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Professional paper

CLINICAL ASSESSMENT OF ENDOSCOPIC HOLMIUM: YAG LASER LITHOTRIPSY FOR URETERAL AND BLADDER STONES. INITIAL EXPERIENCE AT A SINGLE CENTER IN GOSTIVAR

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Abstract

Background: Holmium:Yttrium-Aluminum-Garnet (Ho:YAG) laser lithotripsy has become the preferred modality for fragmented management of ureteral and bladder calculi due to its safety, applicability, and high stone-free rates. This study evaluates the clinical outcomes of endoscopic Holmium:YAG laser lithotripsy for ureteral and bladder calculi in a single-center study.
Objective: To evaluate clinical outcomes of endoscopic Ho:YAG laser lithotripsy in patients treated for bladder and ureteral stones at a single center at the General hospital in Gostivar.
Material and Methods: A retrospective study was conducted including 42 patients treated between January 2023 and December 2024 at the General Hospital "Ferid Murad" in Gostivar. Demographic characteristics, stone size, location, J-J stent placement, operative time, and postoperative outcomes were analyzed.
Results: The mean age was 53.4 years, with 66.7% males and 33.3% females. Mean stone size was 11.3 mm. Distal ureteral stones were the most common (57.1%), followed by bladder (21.4%), proximal ureter (14.3%), and mid-ureter (7.2%). Stone-free rate was 95.2% (40/42). J-J stent placement was performed in 52.4% (22) of patients. Proximal migration occurred in 2 cases (4.8%). No major complications were observed.
Conclusion: Endoscopic Ho:YAG lithotripsy is a highly effective and safe technique with low complication rates, making it suitable for ureteral and bladder stones. High stone-free rates and minimal morbidity support its adoption as a standard treatment option.

Keywords: *urolithiasis, endourology, Ho:YAG lithotripsy, ureteral stones, bladder stones.*

1. Introduction

Currently impacting up to 15% of the population over the course of a lifetime, urolithiasis is a common urological condition with a rapidly increasing global incidence (Türk et al., 2024). The evolution of endoscopic technology has substantially transformed the management of urinary stones, replacing historical open surgical techniques with minimally invasive, high-efficacy laser-based approaches. The prevalence of urolithiasis is rising due to nutritional, metabolic, and environmental variables, making it a major global health concern (Nabi & Marcus, 2022). Endoscopic management is now the standard approach for the treatment of ureteral and bladder stones, particularly due to advancements in Ho:YAG lithotripsy, which enables precise stone fragmentation while minimizing tissue damage (Humphreys & Shah, 2021; Kronenberg & Traxer, 2020). The Ho:YAG laser facilitates fragmentation or "dusting" techniques, rendering it appropriate for various stone types and anatomical sites (D'Addessi et al., 2023; Li et al., 2021; Youssef & El-Nahas, 2020).

Clinical outcomes are influenced by the location and size of stones, the risk of migration, and the experience of the surgeon (Breau et al., 2020; Xu et al., 2019). Distal ureter stones typically exhibit higher success rates owing to their enhanced accessibility (Campobasso & Rossi, 2019), while proximal stones pose challenges such as retrograde migration and longer operative times. Although it is still debatable, J-J stenting and the use of safety devices are

frequently advantageous for certain patients (Keshavamurthy & Patel, 2022; Michel & Knipper, 2019).

When the right tools and qualified medical professionals are available, laser lithotripsy provides a dependable, minimally invasive procedure with excellent success rates at community hospitals. (Seitz et al., 2023). This study aims to present outcomes from a single-center experience in Gostivar, North Macedonia, as a secondary-level urology service, contributing evidence relevant for centers with similar capacities.

2. Materials and Methods

2.1 Study Design

A retrospective analysis was conducted including 42 patients who underwent endoscopic Ho:YAG laser lithotripsy between September 2023 and August 2024 at the Department of Urology, General Hospital "Ferid Murad", Gostivar, North Macedonia.

2.2 Inclusion and Exclusion Criteria

Patients with ureteral or bladder calculi treated exclusively by Ho:YAG endoscopic lithotripsy were included.

2.3 Preoperative Evaluation

All patients underwent urine culture, ultrasonography, and/or CT urography. Negative urine cultures were required before intervention. Prophylactic antibiotics were administered routinely.

2.4 Procedure Technique

All procedures were performed under general anesthesia. The low-power Holmium laser Multipulse Ho from Jena Surgical (Picture 1) with maximum power of 35 watts was used. For bladder stones were used flexible bare fibers with diameter 365 and for ureteral stones were used bare fibers with diameter 272. Laser settings ranged between 1.2–1.6 J, with variable frequency depending on stone hardness. For the disintegration of the stones we used dusting mode. Ureteral stones located in distal, sacral, pelvic, and proximal segments were treated using Ch 9,5 semi-rigid ureteroscopy. Bladder stones were treated with transurethral lithotripsy using continuous irrigation.

