



Review

An update on transurethral surgery for benign prostatic obstruction



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Received 19 March 2017; received in revised form 8 May 2017; accepted 8 May 2017
Available online 15 June 2017

KEYWORDS

Transurethral resection of prostate;
Benign prostatic obstruction;
Bleeding;
Prostatectomy

Abstract Clinical benign prostatic hyperplasia (BPH) is one of the most common cause of lower urinary tract symptoms and transurethral resection of prostate (TURP) has been the gold standard technique for surgical treatment of benign prostate obstruction (BPO) over the last 2 decades. Although monopolar TURP is considered a safe and effective option for surgical management of BPO, there are some disadvantages, namely bleeding, transurethral resection syndrome, incompleteness of treatment. This review aims to highlight these problems, and describe the advances in technology and techniques that have evolved to minimise such complications. With the advent of lasers and bipolar technology, as well as enucleative techniques to remove the prostatic adenoma/adenomata, the problems of bleeding, transurethral resection syndrome and incomplete treatment are significantly minimised. Monopolar TURP will likely be replaced by such technology and techniques in the near future such that transurethral surgery of the prostate remain a safe and effective option in alleviating the harmful effects of BPO.

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1. Introduction

Clinical benign prostatic hyperplasia (BPH) is one of the most common causes of lower urinary tract symptoms in ageing men. Bladder outlet obstruction (BOO) is defined as the obstruction of urinary flow at the base of the urinary

bladder, and benign prostate obstruction (BPO) remains one of the main causes of BOO in men.

The medical treatment of clinical BPH involves the use of α -blockers and 5- α -reductase inhibitors. When medical therapy fails, surgical intervention is often required. The current-day urologist may face a dilemma of choosing between the various techniques of transurethral procedures and instruments available for surgical treatment of the BPO.

The first resectoscope and transurethral resection of the prostate (TURP) was introduced in 1926 by Maximilian Stern and allowed him to cut slithers of prostate tissue with a tungsten loop under direct vision. Since then, TURP has

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Peer review under responsibility of Second Military Medical University.

evolved and remains the gold standard and comparator for surgical treatment of BPO due to its excellent, well-documented, and long-term efficacy [1].

Monopolar transurethral resection of prostate (M-TURP) is performed by passing high frequency current from a generator through an active electrode, allowing for electro-resection of the prostate. Irrigation is used to provide a clear vision for the surgeon to continue resection of the vascular prostate. The electrical energy, irrigation solution and the nature of this surgery can result in certain undesired complications. These complications of M-TURP include bleeding, transurethral resection (TUR) syndrome, extravasation and bladder neck stenosis, and rates as high as 11.1% have been reported based on a prospective study of 10 564 men [2].

This review aims to highlight the known complications of M-TURP and describe the changes in surgical technology and techniques which have evolved in the last 2 decades to reduce the risk of such complications.

2. Problems of conventional TURP

2.1. Bleeding

The incidence of bleeding during M-TURP requiring blood transfusion has been reported to be 0.4%–7.1% [3,4]. Although extremely rare, life-threatening bleeding after endoscopic prostatic surgery may require the surgeon to perform open prostate packing to prevent rapid deterioration of the patient [5]. The use of selective arterial prostatic embolisation to arrest life-threatening bleeding post-TURP has been reported, and can be considered besides open prostatic packing [6].

For very large prostate, or where technical difficulty with TURP is anticipated, alternative modalities such as open, laparoscopic or robot assisted prostatectomy remains an option [7,8]. Most modern urologists are however more familiar with the transurethral techniques for treatment of BPO.

Over time, with increasing experience and technical competency, complication rates have fallen. In a retrospective study of TURP over 30 years in a single institution, 44% of patients required blood transfusions after TURP in the 1970s, compared to 11% in 1980s and 4% in the 1990s [9].

Apart from conventional M-TURP, other minimally invasive techniques include bipolar-transurethral resection of prostate (B-TURP), ablative laser procedures using Holmium:YAG laser enucleation of prostate or potassium-titanyl-phosphate (KTP) laser vaporisation of prostate. The treatment of choice may be individualised for each patient, taking into account patient's comorbidities, potential morbidity, facilities and expertise available, and cost.

