Surgical Options for Benign Prostatic Hyperplasia (BPH)

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Introduction

In 1788 John Hunter first described the pathology of prostatic hyperplasia and its effects on the upper urinary tract. It took a century for the first suprapubic prostatectomy to be carried out in 1887 by AF McGill in Leeds (though Americans tend to claim credit to Fuller in New York in 1894.) The procedure was subsequently popularised by Sir Peter Freyer. Retropubic prostatectomy was first performed in 1908 but failed to attract attention until it was reintroduced by Terrence Millin in 1947. Since then, it remains the open operation of choice in UK for BPH. In 1909 H H Young introduced the transurethral cold punch resection of the prostate. M Stern introduced the first resectoscope in 1926 and shortly afterwards H Bumpus at Mayo Clinic introduced diathermy cutting and coagulation. In 1932 Joseph McCarthy introduced the fore-oblique lens, continuous irrigation and working element for resection, and performed the first series of transurethral resection of prostate (TURP) in a manner similar to what we are doing today. With further advances in technology and technique, TURP became established as the most commonly performed operation for BPH, and the open procedures are relegated only to situations where TURP are difficult or risky. This combination essentially formed the gold standard of surgery for BPH we are still adopting today. However, TURP is not without its complications. It keeps on evolving in technology under pressure for fewer complications. Other new technologies also sprang up in the last two decades utilising other forms of energy to achieve tissue destruction or removal in BPH. Many such techniques came and went. However, some stay as useful adjunct to the gold standard of TURP with open surgery back up, and appear promising as new directions for further evolution of intervention for BPH. This article orientates the reader through the myriad of contemporary procedures Hong Kong urologists are practising or have come across.

When should Surgery be Considered as an Option in Patients with BPH?

According to the EAU (European Association of Urology) guidelines for BPH, the most frequent indication for surgical management is bothersome LUTS refractory to medical management. The following complications of BPH are considered strong indications for surgery:
- Refractory urinary retention
- Recurrent urinary retention
- Recurrent haematuria refractory to medical treatment with 5alpha reductase inhibitor.
- Renal insufficiency
- Bladder stones

Large residual volume may also be an indication for surgery but there is great intra-individual variability and a limit requiring intervention has not been defined. The NICE (National Institute of Clinical Excellence) guidelines in 2010 for LUTS in men reiterate the need to offer surgery only if voiding symptoms are severe or if drug treatment and conservative management options have been unsuccessful or are not appropriate. However, the AUA (American Urological Association) guidelines opine that medical therapy is not a requirement for patients to consider operation because some patients may wish to have the most effective therapy as a primary treatment if their symptoms are particularly bothersome. The decision to elect surgery as the treatment alternative is based upon the patient’s own views of treatment risks versus benefits.

What are the Standard Surgical Options and What are their Limitations?

TURP, TUIP (Transurethral incision of prostate) and open prostatectomy are the standard surgical options.

TURP

TURP is the most commonly performed operation for bladder outflow obstruction. It involves the surgical removal of the prostate’s inner portion via an endoscopic approach through the urethra, with no external skin incision. A cystoscope with a fore-oblique lens and a tungsten resecting loop working on high frequency electric current is used for cutting the prostate tissue into small chips and for coagulating bleeders resulting from the resection. The resecting loop serves as a monopolar electrode and a circuit through the patient is completed with a patient plate returning current to the diathermy machine. Usually, 1.5% glycine is used as a non-conducting irrigant that will neither result in haemolysis or caramelisation (as sugar solutions do). Resected tissue chips are then removed from inside the bladder by flushing with evacuators.

