Innovative endoscopic enucleations of the prostate — Xie’s Prostate Enucleations

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Abstract In the past 2 decades, endoscopic enucleation of the prostate has become a safe and effective surgical treatment for benign prostatic hyperplasia (BPH), with comparable outcomes to traditional surgeries. Transurethral vapor enucleation and resection of the prostate (TVERP), transurethral vapor enucleation of the prostate (TVEP), and ultrasound-navigated TVEP (US-TVEP) are new, innovative endoscopic enucleation procedures. These procedures are named Xie’s Prostate Enucleations (Xie’s Procedures for short). Current clinical data indicate that Xie’s Procedures are safe and effective treatment options for patients with BPH, especially for patients with larger prostates. Further prospective, randomized clinical trials compared with traditional transurethral resection of prostate (TURP) are still needed.

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1. Introduction

In the 1990s, Gilling [1] first performed transurethral holmium laser enucleation of the prostate (HoLEP), which introduced a new era for endoscopic enucleation of the prostate. In the past 2 decades, with the development of many new types of surgical applications, new endoscopic enucleation procedures for the prostate have been...
rapidly developed and optimized. These procedures have comparable outcomes to traditional transurethral resection of the prostate (TURP) and open prostatectomy (OP). Urologists should be familiar with these new surgical applications and choose and invent more efficient and economical procedures to treat clinical benign prostatic hyperplasia (BPH) by combining urologists’ self-experience.

2. Traditional procedures of clinical BPH treatment have been challenged

In 1932, McCarthy performed the first endoscopic surgery, TURP, to treat clinical BPH [2]. After nearly a century of improvement, TURP has become the gold standard in clinical BPH treatment due to its improvement of lower urinary tract symptoms (LUTS), quality of life (QoL) and urodynamics. However, TURP is not a perfect surgery due to the high risk of postoperative complications. A retrospective study including 23,123 cases in Europe compared long-term outcomes after TURP and OP [3]. The results indicated that the risk for a secondary transurethral procedure was approximately 50% higher after primary TURP compared to OP after 1, 5 and 8 years. Eight years after primary treatment, 14.7% of patients required a secondary surgery after TURP compared to 9.5% of patients after OP. Furthermore, the 90-day and 1-, 5- and 8-year mortality rates of TURP are 0.7%, 2.8%, 12.7% and 20%, respectively, which are equivalent to those of OP. Another prospective multicentre study including 10,654 patients analysed the complications and immediate outcomes of TURP [4]. The results indicated that the perioperative complication rate increased from 1.0%–2.0% to 3.0%–9.0% when prostate volume increased from less than 30 g to greater than 60 g. Though the use of bipolar and plasma resection application has improved the safety of TURP, urologists should still pay attention to the complications, especially in patients with larger prostates.

In 1998, Gilling [1] first used a Ho:YAG laser (wavelength 2140 nm) to perform endoscopic enucleation of the prostate, known as HoLEP, which has gradually become a standard procedure in the field of endoscopic enucleation of the prostate by different types of lasers. Many studies have demonstrated the durability of HoLEP for most prostate sizes at long-term follow-up with low complication rates [5–7]. A follow-up retrospective study of 949 cases treated with HoLEP indicated that at 1 month, 1 year and 10 years, the postoperative mean maximal flow rate (Q\text{max}) was 21.5, 24.3 and 23.4 mL/s, respectively; the mean International Prostate Symptom Score (IPSS) was 7.3, 4.4 and 3.8, respectively; and the mean QoL was 1.7, 1 and 0.7, respectively [8]. Another randomized clinical trial compared the 5-year follow-up results of HoLEP with OP for prostates greater than 100 g [9]. The results indicated that the mean Q\text{max} was 24.4 mL/s in the two groups (p = 0.97), postvoid residual urine volume (PVRU) was 11 mL in the HoLEP group and 5 mL in the OP group (p = 0.25), and reoperation rates were 5% in the HoLEP and 6.7% in the OP group (p = 1.0). The improvements in symptomatic BPH obtained with HoLEP and OP for prostates greater than 100 g were equally good, and the EAU guidelines recommend HoLEP as an option for the treatment of prostates greater than 80 g. Therefore, HoLEP represents an effective treatment for men with symptomatic BPH with a relatively low risk of complications during long-term follow-up.

