

Comparison of Holmium Laser and Pneumatic Lithotripsy in Treatment of Ureteral Stones

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ABSTRACT

Introduction: To compare the effectiveness and complications of treatment of ureteric stones by holmium laser lithotripsy and pneumatic lithotripsy.

Methods: Comparison of 100 patients with ureteric stones, 50 of whom were treated with pneumatic lithotripsy and 50 with holmium laser lithotripsy was done and effectiveness and complications of the two were analysed.

Results: Both the groups were similar in respect to sex, age, stone size and location of the stones. Successful stone fragmentation occurred in 94 % on pneumatic group and in 92 % on laser group. On following the patients for a month, stone free rate was 98 % in both the groups. None of the patients had any complications relating to the procedures.

Conclusion: Although pneumatic lithotripsy has more retrograde migration of ureteric stones, the results are comparable to holmium laser. Other complications are very rare.

Keywords: *Lithotripsy, Holmium, Pneumatic*

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INTRODUCTION

Developments in endourology have dramatically changed the approach to ureteral calculi and transureteric endoscopic management emerged as the procedure of choice. The invention of advanced ureteroscopes, lithotripsy devices, and other instruments has made the use of open surgery very rare. Ureteroscopy ensures direct identification of the stone, which is safe and efficacious. The stone in the ureter may be managed by using basket or by fragmentation and removal. Ultrasonic, electrohydraulic, pneumatic, and laser lithotripters are available if fragmentation is necessary.¹

Pneumatic lithotripsy remains more popular among the urologists because of its low cost, easy setup, and high success rate.² There is no electricity and little heat energy is produced. Because the maximum range of the stroke is 2mm, transient and mild mucosal injury evidenced by edema or hemorrhage may occur.³ Proximal migration of calculi is a limiting factor with this method.⁴ The Holmium: YAG laser energy is delivered in a pulsatile manner and has tissue penetration of no more than 0.5mm, so perforation of ureter is unlikely to happen as long as the lithotripsy is performed under direct vision. Furthermore, such a superficial penetration depth leads to milder injury to the ureter than is seen in the pneumatic lithotripsy, so ureteral stricture associated with scar formation is less of a problem.⁵ Holmium laser is a reliable method for the treatment of ureteral stones especially in proximal and impacted ureteral stones although it is expensive and not available in most of the urologic centers.⁶ The laser has proved to be superior due to its high efficacy regardless of stone composition.

METHODS

A comparison of hundred cases of transureteric lithotripsy performed by the author at a single private hospital for surgical treatment for ureteric calculi has been done after approval from the ethical committee of the hospital. Patients were included when they had ureteral stones of more than 10 mm size, presence of hydronephrosis or failed medical and hydrotherapy. Stones of size more than 20mm were excluded. On admission, all patients were thoroughly evaluated by medical history and physical exam, x-ray of the kidney, ureter and bladder, intravenous urography, ultrasound, urinalysis and culture. The patients were explained about both the

techniques, advantages and disadvantages and they themselves decided and consented to the procedure to be undertaken. The patients were also explained that the cost of both the procedures would be similar if the total charge including the operation charge, hospital charges and medicine charges were considered. Before the operation, an informed written consent was taken for the procedure as well as participation in the study.

Both the procedures were done in dorsolithotomy position under spinal anesthesia. Preoperatively all patients received 1 gm ampicillin and 80 mg gentamicin intravenously. Cystoscopy was performed and a guide wire was inserted into the ureteral orifice and ureteroscope (8.5-9 Fr) was used in all patients. In pneumatic lithotripsy, a pneumatic lithoclast of 8.5 Fr was used and in the holmium lithotripsy, same size of lithoclast was used. The stones were fragmented by a 0.8-mm lithoclast probe with the ballistic energy at a rate of 12 Hz or Holmium laser with end-firing probe 365 μ m, 0.5-1 joule energy in frequency of 5-10 Hz. A double J stent was placed in all the patients. X-ray KUB was done on the first postoperative day and after a month in all patients.

A study was carried out when there were fifty patients in each group.

RESULTS

A total of 100 patients who underwent lithotripsy were analysed, first fifty each who were managed with pneumatic lithotripsy and with Holmium laser lithotripsy, according to the patients' choices.

