



Transurethral Resection of the Prostate

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Abstract

For decades, transurethral resection of the prostate (TURP) has been the gold-standard therapy for severe benign prostatic obstruction (BPO). Diagnostic work-up and indications for TURP should follow the European Association of Urology benign prostatic hyperplasia guidelines. Pressure flow studies are not indicated as a routine diagnostic procedure but are highly recommended under certain conditions (eg, unsuccessful TURP, young age, previous pelvic surgery). Various technical improvements such as video-TURP, continuous-flow instruments, and bipolar TURP have substantially decreased the mortality and morbidity of TURP today. In the bipolar transurethral resection era, bleeding remains the most significant intra- and perioperative complication. The short-term and, particularly, long-term efficacy of TURP is unsurpassed, as documented by substantial improvements in symptoms, maximum flow rate, and postvoid residual volume. The retreatment rate of TURP is in the range of 8–12% within a decade after primary surgery, a value reached by many minimally invasive procedures as early as within 1–2 yr. Despite an intense 20 yr of research for a minimally invasive alternative, TURP still is and will most likely remain the reference standard for the surgical management of severe BPO.

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1. Introduction

For >60 yr, transurethral resection of the prostate (TURP) has been the undisputed reference standard for elderly men with lower urinary tract symptoms (LUTS) caused by benign prostatic enlargement (BPE) and benign prostatic obstruction (BPO). During the past 20 yr, this role has been increasingly challenged by the development of medical and, particularly, of minimally invasive treatment options, such as

transurethral microwave thermotherapy (TUMT) or laser procedures. As a result, and despite demographic changes towards advanced ageing, the numbers of TURP cases declined substantially in the United States and (to a much lesser extent) in Europe [1].

The aim of this article is to review the role of TURP in contemporary benign prostatic hyperplasia (BPH) management. In doing so, we discuss (1) diagnostic work-up, (2) indication, (3) technical aspects, (4)

short- and long-term morbidity, and (5) clinical outcome.

2. Diagnostic work-up

The assessment of elderly men with LUTS resulting from BPE or BPO prior to TURP is similar to prior medical or minimally invasive therapy and is not detailed in this paper. (Please refer to the European Association of Urology [EAU] BPH guidelines [2] for more information.) Prostate volume needs to be measured (ideally by transrectal ultrasound [TRUS]) to estimate surgical time. No absolute upper prostate volume limit exists for TURP. Traditionally, a volume exceeding 80–100 ml was considered an indication for open prostatectomy. With the advent of bipolar resection (see below), this limit is no longer justified. A preoperative cystoscopy is usually not recommended unless there is suspicion of urethral or bladder pathologies. One controversial issue is the role of urodynamics. Should pressure flow studies be performed in all cases prior to prostatectomy or only in select patients [3]? None of the current BPH guidelines recommends pressure flow studies as a routine diagnostic measure prior to prostatectomy [2]. Yet there are patients for whom pressure flow studies are strongly recommended, particularly in an elective setting, such as those who are young (<50 yr) or elderly (>80 yr), who have had previous unsuccessful invasive therapy, who have high postvoid residual (PVR) volume (>300 ml), and who have had previous pelvic surgery (eg, rectum resection) [2]. In all these groups, there is a high chance that LUTS are not caused by BPO but rather by detrusor failure or overactivity [2]. Regarding prostate-specific antigen (PSA) assessment, we additionally refer to recent EAU guidelines on prostate cancer (PCa) [4].

3. Indication for transurethral resection of the prostate

The most frequent indication (50–60%) for TURP is LUTS refractory to medical therapy. The following BPE/BPO complications are considered *strong* indications for TURP [2]: (1) recurrent urinary retention, (2) BPH- or BPE-related macrohaematuria refractory to medical therapy with 5 α -reductase inhibitors (5-ARI), (3) renal insufficiency or upper urinary tract dilatation, (4) bladder stones, and (5) recurrent urinary tract infection (UTI). The only contraindications for TURP are untreated UTI and bleeding disorders.

