Sexual outcome of patients undergoing thulium laser enucleation of the prostate for benign prostatic hyperplasia

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INTRODUCTION
Benign prostatic hyperplasia (BPH) is a common medical condition. Transurethral resection of the prostate is currently considered the surgical gold standard worldwide to treat BPH, as well as open prostatectomy (Millin vs the transvesical approach) for an enlarged prostate. Nevertheless these procedures often expose older patients to increased perioperative morbidity.1,2

Indications for surgical treatment of BPH are explained in the EAU Guidelines and are strictly related to lower urinary tract symptoms (LUTS).3 Holmium laser enucleation of the prostate (HoLEP), which is a further option, is also performed as an accepted alternative to transurethral resection of the prostate and open procedures.4 The effects of the latest surgical procedures for treating BPH have been poorly studied, and their effect on the quality of sexual function, mainly associated with ejaculation, is unknown. Previous studies have reported a consistent decrease in the International Index of Erectile Function 5 (IIEF-5) score, which measures orgasmic function, without any difference among analyzed procedures.5

Thulium laser enucleation of the prostate (ThuLEP) is a new procedure for treating BPH.6 The 2010 nm-wavelength thulium laser conducts through saline and enables incision and coagulation of prostatic tissue. Similar to HoLEP, ThuLEP has been implemented with development of the soft tissue morcellator to allow complete enucleation.7

To the best of our knowledge, sexual function in men who have undergone ThuLEP has not been evaluated in a prospective study relying on validated instruments. Therefore, in the current study, we assessed the effect of ThuLEP on sexual function of some patients with LUTS secondary to BPH and retrograde ejaculation.

PATIENTS AND METHODS
Patients' selection
We performed a prospective study on changes in sexual function. The study was approved by our Local Ethical Committee. A total of 180 consecutive patients, who had symptomatic BPH and had a surgical indication according to EAU Guidelines,1 were enrolled in this study from January 2012 to January 2013. Patients who were older than 80 years old who had previous open or endoscopic management of BPH and abdominal surgery, were not included in the study to avoid any bias related to postsurgical overactive bladder syndrome.

Treatment and follow-up
According to the exclusion criteria mentioned below, 110 patients were recruited and each of them was treated with ThuLEP with the...
Cyber TM 150 device (Quanta System, Solbiate Olona, Varese, Italy). All of the surgical procedures were performed by three surgeons (LC, SC, and GB) who were fully trained in ThuLEP. This surgical technique has already been previously described. A maximum power of 110 W was set for each case. The Piranha Morcellator device (Richard Wolf, Knittlingen, Germany) was used at the end of the enucleation step. Postoperative Foley catheter irrigation was performed and removed the day after surgery. Patients were assessed by a prostate physical examination, total serum prostate specific antigen levels, digital rectal examination, urine culture, transrectal ultrasound (TRUS) (to evaluate prostatic volume), the International Prognostic Scoring System (IPSS), and uroflowmetry. Some of them also underwent a urodynamics study to assess whether detrusor hypercontractility could explain altered flow. Patients with a prostate specific antigen level higher than 4 ng ml⁻¹ underwent TRUS biopsy to exclude cases of prostatic carcinoma.

Questionnaires and statistical analysis employed

To assess changes in erection and ejaculation, and the effect of urinary symptoms on the quality of life (QoL), five validated questionnaires were used: the ICIQ-MLUTSsex, MSHQ-EjD, IIEF-5, IPSS questionnaire, and QoL. Index of the intracorrelation coefficients. Patients were evaluated preoperatively and at 3 and 6 months after ThuLEP. Flowmetry was performed during the follow-up period to assess changes in flow. Patients were not asked to ride a bicycle or motorbike during the 1st month after surgery to decrease the risk of hematuria and clot retention.

The collected data were analyzed by an online regression (Student’s t-test, Chi-square test, and logistic regression analysis) tool at www.xuru.org using linear least squares fittings. For all statistical comparisons, significance was considered at $P < 0.05$.

