Progrès en urologie (2017) **27**, 362—368

Disponible en ligne sur
ScienceDirect
www.sciencedirect.com

Elsevier Masson France
EM|consulte
www.em-consulte.com

ORIGINAL ARTICLE

Perioperative and economic analysis of surgical treatments for benign prostatic hyperplasia: A study of the French committee on LUT

Analyse du coût et des résultats périopératoires des traitements chirurgicaux de l'hypertrophie bénigne de prostate : une étude du Comité des troubles mictionnels de l'homme de l'association française d'urologie

R. Mathieu[a,*], S. Lebdai[b], J.N. Cornu[c], A. Benchikh[d], A.R. Azzouzi[b], N.B. Delongchamps[e], O. Dumonceau[f], A. Faix[g], M. Fourmarier[h], O. Haillot[i], B. Lukacs[j], V. Misrai[k], A. de La Taille[l], G. Robert[m], A. Descazeaud[n]

[a] *Service d'urologie, hôpital Pontchaillou, CHU de Rennes, 2, rue Henri-Le-Guillou, 35000 Rennes, France*
[b] *Service d'urologie, CHU d'Angers, 49933 Angers, France*
[c] *Department of Urology, Rouen University Hospital, 76031 Rouen cedex, France*
[d] *Service d'urologie, hôpital Bichat-Claude-Bernard, groupe des hôpitaux universitaires Paris-Nord-Val-de-Seine, université Denis-Diderot, Paris-VII, 75018 Paris, France*
[e] *Service d'urologie, CHU Cochin, Assistance publique—Hôpitaux de Paris, 75014 Paris, France*
[f] *Service d'urologie, Clinique Turin, 9, rue de Turin, 75008 Paris, France*
[g] *Clinique mutualiste Beausoleil, 34070 Montpellier, France*
[h] *Service d'urologie, centre hospitalier Aix-en-Provence, 13616 Aix-en-Provence, France*
[i] *Service d'urologie, CHU de Tours, 37044 Tours, France*
[j] *Service d'urologie, hôpital Tenon, université Paris VI, Assistance publique—Hôpitaux de Paris, 75020 Paris, France*
[k] *Service d'urologie, clinique Pasteur, 40, avenue de Lombez, 31300 Toulouse, France*
[l] *Service d'urologie, CHU Mondor, Assistance publique—Hôpitaux de Paris, 75000 Paris, France*
[m] *Service d'urologie, CHU de Bordeaux, université de Bordeaux, 33000 Bordeaux, France*

* Corresponding author.
E-mail address: romainmath@yahoo.fr (R. Mathieu).

http://dx.doi.org/10.1016/j.purol.2017.03.010
1166-7087/© 2017 Published by Elsevier Masson SAS.

[n] *Service de chirurgie urologique, hôpital Dupuytren, CHU de Limoges, 2, avenue Martin-Luther-King, 87042 Limoges, France*

Received 6 February 2016; accepted 30 March 2017
Available online 8 May 2017

KEYWORDS
Benign prostatic hyperplasia;
Open prostatectomy;
Photoselective vaporization of the prostate;
Holmium laser enucleation;
Transurethral resection of the prostate;
Cost analysis

