



The state of TURP through a historical lens

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Abstract

In 1926 Maximilian Stern introduced a new instrument to treat obstructions at the vesical orifice and baptized it *resectoscope*. With reference to astonishing historical statements about the new instrument and surgical technique made by the pioneers and their critics we will value why transurethral resection of the prostate (TURP) remains the gold standard for most men suffering from lower urinary tract symptoms (LUTS) due to benign prostatic enlargement. TURP is currently challenged by recently introduced new instruments and techniques claiming advantages over TURP. However, TURP offers an excellent balance between high efficacy in symptom relieve and low morbidity along with low costs and favorable long term outcome compared to other treatment options. We will outline these arguments demonstrating that even after a century has elapsed, since its introduction into the urologists armamentarium, TURP continues to stand the passage of time.

Keywords LUTS · Prostatic hyperplasia · Transurethral resection of prostate

Introduction

In 1926 Maximilian Stern (Fig. 1) described a new method and new instruments for the treatment of what he called “obstructions at the vesical orifice” [1]. He named the instrument a resectoscope. Most would agree that ever since then the resectoscope is the urologists most liked and used instrument in the operating room.

As with any other new method, further improvements in the instrument design were introduced rapidly, e.g., the “the two foot switch”, a predecessor of today’s foot pedal by Theodore M. Davis [2] (Fig. 2a, b) and Joseph F. McCarthy’s modifications of the original Stern resectoscope [3]. Needless to say, critics were plentiful questioning the new technique, its safety and outcome. In 1932 Robert V. Day even concluded that the new method will not come into general use [4]. Some 90 years later, his dire prediction did not occur primarily because he failed to envision the true potential of transurethral resection of the prostate (TURP). TURP soon

became the gold standard for the treatment of infravesical obstruction due to benign prostatic enlargement (BPE).

TURP as the reference technique for the surgical treatment of BPE has been challenged in the past decades repeatedly. We will discuss TURP in the light of statements made 80–90 years ago and compare them to the achievements that have been reached in the interim. We will not present a systematic review comparing TURP to emerging new techniques but rather stress the factors why TURP is still considered the reference technique for BPE surgery.

Indication

Maximilian Stern 1926: “From the foregoing it is logical to state that prostatic resection is applicable to a large number of cases of prostatic hypertrophy commonly subjected to prostatectomy” [1].

Harry W. Martin 1932: “It would seem that one is on the safe ground to predict that at least 25 or 30 per cent of hypertrophies will be suitable for this procedure” [2].

Indeed, Stern’s projection holds true even one century later. As of March 2020, the EAU guideline panel on non-neurogenic male LUTS designates TURP as “the cornerstone of LUTS/BPO surgical treatment for more than nine decades” [5]. Likewise, the AUA guidelines calls TURP the “historical standard” and “the single best gold standard”

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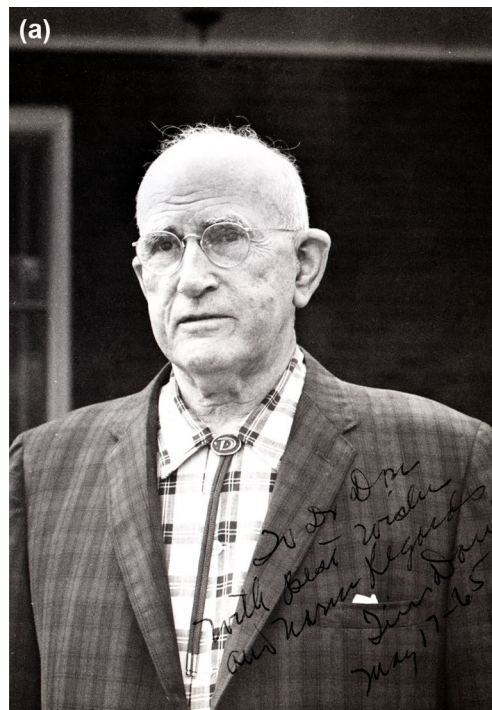
Fig. 1 Portrait Maximilian Stern (with permission from The William P. Didusch Center for Urologic History, American Urological Association)

