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USE OF HOLMIUM: YTTRIUM-ALUMINUM-GARNET LASER FOR ENDOSCOPIC DECOMPRESSION OF URETEROCELE: IS IT SAFE ALTERNATIVE TO ELECTROSURGERY

Urology

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ABSTRACT

Introduction: Few case series report the use of holmium: yttrium-aluminum-garnet (Ho:YAG) laser to decompress ureterocele (UC) in pediatric and adult population, and only two studies compared its outcomes with electrosurgery. This study aims to compare outcomes of Ho:YAG laser transurethral endoscopic incision (LTUI) versus electrocautery transurethral endoscopic incision (ETUI) of UC. We also analyse incidence of secondary surgery, redo trans urethral incision (TUI) and iatrogenic vesicoureteral reflux (VUR). **Patients and Methods:** A prospective study of patients treated by TUI of UC from Jan 2016 to Jan 2020 was performed. Those undergoing Ho:YAG laser TUI were included in Group A, those undergoing electrocautery TUI were included in Group B. Data were compared using Fisher's exact test **Results:** Group A included seven patients . Two required a redo TUI. Two had preoperative VUR, which resolved after TUI. Two developed VUR after TUI, which resolved spontaneously. No secondary surgery was required. Group B included nine patients. One required a redo TUI. Preoperative VUR was detected in 4/9 and persisted after TUI in 2. Three developed post-TUI VUR, which persisted. Five required further surgery because of persistent and symptomatic VUR. Secondary surgery was significantly lower after Ho:YAG laser compared to electrocautery TUI ($P < 0.05$). The incidences of both redo TUI and postoperative VUR were not significantly different between the two groups (P = ns). **Conclusion:** Ho:YAG laser TUI seems to be safe and effective in the decompression of obstructive UCs and maybe advantageous over electrocautery puncture. However, further studies with larger cohort are needed to corroborate our preliminary results.

KEYWORDS

Ureterocele, Ho:YAG laser transurethral endoscopic incision (LTUI), electrocautery transurethral endoscopic incision (ETUI), vesicoureteral reflux (VUR).

INTRODUCTION

A prompt, minimally-invasive treatment is the current approach in patients diagnosed with obstructive ureterocele (UC).[1],[2],[3],[4] Transurethral endoscopic decompression of UC can be performed by several techniques, according to experience and preference. While electrosurgery has been traditionally used, a recent technological advance consists in the use of laser, namely holmium: yttrium-aluminum-garnet (Ho:YAG) laser. It has been reported to be effective, accurate, versatile, and safe.[5],[6],[7] In literature there are just a few case-series and two comparative studies.[5],[6],[7],[8],[9],[10] However, these reports are inconsistent regarding inclusion criteria and operative techniques, while outcomes seem similar to those achieved with electrocautery decompression.

Based on the scientific evidence and clinical experience, it was hypothesized that Ho:YAG laser is highly-effective for the decompression of UC and as ultimate treatment for this uropathy. To test this hypothesis, the primary aim of the study was to compare outcomes of Ho:YAG laser transurethral endoscopic incision (LTUI) of UC versus conventional electrocautery transurethral endoscopic incision (ETUI), analyzing incidence of secondary surgery, redo TUI, and iatrogenic vesicoureteral reflux (VUR) in the population.

PATIENTS AND METHODS

This was a prospective study, conducted at the urological Department of Command Hospital of Pune. After ethical committee approval, we conducted the study of all patients diagnosed with UC over a period of 04 years (2016–2020). Only patients treated with TUI as primary procedure were included in the study population.

All patients underwent renal and bladder ultrasound (US) and voiding cystourethrography (VCUG) before TUI. Renal scintigraphy was performed either before or after TUI, according to patient's age. Antibiotic prophylaxis was used in patients with VUR.

TUI was performed under general anaesthesia and conducted throughout a 20 Fr cystoscope. TUI was performed with a conventional electrocautery 5Fr catheter, incising the UC wall. In case of intravesical UCs, the incision was made just above the junction of the UC and the bladder floor. For ectopic UCs, a incision was carried out on the intravesical portion of the UC, just above the bladder neck. LTUI with Ho:YAG laser was performed at the setting of 6–8 Hz of frequency and 0.6–0.8 J of pulse energy. We used 365 µm laser fibers in the first patient, then we switched to 550 µm. Once puncture on the UC walls were made, it was incised in smiling incision type.

In postoperative period all patients received antibiotic. Follow-up included: periodic US; VCUG at 3 months follow-up and afterwards in case of persistent or de novo VUR; MAG-3 renal scan, performed in case of persistent high-grade hydronephrosis. Patients without an adequate UC and upper tract decompression (i.e., UC and/or upper tract dilatation >10 mm at US follow-up) underwent repeat TUI. The major criteria for secondary surgery were: increasing hydronephrosis due to inadequate UC decompression, with persistent obstructive pattern at renogram, recurrent febrile urinary tract infections (UTIs), persistence of high-grade preoperative VUR, development and persistence of high-grade iatrogenic VUR and/or loss of renal function.