3.1. Acute urinary retention

Several short-term randomised studies have shown that in men with acute urinary retention, a trial without catheter (TWOC) after a blockade for 3–5 d reveals an increased likelihood of spontaneous voiding [5]. Although a substantial number of patients will eventually require surgery within 6–12 mo even under a blockade, about 20% will avoid surgery in the long term [5]. Therefore, a TWOC should be offered to all patients presenting with acute urinary retention [2].

3.2. Benign prostatic enlargement-related haematuria

Randomised controlled trials (RCT) have demonstrated that because of their impact on prostatic angiogenesis, 5-ARIs have a positive effect on BPE-related haematuria [6]. Although long-term randomised data are not available, this possibility needs to be discussed with the patient. The positive effect of 5-ARIs on the natural history of the disease (reduction of the risk of acute urinary retention or risk of surgery) renders this therapeutic approach particularly attractive for men with BPE-related haematuria and prostate volumes >30–40 ml [7].

3.3. Bladder stones

Traditionally, bladder stones have been considered a strong indication for surgery. These patients usually underwent TURP and lithotripsy in the same anaesthesia session. One study showed that these patients can be managed without TURP (ie, that bladder lithotripsy combined with a blockade is feasible and safe in those with spontaneous voiding). This approach is particularly warranted in those with high perioperative risk and limited life expectancy [8].

3.4. When to intervene

The optimal time to initiate surgery in elective cases remains a matter of debate. The long-term data of the Veterans Affairs (VA) Cooperative Trial (watchful waiting vs TURP) suggest that early TURP provides a better long-term outcome than patients who were initially randomised to watchful waiting and were then crossed over to TURP [9]. It has been suggested that progressive detrusor failure resulting from prolonged BPO is responsible for this observation.

Medical therapy should not be continued uncritically. If the patient develops significant PVR volume (eg, >100 ml), TURP should be considered. Vela-Navarrete et al showed that within 1 decade

(1992–2002), patients undergoing BPH surgery were older (72 vs 69 yr), had larger prostates, and had a higher rate of open surgery (28.6% vs 18.8%) [10]. The authors speculated that these observations were the result of the progressive nature of the disease, which is not affected by α 1-blockers [10].

4. Technical aspects

Numerous technical improvements of TURP have been implemented within the past years, including video-TURP, continuous-flow instruments, special loop designs, and modifications of high-frequency (HF) generators [11]. It is beyond the scope of this article to describe all of these innovations; we will concentrate on the most important aspects.

4.1. Resection technique

In 1943, Nesbit described a procedure that starts with the ventral parts of the gland (between 11 and 1 o'clock), followed by both lateral lobes, the midlobe, and finishing with the apex [11]. In Europe, the technique developed by Mauermayer, Hartung, and May gained popularity [11]. In that technique, TURP is divided into four steps: midlobe resection, paracollicular transurethral resection (TUR), resection of lateral lobes and ventral parts, and apical resection. Further development included suprapubic trocar systems and continuous-flow resectoscopes, both of which provide low irrigation pressure [11]. Another milestone was the video-assisted resection [11].

4.2. Transurethral resection of the prostate technology: bipolar transurethral resection of the prostate

Conventional electroresection is performed by monopolar, HF current with a maximum cutting power of 200 W [11]. A microprocessor-controlled electrical unit with an active electrode that transduces permanent signals to the processor allows real-time power adjustment. Coagulation depth during cutting depends on the intensity of the light bow (voltage), so the degree of coagulation is adjusted to the individual tissue properties. Peak powers in the millisecond range may reach 230 W, but the total power for TURP is lower than that of earlier generators. Coagulating intermittent cutting was developed to realise blood-sparing TURP by modifying a standard HF generator.

The most important recent innovation was the introduction of bipolar TURP using saline as the irrigation fluid [11,12]. Several manufacturers such as Gyros, Vista-ACMI, Olympus, and Karl Storz

introduced bipolar devices that differ with respect to the loop shape and technical solution of bipolar TURP [11,12]. HF energy up to 160 W passes through the conductive irrigation solution of 0.9% sodium chloride, which results in a vapour layer of plasma that contains energy-charged particles that induce tissue desintegration through molecular dissociation, leading to a lower resection temperature than conventional monopolar systems and thus theoretically reducing thermal damage to surrounding tissue. The use of physiologic sodium chloride for irrigation nearly eliminates the risk of TUR syndrome.