RESULTS

Table 1 shows the patients’ characteristics. The patients’ mean age was 67.83 years (standard deviation [s.d.]: 7.74; range: 52.28–85.13 years). The mean prostate volume was 75.46 ml (s.d.: 43.75; range: 21.77–235.12 ml). Sixty-nine (62.7%) patients had been previously treated with alpha blockers, while six of them (8.7%) received a combination of finasteride and alpha blockers. Not all of the patients (16/110, 14.5%) reported a stable heterosexual relationship of at least 6 months duration. Thirty-one (28.2%) patients had undergone TRUS biopsy before ThuLEP.

Table 2 shows the changes in scores of the questionnaires used. Table 3 shows flowmetry results. A significant and sustained improvement in the scores of questionnaires for evaluating urinary symptoms was observed. There was no significant difference in patients’ erectile function before and after surgery. Analysis of the postoperative MSHQ-EjD showed 58 (52.7%) patients with consistent ejaculation function (EF) after ThuLEP. This rate was 78.4% (58/74) when we excluded patients with previous ED, no possibility of having sexual intercourse, and those with previous ejaculatory dysfunction not related to alpha blockers. Seven of the 58 patients (12.1%) reported painful ejaculation. Analysis of the postoperative ICIQ-MLUTSsex questionnaire showed no significant change in erectile function after ThuLEP. A similar result was obtained for the IIEF-5 Questionnaire (Table 4).

Interestingly, patients who maintained their antegrade ejaculation were found to be more sexually satisfied than the other patients.

A total of 51.7% (30/58) of patients expertise blood in seminal liquid after the surgical procedure. All of these patients who had undergone TRUS biopsy, also experienced it. Eight (7.3%, 8/110) patients were re-admitted because of clot retention. Adverse events, as well as operative and postoperative findings are shown in Table 5. Two patients had to be re-operated during hospitalization because of gross hematuria after accidental catheter removal. No ureteral strictures were observed during follow-up.

DISCUSSION

Benign prostatic hyperplasia is a common condition in middle-aged and older men. Many surgical treatments have been offered as alternative to current BPH gold standards. Most of these treatments are not as durable or effective as TURP and open prostatectomies for BPH, and these surgical techniques still have a consistent rate of morbidity. Even in skilled hands, bleeding and TUR syndrome remain the most
dangerous complications for patients undergoing TURP. Bleeding, length of hospitalization, and postoperative detrusor contractions, besides common complications following any open surgical approach, are quite frequent in any open prostatectomy performed for large BPH.

Laser-based techniques for BPH have increased in recent years. Their characteristics determine their versatility in BPH and endoscopic treatments for stones. HoLEP is equivalent to TURP and open prostatectomies with respect to clinical outcomes and QoL. However, HoLEP is superior with regard to perioperative morbidity with reduced bladder irrigation, catheter time and hospital stay, even though an equivalent volume of prostatic tissue is resected or enucleated.

Thulium laser enucleation of the prostate is currently used to treat BPH. Gross et al. showed that, similar to HoLEP, thulium vapo-enucleation of the prostate (ThuVEP), which has a different surgical technique, has an equivalent clinical outcome on LUTS compared with gold standard techniques. ThuVEP also minimizes the transfusion rate, the length of hospitalization, and postoperative complications.

Some evidence supports the theory that BPH combined with sexual and ejaculatory dysfunction are simply coexisting, and this is mainly related to metabolic and hormonal changes, usually affecting men. The multinational survey of the aging male, Erycphal and Hatzichristou showed that men with BPH and ED compared to those with ED alone, experienced a significant reduction in QoL. HoLEP and ThuVEP may improve sexual function.

