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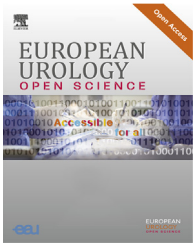

European Association of Urology

Open to Debate: Con

Thulium YAG is the Best Laser for the Prostate Because of Versatility

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Thulium:YAG laser represents the most versatile laser generator, allowing continuous-wave and pulsed laser energy application. For the full spectrum of transurethral endoscopic surgical approaches for benign prostatic obstruction (BPO), thulium:YAG offers the widest range of applications with clinical momentum and usage and is thus currently regarded as a valid alternative to holmium:YAG and bipolar resection. In the absence of significant evidence of superiority of one laser over the other for endoscopic enucleation of the prostate (EEP), laser choice is mainly based on personal preference. However, if the whole spectrum of surgical management approaches for BPO are considered, thulium:YAG provides the greatest versatility because of its physical properties that allow superior vaporising capacity. Procedures focusing on tissue vaporisation can best be carried out using continuous-wave mode. Transition from vapoenucleation to mechanical enucleation can be achieved using either the mechanical force of pulsed thulium:YAG laser energy and/or mechanical preparation with the sheath. In the debate on the "best" laser not only for EEP but also for the whole armamentarium of approaches, thulium:YAG shows superiority to thulium fibre and holmium:YAG lasers because of the broadest spectrum of clinically relevant procedures used today.

Regarding the question of which laser might be the best for surgical management of benign prostatic obstruction (BPO), there is a full range of surgical modalities to consider, although all panel members in this open debate in *European Urology Open Science* are advocates of anatomical endoscopic enucleation of the prostate (EEP) [1–6]. However, as the 2022 edition of the European Association of Urology (EAU) guidelines on management of non-neurogenic male lower urinary tract symptoms (LUTS) and BPO suggest (Fig. 1) [7], surgical management of BPO regarding "ablative procedures" is broader and can be subdivided into resection, enucleation, and vaporisation for different clinical scenarios.

Debating this topic today is rather a luxury issue or a matter of taste and personal view regarding EEP, as the latest generation of laser generators has been well augmented in terms of previous "weak spots". In general, thulium has competence in "mechanical action", that is for lithotripsy and tissue disruption on one hand [8–10], while pulse modification for holmium has improved its vaporising and coagulating flaws [11]. Subsequently, the intraoperative appearance at the level of dissection changed because of new modes of action, so viewers of live and semi-live demonstrations sometimes have difficulties in distinguishing which of the two energy sources is actually at work. Owing to a lack of sufficient head-to-head comparison data from randomised controlled trials (RCTs) for these relatively new kids on the blocks, the 2022 EAU guidelines position thulium-based EEP as a valid alternative to other enucleation techniques—namely bipolar enucleation and holmium laser enucleation of the prostate (HoLEP)—for large and medium prostates and for patients on anticoagulant or antiplatelet medication [12].