The Veterans Affairs (VA) Cooperative Study remains the most definitive published study of the efficacy and safety of TURP. The VA Cooperative Study found a 1% risk of urinary incontinence and a decline sexual function of 6.5% similar to the incidence in the watchful waiting group. Other complications include irritative
voiding symptoms, bladder neck contracture, need for blood transfusion, infection and haematuria. The mortality of contemporary series is around 0.25%. One unique complication of TURP is the TUR syndrome, a dilutional hyponatraemia that occurs when the irrigant solution is absorbed into the blood stream. This occurred in 2%. The need for transfusion ranged from 2 to 5%. The risks of TUR syndrome and significant bleeding increases with the size of the gland. 1,2

According to the recent release of SOMIP (Surgical Outcome Monitoring & Improvement Programme) results of the HA Hospitals, among 2669 cases of prostatectomy, mostly TURP, done over one year, the 30 day mortality was 0.5%, and 6.6% had complications. The commonest complications were urinary tract infection and systemic sepsis. 0.8% had clot retention and 0.08% had bleeding requiring more than 4 units of transfusion within 72 hours of surgery. The median postoperative length of stay was 3 days.

Currently monopolar TURP remains the gold standard surgery for BPH. TURP comprises 95% of all surgical procedures and is the treatment of choice for prostate sized 30-80ml. Open prostatectomy is reserved for very large prostates or those with large bladder calculi. For small prostates TUIP has been associated with fewer complications.

TUIP
TUIP is an endoscopic surgical procedure limited to the treatment of smaller prostates 30ml or less with no middle lobes. Using a Collin’s knife an incision is made at 5 & 7 o’clock positions or on one side of the midline only. It starts just distal to the ureteric orifice and ends just proximal to the verumontanum. One or two cuts are made in the prostate and the prostate capsule, reducing constriction on the urethra. In appropriate patents TUIP results in similar symptomatic improvement as TURP. TUIP has a lower incidence of complications, minimal risk of bleeding and blood transfusion, decreased risk of retrograde ejaculation and shorter operating time and hospital stay. However there is a higher long-term failure rate. 3

Open Prostatectomy
Open prostatectomy involves the surgical removal (enucleation) of the inner portion of the prostate via an incision in the lower abdominal area. Open prostatectomy is the treatment of choice for large glands over 80-100ml, associated complications such as large bladder stones, or if resection of the bladder diverticulum is indicated. With open enucleation of the adenoma there is more complete removal of adenoma and thus a lower retreatment rate, and TUR syndrome is completely avoided. However, the downsides include a midline incision, long hospital stay and more perioperative bleeding.

2 surgical approaches to open prostatectomy are in common use: classical transvesical and Millin’s retropubic approaches.

Suprapubic prostatectomy or transvesical prostatectomy consists of the enucleation of the hyperplastic prostatic adenoma through an extraperitoneal incision of the lower anterior bladder wall. A suprapubic approach is ideal for a large median lobe protruding into the bladder, clinically significant diverticulum or large bladder calculi as it allows direct access to the bladder neck and bladder mucosa. However, with this approach direct visualisation of the apical prostatic adenoma is limited and apical enucleation is less precise. Haemostasis may be more difficult due to inadequate visualisation of the entire prostatic fossa after enucleation.

The retropubic approach permits enucleation of the hyperplastic adenoma through a direct incision of the anterior prostatic capsule. There is excellent anatomical exposure of the adenoma for complete removal. The urethra can be transected precisely distal to the adenoma for preserving continence. Clear visualisation of the prostate bed is possible for haemostasis, and there is minimal to no surgical trauma to the bladder. The main drawback is that direct access to the bladder is not possible.

Contraindications to open prostatectomy include a small fibrous gland and previous pelvic surgery that may obliterate access to the prostate gland. 4

The surgical procedures of TURP, TUIP and open prostatectomy are all efficacious and result in improvement of LUTS exceeding 70%. Need for blood transfusion is in the range of 2-5%, more following open and less following TUIP. Stress incontinence following TURP is 2.2%, TUIP 1.8% and open 10%. Risk of bladder neck contracture is 1.8% after open, 4% after TURP and 0.4% after TUIP. Retrograde ejaculation occurs in 80% after open 65-70% after TURP and 40% after TUIP.