treatment [6]. In terms of indications for surgery, both guidelines panels widely agree on the indications which warrant surgery as initial treatment for BPE (renal insufficiency, refractory urinary retention, recurrent UTI, bladder stones and gross hematuria secondary to BPE, respectively). Thus, even in recent years TURP remains the most commonly performed intervention for BPE [7–9]. However, in absolute numbers TURP has declined significantly in the last 20–30 years [10, 11]. This is mainly attributable to the introduction of medical treatment as first line option for LUTS due to BPE in the 1990s [12]. Therefore, patients undergoing TURP after the advent of medical treatment for BPE presented more frequently with an absolute indication, i.e., necessitating TURP because of complications of BPE such as urinary retention or hydronephrosis [10]. Therefore, over the past decades indications for TURP shifted primarily from men mainly seeking relief of bothersome lower urinary tract symptoms (LUTS) to men undergoing TURP presenting with urinary retention [11].

At this point in time, it is too early to estimate how newer techniques such as Aquablation®, UroLift®, iTIND, prostatic artery embolization or Rezūm™ will affect these figures. More likely, these procedures will challenge long term medical treatment of LUTS, while others may be an alternative to TURP and other surgical techniques.

Harry W. Martin 1932: “The ultimate niche or field of endoscopic resection is positively unanswerable at the present moment” [4]. In response to this quote in the year 2020 every other intervention for BPE than TURP hopes to own a part of the BPH treatment pie.

Fig. 2 **a** Theodore M Davis, **b** Davis generator with “two foot” switch (with permission from The William P. Didusch Center for Urologic History, American Urological Association)



Preoperative evaluation

Doyle and Feggetter 1935 “In addition to renal function tests these patients all had pre-operative cystoscopic and posterior urethroscopic examination” [13].

Neither AUA nor EAU guidelines recommend a cystoscopy as a baseline evaluation for patients scheduled for TURP.

From bipolar to monopolar instruments and back again

Maximillian Stern 1926: “It is thus made evident that the instrument is bipolar, no plate or pad being used under the buttocks as the indifferent pole” [1].

Remarkably, the first resectoscope introduced by Stern, according to his description, was technically spoken also the first bipolar instrument for surgery of the prostate. For the following seven decades; however, monopolar instruments dominated the field. It was only 75 years later that bipolar instruments were re-introduced again. Initially the bipolar instruments were designed to vaporize the prostate [14]. The possible advantages of surgery in saline became apparent quickly and bipolar resection loops were developed shortly afterwards [15]. The natural history of new instruments or techniques unfolded again leading to improvements of the bipolar equipment (generators, loops and resectoscopes) subsequently leading to broader acceptance among the urological community. Advertising initially unproven benefits of new devices is a natural habit: Joseph McCarthy 1931: “Suffice it to state that this apparatus supplies a degree of power considerably in excess of any conceivable clinical requirement” [3].

Historically and not surprisingly, debates and comparative studies about its possible drawbacks and advantages were inevitable. Current reviews and meta-analyses confer some advantages to the bipolar over monopolar technique [16]. In this Cochrane review the bipolar technique is associated with a lower transfusion and TUR syndrome rate than the monopolar technique.

Surgical technique

We will not discuss the surgical technique but believe that the following historical citations are perfect guidelines for the novices.

Harry W. Martin 1932: “The verumontanum should be located before any tissue is removed as this organ is the anterior guide, as it is always the apex of the gland” [4].

Theodore M. Davis 1931: “... and a careful examination is made of the vesical orifice and the posterior urethra. It

is most important at this time to locate and recognize the verumontanum, as this is the anterior guide within the urethra” [2].

Theodore M. Davis 1931: “Additional sections are made in a continuous line having the proximal edge of the preceeding section in view...” [2].

Learning curve

Harry W. Martin 1932: “It is generally agreed by the experts, who have done the greatest amount of work of this kind, that one must perform at least twenty-five to fifty resections before one becomes proficient, and only if he is already the possessor of great cystoscopic skill and patience” [4].

Ideally, any kind of procedure has a steep learning curve, i.e., residents and novices should achieve good results after having performed only a few cases (Fig. 3). Furthermore, during the learning curve the complication rate should be low and the outcome similar to the ones of experienced surgeons. In an analysis of two matched cohorts of 152 and 153 patients operated by residents or senior consultants a study group from Bonn, Germany found no differences in terms of short- or long-term complications or functional results [17]. As stated above, in the early days 25–50 TURP’s were considered necessary to master the procedure [4]. Data in the literature on this topic is scarce. Furuya concluded that after 81 TURPS surgeons’ skills, i.e., speed of resection/weight per minute plateaued and with increasing experience the transfusion rate decreased [18]. However, this is a single surgeon experience and thus its generalizability is questionable.

