TURKISH JOURNAL OF UROLOGY
Turkish Journal of Urology 2011; 37(4): 316–320 • doi:10.5152/tud.2011.061
ENDOUROLOGY
Original Article

# KTP laser photoselective vaporization of the prostate: an initial experience

## *KTP lazer ile fotoselektif prostat vaporizasyonu: ilk deneyim*

Vikas Kumar, Rakesh Kapoor, Anand Dharaskar, Aneesh Srivastava

## ABSTRACT

**Objective:** To review the initial experience of potassium-titanyl-phosphate (KTP) laser photoselective vaporization of the prostate (PVP).

**Materials and methods:** Thirty patients with benign prostatic enlargement who underwent PVP at our institution between March 2007 and June 2009 were prospectively analyzed. The efficacy of the procedure was assessed using the International Prostate Symptom Score (IPSS), Quality of Life (QoL) score, maximum flow rate (QMax), and post-void residual volume (PVR) at 3, 6, and 12 months after surgery and then annually thereafter. Operative time, laser energy and fiber use, and any procedural or postoperative complications were noted.

**Results:** Fourteen (47%) patients opted for PVP by choice, and 16 (53%) underwent PVP because they were at high-risk for transurethral resection of the prostate (TURP), KTP laser PVP was successfully performed in all patients without any intraoperative complications. The median prostate volume was 47 g (range 25-136 g). Median operative time, laser energy, and hospital stay were 84 min (range 66-109 min), 126.1 kJ (range 27.6-235.5 kJ), and 2 days (range 1-9 days), respectively. IPSS, QoL score, QMax, and PVR improved from preoperative median values of 22, 04, 09 mL/sec, and 206 mL to 03, 01, 19.7 mL/sec, and 30.5 mL, respectively, postoperatively. No patient required blood transfusion or had TURP syndrome. Urethral stricture developed in only 2 (6.6%) patients in our study.

**Conclusion:** Although the financial cost of laser installation is difficult to justify in developing countries, our initial results demonstrate that KTP laser PVP is a treatment method that can be adopted to treat patients with benign prostatic hyperplasia safely and effectively, especially those patients with significant systemic comorbidities.

**Key words:** Benign prostatic hyperplasia; KTP laser; prostate.

## ÖZET

**Amaç:** Potasyum-titanil-fosfat (KTP) lazer ile fotoselektif prostat vaporizasyonu (PVP) uygulamasına ilişkin ilk deneyimin bildirilmesi amaçlanmıştır.

**Gereç ve yöntem:** Kurumumuzda Mart 2007 ve Haziran 2009 tarihleri arasında benign prostat büyümesi nedeniyle PVP uygulanan 30 hasta prospektif olarak değerlendirildi. Uygulamanın etkinliğinin belirlenmesi için cerrahiden sonra 3, 6 ve 12 aylarda ve sonrasında yıllık olarak Uluslararası Prostat Semptom Skoru (IPSS), Yaşam Kalitesi (QoL) skoru, maksimum akış hızı (QMax) ve post-void rezidüel volüm (PVR) belirlendi. Cerrahi süresi, lazer enerjisi ve fiber kullanımı, ve işleme bağlı ya da postoperatif komplikasyonlar kaydedildi.

**Bulgular:** Ondört (%47) hasta için PVP uygulaması tercih edilirken, 16 (%53) hastaya transurethral resection of the prostate (TURP) için yüksek riskli olmaları nedeniyle PVP uygulandı. KTP lazer PVP tüm hastalarda herhangi bir intraoperatif komplikasyon olmaksızın başarıyla uygulandı. Ortanca prostat hacmi 47 gr (dağılım 25-136 gr) idi. Ortanca cerrahi süresi, lazer enerjisi ve hastanede kalış sırasıyla 84 dakika (dağılım 66-109 dakika), 126.1 kJ (dağılım 27.6-235.5 kJ), ve 2 gün (dağılım 1-9 gün) idi. IPSS, QoL skoru, QMax ve PVR, preoperatif ortanca değerler olan sırasıyla 22, 04, 09 mL/dakika ve 206 mL'den postoperatif 03, 01, 19.7 mL/dakika ve 30.5 mL değerlerine düzelme gösterdi. Hiçbir hastada kan transfüzyonu ya da TURP sendromu kaydedilmedi. Uretral darlık sadece 2 (%6.6) hastada gelişti.