The potential morbidity of TURP and open prostatectomy and the pressure to reduce hospital stay had provided impetus for the development of alternative procedures for BPH. Many new techniques had appeared around the turn of the century. They have been devised to address specific shortcomings of monopolar TURP and open prostatectomy.

What are the Recognised Options of Surgical Treatment?

We can take reference from some international guidelines.

In EAU guidelines, TURP, TUIP and open prostatectomy are the conventional surgical options. TUVP (Transurethral vaporisation of prostate) and bipolar resections are electrosurgical modifications of the TURP technique. Holmium laser enucleation of the prostate (HoLEP) is considered alternative to the open procedure.

Listed in the procedural options for treatment for BPH in the 2010 AUA guidelines are:

- Minimally invasive therapies:
  - transurethral needle ablation (TUNA)
  - transurethral microwave thermotherapy (TUMT)

- Surgical therapies:
  - open prostatectomy
  - transurethral holmium laser ablation of the prostate (HoLAP)
  - Transurethral holmium laser enucleation of the prostate (HoLEP)
- Holmium laser resection of the prostate (HoLRP)
- Photoselective vapourisation of the prostate (PVP)
- Transurethral incision of the prostate (TUIP)
- Transurethral vapourisation of the prostate (TUVP)
- Transurethral resection of the prostate (TURP)

In NICE guidelines 2010, the following options are mentioned:

If offering surgery for managing voiding LUTS presumed secondary to BPH, offer monopolar or bipolar transurethral resection of the prostate, monopolar transurethral vapourisation of the prostate (TUVP) or holmium enucleation of the prostate (HoLEP).

Offer TUIP or open surgery as an alternative according to the size of the prostate gland. Do not offer minimally invasive treatments (including TUNA, TUMT, HIFU, transurethral ethanol ablation of prostate and laser coagulation) as an alternative only consider offering botulinum toxin injection into the prostate as part of a randomised controlled trial. Only consider offering laser vapourisation techniques, bipolar TUVP or monopolar or bipolar transurethral vapourisation resection of the prostate (TUVRP) as part of a randomised controlled trial.

Among the 2669 procedures done for BPH in HA Hospitals in July 2009–June 2010 there were:

- 2365 TURP
- 190 laser assisted resection of prostate/ incision of bladder neck
- 100 TUVP
- 13 open prostatectomy
- 1 bipolar transurethral enucleation of prostate

Newer techniques can be understood according to the effects they intend to achieve:

1. Resection: improved ways of TUR that reduce bleeding and avoid TUR syndrome
2. Enucleation: as an alternative to open operation but avoiding an open wound and significant bleeding. Usually more technically demanding.
3. Vaporisation: as an alternative to TURP but avoiding bleeding and TUR syndrome. However, there would be no tissue available for diagnosis.
4. Coagulation: induces tissue necrosis by heating as an alternative to TURP but avoiding bleeding and TUR syndrome. Takes time for tissue shrinkage and sloughing for relief of obstruction. Falling out of favour due to post-procedure retention and irritation and delayed relief of obstruction.

However, by convention, they will be discussed according to the different types of energy and technology that is involved.

**Improved Open Operations**

Laparoscopic and robotic prostatectomies are techniques currently associated with the treatment of prostate cancer but there are reports on using these technologies for the treatment of LUTS. Laparoscopic simple prostatectomy and robotic simple prostatectomy can reduce the large surgical wound required for open prostatectomy but they are still considered investigational. The operation can take three to five hours, which is longer than traditional surgery. Blood loss is less and hospital stay is shorter than open operations. The rate and severity of complications are similar.