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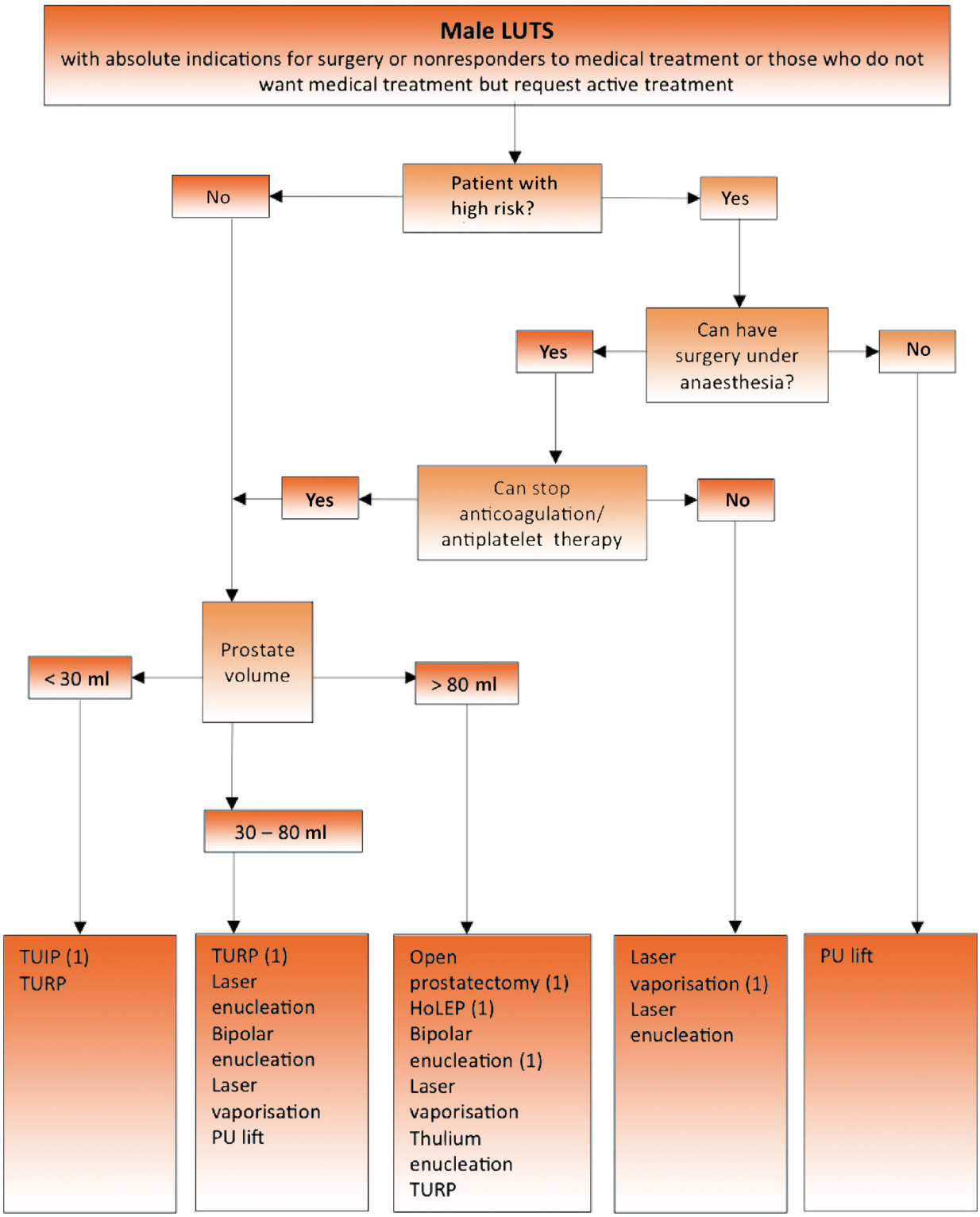

Fig. 1 – Treatment algorithm for bothersome lower urinary tract symptoms (LUTS) refractory to conservative/medical treatment or in cases with an absolute surgical indication according to the European Association of Urology 2022 guidelines [12]. The flowchart is stratified by ability to undergo anaesthesia, cardiovascular risk, and prostate size. The annotation (1) indicates the current standard/first choice, with alternative treatments presented in alphabetical order. Laser vaporisation includes GreenLight, thulium, and diode laser vaporisation. Laser enucleation includes holmium and thulium laser enucleation. HoLEP = holmium laser enucleation of the prostate; PU = prostatic urethral; TUIP = transurethral incision of the prostate; TURP = transurethral resection of the prostate.

