Short term outcomes of GreenLight vapor incision technique (VIT) of the prostate: comparison of outcomes to standard GreenLight 120W HPS vaporization in prostate volumes greater than 80 cc

Tal Ben-Zvi, MD,[1] Pierre-Alain Hueber, MD,[1] Firas Abdollah, MD,[2] Daniel Liberman, MD,[1] Naeem Bhojani, MD,[1] Gagan Gautam, MD,[3] Kevin C. Zorn, MD[1,3]

[1]Section of Urology, Department of Surgery, University of Montreal Health Center, Montreal, Quebec, Canada
[2]Department of Urology, Vita-Salute San Raffaele University, Milan, Italy
[3]Section of Urology, Department of Surgery, University of Chicago, Chicago, Illinois, USA

BEN-ZVI T, HUEBER P-A, ABDOLLAH F, LIBERMAN D, BHOJANI N, GAUTAM G, ZORN KC. Short term outcomes of GreenLight vapor incision technique (VIT) of the prostate: comparison of outcomes to standard GreenLight 120W HPS vaporization in prostate volumes greater than 80 cc. *Can J Urol* 2013;20(1):6633-6639.

Introduction: *To evaluate a hybrid technique involving GreenLight 120W HPS vapor incision tissue removal in prostate glands > 80 cc.*
Materials and methods: *Vapor incision technique (VIT) was performed in 25 consecutive men with a prostate > 80 cc by a single surgeon from May 2010 until September 2010. VIT involved adenoma incisions at 5 and 7-o'clock positions followed by 3, 9 and 12 o'clock down to the surgical capsule. Side-fire vaporization along the capsule excised transurethral resection of the prostate (TURP) like tissue strips for later retrieval. Functional evaluations were performed at 1 and 3 months. Outcomes and complications were compared retrospectively to baseline and a size matched- cohort of 25 men who previously underwent standard vaporization-only photoselective vaporization prostatectomy (PVP).*
Results: *The VIT and control subgroups were comparable. Mean laser time, operative time and energy usage were reduced in the VIT group compared to controls (35 min versus 48 min; 63 min versus 80 min; and 227 k versus 325 kJ respectively; all p < 0.05). At 3 months the VIT subgroup demonstrated improved Qmax and post void residual (PVR) (197% versus 173%, 88% versus 72%; all p < 0.05) compared to control. VIT showed a 68% reduction in mean preoperative PSA at 3 months compared to 50% for the control group (p<0.01). Hospital stay, catheterization time and complication rates were comparable.*
Conclusions: *Our data demonstrates that VIT provides superior short term outcomes to standard HPS-PVP in men with prostate volumes > 80 cc. VIT appears to be more time-efficient, consumes less energy and obtains tissue for pathological evaluation. Further follow up is required to assess the durability of GreenLight HPS-VIT to PVP vaporization-only for large prostate glands.*

Key Words: laser photoselective vaporization, prostate size, GreenLight 120W HPS, benign prostatic hyperplasia

Accepted for publication November 2012

Address correspondence to Dr. Kevin C. Zorn, University of Montreal Health Center (CHUM), 235, boul. René-Levesque Est, suite 301, Montreal, QC, H2X 1N8 Canada

Introduction

The evolution of benign prostatic hyperplasia (BPH) treatment is in constant flux. Open prostatectomy (OP) and transurethral resection of the prostate (TURP) are the surgical modalities of choice (gold standard) for the surgical management of lower urinary tract symptoms (LUTS) refractory to medical management in prostates > 80 cc. However OP and TURP have been associated with complications including heavy bleeding requiring transfusions, longer need for catheterization and bladder irrigation times, as well as electrolytic anomalies (TURP syndrome).[1] While TURP is considered the gold standard endoscopic procedure for BPH treatments, several minimally invasive techniques have been introduced in the recent years.[2]

American Medical Systems, Inc. (Minnetonka, Minnesota, USA) introduced the GreenLight Laser (GL) as a prototype 60W model for minimally invasive treatment of LUTS in BPH. It was succeeded by an 80W unit, a 120W High Performance system (HPS) laser and most recently GreenLight XPS. Photoselective vaporization of the prostate (PVP) is routinely used to vaporize adenomatous tissue until the surgical capsule is attained,[3] creating a TURP like cavity. PVP however can be challenging in larger glands. Moreover, it is time consuming and costly, often resulting in fiber degradation leading to less effective energy delivery and at times requiring a second fiber. When purely vaporizing the tissue, endpoint capsule discrimination can be difficult especially in larger prostates. In addition the standard PVP technique prevents tissue extraction for pathological evaluation.