Summary
Purpose. — To evaluate perioperative cost related to surgical treatments of benign prostatic obstruction (BPO): photoselective vaporization of the prostate (pvp), holmium/thullium laser enucleation (HoLEP/ThuLEP), transurethral resection of the prostate (TURP) and open prostatectomy (OP).
Material and methods. — We retrospectively collected data from 237 patients who consecutively underwent a surgical treatment for BPH between January 2012 and June 2013 at nine institutions in France. An economic simulation model was constructed to estimate the cost of hospitalization related to surgical procedure from the hospital perspective and a cost minimization analysis was performed.
Results. — TURP, OP, HoLEP/ThuLEP and PVP were performed in 99 (42%), 23 (10%), 64 (27%) and 51 (21%) patients, respectively. For men with prostate size < 80 mL: mean operative time was shorter with mTURP and PVP than HoLEP/thuLEP ($P < 0.001$); Mean postoperative length of stay were 1.9, 3 vs. 3.4 days, for HoLEP/Thulep, PVP and TURP respectively ($P = 0.006$); Costs of first hospitalization were comparable between HoLEP/ThuLEP and TURP but higher with PVP ($P < 0.001$). For men with prostate size ≥ 80 mL: Compared to PVP and HoLEP/ThuLEP, OP was associated with shorter operative time ($P < 0.001$) but longer length of stay (2.4, 4.2 vs. 7.8 days, respectively, $P < 0.0001$); Costs of first hospitalization were significantly higher with OP than HoLEP/ThuLEP or PVP ($P < 0.001$).
Conclusions. — PVP and HoLEP/ThuLEP were associated with a shorter LOS than TURP and OP. This benefit suggests these procedures could be more cost effective than OP, but still not cheaper alternatives to TURP.
Level of evidence.— 5.
© 2017 Published by Elsevier Masson SAS.

MOTS CLÉS
Hypertrophie bénigne de prostate ;
Photovaporisation prostatique ;
Énucléation au laser holmium/thullium ;
Résection transurétrale de la prostate ;
Adénomectomie voie haute ;
Analyse des coûts

Résumé
Objectif. — Évaluer les coûts périopératoires de traitements chirurgicaux de l'hypertrophie bénigne de prostate (HBP) : photovaporisation prostatique (PVP), énucléation au laser holmium/thullium (HoLEP/ThuLEP), résection transurétrale de la prostate (RTUP) et adénomectomie voie haute (AVH).
Matériel et méthodes. — Les données de 237 patients traités chirurgicalement pour une HBP entre janvier 2012 et juin 2013 dans neuf centres français ont été recueillies rétrospectivement. Une estimation du coût de l'hospitalisation lié à l'intervention du point de vue de l'institution et une analyse de minimisation des coûts à partir de l'Échelle nationale des coûts 2010 ont été réalisées.
Results. — Au total, 99 (42 %), 23 (10 %), 64 (27 %) et 51 (21 %) patients ont été traités par RTUP, AVH, HoLEP/ThuLEP et PVP, respectivement. Pour les prostates avec un volume < 80 mL : le temps opératoire moyen était inférieur avec la TURP et la PVP comparé à l'HoLEP/thuLEP ($p < 0{,}001$) ; la durée moyenne d'hospitalisation était inférieure avec l'HoLEP/ThuLEP comparé à la PVP et à la RTUP (1,9, 3 vs. 3,4 jours, respectivement, $p = 0{,}006$) ; Les coûts estimés de l'hospitalisation initiale étaient comparables entre HoLEP/ThuLEP et RTUP, mais supérieurs avec la PVP ($p < 0{,}001$). Pour la prostate avec un volume ≥ 80 mL : comparée à la PVP et à l'HoLEP/ThuLEP, l'AVH était associée à une durée opératoire plus courte ($p < 0{,}001$), une durée d'hospitalisation plus longue (2,4, 4,2 vs. 7,8 jours, respectivement, $p < 0{,}0001$) et une augmentation des coûts estimés de l'hospitalisation initiale ($p < 0{,}001$).

Conclusions. — PVP et HoLEP/ThuLEP sont associés à une diminution de la durée moyenne d'hospitalisation. Dans le modèle économique utilisé, cette diminution permettrait de diminuer le coût d'hospitalisation comparé à l'AVH, mais ne permettrait pas à ces procédures d'être plus avantageuses que la RTUP.

Niveau de preuve.— 5.

© 2017 Publié par Elsevier Masson SAS.