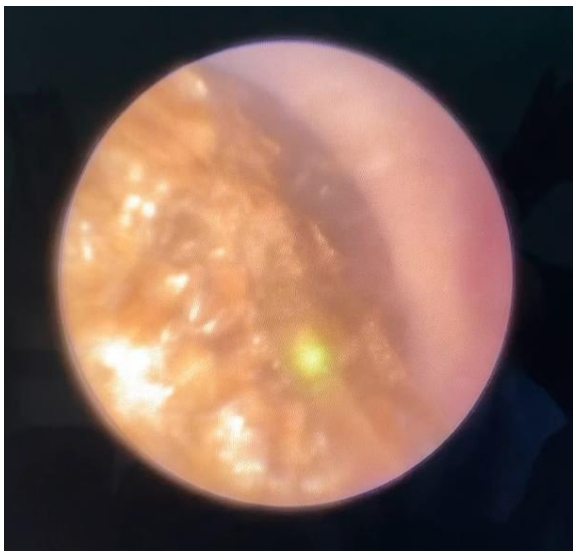


Picture 1. *The low-power Holmium laser Multipulse Ho 35W from Jena Surgical*

The disintegration of urinary bladder stone and ureteral stone with Ho:YAG are shown in picture 2 and 3:



Picture 3. *Ho:YAG of Urinary bladder stone*



Picture 4. *Ho:YAG of ureteral stone*

2.5 Postoperative Management

Double-J stents were inserted in all ureteral stone cases and removed after 3–4 weeks. Bladder stone cases required no stenting. Residual stones were evaluated via follow-up imaging 3–4 weeks after treatment.

3. Results

3.1 Demographics

Among 42 patients, 22 were female and 20 were male, with a mean age of 51 years (range 20–76).

3.2 Stone Characteristics and Location

36 patients (85.7%) had ureteral stones: a) Distal ureter: 18; b) Sacral ureter: 8; c) Pelvic ureter: 6; d) Proximal ureter: 4 and e) 6 patients (14.3%) had bladder stones.
The distribution of stone location is presented in Figure 1:

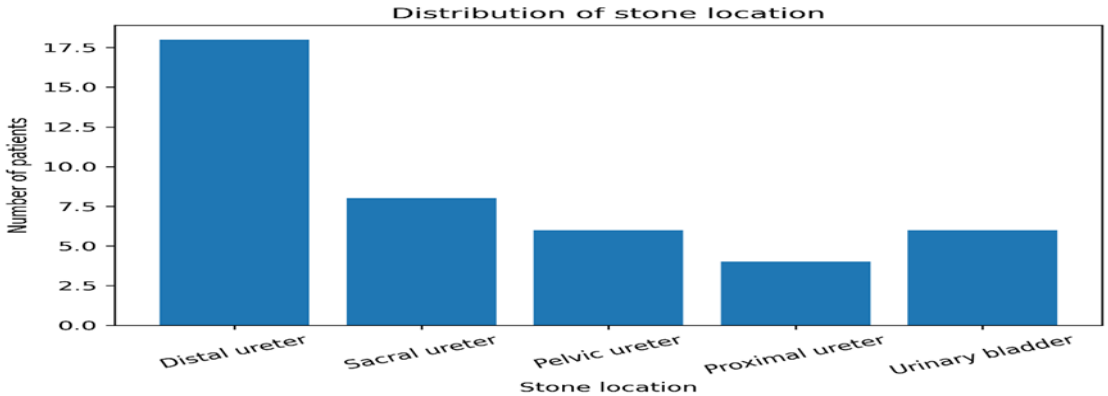


Figure 1. *Distribution of stone location*

3.3 Success Rate

- Stone-free rate: 40/42 (95.2%)
- Residual stones: 2/42 (4.8%), both located in proximal ureter.