The maturity of the data for thulium:YAG enucleation techniques has now overcome the leadtime bias for HoLEP [4]. According to the EAU guidelines panel on male LUTS, the certainty of evidence required in comparison to HoLEP is adequate [13]. The superior haemostatic and cutting properties of thulium:YAG in continuous-wave (CW) mode have been demonstrated in meta-analyses. A meta-analysis evaluating thulium laser energy–assisted mechanical

enucleation (ThuLEP) versus HoLEP showed a significantly lower haemoglobin decrease with ThuLEP [14]. Transient urinary incontinence was more common with HoLEP. Intraoperatively, ThuLEP showed shorter operation times in comparison to HoLEP [15] and a multicentre RCT demonstrated lower haemoglobin loss for ThuLEP in comparison to HoLEP [16]. Surgical enucleation time was significantly shorter with ThuLEP than with HoLEP but there were no significant differences in total operation, catheterisation, or hospitalisation times or in short-term complication rates in a meta-analysis by Xiao et al [17]. Endpoints such as urethral and bladder neck strictures at 18 mo did not differ between the groups in an RCT [18].

After the endoscopic enucleation community had reunited the overarching concept of "anatomical" [19], the focus moved from the energy source to the optimisation, dissemination, and standardisation of enucleating techniques. The clarity of this concept and template is the major strength in comparison to robotic prostatectomy [19].

However, as stated above, the topic of endoscopic "prostatectomy" covers more than just enucleation (Fig. 1) and thulium:YAG demonstrates its status as the best laser in this debate by versatility under this broad perspective. Although EEP is recognised as a size-independent procedure, the vaporisation capabilities of thulium:YAG thanks to the physical properties of the laser energy applied in CW mode have led to surgical techniques that still have clinical momentum in urology, unlike holmium laser resection [20]. Thulium laser vaporesection (ThuVARP) was first described by Xia et al. in 2005 [21]. Since then, further techniques that utilise the vaporisation potential have been developed, including vaporisation (ThuVAP), vapoenucleation (ThuVEP) [3,22], and ThuLEP [5]. Of all the lasers considered in this debate, thulium:YAG with laser emission in CW or pulsed mode allows virtually infinitely variable transition from ThuVEP to ThuLEP according to the clinical scenario and the surgeon's preference [23–25] or, in the words of Peter Gilling, a "gradual transition from large lump resection to anatomical enucleation" [26].

Regarding extra-anatomical techniques, ThuVARP represents the best-studied alternative to transurethral resection of the prostate (TURP) that is clinically still valid. An RCT comparing ThuVARP versus monopolar TURP found no significant difference in efficacy or in the reoperation rate (2.1% vs 4.1%) over long-term follow-up [27]. A meta-analysis revealed that ThuVARP at 70 W was associated with longer operation times, shorter catheterisation and hospitalisation times, and less blood loss, with no significant difference in transfusion rates or any other short-term complication rates in comparison to TURP [28]. A prospective multicentre study on ThuVARP involving 2216 patients showed durable postoperative improvements in International Prostate Symptom Score, quality of life, maximum flow rate, and postvoid residual volume during the 8-yr follow-up [29].

Although publications on vaporisation have been sparse since the initial novelty faded, ex vivo experiments have shown an almost twofold superior vaporisation capacity of thulium:YAG over "green" lasers such lithium-borate lasers at 120 W. Thulium:YAG in continuous mode was superior to Ho:YAG with regard to incision depth beyond 60 W, whereas thulium:YAG in pulsed mode had lower vaporisation rates than Ho:YAG over the whole energy spectrum applied [8].

Therefore, thulium:YAG is a laser with proven efficacy and safety over the whole therapeutic spectrum for transurethral prostatectomy. It is thus the most versatile laser for endoscopic prostate surgery among all lasers considered in this debate. Finally, it is a matter of personal preference regarding which energy source is better for EEP, but for the whole range of surgical approaches for transurethral prostatectomy for BPO, including vaporisation, resection, enucleation, and vapoenucleation, thulium:YAG offers the best choice.

Conflicts of interest: Thomas R.W. Herrmann is a consultant for, has received honoraria from, and is involved in research collaboration with Karl Storz. Christopher Netsch is a consultant for Richard Wolf and Lisa Laser. Benedict Becker is a consultant for Lisa Laser.