Introduction

With a high prevalence in industrialized countries, lower urinary tract symptoms (LUTS) due to benign prostatic obstruction (BPO) is a major public health concern [1]. Transurethral resection of the prostate (TURP) and open prostatectomy (OP) are standard procedures recommended by the European Association of Urology (EAU) for the surgical treatment of BPO [2]. During the last decade, minimally invasive surgical techniques, including photoselective vaporization of the prostate (PVP), holmium laser enucleation (HoLEP) and thullium laser enucleation (ThuLEP) have been introduced as alternatives to TURP and OP. Numerous studies have established that these techniques are safe and effective based on midterm follow-up [3].

New techniques may be associated with an increased cost in terms of equipment and consumables use. However, these additional costs may be balanced by shorter hospital stay and other improvements in perioperative care. Cost effectiveness of these new techniques still remains questionable and is a critical issue in an era of cost savings for healthcare systems.

The objective of this study was to assess perioperative cost related to surgical treatment of BPO.

Methods

Study design and population

Nine academic or private institutions in France participated in this retrospective study. In each center, data from 20 to 30 consecutive patients who underwent a surgical treatment for LUTS related to BPO between January 2012 and June 2013 were collected. All patients met criteria for surgery according to the guidelines of the EAU or the French Association of Urology [2,4]. Patients with a neurogenic bladder or past history of urethral stricture or prostate cancer were excluded.

The following data were collected in a computerized database:

- age;
- ASA score;
- prostate volume on transrectal ultrasound (TRUS);
- urinary retention before surgery;
- co-morbidities and anticoagulation therapy.

We evaluated perioperative parameters including operative time, length of hospital stay (LOS) and intra and postoperative complications (graded according to Clavien-Dindo's classification). Complications were defined as any abnormal medical or surgical event occurring within 30 days after surgery [5].

Procedures

TURP was performed using monopolar technology. PVP was performed using a Greenlight® laser 180 W-XPS (AMS, Minnetonka, MN, USA) with a moxy fiber. Sodium chloride solution (0.9%) was used as irrigation fluid. Generator was usually provided for free to the institution. During procedure, overcost compared to TURP was considered to be the use of a single moxy fiber; 700 € per procedure according to the manufacturer charge policy. ThuLEP and HoLEP were performed using the 100 W holmium laser generator manufactured by Lumenis™ and the Piranha™ morcellator manufactured by Richard Wolf™. Sodium chloride solution (0.9%) was used as irrigation fluid. Generators and morcellators were usually provided for free to the institution. During procedure, overcost compared to TURP was considered to be the use of a reusable laser fiber and blades of the morcellator; 70 € per procedure according to the manufacturer charge policy. OP was performed in each institution either by retropubic or transvesical approach.

Cost analysis

For modelization purposes, we assumed that short-term functional results after each procedure were entirely similar, based on available data from the literature. We performed a minimization cost analysis.

The outcome of each technique was assessed in terms of cost from the institutional perspective. Short-term hospital costs were evaluated for each procedure using the National costs study 2010 from French technical agency of information on hospitals (ATIH; Agence technique de l'information sur l'hospitalisation) database. The National costs study (NCS) defines for different procedures and groups of patients (groupes homogènes de malades [GHM]), variables costs and fixed costs related to the LOS. In our study, for each hospitalization, variables costs were conserved and fixed costs were recalculated by the ratio between observed LOS and mean national LOS. In NCS, only cost related to OP and TURP are considered. For PVP and ThuLEP/HoLEP, we considered variables and fixed costs used for TURP. Cost of equipment and single-use disposal related to innovative techniques were estimated according to the manufacturer charge policy. Using the method of readjusted NCS based on LOS: total cost of hospitalization = Σ variables costs + (fixed costs $\times$ [LOS''study''/MeanLOS''NCS2010'']) + overcost of consumables specific to alternative technique.

Table 1 Practice and characteristics of the institutions enrolled in the study.

