Durability and retreatment rates of minimal invasive treatments of benign prostatic hyperplasia: a cross-analysis of the literature

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Background: *Transurethral resection of the prostate (TURP) has been the gold standard of the treatment of benign prostatic hyperplasia (BPH). In recent years there has been a significant shift in the treatment of BPH and guidelines emphasize minimally invasive surgery as a new treatment option. Minimal invasive technologies (MITs), such as transurethral microwave thermotherapy (TUMT), laser ablations, transurethral needle ablation (TUNA) have emerged as an alternative to the TURP.*

Objectives: *To assess the retreatment rates of the most commonly used minimal invasive techniques.*

Search strategy: *Durability articles were selected by using defined search terms using PubMed as search engine.*

Results: *Comparing to the overall retreatment rates of MITs the results show that TUMT, holmium laser enucleation of the prostate (HoLEP) and contact laser vaporization (CLV) are among the treatments with the lowest retreatment rates. Studies show no significant differences in retreatment rates between TUMT and TURP.*

Conclusion: *A review of the current literature, long term results and retreatment rates of MITs shows large variability in outcomes and retreatment rates. The true definition of a MIT remains unclear. High energy TUMT deserves reconsideration in clinical practices, due to low retreatment rates and the low need of anesthetics.*

Key Words: transurethral resection of the prostate, minimally invasive technologies, transurethral microwave thermotherapy, benign prostatic hyperplasia

Introduction

Benign prostatic hyperplasia (BPH) is a common condition in older men, and can result in lower urinary tract symptoms (LUTS).[1] Treatment has changed in recent years, with a growing understanding of the epidemiology and pathophysiology of BPH affecting how treatment is administered. Historically, treatment was based on extirpative surgery (such as suprapubic prostatectomy and transurethral resection of the prostate (TURP)), but in more recent years, guidelines have begun to emphasize pharmacotherapy and minimally invasive ablative surgery as new treatment options. Minimal invasive technologies (MITs), such as transurethral microwave thermotherapy (TUMT), laser ablations, transurethral needle ablation (TUNA) and a number of others have emerged as an alternative to the long standing TURP, providing the patients and urologists a wide range of therapeutic options for men with LUTS secondary to BPH.[2] Whereas treatment

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efficacy was the primary goal for many years, one of the issues that have emerged as long term follow up data has been gathered is treatment failure and the possible need for retreatment over time.[3] The varying methods and possible retreatment rates of different MITs in combination with cost and reimbursement issues have made a true evaluation of their impact on everyday urological practice difficult. In response, this review seeks to assess retreatment rates of the most commonly used minimally invasive techniques.

Literature search

PubMed was the primary search engine. Durability articles were selected using the search terms "Durability Benign Prostatic Hyperplasia", "Benign Prostatic Hyperplasia long term results" and "Benign Prostatic Hyperplasia 5 year". The focus was to assess retreatment rates by matching definitions of retreatment as closely as possible for different MITs. Only articles presenting an account of their surgical or MIT retreatment rates were included. Additional studies were identified from references of retrieved articles and reviews, and hand searching of peer reviewed international urology journals. Table 1 shows the published long term retreatment rates for the selected MITs.

BPH treatments

BPH is a common symptomatic condition occurring mostly in older men. Histological changes of hyperplasia are generally to be found in over half of men over the age of 65, and almost 90% of those over 85,[4] although not all these men are symptomatic at all times. Over 30% of men over the age of 65 have irritative (urgency, frequency, nocturia) and/or obstructive (weak stream, hesitancy, intermittency and incomplete emptying) urinary symptoms that can be attributed to BPH.[5] Additionally, up to 40% of men present with a clinically significant cause of bladder outflow obstruction.[2]

Transurethral resection of the prostate

Interventional therapy in the form of open surgery currently still remains an important part of BPH treatments. TURP has historically been regarded as the gold standard of BPH treatments against which most alternatively developed treatments are being compared.[6] During TURP, obstructing adenomas tissue is resected using a loop with a cutting diathermy current. The distal end of the incision is the verumontanum, representing the proximal extremity of the distal sphincter mechanism. Bleeding vessels can also be easily visualized and coagulated. TURP is however often associated with considerable morbidity due to its invasive nature,[7,8] but remains popular due to the fact that the outcome following surgery is still superior to all other alternative treatments[9] and retreatment rates are generally low. In recent times however this has begun to be viewed as oftentimes unnecessarily invasive treatment, and the introduction of MIT as considerable decreased the number of TURPs performed worldwide. In the United States, for example, 285000 prostatic resections were performed in Medicare program in 1987, but the figure had fallen to 86000 in 1999.[10] According to American Urological Association (AUA) data this is due to the increasing utilization of pharmacologic treatments and MITs for the treatment of BPH.[11]

Minimally invasive technologies

Compared to other BPH treatments, minimally invasive surgery is generally associated with shorter postoperative hospitalizations and decreased morbidity. Many MITs can additionally be performed without general anesthesia, forgoing any possible anesthesia related complications. Although there is an abundance of short term data on minimally invasive techniques available in the literature, there is a limited amount of long term data, so the procedures have not yet replaced TURP as the 'gold standard' for the surgical management for BPH. MITs can include a number of treatments, such as holmium laser resection, plasma kinetic vaporization, green light laser, YAG laser and transurethral microwave thermotherapy.