**Sonuç:** Gelişmekte olan ülkelerde lazer instalasyonunun finansal maliyetinin karşılanması zor olmakla birlikte, ilk sonuçlarımız KTP lazer PVP uygulamasının benign prostat hiperplazili hastaların, özellikle belirgin sistemik komorbiditesi olanların, tedavisinde güvenli ve etkili olarak kullanılabileceğini göstermektedir.

**Anahtar sözcükler:** Benign prostat hiperplazisi; KTP lazer; prostat.

Sanjay Gandhi Post Graduate Institute of Medical Sciences, Department of Urology and Renal Transplantation, Lucknow, Uttar Pradesh, India

**Submitted:**
07.04.2011

**Accepted:**
31.10.2011

**Correspondence:**
Vikas Kumar
Department of Urology and Renal Transplantation. Sanjay Gandhi Post Graduate Institute of Medical Sciences, India
Phone: 08968911587
E-mail: vickyuro@gmail.com



Available online at
www.turkishjournalofurology.com

Transurethral resection has been the gold standard for the treatment of symptomatic benign prostatic hyperplasia (BPH). Nevertheless, this procedure can be associated with a relatively high inpatient complication rate (approximately 10%)[1] and has a significant impact on postoperative ejaculatory function. Modifications of this gold standard procedure, including bipolar transurethral resection and laser resection and vaporization, have been incorporated into clinical practice to duplicate the results with lower morbidity. Minimally invasive ablative techniques have also been popularized, including transurethral needle ablation and thermotherapy. However, failure of treatment over time and retreatment were noted with these techniques.[2]

Among the various modifications, laser techniques have gained wide acceptance. To date, six types of lasers have been used to treat the prostate: neodymium (Nd):YAG; holmium (Ho):YAG; potassium-titanyl-phosphate (KTP), which is currently being replaced by 120-W lithium borate (LBO); diode; and most recently thulium laser.[3] Of these, only two are currently challengers to transurethral resection of the prostate (TURP): Ho:YAG and KTP.[4,5] Although Ho:YAG laser prostatic enucleation offers an endourological version of open surgery, as it is effective in treating large glands, its use is limited by the need for longer catheterization than with standard TURP, significant postoperative dysuria, and a long learning curve accompanied by a lack of structured training programs.[5,6]

Unlike other so-called minimally invasive surgical alternatives, high-power KTP laser photoselective vaporization of the prostate (PVP) is a truly ablative technique, generating a TURP-like cavity with excellent hemostatic properties, immediate relief of obstructive voiding, minimal intravascular fluid absorption, and the prospect of same-day catheter-free discharge.[7] However in developing countries, the cost of this therapy remains the major obstacle to its widespread use.

## Materials and methods

A prospective analysis of 30 patients with lower urinary tract symptoms with an enlarged prostate who underwent PVP at our institution between March 2007 and June 2009 was performed. Due to the financial constraints of our patient population, patients were not selected through randomization; only those specially opting for laser surgery (either by counseling or knowledge gained through the Internet) along with high-risk cases (who were not fit candidates for TURP) were included in the study. Both techniques along with their effects and cost were explained to the patients.

All patients underwent a general and urological standard evaluation including a clinical history, physical examination including digital rectal examination, complete urine analysis, abdominal ultrasonic evaluation of kidney and prostate volume, determination of serum total prostate-specific antigen (PSA), uroflowmetry, and post-void residual urine (PVR) estimation (excluding those with an indwelling catheter). For symptomatic assessment, patients were required to complete the International Prostate Symptom Score (IPSS) and Quality of Life (QoL) questionnaire.

To rule out carcinoma of the prostate (CaP), transrectal ultrasound guided biopsies were performed in patients with increased PSA and/or abnormal digital rectal examination before surgery.

Only patients presenting with recurrent acute urinary retention (AUR) or with a maximum urinary flow rate of <15 mL/sec and an IPSS score of >8 were considered eligible for the study. All patients provided informed consent.

PVP was performed by two experienced surgeons. Prophylactic antibiotics were administered at the time of induction and continued for at least 5 days postoperatively.

Laser vaporization was performed with an 80-W KTP laser (532-nm wavelength) using the GreenLight PVP System [quasicontinuous wave laser (Laserscope, San Jose, CA, USA)]. The fiberoptic laser system used was the Greenlight PV ADD Stat™, delivering laser energy from the tip of the fiber laterally at 70 degrees, with a beam diameter of 1.2 mm at a distance of 2 mm through a 600-micron fiber. Each fiber of a KTP laser can be used for up to approx. 275 kilojoules of energy. Anesthesia was spinal in 27 patients (90%) and general in three (10%).