The HPS 120W system was introduced in 2006 with significantly greater tissue ablation properties compared to its 80W predecessor.[4] It has been demonstrated safe and effective in symptomatic BPH patients in urinary retention, on anticoagulation therapy and in larger prostates.[5] A recent randomized controlled trial by Al-Ansari et al[6] compared the GL HPS 120W system to TURP for treatment of BPH with midterm follow up (36 months) in 120 men. PVP 120W HPS was shown to provide similar symptom relief to TURP. In addition, it resulted in reduced bleeding, shorter catheterization time and shorter in-patient hospital duration with minimal complications. However, the mean PVP operative times were significantly longer (80+/-13 min versus 89+/-18 min; $p < 0.01$) with lower percentage reduction in serum PSA and prostate size compared to TURP. Moreover, HPS 120W PVP had a significantly increased re-treatment rate compared to TURP (11% versus 1.8%). Interestingly, all men who required PVP re-treatments had prostates > 80 g, leading the author to argue against PVP usage in larger prostates

Recently a modified vapor incision technique (VIT) described by Sandhu et al[7] and Son et al[8] (The Seoul Technique) was demonstrated to save time and increase the efficiency of GL 120W HPS vaporization resection of prostatic tissue. By incising grooves in the lobes down to the prostatic capsule, tissue is resected along this plane, permitting the tissue to be extracted rather than vaporized centripetally. A more uniform endpoint along the capsule is appreciated compared to the hard to distinguish light-tan tissue often encountered with standard PVP. We postulated that the VIT PVP would increase the efficiency of GL HPS, particularly in larger prostates. The premise of our study was to compare the short term outcome at 3 months of a GL HPS 120W PVP to a VIT in prostates > 80 cc in a 25 patient match cohort.

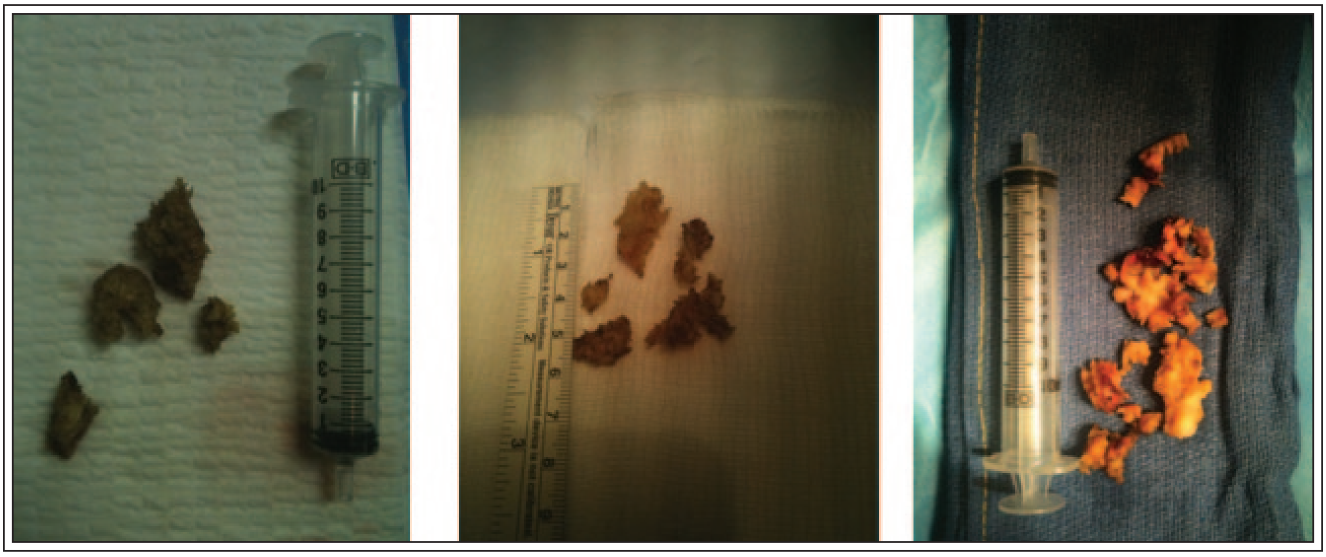

Figure 1. Adenomatous tissue excised utilizing GreenLight HPS-VIT.

