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*RESEARCH ARTICLE*

# MANAGEMENT OF URETERIC CALCULI WITH PNEUMATIC LITHOTRIPSY AND INTRACORPOREAL HOLMIUM: YAG LASER: A COMPARATIVE STUDY.

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## *Abstract*

**Background:** Among many lithotripters available for fragmentation of ureteric stones, pneumatic and Holmium: YAG laser lithotripsy have reported favorable outcomes. Aim of this study is to compare the intracorporeal Holmium: YAG laser with pneumatic lithotripsy in ureteral calculi fragmentation in terms of fragmentation time, stone migration, intra-operative and post-operative complications, stone free rate and need for auxiliary procedures.

**Material & Methods:** Fifty patients selected with diagnosis of calculus in ureter suitable for endoscopic treatment. They were subsequently randomized in to two groups by sealed envelope method. Group 1 was treated with Holmium: YAG laser lithotripsy and group 2 with pneumatic lithotripsy. All patients with ureteral calculi of size 6-20 mm were included while stone size >20mm, patients with sign of sepsis, pregnancy, renal insufficiency or urinary tract abnormalities were excluded from the study.

**Results:** Maximum number of cases (64%) were from 21-40 years age group in both the groups, while least number of cases (8% of all) were from age group <20 years in pneumatic (4%) and Holmium group (12%) respectively. At six weeks, only 22 patients were stone free in pneumatic group (88%) while all patients in holmium group (100%) were free of stones. However, difference was not statistically significant (p=0.074).

**Conclusion:** Both Holmium: YAG laser lithotripsy and Pneumatic lithotripsy are very safe methods of ureteroscopic stone fragmentation in experienced hands. However, Holmium: YAG laser is more successful in treatment of upper ureteric stones.



## Introduction: -

The development of minimally invasive techniques has revolutionized the management of ureteric calculi. With the advent and advancement in fiberoptic, imaging, shock wave, ultrasonic, electrohydraulic, pneumatic and laser lithotripters, a variety of armamentarium is now available to the urologist. Among many lithotripters available for fragmentation of ureteric stones, pneumatic and Holmium: YAG laser lithotripsy have reported favorable outcomes.

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Pneumatic lithotripsy relies on energy generated by the movement of a projectile. The initial movement of the projectile can be induced by a variety of stimuli, but once the projectile is in contact with another object, the ballistic energy is transferred to the object. Flexible objects preserve the momentum of energy but inflexible objects such as stone fragment on impact (a Jackhammer effect). The swiss Lithoclast introduced in early 1990s was the first ballistic lithotrite.[1] Afterward, the electro kinetic lithotripter was introduced.[2]

Pneumatic lithotripsy provides an effective means for stone fragmentation in the entire urinary tract and for stones of all compositions with wide margin of safety. As no heat is produced during lithotripsy, there is no risk of thermal injury. Most importantly it is of low cost and require low maintenance. Main drawback of pneumatic lithotripsy is its rigid nature of technology which requires ureteroscopes or nephroscopes with straight working channel. It is associated with high rate of stone retropulsion and migration. [1,3.]

Holmium laser is a solid-state laser system that operates at a wavelength of 2140 nm in the pulsed mode. The Holmium laser is highly absorbed by water and as tissues are composed mainly of water, the majority of the holmium laser energy is absorbed superficially which results in superficial cutting or ablation. Holmium laser lithotripsy primarily work through photothermal mechanism that causes stone vaporization.

Holmium yag laser is one of the safest, most effective and most versatile intracorporeal lithotripter. Holmium yag laser not only fragments stones of all composition but unlike pneumatic lithotripter, reduces the chances of retropulsion of stones or its fragments. [4,5.] The holmium laser has multiple soft tissue applications and can be used to treat benign prostatic hyperplasia, strictures and urothelial tumors. The major disadvantage of holmium laser is initial high cost of the device and the cost of the laser fibers.