References

[1] Enikeev D, Glybochko P, Rapoport L, et al. A randomized trial comparing the learning curve of 3 endoscopic enucleation techniques (HoLEP, ThuFLEP, and MEP) for BPH using mentoring approach – initial results. Urology 2018;121:51–7. https://doi.org/10.1016/j.urology.2018.06.045.

[2] Saitta G, Becerra JEA, del Álamo JF, et al. 'En bloc' HoLEP with early apical release in men with benign prostatic hyperplasia. World J Urol 2019;37:2451–8. https://doi.org/10.1007/s00345-019-02671-4.

[3] Bach T, Wendt-Nordahl G, Michel MS, et al. Feasibility and efficacy of thulium:YAG laser enucleation (vapoenucleation) of the prostate. World J Urol 2009;27:541–5. https://doi.org/10.1007/s00345-008-0370-0.

[4] Becker B, Netsch C, Bozzini G, et al. Reasons to go for thulium-based anatomical endoscopic enucleation of the prostate. World J Urol 2021;39:2363–74. https://doi.org/10.1007/s00345-021-03704-7.

[5] Herrmann TRW, Bach T, Imkamp F, et al. Thulium laser enucleation of the prostate (ThuLEP): transurethral anatomical prostatectomy with laser support. Introduction of a novel technique for the treatment of benign prostatic obstruction. World J Urol 2010;28:45–51. https://doi.org/10.1007/s00345-009-0503-0.

[6] Herrmann TRW. Enucleation is enucleation is enucleation is enucleation. World J Urol 2016;34:1353–5. https://doi.org/10.1007/s00345-016-1922-3.

[7] Gratzke C, Bachmann A, Descazeaud A, 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. https://doi.org/10.1016/j.eururo.2014.12.038.

[8] Huusmann S, Lafos M, Meyenburg I, et al. Tissue effects of a newly developed diode pumped pulsed thulium:YAG laser compared to continuous wave thulium:YAG and pulsed holmium:YAG laser. World J Urol 2021;39:3503–8. https://doi.org/10.1007/s00345-021-03634-4.

[9] Taratkin M, Kovalenko A, Laukhtina E, et al. Ex vivo study of Ho:YAG and thulium fiber lasers for soft tissue surgery: which laser for which case? Lasers Med Sci 2022;37:149–54. https://doi.org/10.1007/s10103-020-03189-7.

[10] Taratkin M, Herrmann TRW, Enikeev D. Re: Temperature rise during ureteral laser lithotripsy: comparison of superpulse thulium fiber laser (SPTF) vs. high-power 120 W holmium–YAG laser (Ho:YAG). World J Urol 2022;40:1259–60. https://doi.org/10.1007/s00345-021-03852-w.

[11] Nottingham CU, Large T, Agarwal DK, et al. Comparison of newly optimized Moses technology vs standard holmium:YAG for endoscopic laser enucleation of the prostate. J Endourol 2021;35:S1–7. https://doi.org/10.1089/end.2020.0996.

[12] Gravas S, Cornu JN, Gacci M, et al. Guidelines on the management of non-neurogenic male lower urinary tract symptoms (LUTS), incl. benign prostatic obstruction (BPO). Arnhem, The Netherlands: European Association of Urology; 2022.

[13] Speakman MJ, Cornu J-N, Gacci M, et al. What is the required certainty of evidence for the implementation of novel techniques for the treatment of benign prostatic obstruction? Eur Urol Focus 2019;5:351–6. https://doi.org/10.1016/j.euf.2019.05.014.