Materials and methods

After institutional board approval, data was collected from prospective patients diagnosed with LUTS secondary to BPH who underwent GreenLight HPS laser VIT by a single surgeon between May 2010 to September 2010 and was reviewed. Surgical indications were in line with the BPH guidelines of the Canadian Urological Association.[9] Patients were evaluated preoperatively with the American Urological Association Symptom Score (AUA-SS), Quality of Life score (QoL), Sexual Health Inventory for Men (SHIM), uro-flowmetry for maximum flow rate (Qmax), post void residual volume (PVR), cystourethroscopy and transrectal ultrasonography (TRUS) measurement of prostate volume. The preoperative evaluation included a complete medical history, physical examination, and urine and blood sample analysis including complete blood count, electrolytes, renal function and serum prostate specific antigen (PSA). If the patient was found to have an elevated serum PSA or an abnormal digital rectal examination (DRE) a TRUS-guided biopsy was performed to rule out prostate cancer. Prostatic cancer, bladder tumors, urethral strictures or bladder dysfunction due to neurologic disorders were basis for exclusion from the study.

Transurethral PVP was performed using the 120W GL HPS side-firing laser system as previously illustrated by Muir et al.[3] GL HPS-VIT, however, involved adenoma incision, Figure 1, at 5 and 7-oclock positions followed by 3, 9 and 12 o'clock incisions down to the surgical capsule as published by Son et al.[8] Side-fire vaporization along the capsule was carried out thereby excising TURP-like tissue strips for retrieval. Resected pieces were removed thereafter using a 27F resectoscope with transurethral loop for athermal retrieval. Preoperative antibiotic prophylaxis was provided and general or spinal anesthesia was employed. A 23F continuous-flow cytoscope with a 30^{o} lens was used with the laser set at 120W for vaporization and 30W for coagulation. Normal saline at room temperature was used as irrigation fluid. A 20F urethral catheter with 30 cc balloon was placed at the end of the procedure with a voiding trial performed 6 hours postoperatively. If unable to urinate, a urethral catheter was replaced prior to hospital discharge and returned the following morning to the outpatient clinic for a second voiding trial. All procedures were performed on an outpatient basis and patients were discharged the same day with oral antibiotic treatment to complete for 7 days.

Operative parameters including laser time, operating room time, pathological tissue removed (g), laser MoJo fiber utilization and energy usage were recorded. Clinical outcomes (AUA-SS, QoL, Qmax, PVR, serum PSA) were postoperatively assessed for changes from preoperative values at 1 and 3 months. Outcomes were compared to a size matched-cohort of 25 men who previously underwent GL HPS-PVP. Changes in baseline outcomes and complication rates were retrospectively assessed. Continuous variables were presented as mean +/- range, categorical variables and changes in baseline outcomes were presented as a percentage. Statistical analysis was performed using SPS. The student t test was used for statistical validation, with a two-sided $p < 0.05$ considered to indicate statistical significance.

Results

Twenty-five patients underwent GL 120W HPS laser VIT and were compared to a size-matched cohort of 25 men who previously underwent GL 120W HPS-PVP. Mean age, PSA and prostate size (TRUS volume) were comparable between groups, Table 1. Similarly, urinary retention, presence of a median lobe, duration of BPH medication usage and prior BPH surgery were not statistically significant among VIT and PVP groups.

Peri-operative outcomes are summarized in Table 2. Of note, men undergoing VIT demonstrated a significant reduction (27%) in mean laser time compared to PVP (35 min versus 48 min; $p < 0.01$). Mean OR time (63 min versus 80 min; $p < 0.01$) and mean energy usage (227 kJ versus 325 kJ; $p < 0.01$) were also significantly lower in the VIT group. However there was no significant difference in mean laser MoJo fiber usage (1.4 versus 1.3; $p = 0.63$).

Postoperative functional outcomes, Table 3 demonstrate superior objective outcomes for VIT as compared to PVP. Qmax% improvements for VIT versus PVP were 200% versus 170% ($p = 0.01$) at 1 month and 197% versus 173% ($p < 0.01$) at 3 month. Similarly PVR% improvements comparing VIT to control were 84% versus 70% ($p = 0.02$) at 1 month and 88% versus 72% ($p = 0.04$) at 3 month. Mean PSA reduction% at 3 months was significantly higher in the VIT group (68% versus 50%, $p < 0.01$). Additionally VIT had a mean 29.2 g prostatic tissue extracted (range 15 g-49 g).