Institution	1	2	3	4	5	6	7	8	9
Surgeons for procedures related to BPO	6	7	5	3	3	8	6	4	3
Practice	Public	Public	Private	Public	Public	Public	Public	Private	Public
Number of BPO procedures in 2012	179	188	146	113	298	450	235	240	160
Technique									
mTURP	76%	45%	41%	60%	45%	85%	22%	23%	90%
OP	24%	20%	3%	5%	40%	10%	3%	2%	10%
PVP	—	30%	—	—	—	5%	75%	75%	—
HoLEP/ThuLEP	—	5%	56%	35%	15%	—	—	—	—
Other	—	—	—	—	—	—	—	—	—

mTURP: monopolar transuretral resection of the prostate, PVP: photoselective vaporisation of the prostate; HoLEP: holmium laser enucleation of the prostate; ThuLEP: thullium laser enucleation of the prostate; BPO: benign prostatic obstruction.

Statistical analysis

χ^2 tests were performed to compare groups for non-parametric numerical data. Means from three or more groups were compared using the analysis of variance (ANOVA). A P-value < 0.05 was considered statistically significant. Relationships between complications and patient or treatment parameters were first analyzed using univariate regression logistic analysis. Multivariable analyses included covariates with a P-value < 0.05 in univariable analysis. All statistical analyses were processed using STATA 11.0.

Results

Institutional characteristics

Table 1 shows practice at the nine institutions involved in this study. Mean number of BPH procedures per year and institution was 223. None of these institutions performed bipolar TURP but seven proposed an alternative to standard treatments (PVP or Holep/Thulep). Overall, 55% and 14% of the patients underwent a monopolar TURP (mTURP) or an OP, respectively. A PVP or an HoLEP/ThuLEP were performed in 22% and 9% of cases, respectively. The use of a surgical alternative in the institution was not associated with a significant decrease in the use of OP (21% and 27% respectively, $P = 0.23$).

Patients' characteristics

A total of 237 patients who underwent surgery for BPH were included in this study. Patients' characteristics are summarized in Table 2 and grouped by technique. Mean age was 71.7 ± 9.8 years. Mean prostate volume was 65.5 ± 39.3 mL and 70 patients (30%) had a prostate volume ≥ 80 mL. Mean prostate volume was higher in the group of patients who underwent OP as compared to other surgical alternatives (124.3 vs. 65.5 mL, respectively). Fifty-six patients (24%) had a urethral catheter at the time of surgery. Sixty-four patients (27.7%) were receiving platelet aggregation inhibitors or oral anticoagulation before the procedure, with a higher ratio in the groups of PVP and HoLEP/ThuLEP (41% and 36% respectively, $P = 0.001$). Groups were comparable regarding age, ASA score and history of urinary retention.

Operative and postoperative characteristics

Perioperative characteristics are described in Table 3. In prostate of less than 80 mL, mean operative times per gram of tissue were 1.17, 1.29, and 1.69 min per mL of

Table 2 Patient characteristics.

	mTURP	Open prostatectomy	HoLep ThuLep	PVP	*P* value
n	99	23	64	51	
Mean age, years (SD)	71.1 (± 9.6)	72.7 (± 6.8)	71 (± 11)	71.8 (± 9.6)	0.84
Prostate volume, mL (SD)	49.5 (± 25)	124.3 (± 43.2)	64.9 (± 36.8)	68.8 (± 36.6)	< 0.0001
ASA Score					0.09
1–2 (%)	80%	91%	77%	69%	
3–4 (%)	20%	9%	23%	31%	
Urinary retention (catheter preoperatively) (%)	26%	22%	14%	31%	0.15
Platelet aggregation inhibitor or anticoagulation (%)	18%	4%	36%	41%	0.001

SD: standard deviation; mRTUP: monopolar RTUP; PVP: photoselective vaporisation of the prostate; HoLEP: holmium laser enucleation of the prostate; ThuLEP: thullium laser enucleation of the prostate.

