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Editorial

The Role of Lasers in Urology

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In the last two decades, laser techniques have become an increasingly popular treatment method for patients with benign prostatic hyperplasia, bladder tumors, urolithiasis, urinary tract strictures, or lesions of the external genitalia. The first reported use of laser technique in urology was published by Staethler in 1976. [1] Some of the initially introduced laser procedures had to be modified or abolished because of numerous postoperative complications, the need for prolonged catheter maintenance, and because of unpredictable therapeutic effects. The laser technique is a safer treatment for older patients than classic operation. Laser procedures are less invasive, with less bleeding, swelling, pain, or scarring. and hospitalization time may be shorter, more procedures may be done in outpatient settings. The most used lasers in urology are KTP: YAG (Potassium titanyl phosphate), LBO: YAG (lithium borate), diode lasers, Holmium (Ho): YAG and Thulium (Tm): YAG lasers. In the past many other types were used, however, due to many complications, their use was discontinued [1]. A wave of technological improvements has occurred in the field of endoscopic laser lithotripsy. However, clinical evidence regarding the benefits in terms of surgical outcomes in real-life situations is still lacking, as most of the available results originate from pre-clinical studies. [2] In 2017, Lumenis® (Yokne'am Illit) introduced a novel (PM) pulse modulation. they are called Moses Technology, which consists of modifying the shape of a pulse into two sub-pulses with different peak power. The first generates a vapor bubble through which the second sub-pulse travels and reaches the target so that its energy does not scatter in the medium. The manufacturers provide two types of Moses PM: Moses Contact (MC) and Moses Distance (MD), the first to be used at a 1 mm distance and the second at a 2 mm distance [3].

Currently, there are no high-quality studies that support the use of HP lasers with MT over other lasers such as low-power (LP) Ho: YAG lasers or TFL (thulium fiber laser). It seems that LP Ho: YAG lasers are still a good alternative. Further comprehensive experimental studies and clinical trials comparing MT with the new TFL are required. [4] The Thulium fiber laser overcomes the main limitations reported with the Holmium: YAG laser relating to lithotripsy, based on preliminary in vitro studies. This original laser technology seems advantageous for ureteroscopy and may become an important milestone for kidney stone treatment [5]. Recent publications have concluded that the Thulium fiber laser (TFL) is safe in endoscopic lithotripsy. All the speculations about this novel technology generated by laboratory trials are starting to be confirmed, and this promising technology may become the new gold standard soon. [6] In vitro, laser lithotripsy efficiency is higher with the TFL than with the Ho: YAG laser. Indeed, despite low power settings, the ablation rate (AR) was significantly higher, as less energy was required to ablate 1 mg of stone with the TFL. Junior urologists had a faster learning curve with the TFL than with the Ho: YAG laser. Concerning laser safety, both laser technologies are equally safe. So, the Coloplast TFL Drive GUI pre-set values are effective and safe when working with 20 W in the kidney and 12 W in the ureter [7,8].

Apart from the classic indications (staghorn and infectious stones, stones in retrogradely inaccessible calyces, stones in urinary diversions, skeletal deformities, and anomalous kidneys), PCNL is far from being ruled out. PCNL and flexible ureteroscopy became an alternative, in some cases, according to the surgeon's preference. This means that, in current times, not only is there still a place for percutaneous nephrolithotomy, but its application, in specialized centers, is even growing at the expense of Retrograde Intrarenal Surgery (RIRS). [9] Despite improved energy delivery, the longer pulse mode produced a smaller crater volume, suggesting additional processes secondary to photothermal ablation are involved in stone damage. Observations of the difference in stone damage treated in water vs in air, combined with the crater formation by parallel fiber, suggest that cavitation contributes to stone damage during Laser Lithotripsy [10]. It was found that using Moses technology allows a considerable reduction in stone retropulsion. Although not statistically significant, reports are promising, and results deserve further clinical studies in large and varied groups of patients [11]. Moses technology was associated with significantly lower fragmentation/pulverization and procedural times. The significantly lower retropulsion of stones could explain the reduced fragmentation/pulverization time seen using Moses technology during laser lithotripsy [12].

Nevertheless, the laser can cause significant temperature rises in the collecting system fluid and surrounding tissue. The temperature rises varied with laser parameters, irrigation, and duration of pulsing. Under severe conditions, the urinary tract and kidney parenchyma could reach sufficient temperatures to cause irreversible thermal injury. These findings may be clinically relevant, particularly considering trends toward high-power laser treatment of stones [13]. Back to comparison: the Thulium fiber laser overcomes the main limitations reported with the Holmium: YAG laser relating to lithotripsy, based on preliminary in vitro studies. treatment. Laser technology seems particularly advantageous for ureteroscopy and may become an important milestone for kidney stone treatment [14]. Finally, TFL has the potential to be an alternative to the Ho:YAG laser, but more reports are still needed to determine the optimal laser for lithotripsy of urinary tract stones when considering all parameters including effectiveness, safety, and costs [15].

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