Similar symptom relief was achieved by both techniques when compared to baseline. The subjective outcome differences were non-significant (IPSS and QoL at 1 and 3 months, $p > 0.05$). Hospital stay, catheterization time and complication rates were comparable between groups as well (all complications were Grade I according to the Clavien Classification of Surgical Complications[10]).

TABLE 1. **Patient demographics**

	Vapor incision with tissue removal (VIT) group	Standard PVP vapor only group	p value
n =	25	25	
Mean age	68.1	69.3	0.82
Mean PSA (ng/mL)	4.3	4.7	0.65
Mean TRUS volume (cc)	86	84	0.77
Mean AUA-SS	24	26	0.51
Mean QoL	4.1	4.3	0.62
Mean SHIM	15	14	0.43
Mean PVR (mL)	225	212	0.32
Mean QMax (mL/s)	6.8	7.4	0.17
Urinary retention (%)	7 (28%)	8 (32%)	0.75
Prostate configuration (%)			
Bilobar	19 (76%)	17 (68%)	0.53
Trilobar	6 (24%)	8 (32%)	
Medication for BPH	18 (72%)	16 (64%)	0.54
Prior BPH surgery (%)	2 (8%)	2 (8%)	0.99

PVP = photoselective vaporization prostatectomy; PSA = prostate-specific antigen; TRUS = transrectal ultrasonography; AUA-SS = American Urological Association Symptom Score; QoL = quality of life; SHIM = Sexual Health Inventory for Men; PVR = post void residual; QMax = maximum flow rate; BPH = benign prostatic hyperplasia

Discussion

GL HPS-PVP was introduced as a potential alternative to TURP with an improved safety profile.[6] While the GL models have increased in power, most recently with the introduction of AMS GL XPS, HPS PVP remains in use and particularly challenging for larger prostates (> 80 cc), resulting in a less substantial PSA reduction and tissue removal compared to TURP.[6] Retreatment rates of 11% utilizing GL HPS (compared to 1.8% in standard monopolar TURP) were observed in a randomized control study by Al-Ansari et al in prostates > 80 cc.

This VIT series was based upon the Son et al[8] study and had several marked differences in population characteristics and outcomes. Son et al investigated the Seoul technique (VIT) performed in males with smaller glands (64.5 mL +/- 19.3 mL versus 86 mL) and less severe LUTS (Qmax preop of 10.6 mL +/- 4.0 mL versus 7.4 mL/s and PVR preop 64.3 mL +/- 81.5 mL versus 212 cc) compared to this cohort. The operative parameters

TABLE 2. **Operative parameters**

	Vapor incision with tissue removal (VIT) group	Standard PVP vapor only group	p value
n =	25	25	
Mean laser time (min)	35	48	< 0.01
Mean OR time (min)	63	80	< 0.01
Mean laser MoJo fiber	1.4	1.3	0.63
Mean energy (kJ)	227	325	< 0.01

PVP = photoselective vaporization prostatectomy; OR = operating room

TABLE 3. **Postoperative functional outcomes**

	Vapor incision with tissue removal (VIT) group	Standard PVP vapor only group	p value
n =	25	25	
Improvement in Qmax %, (n =)			
1 month	200% (25)	170% (25)	0.01
3 months	197% (24)	173% (24)	< 0.01
Improvement in PVR %, (n =)			
1 month	84% (25)	70% (25)	0.02
3 months	88% (24)	72% (24)	0.04
Mean PSA reduction %, (n =)			
3 months	68% (24)	50% (23)	< 0.01
Mean pathological tissue removed (g)	29.2	-	-
Mean IPSS (n =)			
1 month	9.1 (25)	12 (25)	0.06
3 months	8.0 (24)	8.7 (24)	0.54
Mean QoL (n =)			
1 month	2.1 (25)	2.4 (25)	0.34
3 months	2.2 (24)	2.5 (24)	0.42
Complications (%)			
Delayed hematuria(> 14d)	4 (16%)	5 (20%)	0.71
Urgency/dysuria	4 (16%)	8 (32%)	0.18