### Table 5: Operative and postoperative findings and adverse events

| Findings                                   | Rate                |
|--------------------------------------------|---------------------|
| Stop bladder irrigation (h, mean ± s.d.)   | 20.21 ± 12.82       |
| Catheter removal (h, mean ± s.d.)          | 33.00 ± 13.93       |
| Acute urinary retention, n (%)             | 8 (7.3)             |
| Discharge (day, mean ± s.d.)               | 2.44 ± 1.45         |
| Hemoglobin decrease (g dl⁻¹)               | Δ-1.05              |
| Blood transfusion (n)                      | 2                   |
| Operative time (min, mean ± s.d.)          | 82.00 ± 43.77       |
| Incidental tumors adenocarcinoma (n)       | 4                   |
| Presence of TCC of the bladder (n)         | 3                   |
| Coagulation of bleeders in the prostatic fossa (n) | 2   |

SD: standard deviation; TCC: transitional cell carcinoma

### Table 6: Outcome of male sexual function in different laser prostate surgical techniques

| Author                                    | Laser technique | Laser type | n  | Assessment tool | Control | Outcome (EF and retrograde ejaculation) % |
|-------------------------------------------|-----------------|------------|----|-----------------|---------|----------------------------------------|
| Montorsi et al. 2004²⁹                     | Enucleation (HoLEP) | Ho:YAG     | 52 | IIEF-15         | TURP    | EF did not show a change from baseline |
| Briganti et al. 2006¹⁴                     | Enucleation (HoLEP) | Ho:YAG     | 32 | IIEF-15         | TURP    | Reduced orgasmic function domain significantly with marginal EF improvement |
| Wilson et al. 2006¹⁴                       | Enucleation (HoLEP) | Ho:YAG     | 31 | Nonvalidated questionnaire | TURP | Potency: 3.9 improved, 3.9 deteriorated 6.5 new onset ED |
| Meng et al. 2007²¹                        | Enucleation (HoLEP) | Ho:YAG     | 108| DanPSS sex      | None    | Do not affect the sexual functions significantly but improve ability to achieve early morning erection |
| Jeong et al. 2012²²                       | Enucleation (HoLEP) | Ho:YAG     | 38 | IIEF      | None    | EF did not show a change from baseline |
| Bach et al. 2011¹³                        | ThuVEP           | Thulium:YAG| 90 | IIEF-5         | None    | Marginal nonsignificant EF improvement |
| Yee et al. 2012¹⁴                        | Vaporesection (ThuVaRP) | Thulium:YAG| 113| -            | None    | 20% experienced worsening erectile function |
| Elmansy et al. 2010²²                     | Ablation (PVP)   | Green light - KTP - Ho:YAG | 30.33| IIEF-15 | 2 types of laser | EF did not show a change from baseline |
| Horasanli et al. 2008²⁸                   | Ablation (PVP)   | Green light - KTP | 39 | IIEF-5 | TURP | EF did not show a change from baseline |
| Kavoussi and Hermans 2008²⁷              | Ablation (PVP)   | Green light - KTP | 105| SHIM        | None    | EF did not show a change from baseline |
| Spaliviero et al. 2010²⁰                 | Ablation (PVP)   | Green light - LBO | 72 | SHIM        | None    | No detrimental effect on EF |
| Bouchier-Hayes et al. 2010²⁵             | Ablation (PVP)   | Green light - KTP | 60 | BSFQ        | TURP | EF did not show a change from baseline |
| Bruyère et al. 2010³⁰                   | Ablation (PVP)   | Green light - KTP - LBO | 149.63| IIEF-5 | None | Significant decrease in EF in patients with basal IIEF-5>19 |
| Kumar et al. 2012²¹                    | Ablation (PVP)   | Green light - KTP | 150| IIEF-5 | None | Significant decrease in EF in patients with basal IIEF-5>19 |
| Hossack and Woo 2012²⁵                  | Ablation (PVP)   | Green light - LBO | 328| IIEF-5 | None | Significant decrease in EF |
| Elshal et al. 2012²³                   | Enucleation (HoLEP) Ablation (HoLAP) Ablation (PVP) | Ho:YAG Green light | 191| IIEF-15 | Three types of laser | Laser prostate surgery using more size-related laser energy might have possible negative influence on sexual function |

PVP: photoselective vaporization of the prostate; HoLEP: holmium laser enucleation of the prostate; HoLAP: holmium laser ablation of the prostate; ThuVEP: thulium vapo-enucleation of the prostate; ThuVaRP: thulium laser vaporesection of the prostate; IIEF: International Index of Erectile Function; Ho:YAG: holmium:yttrium aluminium garnet; LBO: lithium triborate laser; KTP: potassium titanyl phosphate; BSFQ: Brief Sexual Function Questionnaire; SHIM: sexual health inventory for men; TURP: transurethral resection of the prostate.
a large-scale, multinational survey on approximately 14,000 men aged 50–80 years, reported that although 90% of men had LUTS, 83% of them still had sexual activity.13 This survey also highlighted that erectile and EF play an important role in the QoL, even in aged men with symptomatic BPH.