Table 3 Perioperative characteristics.

	mTURP	Open prostatectomy	HoLEP/ThuLEP	PVP	*P* value
Mean operative time, min (SD)	48.1 (± 17.3)	69.9 (± 27.5)	82.4 (± 32.7)	72.5 (± 40.4)	< 0.001
Mean operative time per gram, min (SD)	1.10 (± 0.53)	0.61 (± 0.28)	1.51 (± 0.79)	1.17 (± 0.56)	< 0.001
Mean length of postoperative stay, days (SD)	3.4 (± 2.3)	8 (± 3.8)	2.6 (± 2.5)	2.8 (± 2.9)	< 0.001
Median length of stay, days	4	8	3	3	
Prostate < 80 mL, mean length of postoperative stay, days (SD)	3.4 (± 2.5)	—	1.9 (±1.3)	3 (± 3.5)	0.006
Prostate ≥ 80 mL, days, mean length of postoperative stay, days (SD)	—	7.8 (± 3.8)	4.2 (±2.7)	2.4 (± 1.4)	< 0.001

mRTUP: monopolar RTUP; PVP: photoselective vaporisation of the prostate; HoLEP: holmium laser enucleation of the prostate; ThuLEP: thullium laser enucleation of the prostate.

prostate with TURP, PVP and HoLEP/thuLEP respectively ($P < 0.0001$). In prostate ≥ 80 mL, mean operative times were 0.60, 0.96, and 1.04 min per mL of prostate with OP, PVP, and HolepLEP/ThuLEP ($P < 0.0001$). Mean LOS was 3.5 ± 3 days. In prostate ≥ 80 mL, OP was associated with a longer LOS than HoLEP/thuLEP and PVP (7.8, 4.2 and 2.4 respectively, $P < 0.0001$). For men with prostate volumes less than 80 mL, mean LOS with alternative surgical treatment were also shorter compared to TURP ($P = 0.001$).

Per and postoperative complications

No major intraoperative complication was reported. Postoperative complications Clavien ≥ 2 occurred in 52 patients (22%). Twenty-six patients (11%) required readmission. Major complications (grade ≥ 3) were reported in 4 patients and included hemorrhagic events with a new procedure in 3 patients and a myocardial infarct in one patient. In multivariable analysis, age ($P = 0.01$), prostate volume ($P = 0.01$) and ASA score ($P = 0.02$) were independent predictors of overall complications while technique ($P = 0.71$) and API ($P = 0.72$) were not.

Cost analysis

Costs from institution perspective according prostate volume and technique are summarized in Table 4. Costs of hospitalization for prostate < 80 mL were similar between TURP and HoLEP/ThuLEP, but higher with PVP (2168€, 2007€ and 2659€, respectively, $P < 0.001$). For larger prostate, PVP and HoLEP/Thulep were associated with cheaper costs than OP (2501€, 2702€ and 3375€ respectively, $P < 0.001$).

Discussion

PVP and HoLEP are now considered safe and effective surgical alternatives to standard treatments in BPH [3]. These procedures provide several advantages including reduction of bleeding, prevention of TURP syndrome and decrease of hospital stay [6]. One other potential major benefit would be a decrease of healthcare costs. Evaluation of perioperative outcome and cost effectiveness of these techniques compared to standard treatments from multi-institutional study is a critical issue.

Our study shows that PVP and HoLEP are associated with a shorter length of stay than TURP or OP. Data from randomized controlled trials, gathered recently in a meta-analysis by Cornu et al., show that compared to TURP, PVP and HoLEP are associated with a reduction of hospital stay (1.4 and 1.85 days, respectively). Compared to OP, this reduction reaches a mean difference of 4 days with HoLEP [3]. Alivizatos et al. reported a similar reduction of LOS with PVP [7]. In our study, the reduction of LOS is less important than expected. It could be a consequence of patients' comorbidities or anticoagulation in these groups but we did not find such a difference in our analysis. We believe it reflects the management of alternative surgical treatments in few centers during their initial implementation phase or during the learning curve of some surgeons.

