Symposium

Surgical therapy for benign prostatic hypertrophy/bladder outflow obstruction

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ABSTRACT

Monopolar transurethral resection of the prostate (TURP) with endoscopic electrocautery remains the gold standard surgical technique for benign prostatic hypertrophy (BPH) by which all new procedures are compared. We reviewed the current literature, and international urological guidelines and consensus opinion on various surgical options for BPH and present a brief overview of alternative techniques including bipolar TURP, transurethral incision of the prostate, transurethral vaporization of the prostate, laser prostatectomy (with holmium, thulium and potassium titanyl phosphate greenlight lasers) and open prostatectomy (with mention of new techniques including laparoscopic and robotic prostatectomy). Emerging, experimental and less established techniques are also described including endoscopic heat generation (transurethral microwave thermotherapy, radiofrequency transurethral needle ablation of the prostate, high intensity focused ultrasound, hot water induced thermotherapy, pulsed electromagnetic radiofrequency), injection therapy (transurethral ethanol ablation and botulinum toxin) and mechanical devices (intraprostatic stents and urethral lift devices). Despite a plethora of surgical options, none have realistically improved outcomes in the long-term compared with TURP. Improvements have been made on improving surgical morbidity and time in hospital. Questions remain in this area, including what specific elements of bladder outflow obstruction (BOO) result in damage to the urinary tract, how does BPH contribute to BOO and how much prostate volume reduction is necessary to relieve BOO or lower urinary tract symptoms. Given these unanswered questions and the multitude of procedures available, it is clear that appropriate counselling is necessary in all men who undergo BPH surgery.

Key words: Green light laser, holmium laser enucleation of the prostate, laser prostatectomy, prostatectomy, thulium laser, transurethral resection of the prostate

INTRODUCTION

Conservative and medical therapy for male lower urinary tract symptoms (LUTS) secondary to benign prostatic hypertrophy (BPH) is now well established. Management is largely established in terms of alpha-blocker and 5-alpha reductase inhibitor treatment. This is in contrast to the large number of surgical treatment options available. This article highlights the alternative procedures available in widespread usage and also describes uncommon, historic and experimental options.

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ENDOSCOPIC ELECTROCAUTERY

Monopolar transurethral resection of the prostate (TURP) remains the gold standard treatment for the surgical management of BPH and bladder outflow obstruction (BOO). TURP rates have declined over the past two decades due to the significant benefits of medical therapy and, to a lesser extent, the proliferation of alternative surgical techniques.

Recommended indications for TURP include:

- Moderate to severe LUTS (either not controlled with medical therapy or by patient choice)
- Acute urinary retention (AUR) (despite the use of an alpha-blocker)
- Recurrent urinary tract infection
- Recurrent haematuria
- Obstructive uropathy.

BPH resulting in BOO can be inferred by patient's obstructive symptoms, flow-rates, post-void residual urine

measurements and cystoscopic findings, but the diagnosis on BOO can only be firmly made by urodynamic investigation. The latter studies should be performed in a man under 50 or over 80 with LUTS, in a patient with neurological disease and LUTs, in a man with on-going symptoms of BOO after bladder outlet surgery, in a man with disproportionately significant storage LUTS and in a man who cannot void greater than 150 ml.

TURP involves resecting the prostate gland in small chips and washing out the prostate chips and subsequent rollerball diathermy for haemostasis [Figure 1]. A urinary catheter may or may not be irrigated and is usually removed after 24-48 h. TURP is effective in reducing symptoms scores and in improving quality of life (QOL) score.[1] The reduction in symptoms score and improvement in QOL scores remain high after this operation and has not been bettered by any endoscopic technique. Mortality risk is low with this operation and results remain durable with published data up to 22 years.[2] Complications include problematic incontinence (this is less than 2% in contemporary series), retrograde ejaculation (in two-thirds) and a third reported erectile dysfunction (it is important to stress that the natural history of impotence in elderly men remains unknown). Reoperation, usually with another TURP, is around 1-2% per year. The risk of TUR syndrome (dilutional hyponatremia from fluid absorption) has dramatically decreased (better awareness, reduced operating times and better perioperative assessment and care) and is less than 1%. Younger men with BOO, may only need an incision at the bladder neck or transurethral incision of the prostate, usually at the 5 and 7 0'clock positions rather than undergoing a complete TURP to alleviate BOO. This incision technique has been recommended for use in men with prostate gland volume of less than 30 ml and without significant prostatic middle lobes.

