KTP Laser Prostatectomy-Current Status.

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***Abstract**: The objective of the analysis was to evaluate the current role of KTP laser prostatectomy in the treatment of benign prostatic hyperplasia (BPH). The results of a MEDLINE search for randomised trials and case series of the last 10 yr and published review articles were analysed for the safety and efficacy of potassium-titanyl-phosphate (KTP) laser prostatectomy. The analysis included randomised clinical trials, comparative studies and review articles. Laser treatment of BPH continues to evolve. High powered 80-W KTP PVP technique has become popular among urologist because of lesser learning curve. Blood loss is significantly reduced compared with transurethral resection and open prostatectomy. Vaporisation though immediately removes obstructing tissue there is no specimen for histological evaluation. Short-term results of KTP PVP are promising, but large series, long-term results, and randomised trials are still lacking. Prostates of large sizes require more than one laser fibre thus increasing the cost per procedure. **Conclusions**: PVP is not a panacea as has been hyped upon and is plagued by being a BPH exclusive laser with high cost. TURP still remains the gold standard.*

INTRODUCTION

Transurethral electrocautery resection of the prostate (TURP) is the gold standard for treating small and medium-sized prostates. TURP has been associated with an overall morbidity reported rate of 15–20% [1], and transfusion rates between 5% - 11%[2]. A variety of lasers have been introduced as substitutes to TURP, mainly the holmium (Ho): YAG, Nd- YAG and potassium titanyl- phosphate (KTP) laser. Laser used for prostatectomy have their exclusive wavelength and tissue interaction, feature that make each of them to act in a different way when applied to prostatic tissue leading to coagulation ,vaporisation, incisional, resecting, or enucleating procedures[3]. The current role of KTP lasers in the treatment of BPH is evaluated.

MATERIAL AND METHODS

A MEDLINE search over the last 10 yr focused on randomised clinical trials, comparing laser treatment with TURP and larger case series. The safety and efficacy of KTP laser vaporisation is analysed. This analysis included randomised clinical trials, comparative studies and review articles.

GENERAL ASPECTS OF PVP

KTP laser is frequency-doubled Nd: YAG laser. It is formed when the Nd: YAG laser beam is passed through a potassium-titanyl-phosphate (Kalium: German word for potassium) crystal, thus doubling its frequency and halving its wavelength (532 nm). KTP laser is completely transmitted through the aqueous irrigant but is exceedingly absorbed by tissue with high oxyhemoglobin content, such as prostatic tissue. The absorption length in the prostate is only 1–3 mm and the resulting prostate tissue vaporization is focused, exceedingly proficient and for this reason, the KTP laser procedure is referred to as photoselective vaporization of the prostate (PVP) [2,4,9,22]. The short depth of coagulation prevents the large-volume sloughing that is seen with the Nd: YAG laser alone which has now been abandoned. Malek et al. reported the first clinical trial with a 60 W KTP laser in 1998[5]. The power of the KTP laser was further increased to 80 W KTP and 120 W high-performance system (HPS) with lithium triborate (LBO) thereby increasing its acceptance and usage amid urologists for treating larger glands with lesser lasing time[4,6,7,22]. PVP is considered to be an easier technique to learn compare to holmium laser enucleation and therefore is taken with greater enthusiasm amongst urologist[9]. Like all other vaporising modalities, a channel is created through the adenoma to a variable degree to produce a TUR-like cavity. The indication for PVP is almost the similar as with TURP and larger glands can be treated using 80 W KTP laser and 120 W HPS laser[6]. PVP can be used in patients with severe co morbidities and in patients on anticoagulants[6,24,25].

RESULTS

Majority of the studies have a follow up of 1-2 years[9-18] with only 2 studies reporting long term outcome at 5 years[22,23].

INTERIM RESULTS OF PVP

Efficacy

Reduction of prostate volume is from 20-44%[9,10,11,23]. KTP vaporises 0.3–0.5 g of prostatic tissue/min. Prostate-specific antigen (PSA) reduction was to the tunes of 32% to 42%[11,14,22]. When compared with TURP, the improvement in voiding following PVP was similar[6,7,9,16].

Te et al. in 2004 reported a multicenter prospective trial of 139 men and showed statistically significant improvements in IPSS, quality of life (QoL) score, Qmax, and PVR after 12 months[9]. The prostate volume measured by transrectal ultrasound was 54.6 ml at baseline and changed to 34.4 ml at 12 months (Table 1).The decrease in IPSS symptom scores and increase in peak flow rates (Q max) at 1-2 yr postoperatively were significant in many studies and ranged from 11.2 to 19[10,23] points, and 9.9 ml/s to 19.3 ml/s[17,22] respectively.

The mean catheterisation time is between 7.6 – 43 hours in majority of studies[10-14].

Tugcu et al also compared TURP (n=98) and 80 W KTP-PVP (n=112). After 2 years of follow-up, both groups showed significant improvement in IPSS< Qmax and shorter catheter indwelling period and hospital stay in the KTP-PVP group[17].