All patients treated with Ho:YAG laser TUI were included in Group A. All patients treated with conventional electrocautery TUI were included in Group B. Statistical analysis was done with Fisher's 2-tailed exact test with $P < 0.05$ considered significant. Groups were compared regarding the need of a second surgery, the need of a repeat TUI, and the incidence of de novo VUR.

RESULTS

Group A included seven patients, 4 Males and 3 females . The preoperative characteristics of patients are outlined in [Table 1]. Mean age at Ho:YAG laser TUP was 36 years. Two of seven patients (29%) required repeat TUI due to persistent UC distention and hydronephrosis, which resolved after the second endoscopic procedure. None developed postoperative UTIs. In two patients with preoperative VUR (Grade 3) spontaneous resolution after TUP occurred. Mean follow up period was 2.2 years. None of the patients required secondary surgery (0/7 cases, 0%).

Table 1: Preoperative characteristics of patients

Preoperative Characteristics	Group A (n=7)	Group B (n=9)
Gender		
Male	4	5
Female	3	4
System		
Single System	7	8
Double System	0	1

Group B included nine patients, 5 males and 4 females. Preoperative

characteristics of patients are outlined in [Table 1]. Mean age at TUI was 38 years. One patient required a further TUI due to persistent UC distention and hydronephrosis. It was resolved after the second endoscopic procedure. Preoperative VUR, detected in 4 of nine patients, spontaneously resolved after TUP in 2. Three patients developed iatrogenic VUR in the treated moiety which persisted during follow-up. The mean follow-up was of 2.5 years. TUI was the only treatment in 4 of nine patients (44.4%). The remaining five patients (55.6%) underwent further surgery. The reasons that led to secondary surgery were the recurrence of UTIs associated with persistent VUR. Secondary surgery consisted of repair of bladder floor and cross-trigonal ureteroneocystostomy in all patients. In one of these 5, heminephrectomy of a nonfunctioning upper moiety was also performed.

Table 2: Post-operative characteristics of patients

Post-operative Characteristics	Group A (n=7)	Group B (n=9)
Pre-operative VUR Spontaneously Resolved	 2 2	 4 2
Only TUI Intervention	7	4
Redo TUI	2	1
Secondary Surgery	0	5

The postoperative characteristics of groups A and B are outlined in [Table 2]. Comparing groups, secondary surgery after TUI was required in 0 out of 7 (0%) versus 5 out of 9 (55.6%) patients in Groups A and B, respectively, which was statistically significant (P< 0.05). The incidence of a repeat TUI seemed to be superior in Group A (2 out of seven patients, 29%) compared to Group B (1 out of nine patients, 11%), even if it was not statistically significant (P = ns).

DISCUSSION

TUI is an accepted, minimally invasive option to achieve a prompt decompression of UC. Electrosurgery has been traditionally used, with good decompression rates but a significant risk of developing iatrogenic VUR in the punctured/incised moiety (20%–50%). [1],[2],[3],[4],[12],[13]

Laser application in paediatric and adult urology includes patients with PUV, UC, urethral strictures, and urolithiasis. [5],[6],[7],[8],[10],[14], [15],[16],[17],[18],[19],[20] An important challenge in the use of Ho:YAG laser was its application to wider population. Jankowski and Palmer were the first to report the use of this procedure in newborns in 2006,[5] followed by Pagano et al. in 2015.[6] Although the small populations (12 patients in total) and the inconsistent decompression techniques, these papers point out the main advantages of the use of laser fibers in the neonate. As we have already reported,[21] the small caliber of laser fibers, which can fit well through the working channels of the instruments and still allow for some irrigation flow.[6] In Pagano's series small laser fiber (200 μm) were used to decompress UC in newborns. Jankowski and Palmer used larger fibers (365 or 550 μm) except in one case (200 μm).[5] The only one failed attempt at decompression occurred using the smaller laser fiber, which was then successfully decompressed with a 550 μm fiber. As the size of the laser fiber has a direct correlation with the puncture /incision size, this may explain why retreatment was required in the only patient treated with the smaller fiber.[5] We also used 200 μm fiber to incise the first patient and we needed to do a redo TUI because of incomplete UC decompression. As a result, we switched to 550 μm fiber for the following cases, achieving very good outcomes regarding decompression rates (5/6 patients, with only 1 case requiring a second look). The only other study reporting the use of laser to decompress UC is that of Ilic et al.[7] Their population included ten neonates with intravesical UC. They made several punctures (4–8), until UCs collapsed. There were no complications during the procedures, and there was need for re-treatment only in 1/10. Authors concluded that Ho:YAG laser fenestration is minimally invasive, highly effective, and safe treatment for UC in the neonatal period, with minimal complication rates.