In an attempt to improve hemostasis, decrease length of catheterization and reduce TUR syndrome, bipolar TURP has become popular. The technique uses a specialized resectoscope loop, which contains both the active and return electrodes and allows resection in saline irrigation. Prostate tissue is heated indirectly by the heat from the ignition of the spark that occurs between the electrode loops. Contemporary results suggest there are lower rates of clot retention, catheterization, operating time, irrigation and TUR syndrome, but with similar surgical outcomes (international prostate symptom score (IPSS) scores, reoperation rates, etc.,) to TURP. Results appear to be durable and comparable to TURP up to 5 years.[3]

Transurethral vaporization of the prostate involves vaporization (by steam), subsequent desiccation and resultant coagulation [Figure 2] of prostatic tissue. This bipolar technique allows surgery with saline irrigation. There are many electrode designs available, for example a rollerball, and various loop configurations. At 1 year, complication rates are similar to TURP. Similar to TURP, vaporization-resection of the prostate has also been described.

LASER SURGERY

Types of lasers used for BPH surgery by either coagulating, vaporizing or enucleating the prostate:

- Potassium titanyl phosphate (KTP): neodymium (Nd): yttrium-aluminum-garnet (YAG) and lithium borate (LBO): Nd: YAG
- Diode lasers
- Holmium (Ho): YAG (Holmium laser enucleation of the prostate [HoLEP])
- Thulium (Tm): YAG (Thulium laser enucleation of the prostate [ThuLEP] or Thulium vapoenucleation of the prostate [ThuVEP]).

KTP lasers have been used for photoselective vaporization of the prostate (PVP). The power of these lasers has increased since their introduction into prostate surgery, rising from 60 watt (W) to 80 W and more recently 180 W. Two randomized controlled trials (RCT) comparing TURP and 80 W PVP show similar[4] or improved flow rates[5] at up to 1 year follow-up. KTP PVP with 80 W has also shown comparative results with open prostatectomy.[6]