Some studies have provided controversial evidence regarding postoperative erectile dysfunction (ED) after TURP and open prostatectomies for BPH.14,15 Wasson et al.16 investigated ED after TURP in an untreated group and did not find any increase in the rate of ED in the TURP group. Induced neuropraxia by different forms of energy has been indicated as a possible reason of a transient postoperative ED. Conversely, evidence has indicated a strict correlation between surgical management of BPH and retrograde ejaculation. To the best of our knowledge, our study is the first to focus on sexual and EF after ThuLEP.

Briganti et al.17 achieved an equivalent outcome with regard to ED and EF between TURP and HoLEP. This suggests that these two surgical approaches are similarly associated with a high risk of postoperative ejaculatory dysfunction, mainly owing to retrograde ejaculation. Our series, using different questionnaires preoperatively and postoperatively, showed an overall conservation rate of antegrade ejaculation of 52.7%. If only those patients with possibilities of sexual intercourse were included, this rate was 78.3%. However, the rate of ED after ThuLEP was only 2.7% (Table 4). Table 6 shows the outcomes of male sexual function in different laser prostate surgical techniques; the final results can be easily compared with those of the current study.18,19,20,21 Several previous studies, mainly on alpha blockers, have shown how antegrade ejaculation can positively affect sexual satisfaction. There were also no significant differences in EF among three different groups with regard to prostatic volume (<40 ml, ≥40 ml and <100 ml, >100 ml). It is not the prostatic volume that may affect or not antegrade ejaculation after ThuLEP (Table 7). The reason for such a good result could be related to the surgical technique of laser enucleation of the prostate.6 A less deep incision typical of a thulium laser device (0.1–0.2 mm) can also determine the absence of transient ED because it does not involve neurovascular bundles of the capsule in the so-called neuropraxia phenomenon.14 On the same hand similar aspects have been underlined by a recent study by Xia.26 Further, from an anatomical and prospective view, further studies are required to better understand how EF can be better preserved. Also a comparison to TURP in a prospective study would have possibly shown the good results of ThuLEP regarding EF.

In our study, the good results on the postoperative IPSS and flowmetry showed that ThuLEP allowed radical prostatic adenoma enucleation. Preserved antegrade ejaculation was not correlated to partial enucleation of prostatic adenoma, as normally occurs during alpha blocker therapy when retrograde ejaculation appears and disappears once therapy is stopped.

A reduced learning curve is another important advantage of the proposed new surgical technique.8 This can be achieved with the help of a PC-based dry simulator and 15–20 tutored cases. The dry simulator is made by Quanta System.

In the current study, clot retention was the main complication owing to anticoagulants taken by patients because of cardiovascular issues. Blood in seminal fluid is a surgical-related side effect, mainly found in patients with a previous TRUS biopsy.

**CONCLUSIONS**

Thuilum laser enucleation of the prostate is an efficient technique, which is performed with a safe energy source. ThuLEP represents a simple new shift in the endoscopic management of BPH and can be used to treat prostates of any size. This technique improves the scores of questionnaires that are used to assess urinary symptoms and their effect on the QoL in patients. Antegrade ejaculation is mainly conserved in patients who undergo ThuLEP, with good effects on erectile function. Further, from a mainly anatomical and prospective view, further studies are required to better understand how EF can be better preserved with ThuLEP.

**AUTHOR CONTRIBUTION**

LC and GB have made the study design and the critical review. GB and SP have been involved in data interpretation, performed the statistical analysis and drafting the manuscript. AM and SM has been involved in data collections. SC was involved in drafting the manuscript with regards to layout. All Authors read and approved the final manuscript.