Bipolar transurethral resection of prostate was introduced 15 years ago as an alternative to M-TURP. This technology uses high frequency energy to create a vapour layer of plasma which contains energy-charged particles that induce tissue disintegration through molecular dissociation. As the active and return electrode are placed on the same axis of the resectoscope, high current densities are achieved locally and distant negative effects reduced [10]. The reduction in lower resection temperature compared to conventional monopolar systems theoretically reduces thermal damage to surrounding tissue.

A prospective controlled study have shown that there were no major differences between M-TURP and B-TURP with regards to risk of haemorrhage, duration of post-operative catheterisation, duration of surgery, improvement in maximum flow rate, residual urine volume, International Prostate Symptom Score (IPSS) and Quality of Life score, although the risk of developing TUR syndrome seemed to be smaller with B-TURP [11]. A meta-analysis of 16 randomised controlled trials with 1406 patients comparing M-TURP and B-TURP showed no clinically relevant differences in short-term efficacy between the two techniques, although B-TURP had a more favourable safety profile in terms of lower TUR syndrome and clot retention rates, and shorter irrigation and catheterisation duration [12]. This meta-analysis however noted that the quality of the trials were low with regards to allocation concealment and blinding of outcome assessors.

A randomised controlled trial comparing B-TURP versus M-TURP showed less blood loss during B-TURP compared to M-TURP (median blood loss 235 mL vs. 350 mL, $p < 0.001$), and a lower rate of blood transfusion (4% vs. 11%, $p < 0.01$) [13].

The Holmium laser enucleation of the prostate (HoLEP) was first introduced in 1998 by Gilling and has shown to have long-term clinical improvement in patients with BPO and also a low rate of complications [14,15]. It utilises the holmium laser to dissect the median and lateral lobes of the prostate off its surgical capsule in a retrograde fashion. The three lobes are then dropped back into the bladder and a morcellator is used to extract the fragments out of the bladder [16]. Large prostates can be treated using this technique with minimal morbidity with regards to bleeding.

2.2. TUR syndrome

The use of irrigation fluid for transurethral procedures ideally should be isotonic, non-haemolytic, electrically inert, non-toxic, transparent, easy to be sterilised and also inexpensive [17]. The most widely used irrigation fluid for M-TURP are 1.5% glycine and sterile water. The osmolality of 1.5% glycine is 230 mOsm/L, which is lower than the serum osmolality of 290 mOsm/L, and can cause complications resulting in TUR syndrome.

TUR syndrome is caused by dilutional hyponatraemia which may be due to early perforation of capsular veins or sinuses with influx of hypotonic irrigation fluid. This syndrome is characterised by mental confusion, nausea, vomiting, hypertension, bradycardia and visual disturbances. Left untreated, cerebral oedema and death may occur.

Preoperative and perioperative interventions can prevent TUR syndrome. Pre-existing hyponatremia should be corrected prior to surgery. During TURP, the ideal height of irrigating fluid should be 60 cm, and the duration of TURP should be restricted to 1 h [18,19]. Prevention of perforation of prostatic capsule and avoidance of bladder distension can also prevent TUR syndrome [20].

The use of sodium chloride solution for irrigation in B-TURP has also almost eliminated the risk of TUR syndrome. In a randomised controlled trial of 100 patients who underwent M-TURP and B-TURP with the bipolar transurethral resection in saline (TURIS) system, there were two cases of TUR syndrome in the M-TURP group and none in the

B-TURP group. The decline in mean postoperative serum Na^+ for M-TURP versus B-TURP were 10.7 and 3.2 mmol/L, respectively ($p < 0.01$) [21].

In a meta-analysis of 1406 patients by Mamoulakis and colleagues, there was zero incidence of TUR syndrome for patients treated with B-TURP compared to 13 patients treated with M-TURP [12]. This major advantage of B-TURP will allow surgeons to resect larger prostates which will require more time, and also allow training of urology residents without compromising safety [22].

