



Review – Bladder Outlet Obstruction

Current Role of Lasers in the Treatment of Benign Prostatic Hyperplasia (BPH)

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Abstract

Objective: Evaluate the current role of lasers in the treatment of benign prostatic hyperplasia (BPH).

Methods: The results of a MEDLINE search for randomised trials and case series of the last 5 yr and published review articles were analysed for the safety and efficacy of neodymium:yttrium aluminum garnet (Nd:YAG), potassium-titanyl-phosphate (KTP), and holmium (Ho):YAG laser prostatectomy. The analysis includes 12 reports on randomised clinical trials, 2 comparative studies, 10 review articles, and a total of >5000 patients.

Results: Laser treatment of BPH has evolved from coagulation to enucleation. Blood loss is significantly reduced compared with transurethral resection and open prostatectomy. Visual laser ablation of the prostate and interstitial laser coagulation cause coagulative necrosis with secondary ablation. Long postoperative catheterisation, unpredictable outcomes, and high reoperation rates have restricted the use of these techniques. Ablative/vaporising techniques have become popular again with the marketing of new high-powered 80-W KTP and 100-W Ho lasers. Vaporisation immediately removes obstructing tissue. Short-term results are promising, but large series, long-term results, and randomised trials are lacking. Holmium laser enucleation (HoLEP) allows whole lobes of the prostate to be removed, mimicking the action of the index finger in open prostatectomy. Prostates of all sizes can be operated on. It is at least as safe and effective as transurethral resection of the prostate and open prostatectomy, with significantly lower morbidity. It is the only laser procedure that provides a specimen for histologic evaluation.

Conclusions: HoLEP appears to be a size-independent new “gold standard” in the surgical treatment of BPH.

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1. Introduction

Transurethral electrocautery resection of the prostate (TURP) is limited to small and medium-sized prostates. The overall morbidity rate is 15–20% [1], with blood transfusion rates between 5% and 11% [2]. Various lasers have been introduced as alternatives to TURP, mainly the neodymium:yttrium aluminium garnet (Nd:YAG), the holmium (Ho):YAG, and the frequency-doubled Nd:YAG (potassium-titanyl-phosphate [KTP]) laser.

The action of different lasers is by no means the same. Each laser has its distinct wavelength with a unique tissue interaction characteristic that makes one wavelength act differently in tissue than another wavelength. Therefore, it is often misleading when different laser treatment modalities are all described as “laser prostatectomy” instead of differentiating Nd:YAG from holmium and KTP lasers, and distinguishing coagulating from vaporising, incisional, resecting, or enucleating techniques. The current role of lasers in the treatment of BPH is evaluated.

2. Methods

A MEDLINE search over the last 5 yr focused on randomised clinical trials, comparing laser treatment with TURP or open prostatectomy, and larger case studies and was also based on systematic review articles that have already been published. The safety and efficacy of visual laser ablation (VLAP), interstitial laser coagulation (ILC), KTP laser vaporisation, holmium laser vaporisation/ablation (HoLAP), holmium resection (HoLRP), and holmium enucleation of the prostate (HoLEP) were analysed. This analysis included 12 reports of randomised clinical trials [3–14], 2 comparative studies [15,16], 10 review articles [17–26], and a total of >5000 patients.

3. Results

3.1. Nd:YAG laser

The Nd:YAG laser is a solid-state laser. Its wavelength (1064 nm) is invisible and has a very low absorption coefficient in most tissues so that it penetrates tissue deeply between 4 and 18 mm. Therefore, the energy density in tissue is low, and the heating of tissue remains below the boiling point, resulting in coagulative necrosis [21,22]. The hemostasis is excellent, but resection and enucleation of prostatic tissue is impossible.

3.1.1. VLAP

VLAP has been performed since the early 1990s [20] as a transurethral procedure under general or spinal

anaesthesia. The Nd:YAG laser energy is transported via a fiber with a deflecting (60–90°) device at the tip, and the prostatic tissue is lased in a noncontact side-fire technique to create deep coagulative necrosis. Sloughing of the necrotic tissue via the urethra results in secondary ablation of obstructive tissue and formation of some kind of cavity that is re-epithelialized some weeks later [20,24]. No tissue can be obtained for histologic analysis.

