Original Research

Post Ureteroscopy and Laser Lithotripsy Ureteral Strictures Vs ESWL

[1]Dr. Hossam Allahyani, [2]Dr. H Sanjay Bhat, [3]Dr. Rafe Alhayek, [4]Dr. Zeeshan Akhtar, [5]Dr. Sijas Chathoth

[1]Specialist Urologist, Saudi German Hospital Dubai. allahyani.hossam@gmail.com
[2]Consultant Urologist, Saudi German Hospital Dubai. hsanjaybhat@gmail.com
[3]Consultant Urologist, Dubai Hospital UAE. rafealhayek@yahoo.com
[4]Urology resident, Saudi German Hospital Dubai. zeeshan.akhtar169@gmail.com
[5]BSc Allied health sciences Urology technology, The view hospital, Doha. sijas.c@gmail.com

Corresponding Author:
Dr. Hossam Allahyani,
Specialist Urologist, Saudi German Hospital Dubai. allahyani.hossam@gmail.com

Received: 19 April 2024 Accepted: 10 May 2024

Abstract:
Background: Ureteral strictures following ureteroscopic procedures for stones are becoming increasingly prevalent. This study aims to compare the incidence and risk factors of post ureteroscopic ureteral strictures Vs Extracorporeal Shock Wave Lithotripsy (ESWL) for ureteral stones.
Methods: A retrospective analysis was conducted on patients who had ureteral stones and underwent either ureteroscopy with laser lithotripsy or ESWL for treatment. Data regarding stone size, impacted stones, duration of stone presence in the ureter, ureteroscope size "diameter", if prior ureteral stent is done, laser machine settings and lasing time were collected.
Results: Ureteral strictures were significantly more common post ureteroscopy with laser lithotripsy compared to ESWL. Risk factors for stricture includes larger stone size, impacted stones, longer stone presence in the ureter, acute ureteroscopy without prior stenting for large stones, larger ureteroscopes diameter, longer lasing time and improper laser machine settings.
Conclusion: ESWL remains a non-invasive alternative to ureteroscopy with laser lithotripsy and is associated with a lower incidence of ureteral strictures. Proper patient assessment for selection of the right procedure, Competent training in laser machine operation and settings are crucial to minimize complications post ureteroscopy.
Keywords: Ureteroscopy, Laser Lithotripsy, Extracorporeal Shock Wave Lithotripsy (ESWL), Ureteral Strictures, Risk Factors.

Introduction

Ureteral stones are a common urological condition, with ureteroscopy currently becoming the primary modality for their treatment. Over the years, the introduction and extensive use of lasers in ureteroscopy have provided a minimally invasive and effective means of stone fragmentation [1]. However, this advancement is not without its complications. Ureteral strictures is one of the recognized adverse events following ureteroscopy and laser lithotripsy, that can lead to significant morbidity for the patient [2].

In recent years, there has been a noticeable increase in the number of ureteral strictures post ureteroscopy, particularly after the extensive use of lasers in the ureter. This phenomenon has been observed not only in our hospital but also in other urological centers worldwide. It raises concern about the potential risk factors associated with these strictures and the need for better training and understanding of laser machine settings by the operating urologists.

Several risk factors have been proposed for the development of ureteral strictures post ureteroscopy;

1. **Larger Stone Size:** Larger stones that have circumferential contact with ureteral wall often require more extensive and prolonged laser procedures. The heat generated during laser lithotripsy is transferred to ureteral wall, thereby, carries a higher risk of ureteral injury and subsequent stricture formation [3].
2. **Impacted Stone:** Impacted stone is more challenging to dislodge and may require more aggressive laser lithotripsy, thus increases the risk of ureteral injury and stricture formation [4].
3. **Presence of Stones in Ureter for a Long Time:** Stones that remain in the ureter for an extended period of time can lead to chronic inflammation and fibrosis that predisposes to strictures [5].
4. **Type of Laser Machine and its Settings:** The type of laser machine used and its settings, higher level of energy and power can significantly affect the outcome of ureteroscopy;

Formula: Energy J = Power W / Repetition Hz. Improper setting or lack of understanding of the machine's capabilities can lead to ureteral injury and stricture formation [7].

5. **Lasing time:** The longer the time of laser use, the higher the risk of post laser inflammation and scar formation.
6. **Pre-stenting:** Stent placement as a first step procedure for large obstructed stones has been observed to decrease the risk of post URS and laser lithotripsy ureteral strictures.
7. **Larger ureteroscope diameter.** Larger ureteroscopes are more likely to cause ureteral mucosal injuries comparing to thinner scopes.

ESWL remains a non- invasive alternative to ureteroscopy that offers a safer and more straightforward approach for certain ureteral stones. Interestingly, while ureteroscopy is mainly performed by skilled urologists, some still lacks the knowledge and physics behind the laser lithotripsy machines.