Although TUR syndrome is nowadays a rare event, it remains the most dangerous intraoperative complication aside from bleeding [11,12]. TUR syndrome can now be safely avoided by bipolar TURP [11,12]. During prolonged resection, however, patients need to be carefully monitored for fluid load and blood loss might be substantial. Several RCTs also documented an equal efficacy of mono- and bipolar TURP regarding improvement of symptoms, maximum flow rate (Q_{max}), and PVR volume [12,13]. Some RCTs indicate even a lower risk of bleeding with bipolar TURP because of the *cut and seal* effect of the plasma created by bipolar energy [12]. With reduced bleeding and improved visibility, resection time can be decreased; some studies further suggest shorter postoperative catheterisation time, shorter hospital stays, and reduced postoperative storage symptoms [12]. On the down side, urethral strictures seem to be more frequent after bipolar TURP [12]. Whether this is because of the use of larger resectoscopes (27F) or current leak along the sheath remains a matter of debate. Provided that long-term data remain favourable, bipolar TURP will be the new reference standard for surgical treatment of BPE and BPO [12].

4.3. Neoadjuvant use of 5 α -reductase inhibitors

One strategy to reduce perioperative bleeding is the neoadjuvant use of 5-ARIs prior to surgery (for a minimum of 4–6 wk). Several RCTs demonstrated a decrease in the risk of bleeding [14]. Neoadjuvant 5-ARIs are recommended for men with significant BPE prior to TURP in an elective setting.

4.4. Limited resection

The entire transition zone may not need to be removed to relieve BPO. Particularly in patients with small prostates (<30 ml), transurethral incision of the prostate (TUIP) with incision of the obstructing muscle fibres at the bladder neck down to the prostate capsule has proved to be an effective treatment option. To date, six RCTs comparing TURP

to TUIP with follow-up periods >6 mo have been reported [1]. These RCTs convincingly showed that the efficacy of TUIP is almost comparable to TURP [1]. The risk of bleeding, clot retention, and the rate of retrograde ejaculation were all in favour of TUIP [1]. Consequently, TUIP is an interesting option, particularly for younger, sexually active men with small-sized prostates (<20–30 ml).

Another issue to be questioned is the role of radical TURP (ie, resection down to the surgical capsule of the prostate). Aagaard et al reported on the long-term outcome (10-yr follow-up) of patients treated by either total (ie, radical) or minimal (*English Channel*) TURP [15]. The decrease in urinary symptoms and improvements in Q_{\max} and PVR were comparable in both groups; however, the treatment failure rate within 10 yr was higher in the minimal (23%) compared to the total (7%) TURP arm [15]. Despite the higher long-term failure rate of minimal TURP, this study suggests that radical TURP is not necessary in all patients.

4.5. Ejaculation-protective transurethral resection of the prostate

Retrograde ejaculation might be avoided if the tissue around the veru montanum is spared during resection [11]. More importantly, the indication for TURP in younger patients should be carefully made, and alternative approaches have to be considered carefully. In an elective setting, we strongly suggest performing urodynamics prior surgery to document BPO in younger patients (eg, <55 yr).

5. Morbidity of transurethral resection of the prostate

The major driving force in the research of minimally invasive techniques within the past 2 decades was morbidity and the anaesthesia requirements of TURP. In this paper, TURP morbidity is divided into (1) intraoperative, (2) perioperative/early postoperative, and (3) long-term complications. Regarding complications of TURP and their management, we refer to an excellent article by Rassweiler et al [11]. Many aspects of TURP morbidity that are summarised in this paper were extracted from that review.

5.1. Mortality

The intra- and perioperative mortality after TURP has decreased substantially during the past 30 yr and is <1% in contemporary series. Horninger et al, for

instance, reported no postoperative deaths in a consecutive series of 1211 patients undergoing TURP between 1988 and 1991 [16]. Similarly, in a review of 29 RCTs with a TURP arm that included 1480 patients, no perioperative death was reported [1]. In a nationwide analysis, our group reviewed 20 671 patients who were treated between 1992 and 1996 in Austria, which yielded a 90-d mortality of 0.7% [17]. Reich et al prospectively evaluated the outcome of 10 654 patients who underwent TURP in the state of Bavaria, Germany, between 2002 and 2003 [18]. In this large-scale contemporary series, the 30-d mortality was 0.1% [18].