The system was used in nearcontact mode and rotated 360 degrees, which allowed tissue access in multiple planes and is compatible with standard endoscopes and cystoscopes. The fiber was inserted through a 23Fr continuous-flow laser cystoscope with a separate irrigation channel. Normal saline was used as an irrigant in all cases; its continuous flow is necessary to ensure excellent visibility. The direction of the laser energy could always be determined, as the output beam of the Greenlight PV ADD Stat™ is aligned with the raised surface on the circular knob of the fiber. Vaporization of the prostate was carried out in a sequential manner starting at the bladder neck, with the median lobe if present, then the lateral lobes, and finally at the level of prostatic apex. The resection was considered complete upon achieving a widely patent, hemostatically well-controlled cavity. A Foley's catheter was inserted in all patients at the end of surgery. Irrigation was performed in patients with hematuria.

The per-urethral catheter (PUC) was routinely removed on the morning after surgery, followed by free uroflow assessment in the evening. All patients were given serratiopeptidase and phenazopyridine for 1 week prophylactically, as our initial patients complained of dysuria.

Operative time, delivered energy (and thus, number of fibers used), change of hemoglobin (Hb) and serum sodium, operative

Turkish Journal of Urology 2011; 37(4): 316-320
doi:10.5152/tud.2011.061

complications, catheterization time, and postoperative hospital stay were recorded.

Surgical outcomes were assessed based on evaluation of IPSS, QoL score, maximum flow rate (QMax), and PVR. Patients were reassessed at 3, 6, and 12 months after surgery and then annually thereafter. The median follow-up was 26.2 months (range 12-38 months). The final comparison with preoperative parameters was performed using records from the last follow-up.

For statistical analysis the, one-way ANOVA (SPSS version 16.0) was performed and p<0.05 was considered statistically significant. The departmental ethics committee approved the study.

**Table 1. Comorbidities**

| | Number of patients |
|---|---|
| None | 6 |
| Hypertension | 12 |
| Coronary artery disease | 7 |
| Arrythmia | 3 |
| Deranged coagulation profile/liver function test | 4 |
| Chronic kidney disease | 5 |
| Diabetes mellitus | 8 |
| Hemorrhagic cerebrovascular accident | 1 |

**Table 2. Perioperative results**

| Parameter | Median | Range |
|---|---|---|
| Prostatic volume (g) | 47 | 25-136 |
| Serum PSA (ng/mL) | 2.7 | 0.3-16 |
| Total operative time (min) | 84 | 66-109 |
| Total energy used (kilojoules) | 126.1 | 27.6-235.5 |
| Hospital stay (days) | 2 | 1-9 |
| Removal of catheter (postoperative days) | 1 | 1-3 |

## Results

The median age of the 30 patients was 65 years (range 48-88 years). Median baseline prostate volume was 47 g (range 25-136 g). Fourteen (47%) patients opted for PVP by choice, and 16 (53%) patients underwent PVP because they were at high risk (ASA gr III) for open surgery or TURP; however, only 6 patients were free of any comorbidities. Table 1 presents patient characteristics including the details of various comorbidities. Thirteen patients were on anticoagulants for various reasons (one with a history of cerebrovascular accident, seven with coronary artery disease, one with arrhythmia, and four with hypertension). The median preoperative IPSS score was 22 (range 10-31), and the mean QoL score was 4 (range 3-5). Presenting symptoms were predominantly irritative lower urinary tract symptoms (LUTS) in 30% and predominantly obstructive LUTS in 70% of patients, while 12 patients had acute urinary retention.

The median PSA of the patients was 2.7 ng/mL (range 0.3-16 ng/mL), QMax (excluding those with PUC) was 9 mL/sec (range 3.1-14.8 mL/sec), and PVR was 206 mL (range 138-1000 mL).

The operation was completed in a median time of 84 min (range 66-109 min), and the laser energy used was 126.1 kJ (27.6-235.5 kJ) at 80 watts (Table 2). There was decreasing trend in the operative time with successive patients, which we attributed to the learning curve. All but one of the patients needed one laser fiber only, as one fiber can deliver up to 275 kJ of energy. The need for a second fiber in one patient was due to technical reasons, as the machine was turned off during the procedure.