**COMPETING INTERESTS**

All authors declare no competing interests.

**REFERENCES**

1. Serretta V, Morgia G, Fondacaro L, Curto G, Lo bianco A, et al. Open prostatectomy for benign prostatic enlargement in southern Europe in the late 1990s: a contemporary series of 1800 interventions. Urology 2002; 60: 623–7.
2. Mearini E, Marzi M, Mearini L, Zucchi A, Porena M. Open prostatectomy in benign prostatic hyperplasia: 10-year experience in Italy. Eur Urol 1998; 34: 480–5.
3. Oelke M, Bachmann A, Descaseaud A, Emberton M, Grivas S, 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.
4. Kuntz RM. Current role of lasers in the treatment of benign prostatic hyperplasia (BPH). Eur Urol 2006; 49: 961–9.
5. Lefield HH, Stoewelaar HJ, McDonnell J. Sexual function before and after various treatments for symptomatic benign prostatic hyperplasia. BJU Int 2002; 89: 208–13.
6. Herrmann TR, Bach T, Imkamp F, Georgiou A, Burchardt M, et al. Thulium laser enucleation of the prostate (ThuLEP): transurethral enucleation of anterior prostatectomy with laser support. Introduction of a novel technique for the treatment of benign prostatic obstruction. World J Urol 2010; 28: 45–51.
7. Gilling PJ, Kennett K, Das AK, Thompson D, Fraundorfer MR. Holmium laser enucleation of the prostate (HoLEP) combined with transurethral tissue morcellation: an update on the early clinical experience. J Endourol 1998; 12: 457–9.
8. Rosen RC, Catania JA, Althof SE, Pollack LM, O'Leary M, et al. Development and validation of four-item version of Male Sexual Health Questionnaire to assess ejaculatory dysfunction. Urology 2007; 69: 805–9.
9. Reich O, Gratze C, Bachmann A, Seitz M, Schlenker B, et al. Morbidity, mortality and early outcome of transurethral resection of the prostate: a prospective multicenter evaluation of 10,654 patients. J Urol 2008; 180: 246–9.
10. Ahlai SA, Gilling P, Kaplan SA, Kuntz RM, Madersbacher S, et al. Meta-analysis of functional outcomes and complications following transurethral procedures for lower urinary tract symptoms resulting from benign prostatic enlargement. Eur Urol 2010; 58: 384–97.
11. Wilson LC, Gilling PJ, Williams A, Kennet K, Kampton KM, et al. A randomised trial comparing holmium laser enucleation versus transurethral resection in the treatment of prostates larger than 40 grams: results at 2 years. Eur Urol 2006; 50: 569–73.
12. Xia SJ, Zhuo J, Sun XW, Han BM, Shao Y, et al. Thulium laser versus standard transurethral resection of the prostate: a randomized prospective trial. Eur Urol 2006; 53: 382–9.
13. Imkamp F, Bach T, Gross AJ, Kuczky MA, Herrmann TR. ThuLEP – Thulium laser enucleation of the prostate. J Endourol 2009; 23: 24.
14. Gross AJ, Netsch C, Knipper S, Hözel J, Bach T. Complications and early postoperative outcome in 1080 patients after thulium vapoenucleation of the prostate: results at a single institution. Eur Urol 2013; 63: 859–67.
15. Rosen R, Altwein J, Boyle P, Kirby RS, Lukacs B, et al. Lower urinary tract symptoms and male sexual dysfunction: the multinational survey of the aging male (MSAM-7). Eur Urol 2003; 44: 637–49.
16. Brookes ST, Donovan JL, Peters TJ, Abrams P, Neal DE. Sexual dysfunction in men after treatment for lower urinary tract symptoms: evidence from randomised controlled trial. BMJ 2002; 324: 1059–61.
17. Soderdahl DW, Knight RW, Hansbery KL. Erectile dysfunction following transurethral resection of the prostate. J Urol 1996; 156: 1354–6.
18. Wasson JH, Reda DJ, Bruskewitz RC, Elinson J, Keller AM, et al. A comparison of transurethral surgery with watchful waiting for moderate symptoms of benign prostatic hyperplasia. The Veterans Affairs Cooperative Study Group on Transurethral Resection of the Prostate. N Engl J Med 1995; 332: 75–9.
