients included in the analysis were tried to be communicated for collection of missing and follow-up data. Three patients were excluded because of incomplete data. Before 2012, monopolar electrocautery and 2012 onwards, holmium laser has taken precedence in ureterocele management in our department. Preoperative imaging like ultrasound of the kidney, ureter, and bladder (KUB) (Fig.1); intravenous urography (IVU) (Fig. 2); contrast-enhanced computed tomography


**Fig. 2** Intravenous urography (IVU)


**Fig. 1** Ultrasound of the kidney, ureter, and bladder

(CECT) or CT urography (Fig. 3); and diuretic renal scan (DTPA) were reviewed in details.

All the procedures were performed under spinal or general anesthesia by experienced surgeons at our institute. Patients were first placed in lithotomy position and cystoscopic evaluation was performed using 19F cystoscopic sheath with 30-degree telescope. Laser TUI was done using 365 μm end-firing Holmium (Ho:YAG) laser fiber (Lumenis, Santa Clara, CA) with setting of 0.5–1.0 J and 5–15 Hz, while electrocautery (Collins knife) was used in the monopolar group. A classic smiley incision was given at the base of ureterocele in all patients with partially filled bladder (Fig. 4). Adequacy of TUI was established by the subsequent passage of the ureteroscope into the distal ureter. Associated stone in the ureterocele was fragmented with either pneumatic lithotripter or Mauermeyer stone punch forceps in electrocautery group and holmium laser in laser group (Fig. 5). Stone fragments from the bladder were evacuated. Double-J ureteric stent and periurethral Foley catheter was placed at the end of surgery. Periurethral catheter was removed on the 1st postoperative day, while ureteric stent on the 10th postoperative day. Perioperative parameters, postoperative imaging, and follow-up data were collected and compared.

### Statistical analysis

Statistical analysis was performed using SPSS version 21.0 (Chicago, IL, USA). Chi-squared test was used for categorical/dichotomous variables. Unpaired *t* test was used for continuous variables. *p* value less than 0.05 was considered as statistically significant.

## Results

Out of 44 patients, 26 were female and 18 were male patients. Mean age of the patient was 18.5 ± 7.4 years (range 14–26 years). Twenty-eight patients had duplex system ureterocele and 16 patients had single system ureterocele. Six patients had associated stones in ureterocele. Most common presentation was flank pain followed by urinary tract infections and bladder outlet obstruction. Preoperative vesico-ureteric reflux (VUR) was seen in 8 patients (18%). Monopolar incision was made in 20 patients and laser incision was made in 24 patients. Mean (±SD) follow-up was 4.6 ± 1.2 years (range 2.2–7.5 years) (Table 1).

Three patients had associated stone in ureterocele in each group. Laser fragmentation of stone was successfully done with holmium laser without changing the instrument and with lesser difficulty and lower operative morbidity. Three patients in the monopolar group had stone which was removed with pneumatic lithotripter or stone punch forceps, which was more traumatic. Hematuria persisted for significantly more duration in the stone punch forceps group in the postoperative period as compared to the laser group (12.5 h versus 7 h, $p$ value < 0.05). Surgical complications were observed more frequently in monopolar electrocautery group (30%) as compared to laser surgical group (8.3%), which was found to be statistically significant ($p$ = 0.01). More number of patients developed bladder spasm and needed anticholinergic medications in monopolar electrosurgical TUI group (25%) as compared to the laser TUI group (4.2%) ($p$ = 0.001). Pain was significantly lower in postoperative period at 6 and 12 h on visual analogue scale (VAS) in laser TUI group as compared to monopolar TUI group ($p$ value < 0.05). Postoperative successful

