INTRODUCTION

We evaluated the effectiveness and efficiency of Superpulse Thulium Fiber Laser (sTFL) versus Holmium Fiber Laser (Ho:YAG) lithotripsy to treat implanted canine calcium oxalate renal stones during ureteroscopy in an in-vivo porcine model.

METHODS

• 24 kidneys from 12 juvenile female Yorkshire pigs were randomized into Ho:YAG or sTFL groups.
• CT scans of canine calcium oxalate stones measured stone volumes and densities.
• Stones were randomized and implanted via an open pyelotomy into a calyx (Figure 1).
• Retrograde flexible URS was performed with a 9.9 Fr Wolf dual lumen ureteroscope passed via a 14 Fr, 35 cm ureteral access sheath (UAS).
• Intra-renal temperatures were measured with percutaneously placed K-type thermocouples placed in the renal pelvis and stone-containing calyx, along with a temperature sensor probe passed through the ureteroscope lumen (Figure 2).
• Laser lithotripsy was performed using “dusting” settings:
  • Ho:YAG: 200 µm laser fiber at 16 W (0.4 J and 40 Hz)
  • sTFL: 200 µm laser fiber at 16 W (0.2 J and 80 Hz)
• Kidneys were bi-valved and irrigated to capture all residual stones.
• Residual stones were dried, weighed, and measured with an optical laser particle sizer.

RESULTS

• There were no differences in stone volume or stone density between the sTFL and Ho:YAG groups.
• Compared to Ho:YAG, stones treated with sTFL (Table 1):
  • Were ablated three times faster
  • Required three-fold less energy expenditure
  • Had 1.6 times higher stone clearance rate
  • Had three-fold higher stone dusting efficiency
• After sTFL lithotripsy, 77% of the remaining fragments were ≤ 1 mm while only 17% of fragments were ≤ 1 mm following Ho:YAG treatment (p<0.001) (Table 2).
• Maximum temperatures reached in any given kidney:
  • Renal pelvis: sTFL 37°C vs. Ho:YAG 37°C
  • Stone-containing calyx: sTFL 40°C vs. Ho:YAG 39°C

CONCLUSIONS

Thulium Fiber Laser (sTFL) lithotripsy, using “dusting” settings, resulted in significantly greater stone clearance, shorter ablation time, greater lithotripsy efficiency, and smaller stone fragments than Holmium Fiber Laser (Ho:YAG) lithotripsy.