**Modified Transurethral Electro surgery**

TUVP monopolar

TUVP was first described by Kaplan in 1995. 2 Electrosurgical effects are combined: vapourisation and desiccation. The cutting current is set to a maximum of 75% higher than for a standard TURP. The rollerball is only useful for small glands. A grooved rollerbar increases the number of leading edges at which electrovapourisation takes place and increases the efficiency of vapourisation. New second generation electrodes (thick loop) have been developed to vapourise and resect the prostate at the same time (TUVRP). TUVP has equivalent short term improvements of symptoms, flow rate and QoL (quality of life) indices with a decreased risk of TUR syndrome compared with monopolar TUVP. However, the rates of postoperative irritative voiding symptoms, dysuria and urinary retention, as well as the need for unplanned secondary catheterisation, appear to be higher, as are the reoperation rates. TUVP is considered alternative to TUIP and TURP particularly for patients with bleeding disorders and small prostates.

**Bipolar Transurethral Electrosurgery**

Bipolar resection of the prostate utilises a specialised resectoscope loop that incorporates both the active and the return electrodes. The operation is similar to monopolar resections. This design limits the dispersal of the current flow in the body which theoretically reduces the deleterious effects of the stray current flow. The electric effect on a cardiac pacemaker is also markedly reduced. Because the bipolar resectoscope uses normal saline as the irrigation fluid, the risk of TUR syndrome is eliminated. The depth of tissue necrosis is less compared with bipolar resection. However, the resecting loops are less durable and more expensive.

The bipolar electrodes had been modified to a spherical shaped button (TURIs [TUR in saline] plasma vapourisation) and launched in 2009 for endoscopic vapourisation of prostate tissue. With the plasma corona created at the electrode good haemostasis is achieved with a smooth surface left but the time for vapourisation is somewhat longer than resection and no tissue will be available for diagnosis.

The bipolar resectoscope had been used for enucleation of large prostatic adenoma as popularised by Professor CX Liu. Enucleation with monopolar resectoscope carries substantial risks of TUR syndrome and is not preferred. Effects similar to open enucleation are produced with avoidance of any surgical wound. Morcellation is not required and the adenoma is devascularised by endoscopic enucleation from the prostate bed before being cut up into small chips with the bipolar resectoscope. Large glands can be removed quite rapidly and with minimal blood loss. The technique requires, however, a long learning curve.

**Laser Therapies**

The use of lasers to treat BPH has been contemplated since 1986. 4 types of lasers have been used to treat the
An end-firing fibre is used to enucleate the prostate HoLEP to the surgical capsule resulting in a TURP-like effect. Contact mode. Intended to vaporise prostate lobes down to an optical penetration depth of 0.4mm. Various 2120nm laser is absorbed primarily by water and results in secondary tissue sloughing which is associated with tissue oedema. Vaporisation on the other hand dehydrates tissue and decreases heat scattered into tissues to cause oedema. The vaporisation and coagulation effect can be used in combination to effect resection of prostate tissues or enucleation of prostatic adenomas. Today, the holmium and variants of the PVP laser are the most common laser technologies used to treat prostate disease.

NdYAG: VLAP (visual laser ablation of prostate) 1064nm laser of 40-80W is delivered over 60 seconds to each site using a gold-plated distal reflecting mechanism on a lateral firing non-contact laser fibre. The laser is poorly absorbed by water and haemoglobin and is transmitted several millimetres into the tissue with heating and coagulating effects. The best results are obtained for glands below 50-60ml because in larger glands significant amounts of obstructive prostatic tissue can be left behind. Moreover, patients with chronic UTI and chronic bacterial prostatitis are not good candidates due to risks of infection of the necrotic tissue that remains in situ for several weeks after the operation. Despite claims of good short term subjective and objective improvements, the treatment became characterised by prolonged dysuria, retention and extended need for catheterisation. The effect was not improved despite increase of power of subsequent generations to 120W. Combination with bladder neck incision or absorbable stent failed to keep the procedure from being largely abandoned by urologists nowadays.9