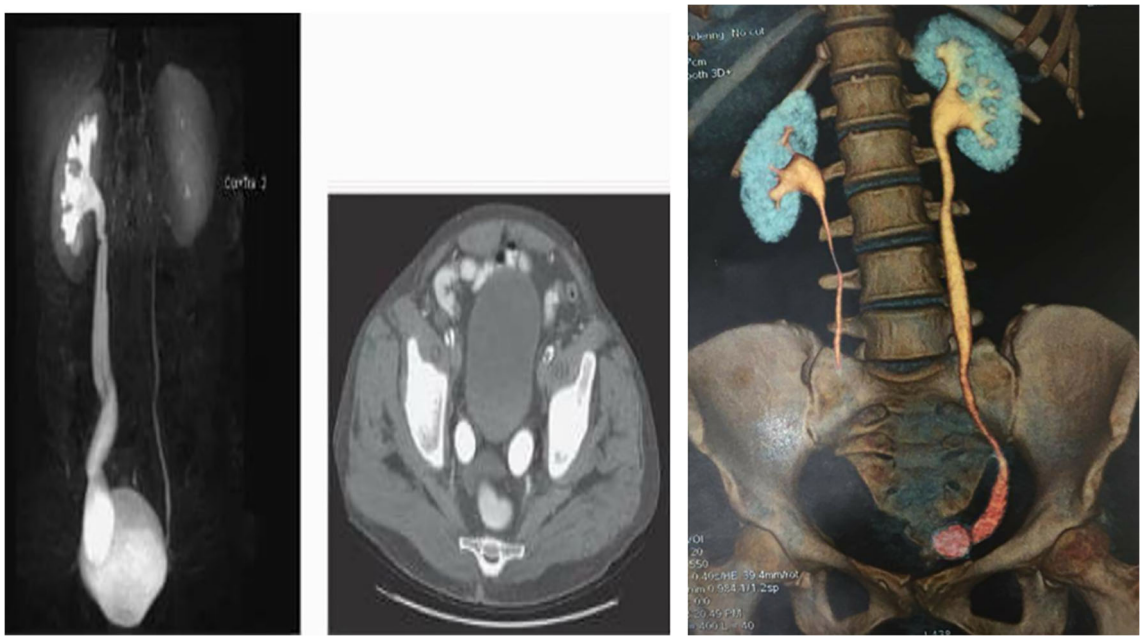

**Fig. 3** Contrast-enhanced computed tomography (CECT) or CT urography (Fig. 3)

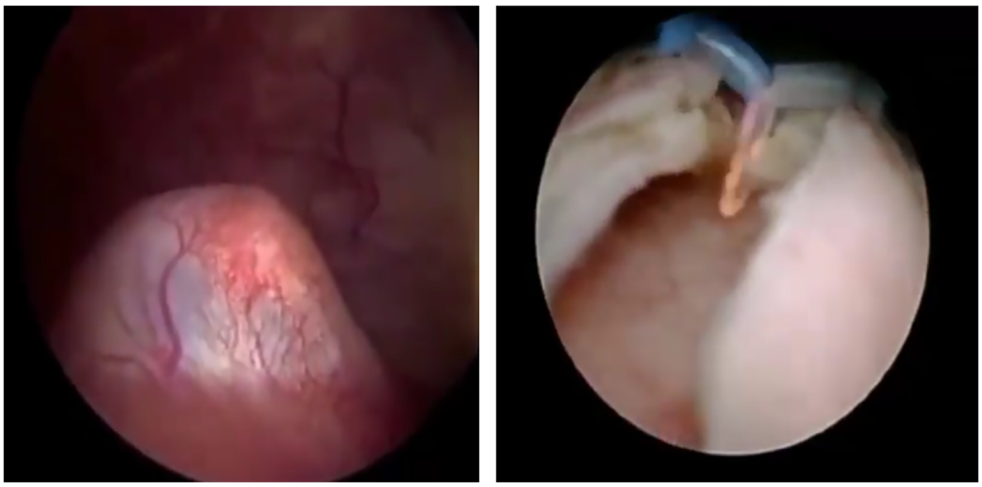

**Fig. 4** A classic smiley incision at the base of ureterocele in partially filled bladder

decompression was evident in 38 (90%) patients. The renal parenchyma thickness was improved on renal ultrasound scan and DTPA renal scan showed non-obstructed system in all patients (Table 2). However, persistent significant VUR at 6 months was observed more frequently in electrocautery incision group (15%) than in the laser incision group (4.2%) ($p$ = 0.01).

## Discussion

The incidence of ureterocele in children is 1 in every 500 live births and 1:5000 in autopsy series [1–3]. They are usually unilateral. However, duplex system ureterocele is most commonly seen in female while single system ureterocele is commonly found in male child. In the present study, female predominance (F:M = 1.44:1) too was observed. Duplex system ureterocele (63.6%) was more common than single system ureterocele (36.4%). Single system ureterocele usually does not require complex open surgical procedure and is managed initially by endoscopic techniques [4, 5].

The diagnosis of ureterocele has become easier with the widespread familiarity of ultrasound [6]. Most of the cases were diagnosed nowadays in either prenatal age or in early childhood [7]. However, in a developing country, patients are still diagnosed with ureterocele in older child or in adult age group as observed in our study cohort as well. The main presentation in adult is flank pain, recurrent UTI, urgency, and abdominal pain rather than incontinence [8]. Adult cases are commonly associated with stone formation in ureterocele [9]. In our study subjects, majority of patients (95.5%) were symptomatic and asymptomatic presentation contributed to only 4.5% of cases. MRI and contrast-enhanced CT scan detect more details of bladder pathology as well as upper tracts. The early diagnosis in a younger age directs treatment approach. Functional imaging to see renal function is best done by renal scan while IVU is less sensitive modality to document renal function [10]. The "Cobra head" finding in IVU is a characteristic but an uncommon sign [11]. Early diagnosis with judicial use of ultrasonography makes endoscopic management of ureterocele more feasible and effective [12].