3.1.1.1. *Effectiveness/outcome.* In 2000, Whellahan et al. [18,19] and, in 2003, Hoffman et al. [19] reviewed the literature and analysed a total of seven randomised clinical trials comparing VLAP with TURP. Reduction of prostate volume was greater with TURP, and improvement in symptom score, peak flow rate, and postvoid residual urine was better with TURP [18,19]. The sustainability of results was strongly affected by the reoperation rate, which at 1 yr postoperatively was 0% in TURP, but 7.5–20% in VLAP [18], and even 26.7% at 2 yr postoperatively [20].

3.1.1.2. *Durability.* Even though some patients (“responders”) had an excellent and durable outcome after VLAP [20], the initially significant micturition improvement seemed to be limited, and symptom scores were no different from preoperative levels at 3 yr postoperatively, in other patients [19].

3.1.1.3. *Morbidity.* Compared with TURP, VLAP significantly reduced the need for blood transfusions (1 of 364 [0.3%] VLAP patients vs. 48 of 685 [7.0%] TURP patients [18]) and the incidence of stricture formation (0 of 133 VLAP patients vs. 40 of 477 [8.4%] TURP patients [18]). However, the unpredictable outcome, high reoperation rate, and long-term retention requiring extended catheterisation up to 4 wk has made VLAP increasingly unpopular, and it has largely been abandoned [19,20,24].

3.1.2. ILC

The laser fiber is pushed into the prostatic adenoma under endoscopic control and the laser energy is emitted radially into the tissue, which causes heat-induced coagulative necrosis. In theory, the mucosa should be spared. The intraprostatic lesions undergo reabsorption and secondary atrophy after a shrinking process lasting 4–12 wk [22], which finally results in some volume reduction of the prostate. No tissue is obtained for histologic analysis.

3.1.2.1. *Effectiveness/outcome.* Reviews by Muschter and Whitfield [21] and Laguna et al. [22] on a total of >1000 patients demonstrated a wide range of results.

Prostate volume reduction ranged from <10% to >40%, [21], decrease in symptom score from 9 to 29 points, [22] improvement in maximum flow rates ranged from 3.3 to 16.7 ml/s [21], and decrease in urodynamic detrusor pressure from 11 to 58 cm H₂O [22]. In all randomised trials comparing ILC and TURP [21,22], improvements of symptoms and flow rates were significantly better in the TURP groups, and the rate of retreatment was higher in the ILC groups.

3.1.2.2. *Durability.* A single series of 394 patients reports a sustained success rate at 3 yr follow-up [22]. However, the most recent review of ICL found that the rate of instrument retreatment ranged from 0% to 15% at 1 yr after the operation and was as high as 20% at 2 yr and 41% at 3 yr [22].

3.1.2.3. *Morbidity.* The main advantage of ILC is the almost nonexistent surgical morbidity [22]. In most cases, ILC is performed under general or spinal anaesthesia, but it has been successfully performed under local anaesthesia only [22], making the procedure suitable for treating outpatients [21]. In contrast, the early postoperative morbidity is high, postoperative catheterisation was required for an average of up to 18.3 d or even 1 mo [22], and urinary tract infection occurred in as many as 35% of patients [22]. ICL is recommended only for selected BPH patients suffering from coagulation disorders.

3.2. Frequency-doubled Nd:YAG laser = KTP laser = green light laser = photoselective vaporization of the prostate (PVP)

When the Nd:YAG laser beam is passed through a potassium-titanyl-phosphate (KTP [Kalium is the German word for potassium]) crystal, it doubles its frequency and halves its wavelength. The invisible 1064 nm wavelength of the Nd:YAG laser is shifted to a 532 nm wavelength, which is within the green light spectrum. The frequency-doubled Nd:YAG laser is therefore also called KTP laser or “green light” laser. The wavelength is not absorbed by water but strongly absorbed by haemoglobin [23]. Because of the instant and nearly complete absorption in blood, the absorption length in vascularised tissue such as the prostate is only 1–3 mm, and the high-energy density [24] causes rapid photothermal vaporisation of intracellular water (photoselective vaporisation of the prostate [PVP]). The short depth of coagulation prevents the large-volume sloughing that is seen with the Nd:YAG laser alone. Like all other vaporising modalities, a channel is created through the adenoma to a variable degree to

produce a TUR-like cavity [19]. Wide interest in vaporising techniques was only recently aroused, when high-powered 80-W KTP lasers were developed and vigorously marketed.