5.2. Intraoperative complications

5.2.1. Bleeding

The major intraoperative complication remains bleeding. Technical improvements of HF generators and instrumentation (continuous-flow instruments, video-TURP) resulted in a significant decrease in the transfusion rate (Fig. 1) [11]. Although studies in the 1970s through the 1990s reported on transfusion rates $\leq 20\%$, this rate dropped in more recent series published after the year 2000 to <10% and in most series, even to <5% (Fig. 1). In a review of 29 RCTs with a TURP arm published between 1986 and 1998, the mean transfusion rate was 8.6%, with a wide range of 0–35% [2]. In Reich's series, bleeding requiring transfusion occurred in 2.9% of patients [18]. Risk of bleeding is associated with preoperative infection and urinary retention because of the congested gland, prostate volume, and resection time. In the case of significant peri- and postoperative bleeding, balloon compression (knotted gauze around the catheter/tension of a 500-cm³ bottle) is the method of choice. Rectodigital compression of the prostate may be useful in select cases [11].

5.2.2. Transurethral resection syndrome

TUR syndrome is characterised by mental confusion, nausea, vomiting, hypertension, bradycardia, and visual disturbances. It is caused by dilutional hyponatraemia (serum sodium <125 mEq/l) because of early perforation of capsular veins or sinuses with a consecutive influx of hypotonic irrigating fluid. Patients under spinal anaesthesia may show unrest, cerebral disturbance, or shivering as early signs [11]. Untreated, TUR syndrome may have severe consequences such as cerebral or bronchial oedema. The incidence of TUR syndrome has decreased significantly during the past few decades from 3–5% to <1% (Fig. 1). In the Bavarian series, TUR syndrome was seen in 1.4% of cases [18]. With any suspicion of TUR syndrome, serum sodium levels must be checked

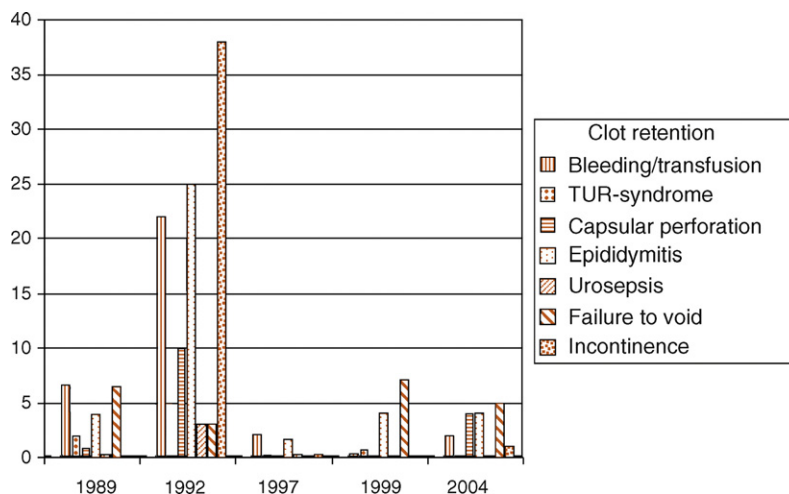


Fig. 1 – Complications of transurethral resection of the prostate in different surgical times: 1989 [19], 1992 [20], 1997 [21], 1999 [22], and 2004 [23]. TUR = transurethral resection.

immediately. For early detection of influx, ethyl alcohol can be added to the irrigant, permitting analysis of the alcohol content in the exsufflated air [11], but this approach is not recommended as a routine measure of the low incidence of TUR syndrome. In cases of significant hyponatraemia, the procedure has to be stopped and 20 mg furosemide applied with infusion of hypertonic sodium chloride [11]. The wide application of bipolar TURP will most largely abandon the risk of TUR syndrome in the future.

5.2.3. Injury of orifices and external sphincter

These rare complications and strategies for prevention and management are not detailed in this paper. The reader is referred to the review by Rassweiler et al [11].