Despite the apparent higher initial costs of the devices and consumables, PVP and HoLEP could be cheaper than TURP and OP due to their benefit regarding LOS. In our study, use of an alternative surgical treatment for prostate larger than 80 mL was associated with a higher operative time per gram but shorter LOS. Mean reductions of cost with PVP and HoLEP/ThuLEP were 874€ and 673€, respectively. These results are similar to those observed in previous studies with PVP [8] and HoLEP [9]. Raimbaud et al. evaluated cost effectiveness of PVP and OP in French healthcare system and reported a mean additional cost of 1450 euros for OP [8]. With HoLEP, Salonia et al. demonstrated a 10% reduction of cost hospitalization [9].

Few studies evaluated the cost effectiveness of HoLEP in comparison to TURP but all reported a significant short-term benefit for this surgical alternative [10,11]. Several studies have already compared costs of PVP and TURP, mostly with the 80 W and 120 W technologies. Most of these studies concluded to a benefit for PVP [12—15]. Recently, some authors did not find any significant difference between TURP and PVP [16,17]. Armstrong et al. previously concluded PVP was even less cost effective than TURP [18]. To our knowledge, only one study compared the last technology XPS 180 W but

Table 4 Cost analysis.

	Prostate volume < 80 mL				Prostate volume ≥ 80 g			
	mRTUP	PVP	HoLEP/ThuLEP	*P* value	OP	PVP	HoLEP/ThuLEP	*P* value
Mean cost of hospitalization (€), SD	2168 ± 595.9	2659.2 ± 1397.1	2007.4 ± 546.1	< 0.001	3375.2 ± 723.4	2501.4 ± 540.4	2702.2 ± 782.8	< 0.001

mRTUP: monopolar RTUP; PVP: photoselective vaporisation of the prostate; HoLEP: holmium laser enucleation of the prostate; ThuLEP: thullium laser enucleation of the prostate; OP: open prostatectomy.

demonstrated a significant benefit for PVP, mostly due to the reduction of LOS [19]. These studies are inhomogeneous regarding quality and methodology. Cost effectiveness of PVP compared to TURP is still questionable. In our study, reduction of LOS was not sufficient to conclude to a significant cost reduction with the surgical alternative when compared to TURP. Cost effectiveness with these new surgical alternatives could probably even be more considerable with their development in an outpatient setting. Indeed, several studies have reported PVP and HoLEP are feasible in an ambulatory setting [20]. Ambulatory surgery requires the development of dedicated unit but is one of national health authorities' priorities [21]. Therefore, Goh and Gonzalez demonstrated that PVP with the greenlight 120W-HPS cost less than TURP ($4266 vs. $5097) but most of the patients were treated on an outpatient basis (defined as discharge home within 23 hours of hospitalization) in this study [12]. In high-risk patients, PVP and HoLEP could also demonstrate better results and provide significant cost savings we did not report in our study.

We observed a low rate of major complications. Complication and readmission rates were higher in the groups of surgical alternatives, mostly due to urinary retentions and hemorrhagic events. Urinary retentions were treated by transient recatheterization and patients were discharged one day later. One month after the procedure, only 4 patients were not catheter free. Hemorrhagic events were mostly managed by transient irrigation and only two patients required new procedure. The cost of readmissions was not evaluable in our study but could limit our conclusions concerning cost effectiveness of these procedures. However, in multivariable analysis, the technique was not a predictive factor of complication and the relation we observed could be partly due to a higher rate of patients with anticoagulation or ASA score > 2 in these groups.