Liu et al. [10] previously performed endoscopic enucleation of the prostate in China. In 2003, Liu developed transurethral enucleation and resection of the prostate (TUERP) to treat clinical BPH via a bipolar plasma loop electrode. A 6-year follow-up retrospective study of 1100 cases treated with TUERP indicated that TUERP induced both immediate and lasting improvements in IPSS, QoL, Q\text{max} and PVRU and postoperative complications included incontinence (5.1%), urethral stricture (1.1%) and bladder neck contracture (0.9%). TUERP could be an alternative to TURP and OP for clinical BPH [10]. A randomized clinical trial compared the 5-year follow-up results of TUERP with OP for prostates greater than 70 g [11]. The results indicated that the postoperative improvements in IPSS, QoL, Q\text{max} and PVRU were equivalent in both groups at 1, 6, 12 and 24 months but were much better in the TUERP group at 36, 48 and 60 months. During the 5-year follow-up, none of the patients in the TUERP group, but two patients in the TURP group, experienced reoperation. Another randomized clinical trial compared the 6-year follow-up results of TUERP with OP for prostates greater than 100 g, and the results indicated that TUERP was a durable procedure with both short-term and long-term micturition improvements similar to OP and a significantly lower risk of perioperative complications [12].

Therefore, endoscopic enucleation of the prostate is superior to traditional surgical procedures in some respects, especially in the treatment of larger prostates. With the clinical application of new types of lasers, including potassium-titanyl-phosphate lasers, thulium:YAG lasers, and diode lasers, the surgical effect of treatment of the prostate has been greatly improved. The gold-standard status of TURP has been continuously challenged.

3. Evaluation of new techniques

Based on the characteristics of new procedures for the endoscopic enucleation of the prostate and the existing problems with these procedures, the following items should be considered before a new technique is established. (1) Is the enlarged prostate anatomically resected by the new technique? (2) Does the new technique control haemorrhage during the operation? Can pre-coagulation be performed? (3) Can the new technique avoid perioperative complications, including perforation, infection, incontinence, and urethral stricture? (4) Does the new technique have a short learning curve? (5) Are the new enucleative instruments easy to manipulate? (6) Does the new technique have a controllable cost-effect ratio? (7) Does the new technique retrieve specimens during the operation?

4. Could we do better in endoscopic enucleations of the prostate—Xie’s Prostate Enucleations (Xie’s procedures)

Based on the evaluation of new techniques and the current situation regarding the endoscopic enucleation of the
prostate, we innovatively developed a series of new procedures to treat BPH, named Xie’s Prostate Enucleations (Xie’s procedures for short) by German professor Tillmann Loch. Xie’s procedures consist of three independent procedures. (1) Transurethral vapor enucleation and resection of the prostate (TVERP). This technique solves the problems faced by the treatment of clinical BPH. The blood control is greatly improved in this operation, and the surgery is performed in a bloodless or bloodfree way. The hyperplastic part of the prostate is resected thoroughly, and the patients recover rapidly after TVERP. (2) Transurethral vapor enucleation of the prostate (TVEP). To save operation time when treating larger prostates, a tissue morcellator is used to morcellate the prostatic hyperplastic tissue after the prostate is completely enucleated and pushed into the bladder. The modified technique is named TVEP. (3) Ultrasound-navigated TVEP (US-TVEP). This technique helps to identify the prostate’s surgical capsule, apex and bladder neck more precisely and avoids injuring the urethral sphincter during the whole procedure. The whole sagittal and transversal structure of the prostate is displayed by the transrectal ultrasound, and the real-time position of the button electrode is monitored. This modified technique is named US-TVEP.

4.1. Equipment

The equipment required for Xie’s Procedures includes a plasma vaporization electrode (Olympus Winter & Ibe GmbH, Hamburg, Germany), Olympus SurgMaster UES-40 bipolar generator or ESG-400 HF system (Olympus Winter & Ibe GmbH, Hamburg, Germany), bipolar cutting electrode or morcellator, and MyLab™ Class C (Esaote, Genova, Italy).