Residents training for this “bread and butter” procedure in some countries is hampered due to decreasing numbers of TURPs performed [11]. Therefore, some authors promote the implementation of simulators and specially focused boot

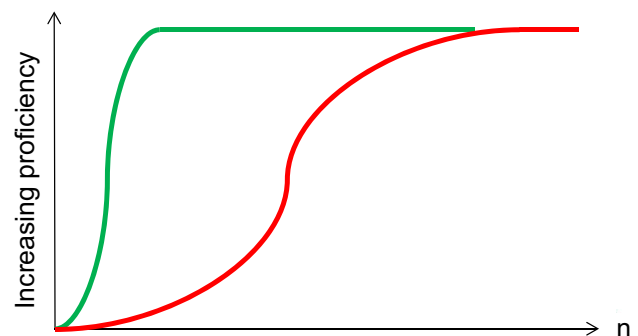


Fig. 3 Green line/steep learning curve: only a few cases are required to achieve proficiency Red line/flat learning curve: many procedures are required to achieve proficiency level (n = number of cases)

campus to provide a practical and theoretical framework for residents scheduled for their first TURPs [19, 20].

LUTS after TURP

Doyle and Feggetter 1935: “Some of the patients operated on were “human derelicts” given a new lease of life” [13].

As outlined above nowadays more men present with absolute indications for surgery due to BPE rather than just because of bothersome LUTS. However, overall improvement of symptoms (according to changes of IPSS) and quality of life after TURP is nevertheless still very impressive [21]. Moreover, not only total LUTS scores but also most of the addressed particular symptoms improve significantly after TURP [22]. A disturbing finding is the notion that prolonged medical therapy before TURP may hamper the outcome and increase the failure-to-void rate [10, 11, 23]. It is hypothesized that deferred operative treatment due to longtime medical treatment may promote underlying detrusor underactivity and thus interferes with favorable outcome after TURP [23].

Sexual function after TURP

Terrence Millin 1932: “Correctly performed, resection leaves the ejaculatory ducts intact and, a point not unimportant to many, sexual function is not impaired” [24].

Many men are concerned that they will suffer from some kind of sexual dysfunction after TURP. On one hand patient’s misconceptions of the side effect profile between TURP and radical prostatectomy (Fig. 4) and on the other hand conflicting data in the literature about the sexual sequelae after TURP trigger these concerns. It is indisputable that classic TURP leads to a deterioration of the ejaculatory function [25]. Several study groups, e.g., Aloussi et al. and Gul et al. published their ejaculatory preserving techniques

demonstrating a high success rate in well-selected men [26, 27]. The latter group described a middle lobe resection technique in men with prominent intravesical protrusion of the prostate [27]. In their cohort more than half of the patients presented with urinary retention and prostate volume was on average 80 g. Antegrade ejaculation was preserved in 97.4% while International Prostate Symptom Score (IPSS), post void residual urine, (PVR), peak urinary flow rate (Qmax) and QoL (quality of life) improved significantly. However, is retrograde ejaculation an important issue for the majority of men undergoing TURP? Of note, semen volume decreases significantly with age, e.g., in men over 70 years of age is about 1.2 ml and in men in the forties about 3.5 ml [28]. According to these findings, the question whether ejaculation preservation needs to be balanced against improvement of LUTS and voiding parameters seems not to be of major importance for most men at risk for BPE surgery but should be discussed in selected cases [29].