Indigo laser (one type of diode laser) 830nm low energy (2-20W) laser energy is delivered directly to tissue from the interstitial laser fibre tip that punctures the prostate. Coagulative necrosis is generated within the adenoma, sparing its urethral surface. The applicator can be inserted to coagulate deeper tissues. Post-procedure, the intraprostatic lesions will result in secondary atrophy and regression of the prostate lobes rather than sloughing of necrotic tissues. Each stab lasts 3 minutes and the whole procedure lasts 30-60minutes. The symptoms need 6-12 weeks to resolve. A postoperative catheter is required for irrigation and the goal is to create a TURP-like cavity for morcellation. The learning curve for holmium laser enucleation of the prostate appears to be longer than that of other technologies.11

HoLRP Prostate adenoma is resected using a holmium laser fibre 550 micron 80W end-fire and specially adapted resectoscope. Symptomatic improvements may be comparable to that obtained after TURP with slightly reduced risks of bleeding, need for transfusion and absence of TUR syndrome.22

Green laser photoselective vapourisation (PVP) PVP is a form of transurethral prostatectomy performed using a 600 micron side-firing fibre in a non-contact mode. Wavelength 532nm is absorbed by both water and haemoglobin resulting in an optical penetration depth of 0.8mm. Lower energy laser (up to 80W) is generated from KTP (potassium titanyl phosphate) generators. High power laser at 120W is generated from the newer LBO (lithium borate) generator. Normal saline is used for irrigation and the goal is to create a TURP-like cavity after ablating the various prostate lobes down to the surgical capsule. Symptom scores improved consistently in all studies, as did the QoL scores and maximum urinary flow rates.13

Other lasers Biolitec laser 980nm at 150W-200W also aims at achieving vapourisation. Local experience is available but limited. The rate of vapourisation with the side-firing fibre seemed to be modest.14 Thulium laser 2000nm is almost identical to holmium except for a continuous rather than pulse discharge of energy. This results in greater efficiency in cutting and haemostasis and is useful for resection with minimal bleeding.15

Generally, transurethral laser approaches have been associated with shorter catheterisation time and length of stay, and with comparable improvement in LUTS. There is a decreased risk of perioperative complication of TUR syndrome. Information concerning retreatment and urethral strictures is limited due to short FUs. Comparison of outcomes between studies should be considered cautiously given the rapid evolution in technologies and power levels. Emerging evidence suggests a possible role of transurethral enucleation and laser vaporisation as options for men with very large prostate of >100g.

Radiofrequency: TUNA TUNA employs a cystoscope-like device. The lumen of the prostatic urethra is directly visualised with an endoscope and 2 needles are inserted from the prostate adenoma, separating the adenoma from the surgical capsule, from apex to base, after any median lobe has been freed from the bladder neck. Typically the technology is used for larger glands that would have been treated surgically with an open prostatectomy. Generally, the results compare favourably to an open prostatectomy in the hands of an experienced surgeon. Holmium enucleation leads to a similar outcome as open prostatectomies for men with large glands of over 100ml at a significantly lower complication rate. Nonetheless, long term data beyond 2 years are still lacking. The procedure requires specialised equipment for morcellation. The learning curve for holmium laser enucleation of the prostate appears to be longer than that of other technologies.11

HoLEP An end-firing fibre is used to enucleate the prostate
lumen laterally into the prostatic adenoma. The generator produces low level monopolar radiofrequency waves of 490kHz which induce a temperature of about 100 degree Celsius in the target area causing necrosis. The number of needling can be adjusted according to the size and length of the prostate. The urethral mucosa is spared and the necrotic tissue will be absorbed over time, thus reducing the prostate volume. TUNA is attractive for being safe with few perioperative complications. Improvements in symptoms, QoL and urinary flow rates are significant but do not generally match the results of TURP. 40% of patients have retention of urine within the first 24 hours. Treatment by other modalities can be expected in 14% of patients within 2 years. 20% underwent TURP in 3 years. TUNA works best for lateral lobe enlargements and is not suitable for prostates over 75ml or for isolated bladder neck obstruction. Like other coagulative procedures, its use is on the decline. 16