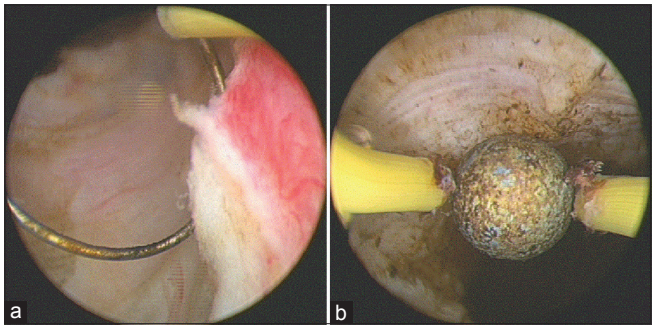

Figure 1: Endoscopiv view during TURP a) resection, b) diathermy

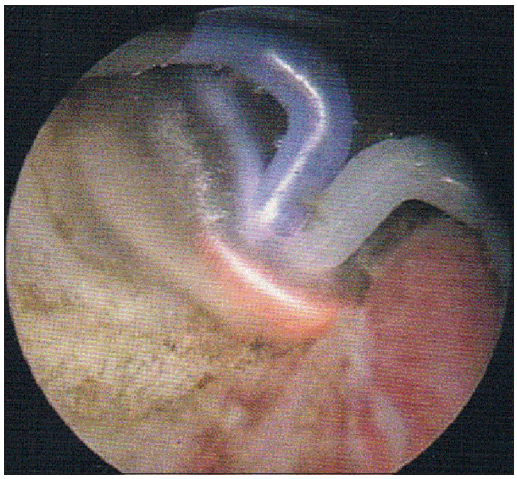

Figure 2: Endoscopic view during TUVP

LBO PVP has shown similar short-term equivalence to TURP. Both KTP and LBO emit green light and have been shown to reduce intraoperative blood loss and have reduced post-operative blood transfusion rates when compared to TURP. Stricture, retrograde ejaculation, and retreatment rates appear similar to TURP.

Much of the data on diode lasers refer to the 980 nm laser diode. These prospective studies with follow-up to 1 year show improvement in flow rates and a reduction in post-void residuals and prostate specific antigen. However, as this technique is associated with higher rates of bladder neck stricture or obstruction from necrotic tissue, it is rarely performed.

The high temperatures generated by the holmium laser create bubbles of steam which tears tissue apart but with resultant excellent hemostasis. Initially holmium lasers were used to vaporize or ablate the prostate (HoLAP), then used to resect the prostate (HoLRP) and now enucleation of prostate lobes (HoLEP). In the latter technique, the lobes are pushed into the bladder and then morcellated [Figure 3]. There have been 6 RCT'S comparing HoLEP with TURP and one comparing HoLEP with open prostatectomy. Essentially there is no statistically significant difference between HoLEP and TURP in improving symptom scores and QOL scores at up to 7 years.[7,8] HoLEP showed greater improvement in flow rates at 1 year, but not at 7 years. Less blood loss and transfusion rates have been observed with HoLEP, but there is a significant learning curve.[9] HoLEP has a significantly longer operating time than TURP but this may be offset by shorter catheterization or hospital stay in some centers. At 5 years follow-up, HoLEP is also comparable with open prostatectomy.[10]

Thulium laser radiation allows better tissue vaporization than holmium and has also undergone similar evolution of techniques with vaporization, vaporesection (ThuVARP), vapoenucleation and laser enucleation (ThuVEP). At 1 year follow-up, currently there seems to be no difference in the outcome or complication rates between TURP and ThuVARP[11] and between HoLEP and ThuVEP[12] or HoLEP and ThuLEP.[13]

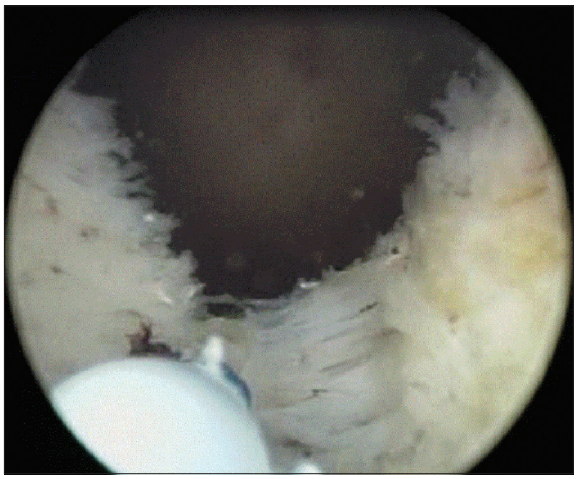

Figure 3: Endoscopic view during HoLEP

Laser techniques for treating BPH appear to have equivalent results to TURP with limited long-term data. They have superiority to TURP in anticoagulated patients where risks of bleeding and the need for post-operative blood transfusion remain low. As with bipolar TURP, saline irrigation can be used with laser surgery and this limits the development of hyponatremia (however, this is still possible following use of large volumes of irrigant, inappropriate post-operative fluid management and inappropriate SIADH release). The advantages of shorter catheterization and possible length of stay with laser surgery need to be offset against the increased operating costs (in terms of equipment and operating time) and learning curve. Prostate enucleation or megaresection is also possible using bipolar electrocautery.[14,15]

OPEN PROSTATECTOMY

Open prostatectomy allows enucleation of the hyperplastic prostatic adenoma. Initially performed by a perineal approach, this was superseded by Freyer's suprapubic transvesical approach,[16] Millin's retropubic transcapsular prostatectomy[17] and more recently laparoscopic[18] and robotic-assisted[19] approaches.