[14] Hartung FO, Kowalewski K-F, von Hardenberg J, et al. Holmium versus thulium laser enucleation of the prostate: a systematic

review and meta-analysis of randomized controlled trials. Eur Urol Focus 2022;8:545–54. https://doi.org/10.1016/j.euf.2021.03.024.
[15] Zhang Y, Yuan P, Ma D, et al. Efficacy and safety of enucleation vs. resection of prostate for treatment of benign prostatic hyperplasia: a meta-analysis of randomized controlled trials. Prostate Cancer Prostat Dis 2019;22:493–508. https://doi.org/10.1038/s41391-019-0135-4.
[16] Bozzini G, Berti L, Aydoğan TB, et al. A prospective multicenter randomized comparison between holmium laser enucleation of the prostate (HoLEP) and thulium laser enucleation of the prostate (ThuLEP). World J Urol 2021;39:2375–82. https://doi.org/10.1007/s00345-020-03468-6.
[17] Xiao K-W, Zhou L, He Q, et al. Enucleation of the prostate for benign prostatic hyperplasia thulium laser versus holmium laser: a systematic review and meta-analysis. Lasers Med Sci 2019;34:815–26. https://doi.org/10.1007/s10103-018-02697-x.
[18] Zhang F, Shao Q, Herrmann TRW, et al. Thulium laser versus holmium laser transurethral enucleation of the prostate: 18-month follow-up data of a single center. Urology 2012;79:869–74. https://doi.org/10.1016/j.urology.2011.12.018.
[19] Herrmann TRW. Endoscopic enucleation of the prostate is better than robot-assisted simple prostatectomy. Eur Urol Focus 2022;8:365–7. https://doi.org/10.1016/j.euf.2022.03.020.
[20] Westenberg A, Gilling P, Kennett K, et al. Holmium laser resection of the prostate versus transurethral resection of the prostate: results of a randomized trial with 4-year minimum long-term followup. J Urol 2004;172:616–9. https://doi.org/10.1097/01.ju.0000132739.57555.d8.
[21] Xia S, Zhang Y, Lu J, et al. Thulium laser resection of prostate-tangerine technique in treatment of benign prostate hyperplasia. Zhonghua Yi Xue Za Zhi 2005;85:3225–8.
[22] Bach T, Xia SJ, Yang Y, et al. Thulium: YAG 2 μm cw laser prostatectomy: where do we stand? World J Urol 2010;28:163–8. https://doi.org/10.1007/s00345-010-0522-x.
[23] Herrmann TRW, Wolters M. Transurethral anatomical enucleation of the prostate with Tm:YAG support (ThuLEP): evolution and variations of the technique. The inventors' perspective. Andrologia 2020;52:e13587.
[24] Gross AJ, Orywal AK, Becker B, Netsch C. Five-year outcomes of thulium vapoenucleation of the prostate for symptomatic benign prostatic obstruction. World J Urol 2017;35:1585–93. https://doi.org/10.1007/s00345-017-2034-4.
[25] Gross AJ, Netsch C, Knipper S, et al. 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. https://doi.org/10.1016/j.eururo.2012.11.048.
[26] Gilling P. Comparison of transurethral enucleation with bipolar and transurethral resection in saline for managing benign prostatic hyperplasia. BJU Int 2012;110:E870. https://doi.org/10.1111/j.1464-410X.2012.11389.x.
[27] Cui D, Sun F, Zhuo J, et al. A randomized trial comparing thulium laser resection to standard transurethral resection of the prostate for symptomatic benign prostatic hyperplasia: four-year follow-up results. World J Urol 2014;32:683–9. https://doi.org/10.1007/s00345-013-1103-6.
[28] Deng Z, Sun M, Zhu Y, et al. Thulium laser vaporesection of the prostate versus traditional transurethral resection of the prostate or transurethral plasmakinetic resection of prostate for benign prostatic obstruction: a systematic review and meta-analysis. World J Urol 2018;36:1355–64. https://doi.org/10.1007/s00345-018-2287-6.
[29] Sun F, Han B, Cui D, et al. Long-term results of thulium laser resection of the prostate: a prospective study at multiple centers. World J Urol 2015;33:503–8. https://doi.org/10.1007/s00345-014-1456-5.