There was no significant bleeding during the procedure in 28 (93.3%) patients, while two (6.6%) needed electrocautery coagulation with a TUR loop for significant bleeders not amenable to control with the laser. None of our patients required blood transfusion. There was no significant decrease in hemoglobin levels, with median preoperative and postoperative values being 10.4 g/dL and 10.2 g/dL, respectively.

**Table 3. Preoperative and postoperative parameters [median (range) or %]**

| Parameter | Preoperative | Postoperative (at the last follow up) | Change (%) | p value[a] |
|---|---|---|---|---|
| Qmax (mL/sec) | 9 (3.1-14.8) | 19.7 (2.5-30) | 118.8 | <0.01 |
| PVR (mL) | 206 (138-1000) | 30.5 (0-80) | 85.1 | <0.01 |
| IPSS score | 22 (10-31) | 03 (0-20) | 86.3 | <0.01 |
| QoL score | 4 (3-5) | 01 (0-4) | 75 | <0.01 |
| Hemoglobin (g/dL) | 10.4 (8.4-14.2) | 10.2 (7.9-13) | 1.9 | 0.251 |

[a]ANOVA one-way
Qmax: maximum uroflow, PVR: postvoid residual urine, IPSS: international prostate symptom score, QoL: quality of life.

In one patient, complete TURP ("mini TURP") and bladder neck incision (BNI) were done at the end of the procedure to remove some tissue tags at the prostatic apex and due to the presence of high bladder neck.

Catheterization was routinely performed in all patients, with irrigation in two patients due to mild hematuria. The catheter was removed the next morning in 23 (76.6%) patients, while it was kept for 2 days in five patients and 3 days in two patients. The latter two included the patient who needed complete TURP and BNI and one patient who needing bleeding control by electrocautery coagulation. In five other patients, the catheter was kept for a longer period at the patients' request.

Of 23 patients whose catheters were removed the morning after surgery, 18 (78.2%) passed urine satisfactorily. Five (21.7%) patients needed recatheterization for 1 week, three due to painful AUR and two due to severe frequency. Only two of these five patients had presented with AUR preoperatively; the rest had reported predominantly storage LUTS. The seven patients in whom the catheter was kept for 2-3 days voided satisfactorily. Nine of 30 patients complained of mild to moderate frequency, and five of dysuria, which settled within 1-2 weeks with anticholinergics and phenazopyridine. The routine use of these drugs has led to inability to accurately assess the intensity of dysuria.

There was no evidence of intravascular fluid absorption manifesting as significant change in serum sodium levels perioperatively, and serum sodium concentration remained between 132 and 147 meq/L. No clinical TUR syndrome was observed in our analysis in spite of long mean operative time and the fact that four (13.3%) patients had a prostate volume greater than 80 mL.

The median hospital stay was 2 days (range 1-9 days). Seventeen (54.83%) patients were discharged on the second day after surgery after assessing the QMax. There was statistically significant improvement in IPSS, QoL score, QMax, and PVR from preoperative median values of 22, 04, 09 mL/sec, and 206 mL to postoperative values of 03, 01, 19.7, mL/sec and 30.5 mL, respectively (Table 3).

Two patients (6.6%) developed urethral stricture (proximal bulbar urethra) during follow-up, both 1 month after surgery. Both patients needed direct visual internal urethrotomy (DVIU). No relationship was found between prostate volume or operative time and the risk of urethral stricture. None of the patients complained of postprocedural incontinence. Nineteen patients in our study were not sexually active; of the remaining 11, none complained of impotence, and one patient complained of retrograde ejaculation postoperatively. During the entire follow-up, the reoperation rate has been 0%.

There were no cases of perioperative mortality and no other relevant surgery-related systemic complications throughout the median follow-up of 26.2 months (range 12-38 months) despite 16 (53%) patients being at high risk.