Management of ureterocele varied from minimally invasive endoscopic incision or puncture to open reconstruction

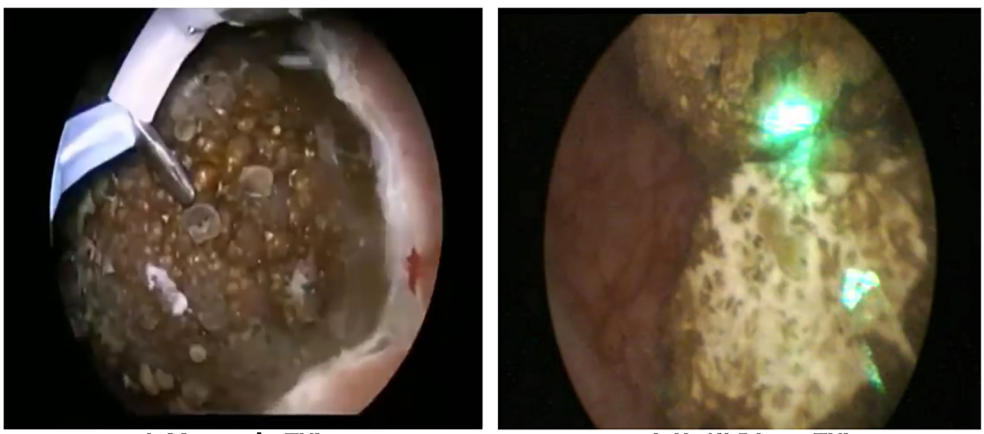


**Fig. 5** Associated stone in the ureterocele fragmented with either pneumatic lithotripter or Mauermeyer stone punch forceps in electrocautery group and holmium laser in laser group

**Table 1** Patient's demographic and baseline characteristics

| Baseline parameters | Number of patients, *n* (%) or results |
|---|---|
| Total number of ureterocele cases | 44 |
| Male/female | 18/26 |
| Mean age at presentation (years ± SD) | 18.5 ± 7.4 |
| Body mass index in kg/m$^2$ (mean ± SD) | 20.7 ± 11.3 |
| Mode of presentation | |
| Flank pain | 28 (63.6%) |
| Urinary tract infection | 11 (25%) |
| Bladder outlet obstruction | 3 (6.8%) |
| Asymptomatic | 2 (4.5%) |
| Type of ureterocele | |
| Intra-vesical | 42 (95.5%) |
| Extra-vesical (bladder neck or urethra) | 2 (4.5%) |
| Anatomical variants | |
| Duplex system ureterocele | 28 (63.6%) |
| Single system ureterocele | 16 (36.4%) |
| Associated vesico-ureteric reflux (VUR) | 8 (18.2%) |
| Associated megaureter | 2 (4.5%) |
| Procedure performed | |
| Monopolar TUI | 20 (45.5%) |
| Ho:YAG laser TUI | 24 (54.5%) |
| Mean follow-up (in years) | 4.6 ± 1.2 |

*SD*, standard deviation; *TUI*, transurethral ureterocele incision

depending on the upper tract changes. However, initial approach should be endoscopic incision as recommended by many authors because it relieved obstruction as well as reflux in most of the patients. Decompression by endoscopic techniques has several options including cold and hot knife incision (monopolar electro coagulation), puncture, and more recently, laser incision (holmium or KTP) [1–3].

Laser ablates or vaporizes tissue to allow discrete tissue destruction. Therefore, risks of resealing of incision are less with laser than with the puncture, conventional incision, or electrocautery technique. There is no thermal effect beyond tissue with laser as energy source. So, tissue cutting is more précised than electrocautery system. Tissue absorption of the laser light is caused by chromophore (hemoglobin, water, or melanin) and then light is converted to the thermal energy, this is called photothermal effect, while monopolar electrocautery application causes transfer of heat from heating electrode and thus cuts by tissue desiccation. Monopolar electrocautery TUI is a more aggressive technique than Ho:YAG laser. Lateral electrical and thermal conduction is seen with monopolar electrocautery uses. While holmium laser has a minimal depth of penetration (0.5 mm) and therefore more precise cutting and relatively safe technique [10–12]. However, holmium laser set-up establishment and use of laser fiber makes it more expensive than monopolar TUI. There is no study in literature until date comparing the two laser (Holmium and KTP) for endoscopic management of ureterocele. However, holmium is universally and versatilely used laser in modern urological practices (including HoLEP, intracorporeal lithotripsy, TUIP or bladder neck incision, endopyelotomy, PUV fulguration, and direct visual internal urethrotomy/DVIU) and has low operating cost as compared to KTP laser. Holmium laser is also used as intracorporeal energy source for fragmentation of stone, while KTP is not useful for it. This makes extra-advantage of Holmium in setting of ureterocele with associated stone management. [12, 13]