PVP = photoselective vaporization prostatectomy; QMax = maximum flow rate; PVR = post void residual; PSA = prostate-specific antigen; IPSS = international prostate symptom score; QoL = quality of life

reported in their series suggested a trend toward a shorter and more efficient procedure. However, mean laser time (31.3 min +/- 10.32 min versus 35.4 min +/- 16.0 min; p = 0.115), mean operating room time (66.3 min +/- 20.8 min versus 69.8 min +/- 27.6 min; p = 0.491) and mean laser energy (128.8 kJ +/- 54.3 kJ versus 151.4 kJ +/- 78.8 kJ; p = 0.086) were not statistically significant. In contrast, our data demonstrated a similar trend however with more substantial operative parameter differences between the two techniques (all achieved statistical significance, p < 0.01), Table 2. The most impressive of these results being the 27% decreased mean laser time by VIT (35 min versus 48 min; p < 0.01). Why our cohort of larger glands achieved statistical significance can be explained by an imperfect analogy. Vaporizing the outer rim of the gland as opposed to vaporizing centripetally can be compared to the exponential difference between the surface area and volume of a sphere ($4\pi R^2$ versus $4/3\pi R^3$). The difference becomes much more important with increasing radius; explaining why the smaller gland cohort showed a less important improvement.

Postoperatively, Son et al[8] reported a significant increase in adenomatous tissue reduction by the Seoul technique; Non-Seoul (PVP) 22.0 mL +/- 12.0 mL versus Seoul technique 27.7 mL +/- 9.9 mL; p = 0.014. These volumes were calculated indirectly by subtracting TRUS postoperative from TRUS preoperative values. The protocols we followed in this study did not include postoperative TRUS measurements. Rather, PSA measurements were used as a surrogate approximation of adenomatous tissue volume. Comparing postoperative PSA measurements at 3 months between the two technique groups, Son et al did not report a significant difference (standard PVP technique 2.3 ng/mL +/- 3.5 ng/mL versus Seoul VIT technique 2.4 ng/mL +/- 3.7 ng/mL; p = 0.597). This corresponded to PSA reduction rates of 38% and 40% respectively. Alternatively, VIT in our larger prostate cohort resulted in a more significant PSA reduction rate of 68% at 3 months (p < 0.01). These results compare favorably to a holmium enucleation of the prostate (HoLEP) series by Elhilali et al[11] of 503 men with a mean TRUS of 83.7 cm^3 ± 49.7 cm^3 (range, 20 cm^3 to 351 cm^3) and a PSA% decrease of 83.6% at 6 months.

Postoperative outcomes measured by Son et al[8] (IPSS, QoL, Qmax, PVR) showed statistically significant improvement for both groups compared to baseline at 1-12 months ($p < 0.05$). However there was no significant difference between either technique. In our larger gland cohort, PVP and VIT produced equivalent subjective symptom relief (IPSS, QoL; $p > 0.05$). Objective outcomes (Qmax% improvement, PVR% reduction) at 1 and 3 months were superior in the VIT group compared to the PVP group. While the mean weight of extracted adenoma in this series was 29.2 g, we believe this value under represents the tissue resected due to the vaporization properties of GL HPS. Unfortunately, they did not report their extracted prostatic tissue and no comparison can be made to standard PVP. Nonetheless, the superior objective outcomes and more important PSA% reduction suggest a more complete tissue resection in prostates > 80 g using VIT. A more complete adenomatous tissue resection could potentially lower the future retreatment rate.

Comparing GL HPS-PVP to the gold standard TURP, a 2 year RCT by Capitan et al[12] concluded that both surgical options produced equivalent functional outcomes. A subsequent RCT by Al-Ansari et al[6] reported that while PVP was safe, it had an increased re-treatment rate compared to TURP (11% versus 1.8%), and all of those were in prostates > 80 cc. As VIT allowed us to circumvent the size limitations of HPS PVP and demonstrated superior functional outcomes, one may postulate that GL HPS-VIT may provide better functional results than TURP in large glands. However such claims must be made with caution in light of this study's small sample size and short follow up.

Several other VIT boons were identified in this study. Tissue extraction permits for pathological analysis. While the benefits of pathological evaluation are controversial,[13] there were no cases of prostate cancer detection in our series. This is comparable to the low prostate cancer detection rate of 3.3% observed by Son et al.[8] Secondly, VIT and PVP resulted in a non-significant complication rate difference. VIT did not lead to increased dysuria rates and IPSS outcomes were comparable at 1 and 3 months. As such, there was no increased morbidity due to VIT. Moreover fewer men experienced delayed hematuria (4 versus 5, $p = 0.71$) and urgency/dysuria (4 versus 8, $p = 0.18$) post VIT. Possible explanations include the decreased energy delivered to the capsular tissue and improved tissue removal resulting in a reduced tissue necrosis layer. Unfortunately due to the small size, these results could not be statistically validated.