The aim of this study is to compare the incidence and risk factors of ureteral strictures post ureteroscopy and laser lithotripsy versus ESWL, providing valuable insights into the optimal management and prevention of this significant complication.

Materials and Methods

A retrospective analysis was conducted on patients who underwent either ureteroscopy with laser lithotripsy or ESWL for ureteral stones at our center between January 2019 and December 2023. Patients with kidney stones were excluded from the study.

Data were collected on the following variables:

1. **Stone Size:** The maximum diameter of the largest stone was measured using preoperative imaging studies.
2. **Impacted Stones:** Stones were classified as impacted if they were firmly lodged in the ureter based on CT scan findings.
3. **Duration of Stone Presence in the Ureter:** The duration from the onset of symptoms to the intervention was recorded.
4. **Laser Machine Settings:** The type of laser machine used, energy level, and frequency were recorded, along with any adjustments made during the procedure.
5. **Ureteroscope diameter.** Fr 4.5; Fr 6 and Fr 8 ureteroscopes compared, with larger scopes being more frequently associated with ureteral and mucosal edema, abrasions and lacerations.

The primary outcome measure was the incidence of ureteral strictures diagnosed post-intervention, confirmed by ureteroscopy and/or imaging studies.

Statistical analysis was performed using SPSS software. Chi-square test and logistic regression analysis were used to compare the incidence of ureteral strictures and identify risk factors between the two groups.

Results

Table 1: Demographic and Stone Characteristics of the Study Population

The demographic and stone characteristics of the two study groups were comparable. The mean age of the patients in both groups was around 45-46 years. The gender distribution was almost equal in both groups, with slightly more male patients. The mean stone size was similar between the two groups, averaging around 10.2-10.4 mm. Approximately 42% of patients in the ureteroscopy with laser lithotripsy group had impacted stones, compared to 38% in the ESWL group. And 16% of the ESWL group. The average duration of stone presence in the ureter was around 6 months in both groups.

Table 2: Incidence of Ureteral Strictures Post-Intervention

The incidence of ureteral strictures post-intervention was significantly higher in the ureteroscopy with laser lithotripsy group compared to the ESWL group. In the ureteroscopy with laser lithotripsy group, 28% of patients developed ureteral strictures, whereas only 8% of patients in the ESWL group developed ureteral strictures.

Table 3: Risk Factors for Ureteral Strictures

Among the identified risk factors for ureteral strictures, larger stone size was observed in 30 (66.7%) patients in the ureteroscopy with laser lithotripsy group and 8 (61.5%) patients in the ESWL group. Impacted stones were present in 19 (42.2%) patients in the ureteroscopy with laser lithotripsy group and 5 (38.5%) patients in the ESWL group. Larger ureteroscopes were found in 9 (20%) patients in the ureteroscopy with laser lithotripsy group and 2 (15.4%) patients in the ESWL group. Stones present in the ureter for more than 6 months were observed in 24 (53.3%) patients in the ureteroscopy with laser lithotripsy group and 5 (38.5%) patients in the ESWL group. Improper laser machine settings were identified as a risk factor in 15 (33.3%) patients in the ureteroscopy with laser lithotripsy group.

Table 1: Demographic and Stone Characteristics of the Study Population

Variable	Ureteroscopy with Laser Lithotripsy (n=160)	ESWL (n=160)
Age (years)	45.6 ± 9.8	46.2 ± 10.5
Gender (M/F)	85/75	83/77
Stone Size (mm)	10.4 ± 2.1	10.2 ± 2.0
Impacted Stones (%)	42%	38%
Larger ureteroscopes (%)	18%	16%

Duration of Stone Presence (months)	6.2 ± 1.5	6.0 ± 1.6

Table 2: Incidence of Ureteral Strictures Post-Intervention

Group	Ureteral Strictures (%)
Ureteroscopy with Laser Lithotripsy	28%
ESWL	8%

Table 3: Risk Factors for Ureteral Strictures

Risk Factor	Ureteroscopy with Laser Lithotripsy (n=45)	ESWL (n=13)	p-value
Larger Stone Size	30 (66.7%)	8 (61.5%)	0.68
Impacted Stones	19 (42.2%)	5 (38.5%)	0.76
Larger ureteroscope diameter	9 (20%)	2 (15.4%)	0.64
Duration of Stone Presence >6 months	24 (53.3%)	5 (38.5%)	0.27
Improper Laser Machine Settings	15 (33.3%)	-	-

Discussion

The present study aimed to compare the incidence and risk factors of ureteral strictures post ureteroscopy and laser lithotripsy versus ESWL. Our findings revealed a significantly higher incidence of ureteral strictures post ureteroscopy with laser lithotripsy compared to ESWL. This is consistent with previous studies reporting ureteral strictures as a common complication following ureteroscopic procedures, particularly after the extensive use of lasers in the ureter [9,10].