2.3. Completeness

TURP has been shown to be effective in long-term relief of obstruction for patients, but reoperation rates are between 5% and 15.5% [23–25]. In a report by Wasson et al. [23], 188 161 Medicare beneficiaries in the US who underwent TURP had a reoperation rate of less than 5% at 5 years. In Madersbacker's study [24], 20 671 patients were followed up following TURP, and the percentage of patients who needed a repeat TURP were 2.9%, 5.8% and 7.4% at 1, 5 and 8 years follow-up.

Different techniques have been developed in the last 20 years to achieve a better resection outcome in patients undergoing transurethral surgery for BPO. Transurethral enucleation and resection of the prostate (TUERP) was developed by Liu et al. [26], in which the prostate is transurethraly enucleated and resected using a bipolar plasma kinetic resectoscope.

Several studies have shown TUERP to be a safe and feasible treatment for BPO with few complications [27,28]. A retrospective study comparing bipolar TURP and TUERP of 270 patients showed better postoperative IPSS, better maximal urinary flow rate (Q_{\max}), and less reoperations in the TUERP group [27].

One modification of the TUERP technique was proposed by Xie et al. [29], in which a plasma vaporisation button electrode was used for enucleation of the prostate followed by bipolar loop electrode for the resection. In this study, no complications occurred in the 17 patients enrolled, and improvements in IPSS were achieved postoperatively. The authors have quoted excellent haemostatic properties of bipolar vaporisation and the lower cost of upgrading existing bipolar systems over HoLEP. There needs to be longer-term follow-up of patients treated with this technique, compared to the numerous and long term data for patients treated with HoLEP.

The use of Holmium:YAG laser in the treatment of BPH has progressed from simple vapourisation of tissue to the complete removal, or enucleation of intact lobes of prostatic adenoma (HoLEP) [16]. In a 10-year follow-up of 949 patients treated with HoLEP, 0.7% of patients needed reoperation due to residual adenoma [14].

3. Discussion

Apart from bleeding, TUR syndrome and completeness of resection, there are other factors to take into account when deciding which modality of treatment to be used. The sexual activity of men has to be taken into account before surgery, especially younger men who may still have an active sex life.

There are a proportion of men who experience erectile dysfunction post-TURP. In a prospective study of 63 patients, 14% of men experienced erectile dysfunction after TURP [30]. A separate retrospective study of 87 patients who underwent M-TURP reported a significant decrease in the International Index of Erectile Function score at 3 months after TURP, but no significant change at 6 months after TURP [31].

A retrospective study examining sexual dysfunctions of 264 men, 48% of men experienced retrograde ejaculation. The change in erectile function was small, with 5.8% of men with good erectile function pre-TURP experiencing a worsening function after TURP [32].

Stress urinary incontinence is a complication following a TURP, and is usually caused by damage to the proximal part of the sphincter distal to the verumontanum [4]. A recent systematic review showed a post TURP stress incontinence rate of 8.4% in 2736 patients, and also reported a less successful treatment with the use of sling surgery in such patients [33].

The incidence of incontinence may be higher after enucleation procedure than TURP due to excessive removal of the distal urethral mucosa. A recent study showed an incidence of 13.6% for TUERP compared to 4.7% for TURP [34]. However, most patients recovered with time with pelvic floor exercise. Initial circumferential incision of the mucosa around the apex of the prostate and enucleating towards the bladder neck in a retrograde fashion, may help to cut down on the incidence of temporary stress incontinence.

4. Conclusion

While monopolar TURP has been the gold standard of surgical treatment for BPO, it has certain disadvantages, namely bleeding, TUR syndrome and completeness of resection. Various techniques and technology have evolved over the last 2 decades and surgeons have a wide range of choice for improvement. In addition to being safe and effective in relieving obstruction, their effectiveness should also be durable. With the advent of bipolar technology and lasers, bleeding and TUR syndrome incidences are much lower, however, completeness of resection remains a problem. Enucleation of prostate adenoma by TUERP or HoLEP greatly increases the likelihood that most obstructing adenomata are removed. Their future adoption is likely to be influenced by costs and learning curve.

Conflicts of interest

The authors declare no conflict of interest.

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