3.2.1. Effectiveness/outcome/durability

Only a limited number of peer-reviewed articles on clinical 80-W KTP laser case series has been published to date [27–33], and there is only one article that reports results for follow-up exceeding 1 yr [30]. The reported KTP-induced reduction of prostate volume was 30% [27] to 44% [28], and the prostate-specific antigen (PSA) reduction 30% [27] to 42% [29]. Intraoperatively, 0.3–0.5 g/min prostate tissue was removed. The decrease in symptom scores and increase in peak flow rates at 1 yr postoperatively were significant in all studies and ranged from 11.2 [28] to 18.9 [30] points, and 11.0 ml/s [28] to 19.3 ml/s [30], respectively. When compared with TURP, the improvement of micturition was similar in the two groups [14,16].

The paucity of results for follow-up periods >1 yr makes it difficult to assess the durability of KTP vaporisation at present. The one and only clinical trial on KTP vaporisation with long-term results reported durable improvement of American Urological Association (AUA) symptom scores and peak flow rates after 2, 3, and 5 yr postoperatively [30].

3.2.2. Morbidity

As shown in Table 1, the morbidity is low, and the intraoperative and postoperative blood transfusion rate was zero in all studies. Catheterisation times ranged from 7.6 h [29] to 43 h [31], with a significant proportion of patients not requiring postoperative catheterisation [32]. The mean length of hospital stay was significantly shorter in American studies [28,30,32] than in German and Swiss studies [27,31,33] (8–23 h vs. 104–122 h). The comparison with TURP is favourable, due to significantly less blood loss and significantly shorter duration of catheterisation and hospital stay [14,16]. The rates of recatheterisation, dysuria, urinary tract infection, incontinence, urethral strictures, and bladder-neck contractures are low and in the same range as in TURP and HoLEP. A multicentre study indicated that PVP is feasible in high-risk anticoagulated patients, even if large prostates are to be treated [34]. Sandhu et al. [28] treated 64 patients with a mean prostate volume of 101 cc. In both studies, no patient required blood transfusions, and the rate of reoperation (TURP or repeat procedures) was 5%. In some patients, however, PVP of large prostates necessitated staged procedures and required operating times of up to several hours [28].

Table 1 – Perioperative results, postoperative outcome, and complications of KTP laser vaporization at 12 mo postoperatively

Authors and year of publication	Reference no.	No. of patients	Mean preop prostate volume (g)	Mean decrease in prostate volume	Mean decrease in PSA	Mean catheterisation time (h)	Mean hospital stay (h)	Mean decrease in AUA/IPSS	Mean increase in peak flow, ml/s	Recatheterisation No. of patients (% of patients)	Dysuria No. of patients (% of patients)	Urinary tract infection No. of patients (% of patients)	Incontinence No. of patients (% of patients)	Urethral stricture No. of patients (% of patients)	Bladder-neck contracture No. of patients (% of patients)	Reoperation No. of patients (% of patients)
Sandhu et al. (2004)	[28]	64	101	44%	n.a.	18	23	11.2	11.0	3 (5%)	n.a.	1 (2%)	n.a.	n.a.	2 (3.5%)	3 (5%)
Te et al. (2004)	[32]	139	54.6	37%	n.a.	n.a.	<23	18.9	14.8	7 (5%)	13 (9.4%)	4 (2.2%)	2 (1.4%)	1 (0.7%)	2 (1.4%)	0%
Suiser et al. (2004)	[27]	65	51.2	30%	34.7 %	37	122	11.3 ^a	10.5 ^a	10 (15.4%)	4 (6.2%)	5 (7.7%)	n.a.	0%	0%	0%
Volkan et al. (2005)	[29]	186	48.1	n.a.	42%	7.6	14.4	12.0 ^a	7.7 ^a	0%	56 (30%)	11 (6%)	0%	0%	2 (1%)	0%
Malek et al. (2005)	[30]	94	45	n.a.	32%	20	8	17.4	19.3	1 (1%)	6 (6%)	0%	0%	n.a.	2%	0%
Bachmann et al. (2005)	[33]	108	n.a.	n.a.	n.a.	40	104	12.2	17.9	10 (10%)	6 (6%)	5 (5%)	0%	4 (4%)	1 (0.9%)	0%
Reich et al. (2005)	[31]	66	49	n.a.	n.a.	43	n.a.	13.7	14.9	7 (11%)	6 (9%)	5 (8%)	n.a.	n.a.	1 (2%)	2 (3%)
Pooled results		722								38/732 (5.2%)	93/668 (13.9%)	31/732 (4.2%)	2/537 (0.4%)	5/508 (1%)	8/732 (1.1%)	5/732 (0.7%)