Chertin et al [12] described endoscopic puncture of ureterocele with 3F Bugbee electrode in 109 pediatric patients. Spontaneous resolution of ipsilateral reflux was seen in 43% of patients and reflux was downgraded in 5% patients. Upper pole nephrectomy was performed in 4 patients due to non-functioning kidney on follow-up. They concluded that most of the patients can be managed with endoscopic techniques and open surgery can be avoided in majority of patients like our observation. Marr Lance et al [13] reported endoscopic laser incision of obstructing ureterocele in 14 children (5 boys, 9 girls). However, they used both KTP and holmium laser and transverse incision was made at the base of the ureterocele near the bladder wall as described by Copen et al. [14] They achieved decompression of ureterocele in all patients with single session of treatment. This study by Marr L et al. resulted that reflux was present in 8 of 12 (67%) ectopic

**Table 2** Comparison of surgical outcomes between monopolar electrocautery and laser TUI groups

| Parameters | Monopolar TUI, *n* (%) (*n* = 20) | Laser TUI, *n* (%) (*n* = 24) | *p* value |
|---|---|---|---|
| USG findings (preoperative) | | | 0.34 |
| Ureterocele | 20 (100%) | 24 (100%) | |
| Hydroureteronephrosis | 18 (90%) | 20 (83.3%) | |
| Stone in ureterocele | 3 (15%) | 3 (12.5%) | |
| IVU findings (preoperative) | | | 0.21 |
| Ureterocele | 20 (100%) | 24 (100%) | |
| Hydroureteronephrosis | 18 (90%) | 20 (83.3%) | |
| Stone in ureterocele | 3 (15%) | 3 (12.5%) | |
| DTPA renal scan (preoperative) | | | 0.43 |
| Obstructed system | 18 (90%) | 20 (83.3%) | |
| Non-obstructed system | 2 (10%) | 4 (16.7%) | |
| Mean operative time (min) | | | |
| TUI | 15 | 12 | 0.44 |
| TUI with stones removal | 33 | 30 | 0 |
| Postoperative pain (mean VAS) | | | |
| At 6 h | 3.32 ± 0.57 | 2.21 ± 0.81 | < 0.01* |
| At 12 h | 1.83 ± 0.37 | 1.21 ± 0.60 | 0.04* |
| Mean hemoglobin drop (gm/dL) | 0.32 ± 0.13 | 0.17 ± 0.10 | 0.03* |
| Mean creatinine drop (mg/dL) | 0.11 ± 0.08 | 0.10 ± 0.09 | 0.25 |
| Need of anticholinergic medications for bladder spasm | 5 (25%) | 1 (4.2%) | 0.001* |
| Hospital stay in days | 1.78 ± 0.45 | 1.23 ± 0.32 | 0.02* |
| Successful decompression | 14 (77.7%), *n* = 18 | 18 (90%), *n* = 20 | 0.09 |
| Surgical complications | | | 0.01* |
| Urinary tract infections | 2 (10%) | 2 (8.3%) | |
| Hematuria | 2 (10%) | 0 (0%) | |
| Bladder mucosal injury | 3 (15%) | 1 (4.2%) | |
| Stricture urethra | 2 (10%) | 0 (0%) | |
| 2nd surgical intervention | 4 (22.2%) | 2 (10%) | 0.09 |
| USG findings (postoperative) | | | 0.35 |
| No hydronephrosis | 14 (77.7%), *n* = 18 | 18 (90%), *n* = 20 | |
| Residual hydronephrosis | 4 (22.3%), *n* = 18 | 2 (10%), *n* = 20 | |
| DTPA renal scan (postoperative) | | | 0.27 |
| Obstructed system | 4 (20%), *n* = 20 | 2 (10%), *n* = 20 | |
| Non-obstructed system | 16 (80%), *n* = 20 | 18 (90%), *n* = 20 | |
| Significant VUR on VCUG at 6 months follow-up | 3 (15%) | 1 (4.2%) | 0.01* |

*TUI*, transurethral ureterocele incision; *n*, number of patients; *USG*, ultrasonography; *IVU*, intravenous urography; *VUR*, vesico-ureteric reflux; *VCUG*, voiding cystourethrogram

systems and 9 of 10 (90%) after incision. However, 5 patients (36%) of that study population required definitive surgery with 13.2 months median follow-up that included ureteroureterostomy and re-implantation (in 1 patient), re-implantation of left and right ureters (in 3 patients), and re-implantation of left and right ureters with upper pole nephrectomy and ureterocelectomy in one patient [13].

