MP 15-14: Ho:YAG Laser Long Pulse And Stabilization Mode Saves Time And Money: A Benchtop Kidney Stone Model

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Introduction

- Long pulse duration settings with the Ho:YAG laser are employed to prevent stone migration. A newly released 100 W laser (Olympus, Empower) has the ability to combine long pulse duration with a stone stabilization mode (Fig. 1).
- The purpose of the present study was to demonstrate the effect of combining long pulse and stone stabilization mode while treating a 1 cm renal stone in a benchtop upper pole kidney model.

Figure 1: 100 W laser (Olympus, Empower) controller screen shows the ability to choose different pulse duration (short, medium and long) with various modes (dusting, fragmenting, popcorning and stone stabilization). *

Methods

- A 3D printed kidney and ureter model were attached over a 2 x 2 mm metal mesh. Ten identical 1 cm BegoStones (CaOx monohydrate consistency) were placed into the upper pole calyx and treated by the same surgeon using a flexible ureteroscope (URF-P6) (Fig. 2).
- Stones were fragmented using 2 different laser/mode combinations: A 272 micron Dornier 30W with no pulse modulation at 1J and 10Hz (10W) and 272 micron Empower laser LPDSM at 1J and 10Hz (10W) (Fig. 3a and b). The cost of the laser box (Empower $95,000, Dornier $35,000), the fibers (Empower $313.73 and Dornier $313.73/fiber), and the mean cost of OR time in California ($37/min) were used to model cost effectiveness.
- A Mann-Whitney U test was performed for comparison.

Figure 2: A 3D printed live size kidney in which a 1 cm BegoStone was placed in the upper pole calyx, was fixed on a 2 x 2 mm metal mesh.

Figure 3: A- (Left) Dornier 30W with no pulse modulation. B- (Right) Olympus Empower 100W with long pulse stone stabilization mode.

Results

- Stone weights were similar between groups (1.10±0.05 and 1.13±0.05 g. p=0.360).
- Lasing time (19.88±1.9 vs. 24.07±3.1 min, p=0.028) and overall procedure time (24.48±3.6 min vs. 44.26±6.3 min, p=0.006) were significantly lower in the long pulse stone stabilization mode (Fig. 4).
- In addition, the total delivered energy was also significantly lower in the stone stabilization mode (11.9±1.1 kJ vs. 14.2±1.8 kJ, p=0.028) (Table 1).
- All trials with the regular pulse duration required 1 fiber stripping, but no fiber stripping was required with the stone stabilization mode.
- Shorter procedure time resulted in a $731.9 cost savings/case with the stone stabilization mode. When modeling cost factoring in the original purchase price, the laser with the long pulse stone stabilization mode became cost effective after treating 81, one cm kidney stones.

Table 1	Dornier 30W no pulse modulation	Empower 100W long pulse duration with stabilization mode	p
Lasing time (min)	24.07±3.1	19.88±1.9	**0.028**
Procedure time (min)	44.26±6.3	24.48±3.6	**0.006**
Total Energy (kj)	14.2±1.8	11.9±1.1	**0.028**
Fiber stripping	1	0	**0.008**

Discussion

- The holmium:YAG laser has traditionally been the gold standard for laser lithotripsy. In addition, modifications to laser algorithms have been developed with the goal of making the holmium laser even more efficient. Two of these modifications are variable pulse duration and stone stabilization mode.
- The advantages of long pulse duration have also been suggested by Emilliani et al. (1) who showed that a long pulse duration may improve the efficiency of popcorning and De Coninck et al. who demonstrated larger ablation volumes in non-contact mode using long pulses (2).
- In addition, Wollin et al. found that a longer laser pulse duration provides effective stone fragmentation with the advantage of reducing laser fiber tip degradation and stone retropulsion (3).
- Our study expands on these previous studies by including both long pulse duration and stone stabilization mode. Furthermore, in our cost analysis these combined modalities, despite a greater initial purchase price of the Empower laser, it will become cost effective after treating 81 one cm kidney stones.

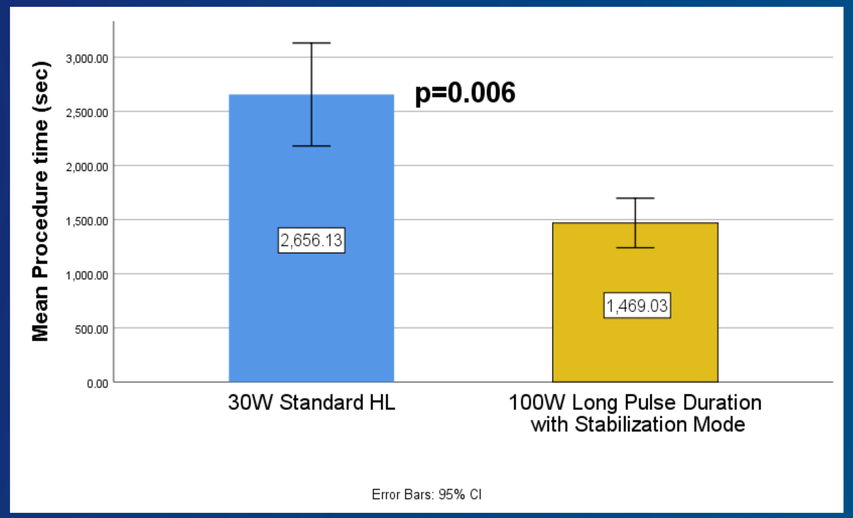

Figure 4: Comparison of overall operating time between 30W HL and 100W HL with long pulse duration.

Conclusions

- Our study showed that the 100W holmium laser with the combination of long pulse duration and stone stabilization was significantly faster (44.7%) than the 30W holmium laser with no pulse modulation.
- The 100W laser with long pulse duration and stabilization mode resulted in decreased laser fiber burnback.
- Despite higher initial purchase price, the 100W laser with long pulse duration and stone stabilization mode will be cost effective in high volume centers.

References

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