

HOLMIUM:YAG LASER: AN OBVIOUSLY NECESSARY PIECE OF EQUIPMENT FOR AN OUTPATIENT UROLOGICAL SURGERY

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Abstract

The objective is to assess validity and usefulness of a holmium laser device in a daily labor of outpatient urological settings during the period of 9 years of use. We assessed a summary database of overall usage of a holmium laser 30W in our institution from 2004 to 2012. During 2011 and 2012 we have been using Litho holmium laser of 30W manufactured by Quanta System, Italy.

We analyzed the overall usage of the 30W laser during the time by dividing the applications to: ureteroscopic lithotripsy (URSL), lithotripsy of urinary bladder stones, ablation of superficial bladder cancer, incisions of urethral strictures and other applications containing mostly the ablation of penile and scrotal skin lesions. We tried to assess our experiences in usage of the laser device with the total of 1510 procedures we performed.

The holmium laser is a multifunctional, very useful and practical device and seems to be an obviously necessary part of equipment, especially for everyday use in an outpatient urology.

Introduction and objectives

The holmium laser, Ho:YAG, has an infrared wavelength of 2100 nm. It is a perfect lithotripter, suitable for sufficient intracorporeal disintegration of all kinds of urinary stones due to the strong photoacoustic effect and high peak power. The optical penetration is only up to 0.4 mm, but due to its high absorption by water the energy density is high enough to heat the tissue above the boiling point, without causing the deep coagulation. This enables the surgeon to make clear cuts with the absence of carbonized tissue, giving the opportunity to perform very precise incisions under visual guidance as soon as the laser fiber gets in contact with the tissue. The created heat at the same time coagulates small and medium blood vessels at the distance of 2-3 mm. The holmium lasers may be divided to classes based on the applied output power: small (10- 20 W), medium (30- 60 W) and high (80- 100 W).^{1,2,4,10,12}

The mentioned features of holmium laser make it a very suitable device for surgical treatment of Transurethral Incision of the Prostate (TUIP), superficial tumors of the urinary tract, and strictures of the upper and lower urinary tract.^{3,5-9}

Treatment of urolithiasis

The holmium laser is suitable for lithotripsy of any calculi located in different levels of urinary system. Lithotripsy is for sure the most common application of a holmium laser in everyday practice of outpatient urological settings. Rigid or flexible small size ureterorenoscopes may be used, due to thin laser fibers (200-600µm) used with the device. This feature enables the surgeon to perform pelvic and calyceal lithotripsy at the same time with the URSL. The holmium laser lithotripsy leads to more efficient fragmentation in comparison to other types of decomposing devices. A key advantage of the laser is that there is less stone retropulsion which enhances efficiency and comfort for surgeons. Some complications may appear during the procedure, where the ureteral wall perforation is the most common. But due to shallow coagulation depth and small laser fiber size, the damages are micro-scaled in most cases and do not require repeated treatment or surgical approach.^{2,10,11}

The holmium laser is more than a sufficient tool for treating urinary bladder stones. In case of stones impacted in a ureterocele, a surgeon may perform incision of the ureterocele and lithotripsy at the same time, by using the same endoscope. It reduces the operating time and makes it less laborious. Local anaesthesia may be used for lithotripsy of distal ureteral stones as well as small bladder stones, which is well tolerated by patients and proved by our so-far experiences.

The holmium laser is superior to other lithotripsy devices in terms of efficiency and safety in our opinion.

Treatment of ureteral and urethral strictures

The holmium laser is very suitable for the treatment of urethral strictures. It may be performed successfully under a local anaesthesia. Minimal tissue penetration enables to control the depth of incisions without extra scarring and reducing intraoperative bleeding.^{1,10}

Flexible endoscopy in combination with X-ray fluoroscopy enables a safe incision of ureteral strictures at any level.

Other applications of a holmium laser in outpatient settings

The holmium laser may be useful for the treatment of the superficial bladder cancer. After taking tissue specimens with biopsy forceps, a laser ablation of the tumor base and surrounding tissue may be performed without the need for exchanging the electrodes during the procedure. Laser ablation causes a non-contact coagulation of the tumor tissue which may explain the lower rate of local recurrence in comparison to electrocauteric resection as reported by some authors. The possibility of performing the procedure under local anaesthesia and without the need of catheterization is an additional advantage of holmium laser ablation of the superficial bladder cancer. The holmium laser may be used for ablation of skin lesions located on external genitalia like condylomas or carcinoma in situ. It enables removal of the lesions with good hemostasis due to superficial coagulation. The shallow tissue penetration of the laser creates fast healing without scarring effect.⁹⁻¹²

Besides, a short penile frenulum may be dissected precisely and successfully with a holmium laser without performing laborious and numerous haemostatic sutures.

Results and conclusions

A total number of 1510 different urological procedures has been reached in our department during the period of nine years (2004-2012), using the holmium laser of 30 W. The division to particular types of procedures is listed below:

Type of procedure	2004	2005	2006	2007	2008	2009	2010	2011	2012 by9/12	TOTAL
URSL	48	69	55	67	64	90	81	89	90	653
Bladder stones	21	31	26	30	21	16	21	20	20	206
Bladder cancer	17	27	25	20	23	33	38	26	18	227
Urethral stricture	24	25	27	37	68	54	38	37	27	337
Others	7	6	5	7	6	9	16	15	16	87
Total	117	158	138	161	182	202	194	187	171	1510

The 653 URSL patients were treated in outpatient settings from 2004 to 2012 in our hospital. The

holmium laser was applied for intracorporeal lithotripsy via an endoscopic approach by using a 365 µm laser optical fiber. The size and location of the stones were noted, as well as laser energy used for disintegration of the stones along with accessory equipment. Quanta System's Litho 30W is characterized by a very user-friendly interface, where a surgeon need to select only energy and repetition rate parameters, while the pulse duration is already integrated inside the application settings.

The 653 cases were analyzed, the age varied from 20 to 78 years (the average of 50), among them 298 female and 355 male patients.

The stone location was the upper ureter in 326 (49.9%) cases and lower ureter in 327 (50.1 %). The average stone diameter was 11mm (4 mm to 25 mm).

The ureteral forceps to evacuate the stone fragments was used in 392 cases (60%). The traditional ureteral catheter was left in 368 cases (56.4%), while the double-J catheter was used in 38 cases (5.8%). The damage of ureteral wall was observed in 19 patients (2.9%). It was successfully treated in a conservative manner in 10 cases.

Regarding the complications, we have experienced 7% rate of renal retropulsion of ureteral stones. Perforation of the ureteral wall occurred in 3% of the cases. The 6% of treated patients required further stenting with a double J catheter.

The overall conclusion of our professional experience confirms the fact of a constant pressure of medical market to less invasive types of treatments which is followed by a shorter duration of hospital stay. Because of this fact, the outpatient treatment units rise in number all over the world, applying eagerly devices like a holmium laser. During the period of 9 years the frequency of application of holmium laser in our institution increased in all mentioned-above clinical cases. All described features of holmium laser allow its usage for a wide variety of everyday clinical circumstances, thus making it as a highly multifunctional surgical tool with acceptable safety standards at the same time. The stone disintegration with holmium laser is a very effective and reliable way of intracorporeal lithotripsy, making the procedure feasible in all the parts of ureter. Ureteral wall damages, if they appear, are neither deep nor vast, due to superficial penetration of the laser beam, which could be managed successfully by using a conservative treatment. Holmium laser appears to be a very effective tool in outpatient settings for plenty of urological procedures.^{1,2,9-12}

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