Transurethral microwave thermotherapy

In the past years, cooled transurethral microwave thermotherapy (TUMT) has emerged as an alternative to medical treatment for patients not suitable for surgery, and has proved to be an effective modality to relieve LUTS.[12-14] TUMT is a single session treatment, requiring only topical anesthesia generally performed on an outpatient basis.[15,16] TUMT has in recent years become the preferred microwave technique due to the fact that treatment can be provided in single outpatient session. Due to its simplicity, minimal morbidity and outpatient nature of the procedure it has gained a firm place in the urologist's arsenal.[17] TUMT uses microwaves to heat obstructive prostatic tissue under topical urethral anesthesia, and the microwaves vary by the degree of prostatic heating. These include hyperthermia (heating prostate tissue to 42 ℃ to 44 ℃),

TABLE 1. **Published long term retreatment rates**

Reference	Study/technology	Duration of results # enrolled/followed	Analysis method	Retreatment rate in %
High energy minimally invasive technologies (and control arms)				
Rosario et al[46]	TUNA	**Median 20 mo** 71 enrolled 71 (100%) assessed	Cumulative incidence	51%
Gravas et al[39]	Prostatsoft 3.5	**Mean 33.9 mo** 213 enrolled 40 (19%) at 60 mo (based on IPSS)	Cumulative incidence	28.6%
Floratos et al[43]	HE TUMT and TURP	**Median 33 mo** 144 treated 100 (70%) followed	Cumulative incidence	14.6% TUMT 9.1% TURP
Djavan et al[38]	High energy TUMT	**12 months** 51 treated 100% assessed	Cumulative incidence	2%
Djavan et al[40]	Urologix	**18 months** 51 treated 100% assessed	Cumulative incidence	5.9%
Roehrborn et al[41]	CTC	**5 years** 66 treated 63 (95%) followed	Kaplan Meier	9.5%
Mattiasson et al[42]	CoreTherm and TURP	**5 years** 100 enrolled 100 followed	Cumulative incidence	8% TUMT 4.3% TURP
Surgical technology				
Hai et al[44]	PVP Greenlight	**5 years** 321 enrolled 246 (77%) followed	Cumulative incidence	8.9%
Gilling et al[3]	HoLEP	**6.1 years** 71 enrolled 38 (54%) followed	Cumulative incidence	1.4%
Hammadeh et al[30]	Vaportrode (TUVP)	**5 years** 104 enrolled 53 (51%) followed	Life table	13% TUVP 14% TURP
Abdel-Khalek et al[31]	TUVP versus YAG	**4 years** 180 enrolled 140 (78%) followed	Cumulative incidence	12% TUVP 38% YAG
Kaya et al[45]	PKVP (Gyrus) and TURP	**3 years** 75 enrolled 40 (53%) followed	Cumulative incidence	12% PKVP 7% TURP
Tuhkanen et a[16]	CLV and TURP	**4 years** 52 enrolled 42 (81%) followed	Cumulative incidence	3.9% CLV 3.9% TURP

thermotherapy (45˚C to 60˚C), and thermoablation (60˚C to 75˚C). TUMT techniques have changed significantly over the past decade, shifting from primary systems using lower energy/heat settings for an average treatment time of around an hour, and while resulting in minimal discomfort, first results fell short of expectations. More recently developed techniques now use higher energy/heat settings, leading to halved procedure times and improved outcomes. This improvement using higher energy has however come at a certain cost, with patients reporting more discomfort throughout the procedure and the therefore often required use of sedation and additional analgesia.[18]

Transurethral needle ablation

Transurethral needle ablation (TUNA) of the prostate is another outpatient treatment of BPH based on thermotherapy. TUNA works by producing selective necrosis in hyperplasic tissue with the use of therapeutic heat generated by radiofrequency energy. The radiofrequency energy passed through two needles placed into the prostate transurethrally. The radio waves apply low level energy (460kHz). Although low energy, the targeted prostatic tissue of the inner region is ablated with comparatively high temperatures approaching 110˚C (230˚F).[19] Overall TUNA achieves similar results to TURP when efficacy after treatment is compared, but at 12 months the degrees of improvement of both subject and objective variables has been found to be significantly lower than TURP.[20]

Laser ablation

Although classified as surgical procedures, laser ablation for BPH can nevertheless be seen as less invasive than the traditional TURP. As with TURP, laser treatments require anesthesia and a hospital stay but result in reduced blood loss and generally faster recovery times. Several different lasers are currently in use, which either employ side-firing laser fibers, or use lasers to vaporize hyperplasic tissue. One of the main issues with laser treatments of BPH has been the level of treatment failure and need to retreat, although with newer lasers and better technology the retreatment rates are steadily improving.