Twenty nine patients in the pneumatic group were males with mean age of 46.5 ± 3.6 years; and 21 cases were females with mean age of 38.4 ± 5.3 years. In the laser group, 38 cases were males with mean age of 42.55 ± 2.8 years and 12 were females with mean age of 41.34 ± 2.2 years. The mean stone size was also similar in both the groups, 10.34 ± 1.2 mm in pneumatic group and 12.34 ± 2.6 mm in laser group. Stones were located in lower ureter in 36 cases of pneumatic group and 27 cases of laser group. In rest the stones were either in the mid or upper ureter.

Retrograde stone migration occurred in 5 cases of pneumatic group (10%) and in 3 cases of laser group (6%). Successful stone fragmentation occurred in 47 cases

(94 %) on pneumatic group and in 46 cases (92 %) on laser group. On following the patients for a month, stone free rate was 98 % in both the groups. Both the patients who had retained stones were managed with pneumatic lithotripsy and eventually all patients in the study were stone – free. Expected complications such as mucosal tearing, perforation of the ureter, urinoma, and urosepsis were not seen in any patients in both the groups.

DISCUSSION

Ureteric calculi which fail conservative treatment require intervention. Lotan and associates stated that the decision to manage a ureteral stone expectantly or to intervene with shock wave lithotripsy or ureteroscopy depends on multiple factors such as stone size and location, treatment cost, success and complication rates, and the patient's preference. They showed that ureteroscopy is more cost-effective than shock wave for ureteral stones at all sites, largely as a result of the high cost of purchasing and maintaining a lithotripter.⁷ Advances in endoscopic techniques have refined the techniques of intervention, making them as the gold standard for management of ureteric stones.⁸ A variety of lithotripters can be used through an ureteroscope. Pneumatic and HO:YAG laser lithotripsy are commonly used in majority of urologic centers. The pneumatic lithotripter uses air pressure to propel a metal projectile within a handpiece against the base of rigid probe, which is thereby accelerated and thrown like a jackhammer against the stone, making the stone disintegrate.⁹ The Ho:YAG laser generator is an impulsed generator, whose working medium is holmium contained in an yttrium – aluminum – garnet crystal. This laser produces light at a wavelength of 2124 nm that can be delivered through flexible optical fiber. The laser energy vaporizes water between the fiber tip and the target surface, creating a cavitation bubble that transmits the energy to the target. A drilling effect is produced, which in turn leads to stone fragmentation.^{10,11}

The ultimate success rate of these procedures include the feasibility of the procedure, number of the sessions required to be the patient stone-free, complication rate, and the requirements to achieve the stone-free status.^{11,12} We have compared the results of ureteral stone treatment with Holmium laser and pneumatic lithotripsy taking two groups similar in terms of age, sex and stone size as has been done in other similar studies.

Under direct vision stone fragmentation was done in both the techniques. In a study done by Sun et al, this was 69.7 % and 95.7% respectively.² Similarly Grasso et al have reported 97% fragmentation rate with laser while Naqvi et al have reported pneumatic lithotripsy to be superior.^{8,11} We did not see much difference in the two techniques, as in our series, successful fragmentation occurred in 94% in the pneumatic and 92% in the laser group.

Proximal migration, which is related with dilatation of proximal ureter, size and hardness of stone, severity of stone impaction and pressure of irrigation fluid, is the major disadvantage in the pneumatic lithotripsy and has been reported to be 2 – 17%.¹¹ In our series, it was 10% in the pneumatic group and 6% in the laser group, all of which were subsequently successfully managed.

Overall stone-free rate at the end of one month was 98%. This result is comparable with other comparable studies^{4,11,13} Both the patients who had retained stones were managed with pneumatic lithotripsy subsequently. In our series, major complications such as ureteral perforation urinoma and urosepsis were not seen on both groups.

CONCLUSION

The size and location of ureteral stones, technological efficiency of the instruments, and endoscopic experience and ability all had a role in the success or failure of ureteroscopic lithotripsy. Although pneumatic lithotripsy has more retrograde migration of stones, the results of pneumatic and laser lithotripsy are comparable in terms of their efficacy and safety making endoscopic management as procedures of choice for management of ureteric stones.

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