The stone-free rate after holmium lithotrypsi is reflected as in Figure 2

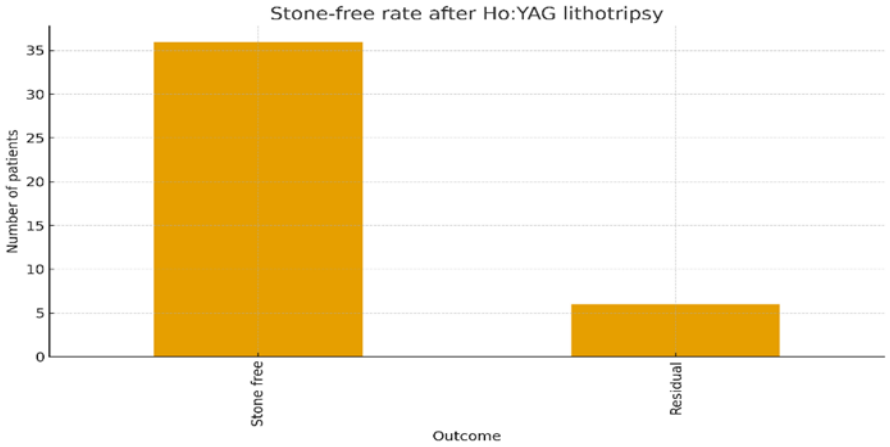


***Figure 2**. Stone free rate after Ho;YAG lithotrypsi*

3.4 Complications

- Two cases of proximal migration (4.7%)
- No perforation cases included in data
- Reintervention rate: 1/42 (2.3%)

The data about complications are shown on the Figure 3:

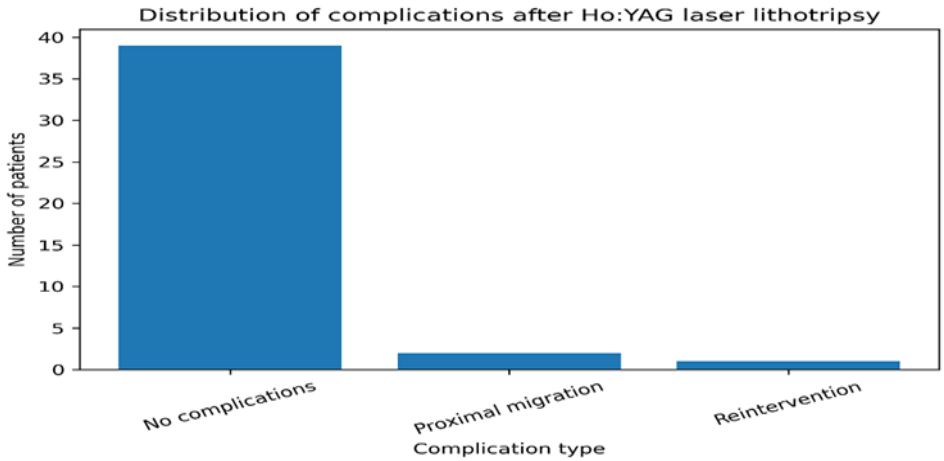


***Figure 3.** Distributrion of complications after Ho:YAG laser liyhotrypsi*

3.5 Operative Time

- Mean operative duration: 55 minutes
- Faster access in females due to urethral anatomy
- Longer time in proximal stones due to access difficulty

Operative time by stone location is shown on figure 4:

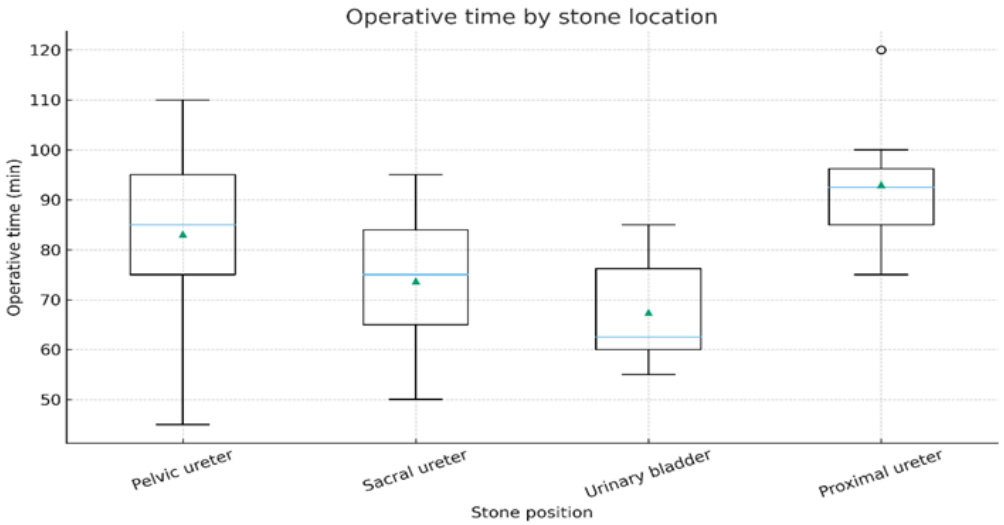


Figure 4. *Operative time by stone location*

On figure 5 is presented mean operative time by gender:

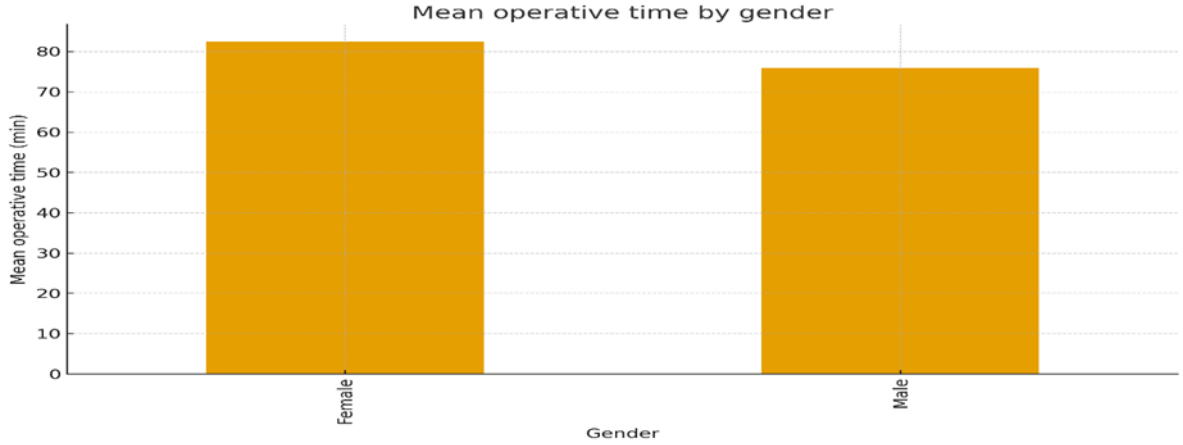


Figure 5. *Mean operative time by gender*

The relationship between stone size and operative time is below, in figure 6:

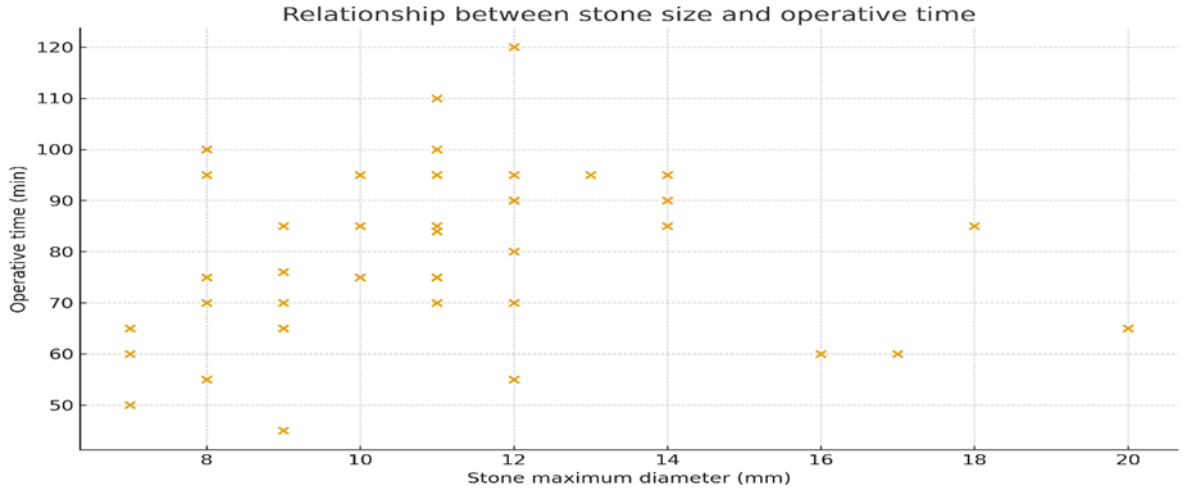


Figure 6. *Relationship between stone size and operative time*

4. Discussion

This study's stone-free rate (95.2%) is consistent with earlier studies that noted Ho:YAG lithotripsy success rates for mid- and distal ureter stones range from 90 to 98% (Bozkurt et al., 2021; Humphreys & Shah, 2021). Due to improved access and a lower risk of migration, higher incidence of distal ureter stones are expected (Campobasso & Rossi, 2019). J-J stents were used in 52.4% of patients, which is in line with guidelines for selective stenting to lessen edema and postoperative colic (Keshavamurthy & Patel, 2022; Türk et al., 2024).

The laser parameters were similar to recommended energy ranges seen in other literature (D'Addessi et al., 2023; Kronenberg & Traxer, 2020). Minimal incidences of complications confirm Ho:YAG lithotripsy has migration rates comparable to the global average, making it a safe method (Xu et al., 2019). Findings support its use for bladder and ureteral stones, particularly in community settings (Seitz et al., 2023).

5. Conclusion

Ho:YAG laser lithotripsy is an effective and safe option for ureteral and bladder stones, providing high stone-free rates and minimal complications. It is a suitable modality for use in regional hospitals with appropriate training and equipment.

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