One of these, the photoselective vaporization of the prostate (PVP) Greenlight laser, has recently gained further acceptance in the treatment of hyperplasic tissue. The PVP laser uses a high-power (80 W) potassium-titanyl-phosphate (KTP) laser or a 120 W lithium triborate (LBO) laser[21] to ablate prostatic tissue. This is done by ablating tissue leaving only a small depth of coagulated tissue in the prostate by employing rapid vaporization.[22] Rapid vaporization results in an instant hemostatic tissue ablation and therefore leads to minimal intraoperative bleeding and allows for a quicker recovery, resulting in the PVP laser being recognized as a safe and effective treatment.[23]

Another closely investigated laser technique that allows treatments of even the largest prostate glands, which would in the past have required an open surgical procedure is the holmium enucleation of the prostate (HoLEP) laser.[24] The HoLEP laser is most effective in treating bladder outflow obstruction caused by BPH and has evolved in the past decade from ablation[25,26] to resection,[27]to the latest complete holmium laser enucleation.[28] The hemostatic effect produced by the laser has the additional benefit of resulting in minimal bleeding after resection.[29]

Vaporization

Electrovaporization is the most recent addition to the possible MIT for BPH. Vaporization most commonly uses a grooved ball electrode and pure cutting current sculpt out the prostatic bed, causing vaporization and desiccation with no possibly dangerous heating of the prostatic capsule or neurovascular bundle.[30,31] Another technique, contact laser vaporization (CLV) removes obstructing tissue and additionally creates a tunnel in the prostatic urethra, enabling early postoperative voiding,[6] but is overall only effective in small to moderately enlarged prostates.[32-34] As with other MITs, vaporization results in less blood loss, reduced catheter and shorter hospital time compared to TURP, and thus generally shorter hospital stays.[35-37]

Retreatment of MITs

Studies relating to MIT and their retreatment rates found during the literature search are summarized in Table 1.

Comparing the overall retreatment rates of MITs and minimally invasive surgical technologies, the results show that TUMT, HoLEP and CLV are among the treatments with the lowest retreatment rates. Due to the fact, that HE-TUMT is a continuous energy and not self limiting the retreatment rates are lower than with other MIT's. The other methods such as the TUNA are self limiting. TUMT retreatment rates range from a low at 2% in one study at 12 months[38] to another study with a rate of 28.6% at 33.9 months,[39] but most rates lie in the single digit figures (1-5 year follow up).[38,40-42] Two studies compared TUMT with TURP retreatment rates,[42,43] and although TURP had lower retreatment rates, Floratos et al[44] reported the difference to be not statistically significant and Mattiasson et al[42] reports rates below 10% for both treatment modalities.

HoLEP retreatment rates are the lowest recorded with 1.4% at 6.1 years,[3] but as this is a single study with an enrollment of only 71 patients and a follow up of 54% of these (38 patients), further studies are needed to confirm these rates. Other laser techniques such as the PVP Greenlight laser show retreatment rates upward of 8.9% after 5 years.[44] Vaporization techniques range from 3.9% for CLV[6] to 13% for TUVP[30] and 38% for the YAG laser.[32] TURP rates are compared in three cases[6,30,45] and retreatment rates are comparable for all. Tuhkanen et al[6] and Hammadeh et al[30] report identical retreatment rates for TURP and laser, and Kaya et al[45] showed statistically significant lower rates for TURP compared to PKVP.

The MIT with the highest retreatment rates was found to be TUNA. A total of 51% of the patients undergoing TUNA had had retreatment at a median follow up of 20 months.[46] These rates are far higher than any of the other techniques investigated.

Despite some superior results of other treatments compared to the rates for TUMT, it must be restated that while less invasive than TURP, laser and vaporization are far more invasive than TUMT, requiring anesthesia and resulting in hospital stays for the patient. While seen as minimally invasive, they are overall far more akin to a surgical procedure than a true minimally invasive approach.

Conclusion

There has been a significant paradigm shift in the treatment of BPH in the past decades. Recent trends showed a revival of minimal invasive devices. The perceived pitfalls however relate to the frequent need for retreatment leading to a significant disappointment over the past years. Our review of the current literature and retreatment rates of a number of available minimal invasive technologies identified high energy TUMT devices as very viable and durable BPH treatment options. The need for general anesthesia has steadily decreased and many of the treatments can now be performed on an outpatient basis (i.e. under local anesthesia only as for high energy TUMT). Recent data with the CTC HE-TUMT device showed retreatment rates as low as 9.5% at 5 years follow up. In conclusion, HE-TUMT deserves reconsideration in the minimal invasive treatment armamentarium of patients with BPH. The outpatient setting and the need for local anesthesia only, in combination with low retreatment rates reflect a revival of HE-TUMT in our current clinical practice. □

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