## Discussion

KTP laser PVP was introduced at the Mayo Clinic in an effort to combine the outstanding tissue debulking properties of TURP with the positive safety profile of laser surgery,[7] and it is rapidly gaining worldwide recognition. This is the first time that transurethral resection of the prostate and open prostatectomy have been challenged.[8]

KTP crystal doubles the frequency of a pulsed Nd:YAG laser to a 532-nm wavelength, which is in the green electromagnetic spectrum (Greenlight laser), and it is selectively absorbed by hemoglobin and not at all by water. Frequency-doubling crystals include KTP LBO. The older 80-W laser devices using KTP crystals are being replaced by the latest-generation ones using LBO crystals with a 120-W power setting. Reduction in wavelength leads to a different interaction between the laser beam and prostatic tissue, and the tissue is ablated by rapid vaporization (earlier observed as a side effect in Nd:YAG procedures). Because of the instant and nearly complete absorption of the laser in blood, the depth of effect in vascularized tissue is only 0.8 mm. The superficial tissue coagulation prevents extensive tissue necrosis, thus avoiding the irritative symptoms due to sloughing of necrotic tissue seen with Nd:YAG laser.[9]

The advantages of this technique include the use of isotonic saline (even sterile water) as an irrigant, thereby decreasing the incidence of dilutional hyponatremia, and minimal intraoperative bleeding, thus allowing good visibility during the procedure. Transurethral resection syndrome is unlikely to develop because intravascular fluid absorption is minimal due to effective superficial tissue coagulation. Dilger et al.[10] reported only one case of full-blown transurethral resection syndrome, which occurred presumably because of absorption of sterile water through the urethral injury induced during insertion of the laser cystoscope.

Another unusual complication with PVP is acute renal failure, which was reported by Kim et al.[11] in three cases on postoperative day 1. This was assumed to result from high intravesical pressures, leading not only to absorption of irrigating fluid absorption but also to transient urinary stasis or even vesicoureteral reflux, which can directly damage tubular epithelial cells.

The KTP laser is a safe and effective treatment option in high-risk patients such as those with severe heart disease and those with bleeding disorders or on anticoagulant therapy who are not good candidates for TURP due to the risk of bleeding and systemic complications[11,12]. Furthermore, patients with severe central nerve disease, dementia, and pulmonary risk, who are often denied TURP, can be managed with a KTP laser.[12,13]

Turkish Journal of Urology 2011; 37(4): 316-320
doi:10.5152/tud.2011.061

The role of KTP laser vaporization is still controversial in cases of large-volume prostates. In their study, with a median follow-up of 11.7 months, Pfitzenmaier et al.[14] found similar functional outcomes in terms of improvements in QMax, IPSS, and QOL scores, but a serious trend toward a higher reoperation rate, 23.1% vs. 10.4%, in larger prostates (>80 mL) compared with that in smaller glands (<80 mL). In our study, only 4 (13.3%) patients had a prostate volume greater than 80 mL, but we did not see any difference in efficacy or reoperation rate. Similar results were reported by Skolarikos et al.,[15] who compared PVP to open prostatectomy for large prostatic adenomas (>80 mL), indicating that PVP is an acceptable treatment alternative to open surgery.

The success story of the KTP laser has been acknowledged in various studies. Malek et al.[16] were the first to report the long-term results over the period of 5 years, with excellent sustained improvement in subjective symptoms and urodynamics. The first 84% of their patients were treated with a 60-W laser, and the rest with 80-W settings. The retreatment rate in their series was 0%. Later, Ruszat et al.[17] reported long-term results with up to 5 years of follow-up in 500 patients [mean prostate volume 56.1 mL (range 10-180 mL)] and showed PVP to be a safe and effective procedure for treatment of LUTS secondary to BPH, with immediate and sustained improvement of subjective and objective voiding parameters and a late complication rate comparable to that of TURP. The mean QMax, IPSS, and QoL score after 3 years were 18.4 mL/sec, 8.0, and 1.3 respectively. The retreatment rate was 6.8%, with urethral stricture developing in 4.4% of patients.

Our study sample was comparatively small, we had a mean follow-up of only 26.2 months (range 12-38 months), and this was our initial experience with the KTP laser. Nonetheless, the surgical outcomes, including a reoperation rate of 0%, urethral stricture rate of 6.6%, and satisfactory improvement in uroflow, IPSS, and QOL scores, were comparable to other, larger reported series. None of our patients complained of impotence or stress urinary incontinence, which have been reported in up to 1% and 1.2% of patients, respectively, in other series.[18] A probable limitation of our study is that postoperative prostatic volume and serum PSA were not measured.

As a conclusion, although the laser and installation cost are difficult to justify financially, especially in developing countries, where the procedural cost of PVP is at least three times that of TURP, our initial results demonstrate that KTP laser PVP is a treatment method that can be adopted to treat patients with BPH safely and effectively, especially patients with significant systemic comorbidities.

**Conflict of interest**

No conflict of interest was declared by the authors.