PSA = prostate-specific antigen; AUA = American Urological Association; IPSS = International Prostate Symptom Score; n.a. = not available.

^a 3 mo postoperatively.

3.3. Ho:YAG laser

The holmium laser is a pulsed solid-state laser with a wavelength of 2140 nm. It is strongly absorbed by water. The absorption length in prostatic tissue is only 0.4 mm, and the resulting energy density is high enough to heat prostatic tissue to temperatures in excess of 100 °C, which creates vaporisation without deep coagulation. This allows clean char-free and precise cutting, incision, and dissection of the prostatic lobes under endoscopic control when the laser fibre is brought into direct contact with and moved through the prostate. Dissipating heat causes simultaneous coagulation of small and medium-sized vessels, to a depth of 2–3 mm. These unique properties of the holmium laser can not only make it a useful tool for prostate surgery but also the ideal intracorporeal lithotripter for virtually all stones [17] and an ideal wavelength for endoscopic multiple soft-tissue applications such as ablation of tumours and incision of strictures of the upper and lower urinary tract [11,19].

3.3.1. HoLAP

HoLAP was first reported in 1994 [35]. A side-fire fibre is moved in a “painting” near-contact mode across the surface of the prostatic lobes to immediately vaporise/ablate prostatic tissue and obtain a prostatic cavity reminiscent of that obtained with traditional TURP [35]. Invisible deep tissue damage as in VLAP or ILC is impossible, and “what you see is what you get” [35]. This method is easy to learn and very adequate in smaller glands. However, ablation by vaporisation was rather time-consuming with the 60-W holmium laser machines of those days. HoLAP has been superseded by more efficient techniques such as resection or enucleation, but has recently been remarketed for small prostates in response to the introduction of the 80-W KTP laser, and now that holmium laser power has been increased to 100 W, allowing more effective power settings with the chance of better operative times.

3.3.1.1. Effectiveness/outcome/durability. Gilling et al. [35] treated 79 patients (prostate volume range of 14–133 cc) with 60-W HoLAP. One month postoperatively, peak flow rates increased from 9.2 ml/s preoperatively to 15.2 ml/s, and AUA symptom score decreased from 18.8 to 8.3. Thirty-four patients (43%) could be re-evaluated after a median follow-up of 89 mo (7.4 yr), and the maximum flow rates had increased to 16.5 ml/s (increase of 83%) and the mean AUA symptoms score was 10 (reduction of 47%) [36]. A randomised prospective study comparing

HoLAP and TURP showed that the efficacy was similar in the two groups at 1 yr of follow-up [6].

3.3.1.2. Morbidity. The perioperative morbidity is low and blood transfusions are not necessary. In the case series, only 1.5% of patients required catheter irrigation, and the mean time of catheterisation was 2.6 d. Only 8% of men suffered from postoperative dysuria that required administration of analgesics. The reoperation rate was as low as 2.5% in the first 3 mo postoperatively [35] and 15% after 7 yr [36]. When compared with TURP, HoLAP was associated with less bleeding, a shorter hospital stay, and routine next day catheter removal and patient discharge [6].