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19 Briganti A, Naspro R, Gallina A, Salonia A, Vavassori I, et al. Impact on sexual function of holmium laser enucleation versus transurethral resection of the prostate: results of a prospective, 2-center, randomized trial. J Urol 2006; 175: 1817–21.
20 Montorsi F, Naspro R, Salonia A, Suardi N, Briganti A, et al. Holmium laser enucleation versus transurethral resection of the prostate: results from a 2-center, prospective, randomized trial in patients with obstructive benign prostatic hyperplasia. J Urol 2004; 172: 1926–9.
21 Meng F, Gao B, Fu Q, Chen J, Liu Y, et al. Change of sexual function in patients before and after Ho:YAG laser enucleation of the prostate. J Androl 2007; 28: 259–61.
22 Jeong MS, Ha SB, Lee CJ, Cho MC, Kim SW, et al. Serial changes in sexual function following holmium laser enucleation of the prostate: a short-term follow-up study. Korean J Urol 2012; 53: 104–8.
23 Bach T, Netsch C, Pohlmann L, Herrmann TR, Gross AJ. Thulium: YAG vapoenucleation in large volume prostates. J Urol 2011; 186: 2323–7.
24 Yee CL, Pal RP, Batchelder A, Khan MA. Risk of erectile dysfunction and retrograde ejaculation associated with thulium laser vaporesection of the prostate for bladder outflow obstruction: a retrospective study. Urol Int 2012; 88: 165–9.
25 Elmansy M, Baazeem A, Kotb A, Mostafa M Elhilali A, et al. Holmium laser enucleation versus photo-selective vaporization for prostatic adenoma greater than 60 ml: preliminary results of a prospective, randomized clinical trial. J Urol 2012; 188: 216–21.
26 Horasanli K, Silay MS, Altay B, Tanriverdi O, Sarica K, et al. Photoselective potassium titanyl phosphate (KTP) laser vaporization versus transurethral resection of the prostate for prostates larger than 70 ml: a short-term prospective randomized trial. Urology 2008; 71: 247–51.
27 Kavoussi PK, Hermans MR. Maintenance of erectile function after photoselective vaporization of the prostate for obstructive benign prostatic hyperplasia. J Sex Med 2008; 5: 2669–71.
28 Spaliviero M, Strom KH, Gu X, Araki M, Culkin DJ, et al. Does Greenlight HPS(TM) laser photoselective vaporization prostatectomy affect sexual function? J Endourol 2010; 24: 2051–7.
29 Bouchier-Hayes DM, Van Appleford S, Bugeja P, Crowe H, Challacombe B, et al. 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.
30 Bruyere F, Puichaud A, Pereira H, Faire d’Arcier B, Rouanet A, et al. Influence of photoselective vaporization of the prostate on sexual function: results of a prospective analysis of 149 patients with long-term follow-up. Eur Urol 2010; 58: 207–11.
31 Kumar A, Vasudeva P, Kumar N, Nanda B, Mohanty NK. Evaluation of the effect of photoselective vaporization of the prostate on sexual function in a prospective study: a single center experience of 150 patients. J Endourol 2012.
32 Hossack TA, Woo HH. Sexual function outcome following photoselective vapourisation of the prostate. Int Urol Nephrol 2012; 44: 359–64.
33 Elshal AM, Elmansy HM, Elkoushy MA, Elhilali MM. Male sexual function outcome after three laser prostate surgical techniques: a single center perspective. Urology 2012; 80: 1098–104.
34 Fried NM, Murray KE. High-power thulium fiber laser ablation of urinary tissues at 1.94 microm. J Endourol 2005; 19: 25–31.
35 Xia SJ. Two-micron (thulium) laser resection of the prostate-tangerine technique: a new method for BPH treatment. Asian J Androl 2009; 11: 277–81.