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Holmium Laser Intrarenal Lithotripsy in Pyelocaliceal Lithiasis Treatment: to Dust or to Extractable Fragments?

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Rezumat

Litotriția intracorporeală holmium laser în tratamentul litiazei pielocaliceale: în nisip sau în fragmente extractabile?

Introducere: Abordul calculilor pielocaliceali utilizând ureteroscopul flexibil ridică o serie de probleme legate de timpul operator, morbiditatea asociată şi costuri, în special prin deteriorarea endoscoapelor.
Metodă: Au fost analizate 5 serii de câte 20 de pacienți cu litiază pielocaliceală unică: Grupul I cu calculi < 1 cm fragmentați "dust", Grupul II cu calculi < 1 cm cu litotriție în fragmente, Grupul III cu calculi între 1-2 cm fragmentați "dust", Grupul IV cu calculi între 1-2 cm cu litotriție în fragmente, Grupul V cu calculi între 1-2 cm la care s-a practicat litotriție "dust" până la 1 cm după care litotriție în fragmente extractabile. În toate cazurile a fost utilizată litotriția Ho:YAG.
Rezultate: Teaca de acces ureteral a fost utilizată în 70% din cazuri. Timpii operatori medii au fost de 39 minute în grupul I, 21 minute în grupul II, 112 minute în grupul III, 72 minute în grupul IV, 51 minute în grupul V. Au fost înregistrate complicații minore în 7 cazuri şi o complicație majoră în Grupul IV.
Concluzii: Metoda eficientă de litotriție a calculilor <1 cm pare a fi în fragmente extractabile. Pentru calculii voluminoşi metoda utilă este distrucția în "dust" până la 1 cm, apoi litotriția fiind realizată în fragmente.

Cuvinte cheie: Holmium laser, litiaza pielocaliceală, litotriție, ureteroscopie flexibilă retrogradă

Abstract

Background: Pyelocaliceal calculi flexible ureteroscopic approach raises problems related to operative time, associated morbidity and costs, especially by potential endoscope damage.
Methods: 5 series, each of 20 patients with single pyelocaliceal lithiasis, were analyzed: Group I with calculi < 1 cm fragmented to dust, Group II with calculi < 1 cm with lithotripsy in fragments, Group III with calculi of 1-2 cm fragmented to dust, Group IV with calculi of 1-2 cm with lithotripsy in fragments, Group V with calculi of 1-2 cm fragmented to dust until they reached 1 cm, and lithotripsy in fragments afterwards. In all cases Ho:YAG lithotripsy was used.
Results: Ureteral access sheath was used in 70% of the cases. Mean operating time was 39 min in group I, 21 min in Group II, 112 min in group III, 72 min in group IV and 51 min in group V. Minor complications occurred in 7 cases, while a single major complication occurred in group IV.
Conclusions: The optimal lithotripsy method for calculi <1 cm seems to be in extractable fragments. Larger calculi should be fragmented to dust until they reach 1 cm and then the lithotripsy should be continued into extractable fragments.
Abbreviations: Ho: YAG – Holmium: Yttrium Aluminium Garnet, Hz – Hertz, mJ – milli joule

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Key words: Holmium laser, pyelocaliceal lithiasis, lithotripsy, retrograde flexible ureteroscopy

Introduction

Despite major technical advances over the last decades, flexible ureteroscopes still remain quite expensive and relatively fragile instruments. Nowadays, the digital models are far more durable and efficient by comparison to the older generation conventional ones. However, the clearly improved visibility and maneuverability also came with a price increase which should be taken into consideration when calculating the cost-effectiveness of the method. The development of Holmium laser lithotripsy proved to be an excellent combination with these endoscopes, thus widely expanding the indications for the flexible ureteroscopic approach.

While technological progresses are still possible, many are already seeking new ways to directly improve the actual surgical technique. The aim of our study was to determine the effectiveness and safety of Holmium laser lithotripsy into dust versus extractable fragments during the ureteroscopic approach of pyelocaliceal calculi.

Material and Methods

We analyzed five groups, each of 20 consecutive patients, presenting unique pyelocaliceal lithiasis. Different Holmium laser settings were applied during intrarenal lithotripsy for each series. The first two groups included consecutive patients with calculi smaller than 1 cm, lithotripsy into dust being performed in group I and lithotripsy in extractable fragments in group II. The next three series were constituted by consecutive patients with calculi between 1 and 2 cm. In group III, lithotripsy was applied until dust was obtained, in group IV calculi were divided into extractable fragments, while in group V, the stones were fragmented into dust until reaching 1 cm in diameter, continuing after that with lithotripsy in extractable fragments.

Success of the procedure was considered only if no stone fragment larger than 1 mm (verified both visually at the end of the procedure and radiologically, 24 hours after the procedure) persisted in the upper urinary tract.