Aim of this study is to compare the intracorporeal Holmium: YAG laser with pneumatic lithotripsy in ureteral calculi fragmentation in terms of fragmentation time, stone migration, intra-operative and post-operative complications, stone free rate and need for auxiliary procedures.

## Material and Methods: -

This study was conducted in the department of urology, Dr. B. S. A. Hospital, Delhi. Fifty patients were selected from the outpatient department with the diagnosis of calculus in ureter suitable for endoscopic treatment. They were subsequently randomized in to two groups by sealed envelope method. Group 1 was treated with Holmium: YAG laser lithotripsy and group 2 with pneumatic lithotripsy.

All patients with ureteral calculi of size 6-20 mm were included while stone size >20mm, patients with sign of sepsis, pregnancy, renal insufficiency or urinary tract abnormalities were excluded from the study. Informed consent was taken from all the patients before entering the study. Preoperative evaluation with all the routine investigations were done on an outpatient basis. Stone size was recorded and patient evaluated for routine pre-anesthetic checkup.

Standard operative techniques were followed in all the patients. Ureteroscopy was performed in both the group using 6/7.5 Fr semirigid ureteroscope under fluoroscopic guidance. Fragmentation time since beginning of the procedure till the complete fragmentation of stone was noted meticulously. 30 watts convergent Holmium: YAG laser was used with a fiber of 365qm. Pneumatic lithotripsy was done using Richard wolf pneumatic lithotripter. All post-operative as well as follow-up events were noted. Statistical analysis was done using chi square and student t test to study the difference of various parameters.

## Results: -

As far as epidemiological profile of the patients is concerned, Maximum number of cases (64%) were from 21-40 years age group in both the groups, while least number of cases (8% of all) were from age group <20 years in pneumatic (4%) and Holmium group (12%) respectively. (Table 1.)

**Table 1: -**Patients age profile (Mean, Range, SD)

| Age (yrs.) | Holmium group | | Pneumatic group | | Total | P |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| <20 | 3 | 12.0 | 1 | 4.0 | 4 | 8.0 |
| 21-40 | 16 | 64.0 | 16 | 64.0 | 32 | 64.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| >40 | 6 | 24.0 | 8 | 32.0 | 14 | 28.0 |
| Total | 25 | 100 | 25 | 100 | 50 | 100 |
| Mean | 34.12 | | 37.96 | | | |
| SD | 12.16 | | 12.69 | | | |
| SE | 2.43 | | 2.54 | | | |
| Range | 19-65 | | 18-70 | | | |
| T | 1.093 | | | | | |
| P | 0.280NS | | | | | |

None of our Patients had intra-operative complications in both holmium and pneumatic groups. This suggests that both holmium and pneumatic lithotripsy are safe methods of ureteral calculi fragmentation. Majority of patients had no postoperative complications in both groups i.e. 96% and 92% in holmium and Pneumatic groups respectively. While only 1 case in holmium group had a postoperative complication in the form of urosepsis, one case each in pneumatic group had postoperative complications i.e. Hematuria and Urosepsis. However, the difference was not statistically significant. (Table 2.)

**Table 2: -**Post-Operative Complications

| Postoperative Complications | Holmium group | | Pneumatic Group | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| Absent | 24 | 96 | 23 | 92 | 47 | 94 |
| Hematuria | 0 | - | 1 | 4 | 1 | 2 |
| Urosepsis | 1 | 4 | 1 | 4 | 2 | 4 |
| Total | 25 | 100 | 25 | 100 | 50 | 100 |
| $X^2$ | 1.021 | | | | | |
| P | 0.600NS | | | | | |

At end of two weeks' time interval 24 patients from Holmium group (96%) and 21 patients from pneumatic group (84%) were stone free (p = 0.157). At six weeks, only 22 patients were stone free in pneumatic group (88%) while all patients in holmium group (100%) were free of stones. However, difference was not statistically significant (p=0.074). (Table 3.)