Our study has several other limitations. First, the study is limited by its retrospective nature and the corresponding cost minimization analysis methods. Due to the lack of specific data in the National cost study and no specific reimbursement for PVP and HoLEP/ThuLEP in France, cost evaluation and profitability is mostly extrapolated from TURP evaluation and comparison essentially based on direct costs associated with the LOS and related French healthcare specificities. Evaluation of the reduction of some consumables such as intraoperative glycine and irrigation fluids, overtime in the operatory room and potential depreciation expense associated with generator acquisition were not considered. We assumed that for PVP one fiber was used per patient and that for LEP, one fiber was used for twenty procedures. A higher use of fiber especially in large prostate could limit our conclusions in this group. Surgeons' skills and experience regarding the procedures were not available. Therefore, the impact of the learning curve and results from few centers during their initial implementation phase of management for some alternative surgical treatments may have biased the results, especially regarding the LOS. No assessment of economic value related to the reduction of LOS in terms of bed availability, early rehabilitation for workers has been either considered. Finally, our study is a short-term cost analysis of the procedures that only relies on the costs incurred during first hospitalization. Integration of the costs related to readmissions may confer further evidence regarding cost effectiveness of alternative surgical treatments. In a midterm follow-up, some authors suggest new alternative treatments could be associated with a higher reinterventions rate, especially in patients with larger prostate volume [22]. Overcost associated with these new procedures could limit our results and cost effectiveness of HoLEP and PVP in large prostate.

However, we believe it is a fair evaluation of the cost-effectiveness of new alternatives for surgical treatments of BPH that compared PVP and HoLEP/thuLEP to TURP and OP in a real world setting in several public and private institutions. This minimization cost analysis is mainly based on a simulation of first hospitalization costs between techniques and differences related to a reduction of LOS. This endpoint is often part of the discussion between the urological community and their institutions. However, long-term longitudinal prospective studies of total costs of these techniques are necessary to clearly conclude on their cost effectiveness.

Conclusion

In this multi-institutional study, use of PVP and HoLEP/ThuLEP significantly decreases LOS. Regarding first hospitalization cost, these procedures could be cost effective alternatives to OP. However, the mean LOS we observed in our study is still not sufficient to consider that these procedures are cheaper or more cost effective than TURP for prostate less than 80 mL.

Disclosure of interest

R. Mathieu: support for Congress by AMS; S. Lebdai: no; J.N. Cornu: consultant for companies, Allergan, Astellas, Boston Scientific, Bouchara-Recordati, Coloplast,

Medtronic, Mundipharma, Pfizer, SAP, Takeda and investigator for Astellas, Cousin Biotech, Coloplast, GT Urological, Ipsen and Medtronic; A. Benchikh: no; A.R. Azzouzi: no; N.B. Delongchamps: no; O. Dumonceau: no; A. Faix: no; M. Fourmarier: trainer for company EDAP-TMS and Boston scientific; O. Haillot: not stated conflict of interest; B. Lukacs: lecturer for Mylan; V. Misrai: trainer for Boston Scientific; A. de la Taille: no; G. Robert: trainer for company EDAP-TMS and Lumenis; A. Descazeaud: no.

References

[1] Wei JT, Calhoun E, Jacobsen SJ. Urologic diseases in America project: benign prostatic hyperplasia. J Urol 2008;179:S75—80.

[2] Gratzke C, Bachmann A, Descazeaud A, Drake MJ, Madersbacher S, Mamoulakis C, et al. EAU guidelines on the assessment of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. Eur Urol 2015;67:1099—109.

[3] Cornu JN, et al. A systematic review and meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic obstruction: an update. Eur Urol 2014, http://dx.doi.org/10.1016/j.eururo.2014.06.017.

[4] Descazeaud A, Robert G, Delongchamps NB, Cornu JN, Saussine C, Haillot O, et al. Initial assessment, follow-up and treatment of lower urinary tract symptoms related to benign prostatic hyperplasia: guidelines of the LUTS committee of the French Urological Association. Prog Urol 2012;22:977—88.

[5] 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;240:205—13.

[6] Oelke M, Bachmann A, Descazeaud A, Emberton M, Gravas S, Michel MC, et al. EAU guidelines on the treatment and follow-up of non-neurogenic male lower urinary tract symptoms including benign prostatic obstruction. Eur Urol 2013;64:118—40.

[7] Alivizatos G, Skolarikos A, Chalikopoulos D, Papachristou C, Sopilidis O, Dellis A, et al. Transurethral photoselective vaporization versus transvesical open enucleation for prostatic adenomas > 80 mL: 12-mo results of a randomized prospective study. Eur Urol 2008;54:427—37.