Gul et al. observed a de novo rate of erectile dysfunction (ED) as low as 0.3% [27]. This compares favorably to data in the literature reporting an ED rate of about 14% (0–32%) [30]. However, in a review from Becher et al. overlooking the impact of TURP for BPE on sexual health the authors concluded that most data derive from uncontrolled single-center studies with poor quality frequently lacking baseline preoperative sexual function [30]. A Swiss multicenter study addressed many points of criticism mentioned by Becher et al. [25]. This study group evaluated 1014 patients scheduled for TURP, whereof 988 patients returned the DAN-PSSsex questionnaire pre and 642 patients postoperatively. The rate of men being sexually active before and after TURP remained unchanged (73%). However, out of the sexually active men before and after TURP 37.5% and 40.4% of men had normal erections before but 58.7% and 53% had an impaired and 3.8% and 6.3% had no erections. LUTS was an independent risk factor for sexual dysfunction. Along with

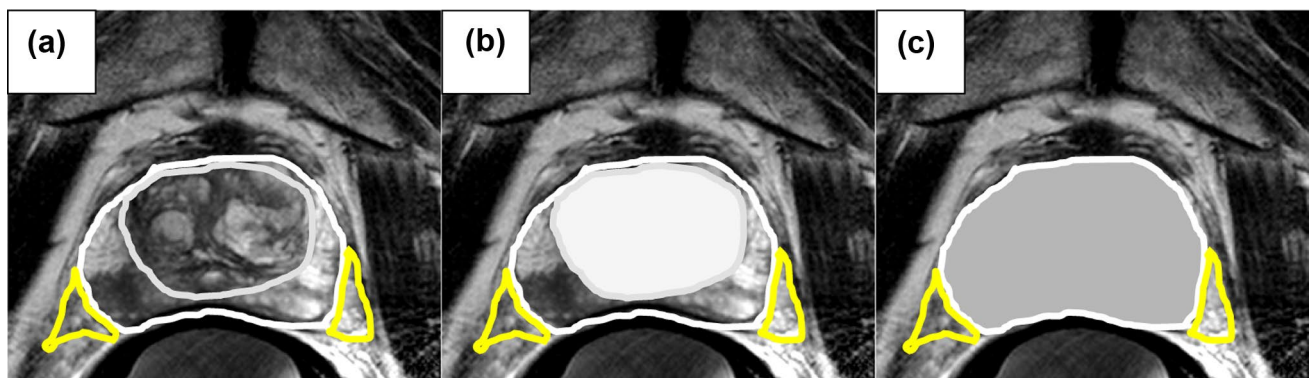


Fig. 4 Anatomy scheme (a) (white line: border of the prostate, grey line: encompassing the adenomatous tissue, yellow line: area of neurovascular bundle) to explain patients the differences between TURP

(b) and radical prostatectomy (c) and the respective consequences on erectile function

improvement of LUTS Müntener et al. noted a trend towards an increased mean erectile function score after TURP; however, this was statistically insignificant ($p=0.11$) [25]. These data are corroborated by Mishriki et al. and Brookes demonstrating that pre-operative ED may be improved by TURP [31, 32].

Long term outcome

Maximillian Stern 1926: “With the evidence at hand, it is not too much to assume that permanent results can thus be obtained” [1].

It is not only that TURP stands the test of time but also a robust set of data that proves the long-term efficacy of TURP up to 22 years [33–35]. Satisfaction rates 15 years after TURP are as high as 79% and in the same cohort 12% of patients had a neutral attitude towards the outcome after the operation [36]. Within 8 years the re-TURP rates range up to 8.3% [37].

Complications

Doyle and Feggetter 1935: “In 156 endoscopic resections eighteen deaths occurred, a mortality rate of 11 per cent. It is interesting, incidentally, to see how the death rate diminishes with experience” [13].

Fortunately, mortality rates in contemporary series are as low as 0–0.3% and compare favorably to open prostatectomy or laser vaporization [7, 38].

According to multicenter studies and meta-analyses the most common complications nowadays are failure to void (2.4–6.8%), urinary tract infections (1.4–7.9%) and postoperative bleeding requiring either blood transfusion or postoperative revision (2–2.9%) [8, 22, 23, 38].

Garske et al. 1949: “The post-transurethral resection oliguria syndrome has been the subject of much discussion” [39].

Although the post transurethral resection syndrome was described shortly after the widespread adoption of TURP its pathophysiology was not fully understood. However, it became apparent that non-hemolyzing fluids reduced the subsequent risk of the syndrome. Another important step ahead was the introduction of the bipolar technique performed in 0.9% saline solution. Thus, the risk of transurethral resection syndrome traditionally observed in up to 1.4% [38] can be significantly reduced when employing bipolar resection techniques [16].