Shah et al [4] reported laser incision of ureterocele associated with stone in 16 patients. All patients showed resolution of hydronephrosis and free of stone at 3 months follow-up. There was no reflux at 6 months follow-up as measured by micturating cystourethrogram (MCU). Author concluded that holmium laser should be used for ureterocele associated with stone whenever available. The reported success rate of ureterocele incision varies from 76 to 100 % in different studies [15, 16]. Vijay et al [17] reported 100% success rate of decompression following laser incision of ureterocele and concluded that endoscopic treatment often eliminate the need of open surgery in majority of patients.

Successful decompression of ureterocele was achieved in 90% of our patients. Efficacy rate of both energy sources for decompressing ureterocele was statistically comparable (77.7% vs 90%, $p = 0.09$). The rest of the patients needed second course of endoscopic incision. Long-term outcome

has been favorable to laser incision group. Theoretically, the stricture rate may be more in monopolar electrosurgical TUI group due to use of larger working channel and instruments. Adult patients commonly present with associated stone in ureterocele. Obstruction and urinary stasis is the main cause for stone formation. Urinary reflux and repeated infection due to obstructing ureterocele may also contribute to stone formation. Associated stones also contributed to significant proportion (27.5%) of cases in our series. Laser is an effective versatile energy source for these patients.

Postoperative pain was significantly lower in laser TUI group. This was again due to use of smaller working sheath in the laser group in comparison to the monopolar TUI group and lesser incidence of iatrogenic bladder mucosal injury or bladder spasm. Secondly, laser cuts tissue by photo-thermal effects and lateral thermal conduction injury and unwanted tissue damage is minimal. Monopolar electrocautery TUI is a more aggressive technique than Ho:YAG laser in our opinion. De-novo vesico-ureteric reflux is a problem with endoscopic incision of ureterocele. The rate of reflux varies from 4 to 50% in different studies [6, 18]. To prevent this, the transverse incision should to be made preferably above the base of the ureterocele and just adequate length of incision to relief the obstruction. Some authors believe that puncture of ureterocele decreases reflux more efficiently rather than incision. However, VUR can be prevented/decreased by bulking agent injection to bladder wall after the puncture [19]. Ilic P et al. demonstrated that VUR persisted more frequently in the laser puncture group (8.3%) than in the electrosurgery group (65%) of neonate patients after 6 months of the procedure. We also showed the similar finding of significant disparity in the persistence of VUR between two therapeutic modalities in our study subjects but with less robust difference.

### Limitation of the study

Retrospective study had its inherent bias in data collection and data itself. Due to presence of an adjacent pediatric surgery unit in our institute, we mostly receive adult patients for treatment and it is also reflected in our study cohort. Actual cost comparison of two techniques could not be done in our study. Regular and uniform follow-up was not available for all patients. However, despite all these limitations, our study is the first of its kind to compare the two endo-surgical modalities in treating adult ureterocele in a systematic fashion

## Conclusion

Both laser and monopolar incision have similar operative duration and equal efficacy in decompressing the ureterocele in long-term follow-up. However, laser has added advantage of lesser morbidity, pain score, need of anticholinergic drugs, hospital stay, and surgical complications. Associated stone can be managed more conveniently with holmium laser utilization.

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**Authors contribution** 1. Dr. Ashish Sharma—Concept, design, supervision, processing, writing manuscript, and critical analysis.
2. Dr. Gaurav Garg—Concept, design, supervision, processing, writing manuscript, and critical analysis.
3. Dr. Anamika Sharma—Writing manuscript, critical analysis, and statistical analysis.
4. Dr. Manoj Kumar—Concept, design, supervision, processing, writing manuscript, and critical analysis.
5. Dr. S N Sankhwar—Concept, supervision, writing manuscript, and critical analysis.

## Compliance with ethical standards

**Informed consent** Written informed consent was obtained from the all the patients/relatives.

**Conflict of interest** The authors declare that they have no conflict of interest.

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