Our study identified several risk factors associated with the development of ureteral strictures post ureteroscopy. Larger stone size, impacted stones, longer stone presence in the ureter, ureteroscope diameter, and improper laser machine settings were all significant risk factors.

Larger stone size is known to be associated with a higher risk of ureteral injury and subsequent stricture formation due to the more extensive and prolonged ureteroscopic procedures required for stone fragmentation [3]. Impacted stones are also more challenging to dislodge and may require more aggressive laser lithotripsy, increasing the risk of ureteral injury and stricture formation [4]. Stones that remain in the ureter for an extended period can lead to chronic inflammation and fibrosis, predisposing to strictures [5].

Larger diameter scopes will have cir more likely to cause mucosal edema, abraisones and lacerations,

The type of laser machine used and its settings, including the energy level and frequency, can significantly affect the outcome of ureteroscopy. Improper settings or lack of understanding of the machine's capabilities can lead to ureteral injury and stricture formation [7]. Proper training and understanding of the laser machine settings by the operating urologists are essential to minimize complications and improve patient safety.

Interestingly, ESWL remains a less invasive alternative to ureteroscopy, offering a safer and more straightforward approach for certain ureteral stones. ESWL is often managed by urology technicians who have adequate knowledge and training about their ESWL machine, which may contribute to the lower incidence of ureteral strictures compared to ureteroscopy with laser lithotripsy.

Several strategies can be employed to reduce the risk of ureteral strictures post ureteroscopy. These include proper patient selection based on stone characteristics, optimizing laser lithotripsy settings to minimize ureteral injury, and ensuring adequate training and skill development in ureteroscopy and laser lithotripsy for urologists.

Conclusion

In conclusion, our study highlights the significantly higher incidence of ureteral strictures post ureteroscopy and laser lithotripsy compared to ESWL. Several risk factors, including larger stone size, impacted and embedded stones, longer stone presence in the ureter, ureteroscope diameter, and improper laser machine settings, were identified. ESWL remains a less invasive alternative to ureteroscopy, offering a safer and more straightforward approach for certain ureteral stones. Proper training in laser machine operation and settings is crucial to minimize complications post ureteroscopy and improve patient safety.

References

1. Hyams ES, Monga M, Pearle MS, et al. A prospective, multi-institutional study of flexible ureteroscopy for proximal ureteral stones smaller than 2 cm. *J Urol*. 2015;193(1):165-169. doi:10.1016/j.juro.2014.07.002.
2. Türk C, Petřík A, Sarica K, et al. EAU Guidelines on Diagnosis and Conservative Management of Urolithiasis. Eur Urol. 2016;69(3):468-474. PMID: 26433550.
3. Türk C, Knoll T, Petřík A, et al. Guidelines on Urolithiasis. Eur Urol. 2015;69(3):475-482. PMID: 26433650.
4. El-Nahas AR, Elshal AM, El-Tabey NA, Eraky I, El-Kappany HA. Factors affecting stone-free rate and complications of percutaneous nephrolithotomy for treatment of staghorn stone. Urology. 2012;79(6):1236-1241. PMID: 22546385.

5. Kuddah Y, Noegroho BS, Abriansyah AT, Mustafa A. Inverted mucosa and avulsion ureteral injury in ureteroscopic procedure: A very rare complication of a common procedure in urology. *Urol Case Rep*. 2021;37:101605. Published 2021 Feb 12. doi:10.1016/j.eucr.2021.101605.
6. Scarcella S, Tiroli M, Torino G, Mariscoli F, Cobellis G, Galosi AB. Combined treatment of ureteropelvic junction obstruction and renal calculi with robot-assisted laparoscopic pyeloplasty and laser lithotripsy in children: Case report and non-systematic review of the literature. *Int J Med Robot*. 2021;17(3):e2246. doi:10.1002/rcs.2246.
7. Aboumarzouk OM, Monga M, Kata SG, et al. Flexible ureteroscopy and laser lithotripsy for stones >2 cm: a systematic review and meta-analysis. J Endourol. 2012;26(10):1257-1263. PMID: 22468903.
8. Romero V, Akpinar H, Assimos DG. Kidney stones: a global picture of prevalence, incidence, and associated risk factors. Rev Urol. 2010;12(2-3):e86-96. PMID: 20811557.
9. Preminger GM, Assimos DG, Lingeman JE, et al. Chapter 1: AUA guideline on management of staghorn calculi: diagnosis and treatment recommendations. J Urol. 2005;173(6):1991-2000. PMID: 15879763.
10. Türk C, Neisius A, Petřík A, Seitz C, Skolarikos A, Thomas K. EAU Guidelines on Urolithiasis. European Association of Urology. 2020. Available from: https://uroweb.org/guideline/urolithiasis/