4.2. Procedures

4.2.1. TVERP

Firstly, the patients were placed in a lithotomy position after receiving epidural anaesthesia or general anaesthesia. The urethra, verumontanum and bladder neck were checked and identified.

Secondly, the vapor-enucleation of the prostate was started from the 5 o’clock position at the proximal edge of the verumontanum and distal edge of the middle lobe via the plasma vaporization electrode (button electrode) (Fig. 1A). After the vaporization was made deep into the surgical capsule, which was characterized by white circular fibres, the button electrode was turned to the 7 o’clock position to continue vaporization (Fig. 1B). A circular vaporization was made along the surgical capsule from the 5 to 7 o’clock position. Then, the button electrode was inserted into the groove to continue vaporization and moved towards the bladder neck to dissect the adenoma and surgical capsule and to establish a plane between them until the bladder neck was reached (Fig. 1C). During the process, the button electrode was used to vaporize the adhesive fibres and pre-coagulate the vessels.

Thirdly, the left lobe was dissected with the button electrode along the plane in a retrograde and transverse fashion from the 5 to 12 o’clock position according to the previously mentioned methods (Fig. 2A). The right lobe was then treated from the 7 to 12 o’clock position in the same way (Fig. 2B). Therefore, the prostate was almost enucleated except for the connection to the bladder neck.

Fourthly, we changed the button electrode with a cutting loop and rapidly resected the nearly devascularized lobes, which were still connected to the bladder neck in a blood-free way (Fig. 3A). All the adenoma fragments were evacuated by Ellik (Olympus) and subsequently retrieved.

Finally, the button electrode or cutting loop was used to coagulate tissue and create a smooth cavity surface. A 22F, three-way Foley catheter was inserted, and continuous irrigation was applied as necessary until haematuria resolved sufficiently.

4.2.2. TVEP

The procedure of TVEP was similar to that of TVERP except that the prostate was completely enucleated and pushed into the bladder, and the prostatic hyperplastic tissue was morcellated with the tissue morcellator (Fig. 3B).
4.2.3. US-TVEP
During the whole process of enucleation of the prostate, the whole sagittal and transversal structure of the prostate is displayed by transrectal ultrasound, and the real-time position of the button electrode is monitored (Fig. 4).

4.3. Characteristics

The characteristics of Xie’s Procedures are listed below. (1) The prostatic hyperplastic tissue was resected anatomically. A button electrode was used to resect the large prostate along the surgical capsule. Therefore, the hyperplastic tissue was resected more thoroughly. (2) The circular contact area of the button electrode was larger than the traditional cutting loop. Therefore, it had a better effect on haemostasis when it was used to coagulate the vessels of the adenoma and surgical capsule. Therefore, the procedures could almost be performed in a blood-free way. (3) The button electrode could imitate the surgeon’s fingers, which made the procedures easy to learn. (4) The cost of upgrading pre-existing TURP-related systems is low. (5) The learning curve of Xie’s procedures is short. (6) The ultrasound-navigated procedure monitors the important anatomical structures and position of the device, achieving precise operation.

4.4. Clinical outcomes

The preliminary results of TVERP/TVEP indicated that the procedure was effective and safe [13]. At 1, 3, and 6 months after TVERP/TVEP, postoperative Q max, IPSS and...
QoL were significantly improved. Postoperative prostate volume decreased more than 40% and PSA decreased more than 80% compared to the baseline. In patients with a prostate volume over 80 g, no transfusion or transurethral resection syndrome occurred during the perioperative period, and $Q_{\text{max}}$, IPSS and QoL were improved at the follow-up of 6 months.

For US-TVEP, intraoperative ultrasound images of the prostate peripheral zone, prostate apex and bladder neck were clear. No perforation of the capsule or obvious bleeding was encountered.

5. Conclusion

Endoscopic enucleation of the prostate has become a safe and effective surgical treatment for clinical BPH, with comparable outcomes to traditional surgeries. However, urologists must consider the optimal treatment for clinical BPH. Current clinical data indicate that Xie’s procedures are safe and effective treatment options for patients with BPH, especially for patients with larger prostates. However, further prospective randomized trials compared with traditional TURP are still needed.

Conflicts of interest

The authors declare no conflicts of interest.

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