In all cases, a Storz Flex-Xc digital flexible ureteroscope was used. During the lithotripsy process we used a Dornier Medilas H20 Ho:YAG laser. The switching between the two lithotripsy modalities was performed by changing the laser settings: low power (500 mJ) and high frequency (12 Hz) for lithotripsy into dust (*Fig. 1*) and high power (1000-1200 mJ) and reduced frequency (8-10 Hz) for lithotripsy in extractable fragments (*Fig. 2*).

Results

A Flexor Cook ureteral access sheath 12/14 F was used in all cases of lithiasis larger than 1 cm and in 25% of cases with smaller stones.

The mean stone volume was statistically similar in group I and II and in group III, IV and V. The success rates were also similar among the 5 groups (*Table 1*).

The mean operative times were significantly lower in group II by comparison to group I and in group V when compared to groups III and IV (*Table 1*).

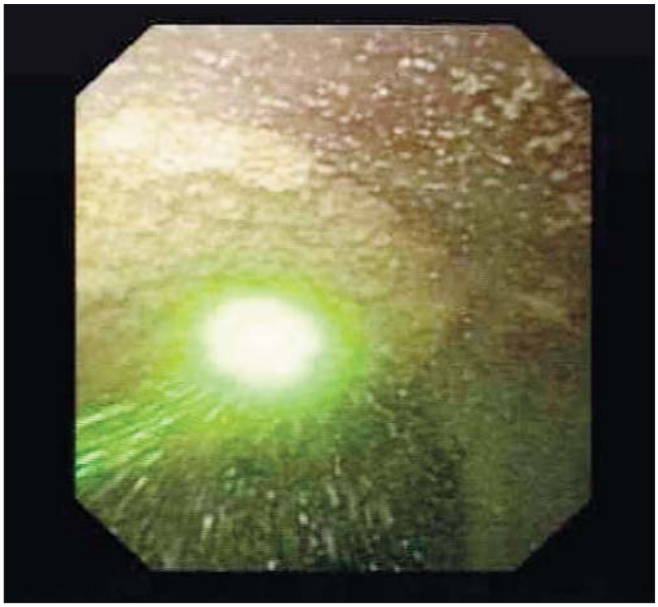

Figure 1. *Lithotripsy in very small fragments (dust)*

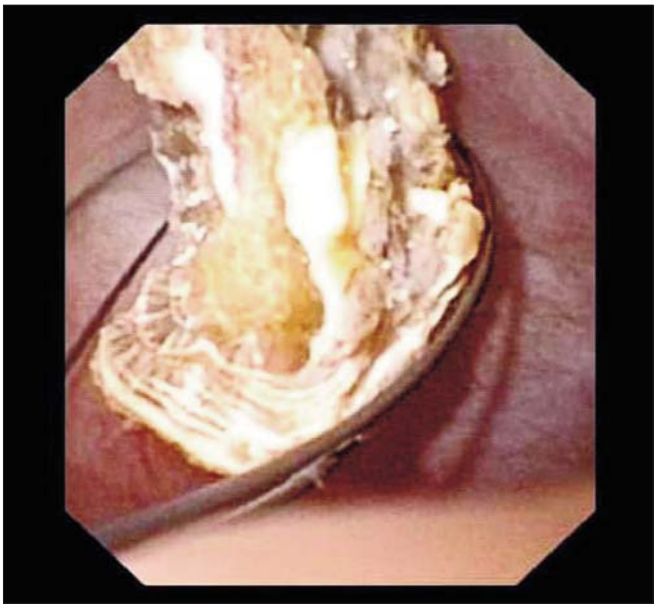

Figure 2. *Stone fragment extracted with a tipless basket*

Table 1. *Results of retrograde flexible approach in each of the five groups*

	Group I	Group II	Group III	Group IV	Group V
Success rate	95%	100%	95%	95%	100%
Minor complications rate	10%	5%	5%	5%	10%
Major complications rate	0%	0%	0%	5%	0%
Operative time	39 min	21 min	112 min	72 min	51 min

Minor complications were encountered in 7 cases (fever in 2 cases and persistent bleeding which didn't require blood transfusions in 5 cases).

Major complications occurred in one case from group IV: massive extravasation of irrigation fluid in the retroperitoneum which imposed percutaneous drainage.

Discussion

The flexible ureteroscopic approach of upper urinary tract pathology is already a routine procedure in many centers (1). Holmium laser was widely acknowledged as an excellent addition to these endoscopes. Being able to fragment stones as well as incising stenosis and ablating tissue masses, it expanded the indications and efficacy of flexible ureterorenoscopic approach beyond all initial expectations (2,3). Holmium laser acts through its photo-thermal effect (and not photo-acoustic like other lasers), while not being influenced by the chemical composition of the calculi (4,5).