In a large Canadian population-based cohort study covering men undergoing surgery for BPE in Ontario between 2003 and 2014 an increase of complications over time, mainly among older and more comorbid patients, was observed [8]. But even more disturbing was the observation that use of alpha-blockers (but not 5-alpha reductase

inhibitors or a combination) in the year prior to surgery increased the risk of complications. The authors hypothesized that prolonged conservative and medical treatment may hamper surgical outcome acknowledging an increasing duration of medical therapy before surgery in the study period [8].

Doyle and Feggetter 1935: “Thoughts on clot retention: Trained attendants are essential in the nursing of these patients” [13].

As for any other surgical procedure a team approach is essential to decrease the complication rate.

Costs

In a very recent cost comparison analysis of different BPH treatment options by DeWitt-Foy et al. [40] TURP generated lower costs compared to most of the other currently performed office based, or in- or outpatient procedures. As outlined in the previous sections this goes along with an excellent and durable improvement of symptoms and thus TURP offers a superb cost-benefit ratio.

Theodore M. Davis 1931: “A few patients with small enlargements who lived in close proximity have not been hospitalized at all” [2].

Currently most TURPs are performed in a hospital or surgical center. However, in selected patients TURP may be performed in an outpatient setting and thus further lowering costs of the procedure [41]. In a recent meta-analysis comparing TURP, Green-light laser vaporization and Holmium Laser enucleation as outpatient procedure for BPE interestingly TURP had a lower failure rate, whereby failure was defined as either immediate readmission or inability to discharge the patient [42].

Limitations

A. C. Gilbert comment to Maximillian Stern 1926 “If it will do all that its designer anticipates, it seems that it may revolutionize prostatic surgery; but I doubt whether it will ever be applicable to large adenomas” [1].

It is fair enough to acknowledge Gilberts comment about limitations for TURP. Urologists who believe that large adenomas that are beyond their comfort zone via transurethral approaches, open prostatectomy or some sort of transurethral enucleation should be considered [5]. However, bipolar instruments allow for longer resection times and thus in favorable cases (e.g., anatomy, healthy patients) and experienced hands even larger glands are amenable to TURP.

Robert V. Day 1932: “In an improved form, transurethral prostatic resection is here to stay, but its limitations will be

more definitively defined with increased experience in its use" [4].

Besides prostate size, patients on (dual) platelet inhibition or anticoagulant drugs need special attention [43–45]. Considering TURP in these patients needs close interdisciplinary collaboration and an understanding of patient's individual risk for thromboembolic complications in case of discontinuation of the drugs and vice versa for bleeding complications in case of continuous use. A basic understanding of the annual stroke risk in the large group of men with atrial fibrillation helps to manage perioperative drug administration. The CHA₂DS₂-VASc Score is an excellent tool to assess the patient's annual stroke risk, e.g., a 65 year old man with atrial fibrillation without any other medical conditions harbours an annual stroke risk of <1%. Therefore, antiplatelet or anticoagulant can easily be paused perioperatively after counseling the patients about pros and cons of pausing or continuing the medication. Having said this, counseling patients on dual platelet inhibition or anticoagulant drugs should include alternative treatment options such as laser vaporization or enucleation. These techniques offer favorable intraoperative hemostatic properties compared to TURP [5]. The postoperative advantages in terms of delayed bleeding complications, however, are less clear.

Conclusion

TURP has continued to stand the test of time. It is embraced by various generations of Urologists and currently it remains the surgical gold standard for most men suffering from BPE.

Furthermore,

- It is easy to learn
- The bipolar technique offers advantages over the monopolar technique
- It is cheap
- It has excellent short and long term results
- Sexual function may be preserved

A. A. Kuntzmann 1932: "This method of electrosurgical treatment is here to stay, but not until we have acquired more skill and experience in its performance and careful consideration and observation in the follow-up and end-results over a satisfactory period of time, of at least several additional years, will we be able to give this method its proper indications and evaluation and assign to it its place in the treatment of vesical-neck obstructions" [4].

Nine decades have elapsed, since this statement and so far TURP remains undisputedly the gold standard in the surgical treatment of BPE. If just one reason has to be brought up to justify TURP's place in the treatment of BPH it's the argument of time that supports TURP.

Robert V. Day 1932: "The method will not come into general use" [4].

In summary: In the hindsight Robert Day was incorrect. However, it is the checks and balances between the pioneers and their critics that ultimately stimulate progress in medicine and push our specialty forward.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no competing interest.

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