3.3.2. HoLRP and HoLEP

To increase the efficacy of HoLAP, HoLRP and subsequently HoLEP were developed, as described in detail by Gilling and coworkers [35], the pioneers of holmium laser surgery of the prostate. In HoLRP, the laser fibre cuts the prostatic lobes into pieces small enough to be evacuated through the resectoscope sheath, while dissecting the adenomatous tissue down to the prostatic capsule to create a TUR-like cavity. The development of a transurethral mechanical tissue morcellator has enabled a true enucleating technique. In shelling out the adenoma, the laser fibre moves in exactly the same plane as the surgeon's index finger does when performing open prostatectomy. The prostatic lobes are enucleated in their entirety and pushed into the bladder where they are fragmented and aspirated with the morcellator. The excellent hemostatic properties of the holmium wavelength and the use of iso-osmotic saline solution as irrigating fluid enable operations to be performed on prostates of all sizes. The transfusion rate is minimal, and TUR syndrome cannot develop. Studies on several hundred patients have demonstrated that HoLEP is a true endourologic alternative to open prostatectomy in large prostates, and glands of >300 g have been successfully enucleated [12,13,15,37–40].

In addition, patients who are normally considered unfit for TURP, that is, those with significant comorbidities, such as coagulopathy, anticoagulant dependency, and significant anemia, can be treated safely with the holmium laser [19,41].

3.3.2.1. Effectiveness/outcome. HoLRP and HoLEP have been extensively evaluated clinically. Table 2 summarises the data of recent large case series. The improvements of peak flow rates, symptom scores, and residual volumes were striking. The prostate volume reduction was 62% [39] to 77% [44]. Randomised studies comparing HoLRP/HoLEP with TURP

[3–10] showed that the micturition improvement with HoLRP/HoLEP was better than that with TURP [3,9,10]. Decrease in both the detrusor pressure at maximum urinary flow and passive urethral resistance is significantly greater in men treated with HoLEP, and HoLEP is the first and only endourologic procedure that has been shown to provide better relief of bladder outflow obstruction in urodynamic studies than TURP [3]. The systematic review of holmium laser prostatectomy by Tooher et al. also concluded that HoLEP is at least as effective as TURP in improving the symptoms of BPH [25]. At our institution, we compared 120 patients randomised to open prostatectomy or HoLEP. There were no differences in symptom scores, peak urinary flow rates, and residual urine volumes. The amounts of tissue that were removed indicate that HoLEP is the endoscopic equivalent to open prostatectomy [11].

3.3.2.2. Durability. HoLEP produces lasting improvement of micturition. Ahyai et al. reported the results of a randomised trial comparing 100 HoLEP with 100 TURP patients at 3 yr postoperatively, and HoLEP resulted in a significantly better relief of symptoms [10]. Westenberg and coworkers reported on a minimum of 4 yr of follow-up from a randomised trial comparing TURP with HoLRP and noted no differences in terms of peak flow, symptom scores, potency, and continence between the two groups [5]. The comparison of HoLEP with open prostatectomy showed that HoLEP was equivalent in improving symptoms, residual urine volumes, and flow rates at 6 mo [11], 18 mo [12], and 3 yr [13].

3.3.2.3. Morbidity. Perioperative morbidity and postoperative complications are listed in Table 2. Mean catheterisation time and hospital stay were 1–2 and 1–3 days, respectively. The pooled results of large case series revealed low complication rates of recatheterisation (2.9%), urinary tract infection (2.3%), urethral stricture/bladder-neck contracture (3.2%), and reoperation (2.8%). The perioperative mortality rate was 0.05% (1 of 1847 patients). HoLRP/HoLEP compared very favourably with TURP and open prostatectomy in randomised trials [3–13]. The operation time was significantly longer in the HoLEP group, but the perioperative morbidity was significantly lower. The blood loss was significantly less, and no blood transfusions were required. The catheter time and hospital stay were significantly shorter. In large prostates of >100 g weight, the rate of urethral strictures/bladder-neck contractures was identical in HoLEP and open prostatectomy [11]. In randomised trials [5,10,13], the reoperation rate of HoLEP at 3 and 4 yr after operation were just

Table 2 – Perioperative results, postoperative outcome, and complications of HoLEP at 12 mo postoperatively