This single surgeon, single center experience is not devoid of limitations. Among them is the use of retrospective size-matched historical controls which could have introduced a learning curve bias. While not discounted, this cohort of GL HPS procedures was performed by a single surgeon with several years of GL experience and over 250 GL surgeries performed prior, reducing the probability of this bias. The results warrant a multi-institutional follow up with several surgeons of differing levels of expertise and a larger, prospective, randomized patient base to evaluate VITs' potential learning curve, efficacy, complication rate and long term outcomes as opposed to standard PVP. Nonetheless, our short term data demonstrated VIT to be a promising technique that increases surgical efficiency and warrants additional study.

This series validates the increased operative efficiency trend reported by Son et al using the Seoul technique versus GL HPS-PVP. As such, VIT should be recommended for use in > 80 g prostates for those surgeons utilizing GL HPS surgical treatment as it produces similar outcomes with decreased operating time and energy (kJ) usage. Moreover, in our cohort of larger glands, the GL HPS-VIT technique resulted in operative parameters that were statistically superior to PVP along with a more important and more efficient tissue resection.

Conclusion

Short term analysis supports that VIT PVP provides superior perioperative and short term outcomes to standard GL HPS-PVP in men with prostate volumes > 80 cc. More specifically, VIT appears to be more time-efficient, requires less laser energy and obtains tissue for pathological evaluation. Further follow up is required to assess the durability of GL HPS-VIT to PVP vaporization-only for large prostate gland. ☐

References

1. American Urological Association Education and Research I. BPH: Guideline on the Management of Benign Prostatic Hyperplasia. Baltimore: American Urological Association Education and Research, Inc., 2010; Available at: http://www.auanet.org/content/guidelines-and-quality-care/clinical-guidelines/main-reports/bph-management/chap_1_GuidelineManagementof(BPH).pdf
2. Choi B, Tabatabaei S, Bachmann A. GreenLight HPS 120-W laser for benign prostatic hyperplasia: comparative complications and technical recommendations. *Eur Urol Suppl* 2008;7(4):384-392.

3. Muir G, Sancha FG, Bachmann A et al. Techniques and training with GreenLight HPS 120W laser therapy of the prostate: position paper. *Eur Urol Suppl* 2008;7(4):370-377.
4. Heinrich E, Wendt-Nordahl G, Honeck P et al. 120W lithium triborate laser for photoselective vaporisation of prostate: comparison with 80-W potassium titanyl phosphate laser in an ex-vivo model. *J Endourol* 2010;24(1):75-79.
5. Woo H, Reich O, Backman A et al. Outcome of GreenLight HPS 120-W laser therapy in specific patient populations: those in retention, on anticoagulants, and with large prostate (80 ml). *Eur Urol Suppl* 2008;7(4):378-383.
6. Al-Ansari A, Younes N, Sampige VP et al. GreenLight HPS 120-W laser vaporization versus transurethral resection of the prostate for treatment of benign prostatic hyperplasia: a randomized clinical trial with midterm follow-up. *Eur Urol* 2010; 58(3):349-355.
7. Sandhu J, Te AE. Photoselective vaporization of the prostate - the vaporization incision technique for large volume prostates [abstract]. *J Urol* 2005;173(4 Suppl):366.
8. Son H, Ro YK, Min SH et al. Modified vaporization-resection for photoselective vaporization of the prostate using a GreenLight high-performance system 120-W Laser: the Seoul technique. *Urology* 2011;77(2):427-432.
9. Nickel JC, Méndez-Probst CE, Whelan TF et al. 2010 Update: Guidelines for the management of benign prostatic hyperplasia. *Can Urol Assoc J* 2010;4(5):310–316.
10. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. *Ann Surg* 2004;240(2):205-213.
11. Elzayat EA, Habib EI, Elhilali MM. Holmium laser enucleation of the prostate: A size-independent new "gold standard". *Urology* 2005;66(5 Suppl):108-113.
12. Capitán C, Blázquez C, Martin MD et al. GreenLight HPS 120-W laser vaporization versus transurethral resection of the prostate for the treatment of lower urinary tract symptoms due to benign prostatic hyperplasia: a randomized clinical trial with 2-year follow-up. *Eur Urol* 2011;60(4):734-739.
13. Haley R, Boddy J, Wharton I et al. A retrospective audit of TURP to assess the potential impact of Green Light Laser surgery on the diagnosis of prostate cancer [abstract]. *Eur Urol Suppl* 2007 6(2):195.