[8] Raimbault M, Watt S, Bourgoin H, Brichart N, Bruyere F. Comparative analysis of photoselective vaporization of the prostate with the Greenlight laser and open prostatectomy for high volume prostate hypertrophy. Prog Urol 2014;24:470—6.

[9] Salonia A, Suardi N, Naspro R, Mazzoccoli B, Zanni G, Gallina A, et al. Holmium laser enucleation versus open prostatectomy for benign prostatic hyperplasia: an inpatient cost analysis. Urology 2006;68:302—6.

[10] Fraundorfer MR, Gilling PJ, Kennett KM, Dunton NG. Holmium laser resection of the prostate is more cost effective than transurethral resection of the prostate: results of a randomized prospective study. Urology 2001;57:454—8.

[11] Lourenco T, Armstrong N, N'Dow J, Nabi G, Deverill M, Pickard R, et al. Systematic review and economic modelling of effectiveness and cost utility of surgical treatments for men with benign prostatic enlargement. Health Technol Assess 2008;12:iii [ix-x, 1-146, 169-515].

[12] Goh AC, Gonzalez RR. Photoselective laser vaporization prostatectomy versus transurethral prostate resection: a cost analysis. J Urol 2010;183:1469—73.

[13] Bouchier-Hayes DM, Van Appledorn S, Bugeja P, Crowe H, Challacombe B, Costello AJ. A randomized trial of photoselective vaporization of the prostate using the 80-W potassium-titanyl-phosphate laser vs. transurethral prostatectomy, with a 1-year follow-up. BJU Int 2010;105:964—9.

[14] Stovsky MD, Griffiths RI, Duff SB. A clinical outcomes and cost analysis comparing photoselective vaporization of the prostate to alternative minimally invasive therapies and transurethral prostate resection for the treatment of benign prostatic hyperplasia. J Urol 2006;176:1500—6.

[15] Stafinski T, Menon D, Harris K, Md GG, Jhangri G. Photoselective vaporization of the prostate for the treatment of benign prostatic hyperplasia. Can Urol Assoc J 2008;2:124—34.

[16] Whitty JA, Crosland P, Hewson K, Narula R, Nathan TR, Campbell PA, et al. A cost-minimisation analysis comparing photoselective vaporisation (PVP) and transurethral resection of the prostate (TURP) for the management of symptomatic benign prostatic hyperplasia (BPH) in Queensland, Australia. BJU Int 2014;113(Suppl 2):21—8.

[17] Liatsikos E, Kyriazis I, Kallidonis P, Sakellaropoulos G, Maniadakis N. Photoselective GreenLight laser vaporization versus transurethral resection of the prostate in Greece: a comparative cost analysis. J Endourol 2012;26:168—73.

[18] Armstrong N, Vale L, Deverill M, Nabi G, McClinton S, N'Dow J, et al. Surgical treatments for men with benign prostatic enlargement: cost effectiveness study. BMJ 2009;338:b1288.

[19] Benejam-Gual JM, Sanz-Granda A, Budia A, Extramiana J, Capitan C. Multicenter study on costs associated with two surgical procedures: GreenLight XPS 180 W versus the gold standard transurethral resection of the prostate. Actas Urol Esp 2014;38:373—7.

[20] Berquet G, Corbel L, Della Negra E, Huet R, Trifard F, Codet Y, et al. Prospective evaluation of ambulatory laser vaporization of the prostate for benign prostatic hyperplasia. Lasers Surg Med 2015;47:396—402.

[21] Sinclair AM, Gunendran T, Pearce I. Day-case urological surgery: are we improving? BJU Int 2007;99:491—3.

[22] Al-Ansari A, Younes N, Sampige VP, Al-Rumaihi K, Ghafouri A, Gul T, et al. G reenLight 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;58:349—55.