Prostatectomy still holds a strong place in BPH surgery in many countries where resources, endourological equipment and experience is not available. Simple prostatectomy provides good functional outcome with excellent long-term improvements in flow rates, postvoid residuals, and symptom scores.[20] Disadvantages include a longer operating time, and hospital stay and recovery, need for a lower midline incision and higher post-operative bleeding potential. In men with very large prostates, this type of surgery has largely been replaced by endourological laser techniques. However, in men with urethral disease (e.g.following hypospadias repair and/or on-going stricture disease), or with large bladder calculi or in men with fixed hips that do not allow flexion, open prostatectomy maybe necessary.

HEAT GENERATION

A number of minimally invasive techniques have been tried and have fallen out of general use, but they do have a role in the office setting. These techniques involve applying various heat sources to the prostate to cause necrosis and sloughing of prostate tissue. These techniques have been marred by significant post-operative irritative urinary symptoms and dysuria and high re-operation rates and are therefore not in common practice or appear within recommended guidelines. Heat sources that have been tried include transurethral microwave thermotherapy (TUMT),

transurethral needle ablation (TUNA), high intensity focused ultrasound and water induced thermotherapy. Pulsed electromagnetic radiofrequency has also been investigated.[21] This investigational study showed a greater improvement (than an alpha-blocker) in symptom scores and prostate volume when patients attended 30 min session daily for 2 weeks. TUNA and TUMT result in less favorable outcome when compared to TURP and have a higher retreatment rate in low quality cohort studies; however given that these procedures are safe with low peri-operative complications, they have a role in the office setting and have been recommended in American Urological and European Urological Association guidelines.

INJECTION THERAPY

Transurethral ethanol ablation involves endoscopic injection of dehydrated ethanol (98% concentration) at 4-8 sites in the prostate. This can be delivered transurethrally, transperineally or transrectally. As above, this results in coagulative necrosis and subsequent prostate gland volume reduction. As above, symptom scores and flow rates do improve but again, a high reintervention rate is observed (single center series with short follow-up only have been described).[22,23] Significant adverse events have been noted with this technique including bladder neck necrosis and ureteric injury requiring reimplantation. Botulinum toxin has also been injected into the prostate. Administration routes described include transperineal ultrasound guided injection as well as transurethral and transrectal routes. Short-term improvement has been observed in symptom scores in medically unfit patients.[24] Mechanism of action of the toxin for prostatic injection remains unknown; it may work locally or centrally, through muscle relaxation or by prostate apoptosis and longer term volume reduction. Potential adverse effects of the need for repeated injection into prostate tissue is also unknown and potentially alarming. Hence, currently this therapy is experimental.

MECHANICAL DEVICES

Initially, intraprostatic stents were used for patients who were not fit enough for surgical intervention and did not want to stay permanently catheterized. A variety of stent material exists and this includes self-retaining spiral stents, malleable stents and heat-expandable stents. Early results suggested reasonable longevity in improvement in symptoms scores, but this was offset by high rates of stent repositioning and stent removal with symptoms of hematuria and perineal pain. Urolume is a permanent stent that promotes epithelialization of the urethra over the stent and has been used with reasonable success in medically unfit patients with AUR or with marked LUTS. Complications include irritative LUTS and painful ejaculation necessitating device removal.[25]

