Soft Tissue Applications of Holmium Laser in Urology.

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***Abstract**: Holmium : YAG Laser is solid state, pulsed laser that emits light at 2100 nm. It combines the qualities of the carbon dioxide and Nd: YAG laser providing both tissue cutting and coagulation in a single device. Since Holmium wavelength can be transmitted down optical fibers, it is especially suited for endoscopic surgery. Holmium :YAG Laser is a multipurpose, multi-specialty surgical laser. It is safe and effective for multiple soft tissue applications and stone fragmentation. Its utilization in urology is anticipated to increase with time because of its unique features.*

INTRODUCTION

Holmium laser at the wave length of 2100 nm has clinically very important physical properties owing to a balance between the coefficients of absorption and scatter. The property of a laser to be absorbed by the incident target (in the present context human tissue) gives it the ability to cut sharply, and is described as the coefficient of absorption. Carbon dioxide laser happens to be on one end of the spectrum with one of the sharpest cutting lasers. On the other hand, lasers with a high coefficient of scatter result in coagulation of the incident tissue. Scatter is important to seal the blood vessels in the surrounding tissues to maintain hemostasis. However if the scatter is more, extensive coagulation with a zone of devascularisation results in unwanted effects in the tissues and defeat the purpose of surgical precision. The cutting and coagulating properties of the laser also depend upon the pulse duration and the pulse strength. Holmium laser possess the ability to cut sharply and at the same time coagulate the tissues just sufficient for hemostasis due to its limited penetration up to 0.4mm[1]. Therefore, it is an ideal tool for incision, resection and hemostasis when applied on soft tissue lesions. The ability of holmium laser energy to be delivered efficiently through thin, flexible silica fibres makes it useful to be used through flexible miniature endoscopes to treat the soft tissue lesions of urinary tract. In order to be effective with minimum collateral damage, holmium laser is used at lower energy settings. Most of the authors have recommended the use of 0.2-0.8 joules at 10 -20 pulses per second. Other lasers which have been tried are Nd YAG, Erbium YAG, Thulium and Diode lasers. Nd Yag Laser has a higher scatter coefficient and therefore leaves behind a significant ischemic tissue beneath the coagulative zone. While Erbium laser has more precise incisional abilities as compared to Holmium, its use is restricted by difficulties in the delivery systems[2] . The others are still under trial and currently available published data is not sufficient for recommending them for routine use.

The various soft tissue **applications of holmium laser** are being described in the following text.

URETHRAL STRICTURES

Strictures of urethra can be divided using holmium laser in a blood less manner. This can be used to divide the stricture up to the apparently fibrotic area with clear vision to have a view of the underlying healthy tissues. This, while keeping the field clean, does not allow ischemic injury to the underlying tissues, giving them an opportunity to heal with minimal fibrosis. Even core through urethrotomy in complete occlusion of urethra with excision of sub epithelial fibrotic scar to increase the size of available lumen has been described in literature[3]. In various series the success rate has been shown to be between75-90%[4,5].

BLADDER NECK OBSTRUCTION

Bladder neck may be obstructed primarily due to hypertrophied circular smooth muscle fibers at the bladder neck or secondary to surgery in this area. For primary bladder neck obstruction, incisions may be made starting from the just distal to the ureteric orifice on either side and proceeding distally just falling short of veru montanum. If the tissue in between the two incisions is substantial, it may be removed leaving behind a transverse strip of bladder mucosa hanging into the prostatic urethra. In case of secondary bladder neck stenosis as occurs after trans urethral resection of prostate and now increasingly encountered after radical prostatectomy as more and more such procedures are being carried worldwide. The scarred tissue at the bladder neck needs to be divided up to the healthy tissues. Most authors recommend visualising perivesical fat in the floor of the incision as the end point. Post radical prostatectomy vesicourethral stenosis , which has been reported in various series between 0.5 -25.7%[6], presents a challenging problem as the urethral sphincter is at risk and so is the closely adherent rectum. In order to avoid incontinence and rectal injury leading on to a rectourethral fistula, it is recommended to incise the stenotic segment at 3 and 9 o clock positions. It is recommended to drain the bladder using a foley catheter for a period of 5-7 days post operatively. The results are reasonably good with initial success rate approaching 100%[7]. Repeat procedures may be required before resorting to more aggressive approaches. Although no cohort studies are available, holmium laser incision of stenosed vesicourethral junction may be recommended as first line of treatment.