In high risk patients: Reich et al. performed 80 W KTP-PVP on 66 patients with high cardiopulmonary risk including 29 patients on anticoagulants with no major complications. After a maximum follow-up of 12 months Qmax and IPSS score improved significantly[25].

Kim et al. and Ku et al. demonstrated that the 80 W KTP-PVP is safe and efficacious for up to 24 months of follow-up, despite of prostate volume, even though a larger prostate requires more time,

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energy and fibers[19,20].

Durability

Malek et al. reported on long term results in 2005[22]. They reported exceptional and sustained improved clinical outcomes both symptomatically and urodynamically. IPSS, QOL score and Q max improved significantly at 1, 2, 3 and 5 years, ranged from 83% to 88%, 86% to 90%, 170% to 252% and 76% to 89%, respectively. Hai et al. evaluated the outcomes and durability of KTP-PVP.and reported improvement in the IPSS (79%), QoL score (80%), Qmax (172%), TRUS (17%), and PVR (77%) at five years[23].

Morbidity

Morbidity is essentially low in all reported studies. When compare with TURP results are favourable, due to significantly less blood loss and shorter duration of catheterisation and hospital stay[11]. Catheterisation times ranged from 7.6 hours to 43 hours[12,14]. Majority of the patients did not required postoperative catheterisation and few studies reported a retention rate requiring intervention was between 5% to 11%[18,20,23]. The mean lengths of hospital stay range from 8 to122 hours[11,22]. Araki et al. [15] reported on 160 consecutive patients with mean prostate volume was 72.3 cm^3 (range 20.3–261 cm^3). 28 patients need catheter drainage for 1 week, 14 had cllinically insignificant hematuria for more than 1 week 3 patients had persistent urinary retention and 13 patients developed UTI. Bladder neck contractures requiring intervention developed in 3 patients and none developed urethral strictures or urinary incontinence. Transient haematuria was reported by Te et al. In 12 patients (8.6%)[9]. Spaliviero et al. reported intraoperative bleeding (1.4%), postoperative clinically nonsignificant hematuria (78.5%), hematuria requiring clot evacuation in 3 (1.4%) patients[18]. The rates of recatherisation, urinary tract infection, dysuria, incontinence, urethral strictures, and bladder-neck contractures are low and in the same range in randomized trial as well as in prospective study comparing PVP and TURP[34,36]. In high-risk anticoagulated patients PVP seems efficacious, even if large prostates are to be treated though some may require staged procedures[10,24,25]. Reich et al. treated 66 patients with high cardiopulmonary risk with 80 W KTP PVP. 29 patients were being treated with ongoing oral anticoagulant therapy. In all 66 patients KTP laser vaporization was performed successfully with sustainable long term results. No major complication occurred intraoperatively or postoperatively in both studies and none of the patients required any blood transfusions, and the rate of reoperation (TURP or repeat procedures) was 5%[24,25].

Long-term follow-up also showed equivalent results. Complications reported were transient dysuria (6%), delayed haematuria (3%), bladder neck contracture (2%) and 2-day retention (1%). Retrograde ejaculation was reported in 26% of sexually active men and none developed incontinence or impotence[22].

Re-operation rate reported after TURP due to recurrence of BPH is less than 12% [30]. According to 5-year follow-up data by Hai et al. only 19 of 246 (7.7%) patients were treated with repeat PVP because of reobstruction by large glands[23].

Table 2 elaborates the studies of the complications after PVP

DISCUSSION

The new generation of KTP laser PVP results in a larger (2.4 cm), practically collagen-free unscarred prostatic channel almost bloodlessly, with the added benefit of a day care procedure[31]. KTP laser PVP is considerably more time-consuming than TURP, although the haemostasis is more effective[30]. KTP laser PVP removes less

Table 1: *Outcome variables following PVP*

Authors [ref.] year	No. of patients	Pre op prostate volume (g) (Mean)	Post op decrease in prostate volume (%)	Post op Mean decrease in PSA(%)	Mean catheterisation time (h)	Mean hospital Stay (h)	Mean decrease in IPSS	Mean increase in Qmax ml/s
Te et al. [9] 2004	139	54.6	37	n.a.	n.a.	<23	18.9	14.8
Sandhu et al. [10] 2004	64	101	44	n.a.	18	23	11.2	11.0
Sulser et al. [11] 2004	65	51.2	30	34.7	37	122	11.3	10.5
Reich et al [12]2005	66	49	n.a.	n.a.	43	104	12.2	17.9
Bachmann et al. [13] 2005	108	n.a	n.a	n.a	40	104	12.2	17.9
Volkan et al. [14] 2005	186	48.1	n.a.	42	7.6	14.4	12	7.7
Araki M et al. [15] 2008	160	72.3	n.a.	n.a.	n.a.	n.a.	16.9	11.0
Ruszat R et al. [16] 2008	269	64.8	48	n.a	n.a	n.a	n.a	n.a
Tugcu V et al. [17]2008	98	49.1	n.a.	n.a.	n.a.	n.a.	14.8	9.9
SpalivieroM et al. [18] 2009	70	61.6	50	n.a.	n.a.	n.a.	18	10.6
Malek et al. [22] 2005*	94	45	n.a.	32	20	8	17.4	19.3
Hai et al. [23] 2009*	321	45	20	n.a.	n.a.	n.a.	19.0	14.5