## References

1. Hammadeh MY, Madaan S, Hines J, Philip T. 5-Year outcome of a prospective randomized trial to compare transurethral electrovaporization of the prostate and standard transurethral resection. Urology 2003;61:1166-71. **[CrossRef]**
2. Reich O, Gratzke C, Stief CG. Techniques and long term results of surgical procedures for BPH. Eur Urol 2006;49:970-8. **[CrossRef]**
3. Tooher R, Sutherland P, Costello A, Gilling P, Rees G, Maddern G. A systematic review of holmium laser prostatectomy for benign prostatic hyperplasia. J Urol 2004;171:1771-81. **[CrossRef]**
4. Gravas S, Bachmann A, Reich O, Roehrborn CG, Gilling PJ, De La Rosette J. Critical review of lasers in benign prostatic hyperplasia (BPH). BJU Int 2011;107:1030-43. **[CrossRef]**
5. Tan AH, Gilling PJ. Lasers in the treatment of benign prostatic hyperplasia-an update. Curr Opin Urol 2005;15:55-8. **[CrossRef]**
6. Rajbabu K, Chandrasekara SK, Barber NJ, Walsh K, Muir GH. Photoselective vaporization of the prostate with the potassium-titanyl- phosphate laser in men with prostates of > 100 ml. BJU Int 2007;100:593-8. **[CrossRef]**
7. Malek RS, Barrett DM, Kuntzman RS. High-power potassium-titanyl-phosphate (KTP/532) laser vaporization prostatectomy: 24 hours later. Urology 1998;51:254-6. **[CrossRef]**
8. Alivizatos G, Skolarikos A. Greenlight laser in benign prostatic hyperplasia: turning green into gold. Curr Opin Urol 2008;18:46-9. **[CrossRef]**
9. Bachmann A, Ruszat R. The KTP-(greenlight-) laser--principles and experiences. Minim Invasive Ther Allied Technol 2007;16:5-10. **[CrossRef]**
10. Dilger JA, Walsh MT, Warner ME, Mynderse LA, Sprung J. Urethral injury during potassium-titanyl-phosphate laser prostatectomy complicated by transurethral resection syndrome. Anesth Analg 2008;107:1438-40. **[CrossRef]**
11. Kim MJ, Bachmann A, Mihatsch MJ, Ruszat R, Sulser T, Mayr M. Acute renal failure after continuous flow irrigation in patients treated with potassium-titanyl-phosphate laser vaporization of prostate. Am J Kidney Dis 2008;51:19-24. **[CrossRef]**
12. Kuwahara Y, Otsuki H, Nagakubo I, Horiba M. Photoselective vaporization of the prostate in severe heart disease or dementia patients who are not candidates for TUR-P. Nihon Hinyokika Gakkai Zasshi 2008;99:688-93.
13. Yuan J, Wang H, Wu G, Liu H, Zhang Y, Yang L. High-power (80 W) potassium titanyl phosphate laser prostatectomy in 128 high-risk patients. Postgrad Med J 2008;84:46-9. **[CrossRef]**
14. Pfitzenmaier J, Gilfrich C, Pritsch M, Herrmann D, Buse S, Haferkamp A, et al. Vaporization of prostates of > or =80 mL using a potassium-titanyl-phosphate laser: midterm-results and comparison with prostates of <80 mL. BJU Int 2008;102:322-7. **[CrossRef]**
15. Skolarikos A, Papachristou C, Athanasiadis G, Chalikopoulos D, Deliveliotis C, Alivizatos G. Eighteen-month results of a randomized prospective study comparing transurethral photoselective vaporization with transvesical open enucleation for prostatic adenomas greater than 80 cc. J Endourol 2008;22:2333-40. **[CrossRef]**
16. Malek RS, Kuntzman RS, Barrett DM. Photoselective potassium-titanyl-phosphate laser vaporization of the benign obstructive prostate: observations on long-term outcomes. J Urol 2005;174:1344-8. **[CrossRef]**
17. Ruszat R, Seitz M, Wyler SF, Abe C, Rieken M, Reich O, et al. Green light vaporization of the prostate: Single-center experience and long term results after 500 procedores. Eur Urol 2008;54:893-901. **[CrossRef]**
18. Sarıca K, Alkan E, Lüleci H, Taşçı AI. Photoselective vaporization of the enlarged prostate with KTP laser: long-term results in 240 patients. J Endourol 2005;19:1199-202. **[CrossRef]**