**Table 3: -**Stone Free rate

| Stone free Rate | | Holmium Group | | Pneumatic group | | $X^2$ | P |
|---|---|---|---|---|---|---|---|
| | | No. | % | No. | % | | |
| 2 Weeks | Present | 1 | 4.0 | 4 | 16.0 | 2.000 | 0.157NS |
| | Absent | 24 | 96 | 21 | 84 | | |
| 6 Weeks | Present | 0 | - | 3 | 12 | 3.191 | 0.074 |
| | Absent | 25 | 100 | 22 | 88 | | |
| 3 Months | Present | 0 | - | 2 | 8 | 2,083 | 0.149 |
| | Absent | 25 | 100 | 23 | 92 | | |

One patient required percutaneous nephrolithotomy and one patient required repeat ureteroscopy in pneumatic group for stones remaining at three months while none patients from holmium group required auxiliary procedure. However, the difference was statistically insignificant (p>0.05).

## Discussion: -

The majority (64%) of the patients were in the age group of 21-40 years. Incidence of ureteral calculi was found to be higher in men (58%) as compared to women (42%) with a male: female ratio of 1.4:1. This is comparable to other studies done worldwide. The majority of patients (n=36; 72%) had a lower ureteric calculus in both the group. Binbay et al also found that calculi were located in distal ureter in most of the patients in both group which they studied. [6]

The mean stone size in holmium: YAG laser group was comparable to pneumatic group. Access to the ureter was possible in 100% of our patients. The mean stone fragmentation time was 11.0+/- 2.31 in the Holmium: YAG laser

group which was significantly longer than the 8.92+/- 1.73 min required for stone fragmentation in the pneumatic group (p=0.001 HS). These findings are comparable to other studies. [7,8.]

The longer fragmentation time noted with Holmium: YAG laser lithotripsy was because of its capacity to fragment the stones in to very small pieces. Three patients had stone up migration in pneumatic group as compared to none in Holmium: YAG group. However, this difference was statistically not significant (p=0.074). Similar findings were reported by Tipu et al and so many other studies done in the past. [6,8-10.]

Bapat et al studied the difference between the two modalities in fragmentation of upper ureteral stones selectively and found significantly more cases of stone up migration in pneumatic group (13.98%) versus the laser group (1.99%). [11.]

Need for placing a double J stent in the ureter was felt in 18 (72%) of patients in pneumatic group which was significantly higher than 8 (32%) patients in Holmium: YAG laser group (p=0.005). These findings are comparable to so many studies done in the past. [6,11,12.]

In our study, no intraoperative complications were noted in either group as also reported by Koura et al. [13.] Dogen et al reported ureteral perforation in 2 of the first 5 patients in their series. [14.] Jeon et al reported ureter perforation in 2/26 patients during lithotripsy versus 0/25 in ;aser group (p=0.490).[10.]

One patient (4%) in each group developed signs and symptoms of urosepsis and one patient (4%) in pneumatic group versus none in Holmium group developed hematuria. Our findings are comparable to other study. [11.] In our study the 2 weeks stone free rate of holmium: YAG laser lithotripsy (96%) was superior as compared to pneumatic lithotripsy (84%). However, the difference was not statistically not significant. This is again comparable with findings of other study. [10.]

Our results which is supported by many other studies suggest that Pneumatic lithotripsy is more likely to cause up migration in proximal ureteral stones as compared to Holmium: YAG laser lithotripsy and this can subsequently lead to treatment failure. In our study two patients in the pneumatic group, who still had stones at the end of 3 months, needed auxiliary procedures to achieve complete stone clearance. Our results are in line with the results of other studies. [6.]

## Conclusion: -

The very low incidence of both intraoperative and postoperative complications in both groups establishes the fact that both Holmium: YAG laser lithotripsy and Pneumatic lithotripsy are very safe methods of ureteroscopic stone fragmentation in experienced hands. However, Holmium: YAG laser is more successful in treatment of upper ureteric stones.

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