Table 2: *Complications following PVP*

Authors [Ref. No]	No. of pt.	Dysuria No.(%)	Urinary tract infection(%)	Acute urinary retention (%)	Haematuria	Urinary incontinence	Urethral stricture	Bladder neck contractures
Te et al. [9] 2004	139	13(9.4)	4(2.2)	7(5)	12(8.6%)	2(1.4)	1(0.7)	2(1.4%)
Sandhu et al. [10] 2004	64	n.a.	1(2)	3(5)	0	n.a.	n.a.	2(3.5%)
Sulser et al. [11] 2004	65	4(6.2)	5(7.7)	10(15.4)	0	n.a.	0	0
Malek et al. [22] 2005	94	6(6.4)	0	1(1)	0	0	n.a.	2
Volkan et al. [14] 2005	186	56(30)	11(6)	0	0	0	0	2
Reich et al. [12] 2005	66	6(9)	5(8)	7(11)	0	n.a.	n.a.	1(2)
Bachmann et al.[13] 2005	108	6(5.5)	5(5)	10(10)	0	0	4(4)	1(0.9)
Spaliviero et al. [18] 2009	70	n.a.	3(4.3)	2(2.8)	3(4.3%)	0	0	0
Araki M et al. [15] 2008	160	-	13(8)	3(2)	14(9)	0	0	3(2)

n.a. = not available

tissue (maximum of 0.5 g/min) compare from standard TURP or holmium enucleation and therefore the KTP-induced prostate volume reduction of 20–53% is significantly less than 62–77% as reported for HoLEP[9]. This lesser amount of prostate volume reduction KTP laser vaporisation gives rise to some uncertainty about the durability of the marked short-term micturition improvements reported so far. Apart from the studies by Malek and Hai none of the studies have shown equally significant improvements in subjective and objective outcomes compare from TURP which are sustainable for 5 years. Malek et al. hypothesize that the bottom line of the rather impressive outcomes of KTP-PVP is because of an unscarred, elastic bladder neck and an open and pliable prostatic channel may perform better than a scarred, rigid, albeit open, pipe as with other lasers. The learning curve for PVP is shorter and 15 procedures on smaller (50 ml or less) prostates are usually adequate and therefore this procedure has become popular among urologist[22]. The authors emphasize that in spite of similar landmarks and goals, the techniques for PVP and TURP are substantially different and, just as with TURP, incomplete PVP may lead to early recurrent obstruction in 2% to 3% of patients[22]. The need for reporting postoperative decrease in prostate volume or PSA values after KTP vaporisation has to be call attention to as the quantity of tissue vaporised is difficult to estimate because no tissue is retrieved and many studies have not reported on these parameters[9,10,12,13].

PVP is safe despite some lengthy operative times for larger prostates[24,25] and also suitable for high risk cases[24,25]. Patients

undergoing KTP laser PVP are generally treated as outpatients and many become catheter-free in less than 24 hours and stated to return to work in 2 to 3 days thus minimising loss of productivity, thus reducing the health care costs despite the additional cost of a single use laser fiber[22]. The cost effectiveness depends to a large extent on the different reimbursement systems in different countries, which may be the reason that the majority of KTP laser patients are treated as outpatients in the United States but hospitalised in European countries. In general, all three procedures, PVP, HoLAP, and HoLEP can be performed as day care procedures, at least in patients with small and medium sized prostates. In larger glands undergoing PVP two or even three fibres may be necessary thus adding to exorbitant cost per procedure. The KTP laser is an exclusive "benign prostatic hyperplasia only" laser. The simplicity of the procedure is not an exclusive feature of KTP laser vaporisation because the identical procedure can also be executed with the holmium side fire laser. The cost and availability of the equipment is an important factor in developing countries as India. The initial cost of KTP laser is high and the cost of fiber is added in every case. Apart from this, there is a high maintenance cost associated with laser machines. In comparison, TURP equipment is easily available, cheap with minimum maintenance cost, and is available with every urologist as basic equipment. The large variety of lasers and techniques of laser prostatectomy shows that none is perfect so far.

CONCLUSIONS

PVP has a well established record for safety, low morbidity, rapid recovery and short-term durability. Early results are encouraging but the long-term outcome is still faltering. PVP is not a panacea as has been hyped upon and is plagued by being a BPH exclusive laser with high cost. KTP PVP Lasers are unwanted in the surgical management of BPH in developing countries because of the cost, unproven long-term durability and no advantages over the gold standard management of TURP.

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