The second advantage is the energy supplied by the laser. It vaporizes the treated tissue rather than cauterizing, incising, or puncturing the tissue as performed with electrocautery, stylet, and cold knife incision, respectively. This may allow for the small incision or puncture made by the laser not to reseal compared with the other conventional techniques.[5]

Another advantage of laser fibres is the lack of thermal effect beyond the incision site compared with electrosurgery. This allows for precise puncture/incision of the UC and if necessary, multiple, small punctures can be made rather than one comparably large puncture with the Bugbee electrode.[5] In our opinion, multiple small punctures with a laser fibre result in adequate drainage outlet for the obstructive UC, with a decreased possibility of de novo VUR into the ipsilateral renal unit.

Outcomes regarding laser decompression of UC could also be affected by the operative technique, namely single or multiple punctures, or incision. As previously stated, the endoscopic technique we performed with the assistance of Ho:YAG laser consisted in making multiple punctures on the UC wall (4–8). On the other hand, both Marr and Pagano performed a single laser incision on the UC wall.[6],[8] Another technique to decompress UC is the one called "watering can" puncture (WCP), in which multiple punctures, 10–20, are done on the UC wall, creating a watering-can appearance, until stable decompression is obtained. It was first introduced by Palmer et al. in 2011.[24] In a more recent paper from the same group[25] a comparative retrospective study between two different UC decompressing techniques, namely incision and WCP, was conducted. Incision was performed throughout Collins knife, electrocautery hook, Bugbee electrode or Ho:YAG laser, while WCP with Ho:YAG laser only. Decompression rates were similar between the two groups, while incidence of de novo VUR and need of secondary, more invasive surgery were significantly lower in the WCP group. They concluded that WCP led to fewer complications associated with endoscopic UC management. However, it should be noted that the incision group is not consistent because they used either electrosurgery with different devices or laser to incise UCs. This could create a bias in the results.

A recent paper by Caione et al.[10] stressed the importance of an early endoscopic decompression of obstructing UC by Ho:YAG laser in children and adults. Moreover, authors underlined the requirement of multiple punctures at the basis of the UC, varying the energy and the frequency of the laser, depending to the quality and thickness of the UTC wall. Therefore, authors adopted 0.5–0.8 Joule energy (mean laser setting energy 0.6 Joule), with 5–9 Hz frequency (mean frequency pulse rate 7 Hz). This resulted a minimally invasive treatment, hence reducing the risk of further aggressive surgery.

In our study, we evaluated how effective Ho:YAG laser TUI is as primary and ultimate treatment. Furthermore, we focused on possible complications related to the procedure. In the reported literature, outcomes of classic TUI regarding need of secondary surgery are up to 25% for intravesical UC and up to 100% for ectopic UC and the incidence of iatrogenic VUR is 20%–50%.[1],[2],[3],[4],[12],[13] Although we got a wide experience with TUI performed with electrosurgery,[25] our preliminary results with laser TUI appear to be promising. The need of secondary surgery seems to be lower in the laser group. Given the small number of cases in our study, the resuts can't be extrapolated to the large group.

In literature two studies compared the outcomes of electrosurgery and laser TUP. Ilic et al. retrospectively analysed the results of laser-puncture of UC (LP group) in 12 patients and electrosurgery-incision (ES group) in 20 patients.[9] Only neonates with intravesical single or duplex system UCs were included in the study population. In ES group, electrocautery was used to incise the UC wall. In LP group, Ho:YAG laser was used, making several punctures (4–10) in the UC wall. There was no statistically significant difference between the groups regarding the need for retreatment, while there was a significantly higher rate of postoperative VUR in ES group. However, results could be partially biased by a different decompression technique in the two groups (incision vs. puncture). Caione et al. compared the results of TUP in both infants and children (laser-punctures in 64 patients, diathermic energy in 26 cases).[10]De novo VUR developed in 61.5% of patients instead of 29.7% observed in the laser energy punctures group (P< 0.05). The need of secondary decompression by re-do endoscopy for recurrent obstruction was similar in the laser group of patients (8%), compared with the diathermic group (7.7%; P = ns). The need of further open surgery was 18% (12 patients) in the laser group and in 50.0% (13 patients) in the diathermic group (P< 0.05).

Our study has a few limitations. The first limitation in this study

include the relatively low numbers of patients. The second limitation is the results from a single centre, without synchronous randomization with a historical control group. The patients treated by electrosurgery incision and the laser group was not by a single surgeon but three surgeons were involve hence causing a possible selection bias. Moreover, the follow-up period was shorter in both the electrosurgery group and the laser group. Finally, the treatment by Ho:YAG laser requires the availability of the specific laser energy equipment, not universally present in all the operating rooms, considering also the related costs.

CONCLUSIONS

Based on our experience, Ho:YAG laser proves to be safe and effective for the decompression of obstructive UCs, with no complications. The need of secondary surgery seems to be lower after Ho:YAG laser TUI than electrosurgery TUI. The need for repeat TUI is comparable between the two procedures. Given the small number of patients in our study, further larger case-series with homogenous populations and/or a randomized controlled trial is necessary to corroborate our preliminary results.

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