NEOPLASMS OF URINARY BLADDER

Transitional cell carcinomas (TCC) are the commonest neoplasms of the urinary bladder encountered in urology practice. The ability to shave off the tumor from the bladder wall using hemostatic cutting laser is feasible while maintaining the histopathological details of specimen. The laser beam can be aimed at the base of the tumor and slowly made to lift the tumor off the bladder wall, strictly maintaining the curve of the bladder cavity. This prevents any inadvertent deep cut and perforation of the urinary bladder. As the laser beam coagulates the vessels at the base, the hemostasis is excellent and the blood loss is minimised[8]. There is an added advantage of lack of obturator jerk. Various series have reported the success rate of holmium laser resection as good as the standard electrocautery

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resection. A submucosal paragangloima of bladder has been removed using holmium laser by transurethral approach[9].

UPPER TRACT TCC

Traditionally the upper tract TCC has been treated with aggressive surgical extirpation. With advent and miniaturisation of endoscopes, both rigid and flexible, endourological ablation and survellence has become a viable option in the treatment of the upper tract tumors. The diagnosis is sometimes difficult and a preliminary brush cytology/ cold cup biopsy is required to establish the diagnosis and grade the tumor. Staging is a difficult issue and more often than not it is the grade of the tumor which determines the treatment strategy. Endourological treatment should be carried out for low grade lesions without obvious radiological evidence of invasion or metastasis. The other indications include deranged renal function and poor performance status. The recommended procedure is a no touch technique wherein the scope is passed into the ureter without preliminary guide wired, which may dislodge the tumor distorting the morphology of lesion and causing hemorrhagic back ground jeopardising the vision. The tumor should be snared/biopsied using flatwire basket or loop if significant intraluminal component is present. In other cases where the lesion may be flat, coldcup biopsy must obtained before ablating the tumor. After adequate specimen for histological evaluation has been obtained, flat tumors could be ablated using holmium laser while others could be resected carefully following the curve of the cavity. Using flexible ureteroscope,most upper tract TCC could be treated in this manner except the lesions on the medial wall of the inferior calyceal infundibulium. Bulky upper tract lesions with patients unsuitable for aggressive extirpation have been treated by percutaneous access and use of larger calibre scopes. Recurrence after endourological treatment is high (20-88%) and therefore follow up by radiological imaging, urine cytology and ureteroscopy is mandatory .Intra luminal instillation of Mitomycin C and Thiotepa has been done to minimise the recurrence. Complications such as perforations can usually be managed by ureteral stenting with or without nephrostomy depending upon the extent of extravasation[10-13].

STRICTURES OF THE URETER

These could occur secondary to impacted stones, uretroscopic removal of stones, post operatively after ureteroileal anastomosis ,post transplant ,post inflammatory or rarely congenital. The endourological incision of the ureteric stricture is minimally invasive and gives a very good chance of cure. The technique described is to pass two guide wires into the ureter and work the endoscope in between the two of them thereby providing an idea of the extent of stricture. The incision is carried out till the supple tissues are seen beyond the divided segment. It is recommended to leave a 12 F size stent to keep the ureteric lumen open for at least 6-12 weeks. The success of treatment depends upon the etiology of stricture and a long segment of ischemic fibrotic ureter may not yield a satisfactory outcome. However, as a first line management, endourological holmium laser incision of ureter is recommended. Periodic radiological follow up is mandatory to look for delayed recurrence and slow atrophy of kidney[14-17].

PELVIURETERIC JUNCTION OBSTRUCTION

Suitable patients with pelviureteric junction obstruction may be treated with endopyelotomy which may be done by percutaneous antegrade approach or in a retrograde ureteroscopically. Case selection is important determinant of the outcome of holmium laser endopyelotomy as in any other method. The stenotic segment is incised posterolaterally and the dilated with a balloon. An endopyelotomy stent (6/12 F) is left for 6-12 weeks. Follow up with radiological imaging is recommended to pickup any late restenosis[1,18]. Apart from these well documented procedures, holmium laser has been used to remove a giant fibroepithelial polyp from ureter[19], epilation of skin segment used for repair of hypospadias[20], removal of retained TVT mesh from urinary bladder[21] etc. Holmium laser has been used to excise renal tissue in a hemostatic manner during laparoscopic partial nephrectomy[22]. However standard recommendations in this regard are awaited.

CONCLUSION

Holmium laser has proven to be a versatile energy source for various urological applications apart from revolutionalising the transurethral treatment of benign enlargement of prostate and intra corporeal lithotripsy. As the time passes, this is likely to further change the way urological procedures are being performed today.

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