Microwave Thermotherapy

Transurethral microwave thermotherapy (TUMT) Original machines were low power and generated temperatures too low to achieve any effect. Newer TUMT devices seek higher temperatures (thermotherapy) as well as a transurethral approach to target the transitional zone. An interstitial temperature of 50-80 degrees Celsius could be achieved and a cooling system to protect the bladder neck and prostatic urethra are required. Prostatron operates at 1296MHz and is capable of generating up to 80W. Prostalund is the only device to use an interstitial probe with three sensors to monitor intraprostatic temperature, thereby providing a mechanism to control and adjust the volume of tissue ablation. It operates at a frequency of 915MHz with three different length catheters and can deliver up to 100W. TUMT is effective in partially relieving LUTS secondary to BPH. There are various devices and protocols with different outcome measures, and there is no compelling evidence from comparator trials to conclude that one device is superior to another. Outpatient capability, lack of sexual side effects and avoidance of actual surgery are attractive to patients and clinicians alike. But the perception that the treatment lacks durability of effect has held back greater utilisation. A catheter is required for retention after treatment. High energy TUMT is associated with improved objective results compared with low energy TUMT, but with increased morbidity.

HIFU
A beam of ultrasound can be brought to a tight focus at a selected depth within the body to produce tissue destruction without damage to the overlying or intervening structures. The source of HIFU is the piezoceramic transducer. The energy can be delivered trans-abdominally through a water bath or trans-rectally through a probe. Patients develop retention of urine for 3-6 days. Haemospermia is observed in 80% of sexually active men. 43.8% men need TURP due to insufficient therapeutic response within 4 years. The treatment is unsuitable for prostates with calcifications, large middle lobe, or over 75ml. 17

Stent
The idea of using stents for splinting the lobes of the prostate was derived from their original use in the cardiovascular system. Fabian (1980) first described the use of stents for obstruction by prostate. Their major role was likely to be in patients unfit for surgery, where the alternative would be long term indwelling urethral or suprapubic catheterisation.

Temporary: can be nonabsorbable or biodegradable. They are for short term use to act as an alternative to indwelling caths. The newer generation of temporary stents includes the Memokath, which is made of nitinol (nickel titanium alloy), with the property of shape memory, heat expandable at 45-50 degrees Celsius. This property allows the Memokath to maintain position better. Close contact of wires prevents ingrowth of the epithelium. It may be left in place up to 36 months. It comes at a calibre of 22Fr and a length choice of 35-95mm. 80% remains successful at 3 months.

Permanent:
The Urolume endourethral prosthesis is a woven tubular mesh that maintains its position in the urethra by outward external pressure. The original device had a calibre of 42Fr and varied in length from 1.5 to 4cm. Epithelialisation occurs ideally in a smooth manner, covering the wires of the mesh. Severe irritative symptoms were common up to 3 months. Migration of the stent, encrustation and hyperplasia of epithelium can occur. Removal was eventually required in 47% and most removals occurred in the first 2 years. (Masood 2004)

Injection Therapies
Injection with alcohol to effect coagulative necrosis of prostatic tissue and injection with botulinum toxin to induce atrophy of smooth muscle fibres in the prostate gland had been proposed for relief of outflow obstructions related to prostate. These measures are still investigational at best.

Conclusion
Urologists are renowned for being able to capitalise on advances in technologies. Not surprisingly, the same resourcefulness is evident in our pursuit of better ways to serve our patients with BPH. We need to keep our minds open for new techniques, and at the same time be very meticulous in scrutinising their efficacy and safety. In Hong Kong, urologists are privileged to have exposure and access to various new surgical modalities for BPH. With a diversified armamentarium in hand, we are in a better position to individualise our surgical treatment for our BPH patients according to their disease severity, their physical condition and their expectation.

“Plus ca change, plus c’est la meme chose.” (The more things change, the more they are the same.)
Alphonse Karr 1808-90

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