Authors and year of publication	Ref. no.	No. of patients	Mean prostate weight preoperatively (g)	Mean prostate volume reduction (g)	Mean catheterisation time (d)	Mean hospital stay, d	Mean decrease in AUA/IPSS	Mean increase in peak flow (ml/s)	Blood transfusion	Recatheterisation No. of patients (% of patients)	Urinary tract infection No. of patients (% of patients)	Incontinence No. of patients (% of patients)	Urethral stricture No. of patients (% of patients)	Bladder-neck contracture No. of patients (% of patients)	Reoperation No. of patients (% of patients)
Seki et al. (2003)	[42]	70	n.a.	29.5	2.5	4.6	16.8	12.0	0	n.a.	4/70 (6%)	1/70 (1.5%)	5/70 (7%)	0	3/70 (4.2%)
Glezerson and Krahn (2000)	[45]	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1/226 (0.4%)	n.a.	10/226 (4.4%)	n.a.	5/226 (2.2%)	6/226 (2.6%)	6/226 (2.6%)
Kuo et al. (2003)	[38]	108	163.8	121.8 (74.4%)	1.2	1.2	15.6	n.a.	2/108 (1.8%)	3/108 (2.8%)	n.a.	n.a.	0	1/108 (0.9%)	2/108 (1.8%)
Kuo et al. (2003)	[37]	206	n.a.	68.2	1.1	1.1	n.a.	n.a.	2/206 (1%)	16/206 (7.7%)	n.a.	n.a.	5/206 (2.4%)	8/206 (3.8%)	7/206 (3.4%)
Vavassori et al. (2004)	[43]	196	54.3	36 (67%)	n.a.	1.5	23.7	20.2	0	n.a.	8/196 (4%)	1/196 (0.5%)	6/196 (3%)	1/196 (0.5%)	8/196 (4%)
Peterson ^a et al. (2005)	[44]	164	107.1	81.9 (77%)	0.9	1.4	n.a.	24.1	0	4/164 (2.4%)	7/164 (4.2%)	5/164 (3%)	1/164 (0.6%)	0	1/164 (0.6%)
Elzayat et al. (2005)	[39]	552	83.7	52.1 (62%)	1.4	1.5	18.2	7.9	11/552 (1.9%)	8/552 (1.4%)	6/552 (1.1%)	3/552 (0.5%)	7/552 (1.3%)	7/552 (1.3%)	2/552 (0.3%)
Kuntz et al. (2004)	[9]	100	53.5	36 (67%)	1.1	2.2	20.3	23.0	0	0	n.a.	1/100 (1%)	3/100 (3%)	3/100 (3%)	2/100 (2%)
Elzayat et al. (2006)	[40]	225	126	86.5 (68.7%)	1.3	1.2	14.8	18.8	3/225 (1.3%)	n.a.	4/225 (1.7%)	4/225 (1.7%)	3/225 (1.3%)	1/225 (0.4%)	2/225 (0.9%)
Pooled results		1847							19/1847 (1%)	31/1130 (2.7%)	39/1433 (2.7%)	15/1307 (1.1%)	35/1847 (1.9%)	27/1847 (1.5%)	33/1847 (1.8%)

AUA = American Urological Association; IPSS = International Prostate Symptom Score; n.a. = not available.
^a All patients with preoperative urinary retention.

as low as in TURP and open prostatectomy. In a prospective study, 389 patients were stratified in subgroups (up to 40 g, 40–79 g, and ≥ 80 g) to determine whether or not outcomes of HoLEP depended on prostate size; no differences in catheter time, hospital stay, blood transfusion rate, complication rate, and micturition outcome were detected [46]. This contrasts sharply with TURP where the complication and transfusion rates rise significantly with increase in gland size and resection time [1].

The low perioperative morbidity enables HoLEP to be successfully performed as a 1-d case procedure in smaller glands [37,47]. In a large series on >200 patients with an average enucleated tissue weight of 70 g, 90% of patients were discharged home on postoperative day 1 or earlier without a catheter [37].

3.3.2.4. Histologic evaluation. In contrast to all vaporisation techniques, prostatic tissue can be retrieved at the end of the operation to be evaluated histologically. Naspro et al. [48] showed that histologic evaluation of HoLEP specimens can be done with the same quality as with TURP specimen, especially with respect to the detection of incidental carcinoma of the prostate.