This type of lithotripsy has started to be used even in larger and complex pyelocaliceal stones with good safety profile and success rates (6). This aspect raises new problems regarding the quest for methods aimed to optimize this procedure by making it as fast as possible, as well as to decrease the stress on the endoscopes, ancillary instruments and energy sources. The increased costs of the device or its fibers and the prolonged time necessary for the lithotripsy process were cited as the main disadvantages of Holmium laser (7). In this regard, planning the strategy by taking into account the stone volume and eventually its hardness is quite important in order to improve the outcomes (8).

There were various modalities of fragmenting stones imagined and described: dancing, chipping (8), fragmentation (9) or popcorn (10) techniques. Overall, these approaches may be divided into two main categories: dust fragmentation into very small particles which do not require extraction and fragmentation in extractable stones.

The instruments' durability seems dependent on the total operative time. From this perspective, our results suggested that the best time-effectiveness is correlated with dust lithotripsy for larger volumes and lithotripsy into extractable fragments for smaller calculi. Moreover, Holmium laser lithotripsy seems to constitute a safe alternative, applicable even in patients with risk factors such as bleeding diathesis (11). In accordance with our trial, different lithotripsy strategies emphasized relatively similar safety features.

Of course, as always when discussing the outcome of procedures for urolithiasis, the debate regarding the definition of success remains (12,13). We defined it more restrictively (persistence of residual fragments of no more than 1 mm) due to the parameters we compared (interventions' outcome after lithotripsy in dust vs. lithotripsy in extractable fragments) and in order not to bias the results.

Even for larger stone burdens (2-3 cm and above), the flexible ureteroscopic approach with Holmium laser lithotripsy still remains an attractive option, staged interventions representing a strategy which may lead to a higher stone-free rate (14). There were authors advocating employment of each technique dependent on the hardness of stones, like dancing for softer lithiasis and chipping for harder calculi (8). However, this is a subject which requires further research.

Conclusions

The most efficient lithotripsy technique for calculi smaller than 1 cm is into extractable fragments. For larger stones, it is optimal to pulverize them into dust until reaching 1 cm in diameter. Under 1 cm, laser lithotripsy can be performed until obtaining extractable fragments, thus optimizing the procedure.

References

1. Geavlete P, Mulțescu R, Georgescu D. Flexible ureteroscopic approach in upper urinary tract pathology. Chirurgia (Bucur). 2006;101(5):497-503.
2. Adkins WC, Dulabon DA, Lund PL, et al. Holmium:YAG laser - a 'Swiss army knife' of lasers. Lasers Surg Med. 1994;6(Suppl):59-61.
3. Geavlete P, Multescu R, Geavlete B. Retrograde flexible ureteroscopy: reshaping the upper urinary tract endourology. Arch Esp Urol. 2011;64(1):3-13.
4. Vassar GJ, Chan CK, Teichman JM, Glickman RD, Weintraub ST, Pfefer TJ et al. Holmium:YAG laser: photothermal mechanism. J Endourol 1999;13(3):181-90.
5. Wiener SV, Deters LA, Pais VM Jr. Effect of stone composition on operative time during ureteroscopic holmium:yttrium-aluminum-garnet laser lithotripsy with active fragment retrieval. Urology. 2012;80(4):790-4.
6. Cohen J, Cohen S, Grasso M. Ureteropyeloscopic treatment of large, complex intrarenal and proximal ureteral calculi. BJU Int. 2013;111(3 Pt B):E127-31.
7. Zheng W, Denstedt JD. Intracorporeal lithotripsy. Update on technology. Urol Clin North Am. 2000;27(2):301-13.
8. Hecht SL, Wolf JS Jr. Techniques for holmium laser lithotripsy of intrarenal calculi. Urology. 2013;81(2):442-5.
9. Bagley D, Erhard M. Use of the holmium laser in the upper

urinary tract. Tech Urol. 1995;1(1):25-30.
10. Chawla SN, Chang MF, Chang A, Lenoir J, Bagley DH. Effectiveness of highfrequency holmium:YAG laser stone fragmentation: the “popcorn effect”. J Endourol. 2008;22(4): 645-50.
11. Aboumarzouk OM, Somani BK, Monga M. Flexible ureteroscopy and holmium: YAG laser lithotripsy for stone disease in patients with bleeding diathesis: a systematic review of the literature. Int Braz J Urol. 2012;38(3):298-305.
12. Geavlete P, Mulțescu R, Geavlete B. Endoscopic surgery for urolithiasis: what does "stone free" mean in 2012. Chirurgia (Bucur). 2012;107(6):693-6.
13. Deters LA, Jumper CM, Steinberg PL, Pais VM Jr. Evaluating the definition of "stone free status" in contemporary urologic literature. Clin Nephrol. 2011;76(5):354-7.
14. Al-Qahtani SM, Gil-Deiz-de-Medina S, Traxer O. Predictors of clinical outcomes of flexible ureterorenoscopy with holmium laser for renal stone greater than 2 cm. Adv Urol. 2012;2012: 543537, available from: http://www.hindawi.com/journals/au /2012/543537/