The urethral lift technique pulls the lateral lobes of the prostate laterally toward the capsule to increase the size of the urethral lumen. Its advantage is that this technique causes immediate relief of obstruction with minimal morbidity. With a cystoscope and a custom implant delivery device (The UroLift System®), a non-absorbable monofilament suture with a nitinol capsular tab is inserted in an anterolateral fashion to compress the lateral prostatic lobes. Additional implants are then placed as required to achieve a visually open urethral lumen [Figure 4]. A key advantage of this emerging technique is that it can be performed with local anesthesia and oral sedation. Complications include hematuria, dysuria and irritative urinary symptoms; retrograde ejaculation is rare. Later complications uncommonly include UTI and prostatitis and transient erectile dysfunction. TURP is still possible at a later stage. Short-term results show a 40% reduction in IPSS, 40-50% improvement in QOL scores and 30% improvement in peak flow rates. This improvement occurs at 2 weeks and appears to be sustained at 2 years.[26-28]

CONCLUSIONS

A number of surgical treatment options exist for BPH [Table 1]. None have realistically improved outcomes in the long-term compared with TURP although improvements have been made on improving surgical morbidity and time in hospital. Indications for BOO surgery are well-defined, but questions remain in this area.[29] We do not what specific elements of BOO result in damage to the urinary tract, how does BPH contribute to BOO and how much prostate volume reduction is necessary to relieve BOO or LUTS. BOO surgery is more successful in men who suffer from confirmed BOO,[30] but untreated BOO does not always result in long-term loss of bladder function or improvement in LUTS.[31] Finally, those with underactivity prior to surgery may continue to suffer from bladder underactivity and its associated LUTS after BOO surgery.[32] It is clear that appropriate counselling is necessary in all men who undergo BPH surgery.

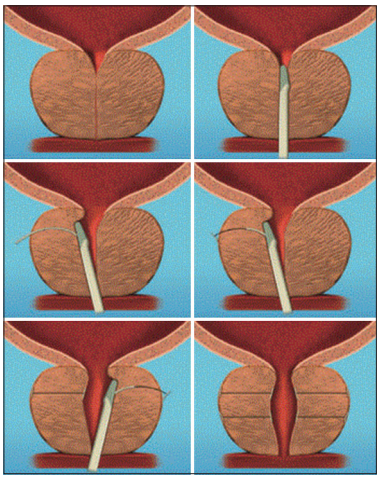

Figure 4: Diagrammatic representation of UroLift

Table 1: Summary of BPH surgical techniques (see text for explanation of abbreviations; levels of evidence is listed in brackets for the place in current common management pathways)

Common usage	Experimental
Electrocautery	Heat generation
Monopolar TURP (1a)	TUMT (2)
Bipolar TURP (1a)	TUNA (2)
TUVP (1b)	HIFU (2)
Laser therapy	WIT (2)
KTP PVP, 532 nm (1b)	Pulsed electromagnetic radiofrequency (2)
HoLEP, 2140 nm (1b)	Injection therapy
ThuLEP or ThuVEP, 2014 nm (1b)	TEAP (2)
LBO and diode lasers (rarely used), 980-1064 nm (3)	Botulinum toxin (2)
Open surgery	Mechanical
Suprapubic transvesical (1b)	Prostatic stents (2)
Retropubic (1b)	Urethral lift (2)
Laparoscopic (2)	
Robotic (2)	

BPH=Benign prostatic hypertrophy, TURP=Transurethral resection of the prostate, TUMT=Transurethral microwave thermotherapy, TUNA=Transurethral needle ablation, TUVP=Transurethral vapourisation, HIFU=High intensity focused ultrasound, KTP=Potassium titanyl phosphate, PVP=Photoselective vapourisation of the prostate, LBO=Lithium borate, HoLEP=Holmium laser enucleation of the prostate, ThuLEP=Thulium laser enucleation of the prostate, ThuVEP=Thulium vapoenucleation of the prostate, WIT=Water induced thermotherapy, TEAP=Transurethral ethanol ablation of the prostate

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