4. Discussion

The new generation of high-powered KTP lasers can create a cavity almost bloodlessly, with the added benefit of little to no learning curve and the prospect of successful same-day catheter-free discharge. However, an experimental study has indicated that the vaporisation is considerably more time-consuming than TURP, although the hemostasis is more effective [49]. Clinical studies suggest that the amount of tissue vaporisation will not significantly exceed 0.5 g/min [32]. They further indicate that less tissue is removed than with standard TURP or holmium enucleation, because the KTP-induced volume decrease of 27–53% is significantly less than 62–77% volume reduction as reported for HoLEP. This less “radical” removal of obstructive tissue in KTP laser vaporisation gives rise to some skepticism about the durability of the pronounced short-term micturition improvements that have been reported so far. The need for reporting postoperative decrease in prostate volume or PSA values after KTP vaporisation has to be emphasised. Otherwise the amount of tissue vaporised is difficult to evaluate because no tissue is retrieved.

The simplicity of the procedure is not an exclusive feature of KTP laser vaporisation because the identical procedure can also be performed with

the holmium laser. The absorption of holmium laser energy by water is more intense than the absorption of KTP laser energy by hemoglobin [50]. The urologists who decide in favour of the holmium laser could start with vaporisation and proceed later to more effective enucleation techniques after familiarising themselves with the laser.

HoLEP seems to be the state-of-the-art procedure for laser treatment of BPH in terms of immediate and lasting relief of obstruction and improvement of micturition in prostates of any size.

High cost is frequently cited as a drawback of the holmium technique. However, the cost effectiveness of surgical procedures is a complex issue [11]. At current prices, a 100-W holmium laser costs about EUR 90,000, a morcellator about EUR 15,000. However, once the system has been purchased, the costs per case are low, because a laser fiber (EUR 400) can be resterilised and used in about 20 patients, depending on their prostate size. In terms of costs, the holmium laser compares favourably with the KTP laser, which was pushed on the market as an alternative to TURP and HoLEP. Although the purchase costs of both lasers are in the same range, the KTP laser fibre (EUR 500) is designed for single use only, and in large prostates two or even three fibres may be necessary. That means that the holmium fibre costs per patient are 5% of the KTP fiber costs. (This does not apply to the holmium vaporisation side-fire fibre, which is also for single use only and in the price range of the KTP laser fiber.) In some places, the KTP laser manufacturers have begun to provide the KTP laser nearly gratis and predominantly depend on the cost of fibres. The cost effectiveness depends very much 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 Switzerland and Germany. In general, all three procedures, PVP, HoLAP, and HoLEP can be performed as 1-d procedures, at least in patients with small and medium-sized prostates. Furthermore, the high-powered holmium laser is a highly efficient multifunctional endourologic instrument. It is the most effective intracorporeal lithotripter and can be successfully used for incision of strictures and ablation of tumours of the lower and upper urinary tract. In contrast, the KTP laser is a “benign prostatic hyperplasia only” [21] laser, with no other use in urologic surgery.

A drawback of HoLEP is the prolonged learning curve, which is the main reason for the lack of widespread acceptance. In this context, one cannot understand why no tutoring for HoLEP is offered currently by the companies in most countries, and therefore learning the procedure is left exclusively

to the initiative of interested urologists [26]. It is difficult to define how many procedures a surgeon must perform to become competent, but it is generally agreed that about 30 patients are required for a urologist familiar with transurethral surgery to feel reasonably safe performing the HoLEP technique [11,39]. The beginner should have sound endoscopic skills and should start with small prostates (30–60 cc). He can always switch to TURP when he feels that it is necessary. The learning curve for HoLEP is certainly shorter than that of laparoscopic procedures and probably shorter than that of TURP. For all urologists who manage to complete the learning curve, HoLEP has doubtless made TURP and open prostatectomy operations of the past.

5. Conclusions

Laser treatment has evolved from coagulation to enucleation. Coagulative techniques such as VLAP and ILC have been widely abandoned because of the need for long catheterisation time, unpredictable results, and high reoperation rates. The development of high-powered KTP and holmium lasers have excited a new interest in laser vaporisation/ablation of the prostate. Early results are encouraging but the long-term outcome is still uncertain, and no tissue is retrieved. By contrast, several randomised trials have shown that holmium laser enucleation is safer and at least as effective as TURP and open prostatectomy, and produces lasting results. HoLEP is not easy to learn, but it appears to be a size-independent new “gold standard” of the surgical treatment of BPH.

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