5.3. Perioperative phase

5.3.1. Bladder tapenade

Recurrent or persistent bleeding may lead to clot formation and bladder tapenade requiring evacuation or even reintervention (1.3–5%) [11]. Occasionally, associated coagulation disorders that were undetected preoperatively may not respond to coagulation alone. In such situations, additional rectodigital compression may stop the bleeding. If surgical reintervention remains unsuccessful, transfemoral superselective embolisation should be considered [11].

5.3.2. Urinary tract infection

The rate of UTI is usually low, although percentages reported in literature vary from 4% up to 20% [11].

Risk factors for postoperative UTI are perioperative bacteria, longer duration of the procedure, preoperative indwelling catheters, prolonged hospital stay, and discontinuation of the catheter drainage. Routine perioperative antibiotic therapy is not recommended; in risk groups mentioned above, antibiotic prophylaxis is advisable [11].

5.3.3. Urinary retention

Urinary retention after catheter removal occurs in 3–9% of cases and is usually attributed to detrusor failure rather than incomplete resection, resulting in persisting obstruction. The indication for re-TURP should be posed with great caution, and waiting is recommended for at least 4–6 wk after surgery. If spontaneous voiding is not regained, a pressure flow study should be performed. Only about 20% of patients are urodynamically obstructed after primary TURP; hence, another TURP without prior urodynamics carries a high risk of failure [2,3]. In case of detrusor failure, the chance of spontaneous voiding after a well-done primary TURP following a second TURP is minimal, and the patient should be carefully advised about this fact.

5.4. Long-term morbidity

5.4.1. Urinary incontinence

Urinary incontinence may occur in up to 30–40% cases in the first postoperative weeks and is mainly to the result of detrusor overactivity, which might have existed preoperatively or is to the result of fossa healing or UTI [11]. Symptomatic treatment includes anticholinergics and anti-inflammatories. Incontinence that persists for >6 mo requires an

in-depth evaluation, including cystoscopy and urodynamics. There are several causes of prolonged urinary incontinence after TURP: sphincteric incontinence (30%), detrusor overactivity (20%), mixed incontinence (30%), residual adenoma (5%), bladder neck contracture (5%), and urethral stricture (5%). Treatment includes pelvic floor reeducation, biofeedback, duloxetine (caveat: off-label use), or surgical intervention (eg, Pro-ACT, numerous slings, bulking agents, artificial urinary sphincter). The rate of severe iatrogenic stress urinary incontinence is <0.5% [11]. To minimise the risk of iatrogenic urinary incontinence, the verumontanum should be repeatedly checked during surgery, especially during apical resection. Particular care is necessary when the verumontanum is not visible (eg, because of previous resection).

5.4.2. Urethral strictures

The rate of urethral strictures varies from 2% to 9% [11]. The two main reasons related to location are (1) meatal strictures, usually because of the relationship between the diameter of the instrument and the meatus; and (2) bulbar strictures resulting from mechanical trauma and insufficient current isolation. Preventive measures include generous application of gel (also during the procedure, when resection time is prolonged), minimal mechanical movement of the resectoscope in situ, and avoidance of high cutting currents.

5.4.3. Bladder neck stenosis

Incidence varies from 0.3% to 9.2%, more likely after treatment of smaller glands. As indicated above, TUIP should be considered for patients with small glands. Treatment includes electrical or laser bladder neck incision.

5.4.4. Sexual dysfunction

Retrograde ejaculation occurs in up to 90% of cases and might be avoided if the tissue at the verumontanum is spared [11]. Because of retrograde ejaculation, the indication for TURP should be carefully made in younger patients. In this age segment, TUIP should be considered because of a lower rate of retrograde ejaculation. The long-standing controversy on erectile dysfunction (ED) after TURP was clarified by the VA Cooperative Study, which compared TURP with watchful waiting [24]. At a mean follow-up of 2.8 yr, the proportion of patients reporting a deterioration in their sexual performance was identical in both study arms (ie, 19% after TURP and 21% in the watchful waiting group; 3% in each group reported an improvement in sexual function during the study period) [24]. The

two recent systematic meta-analyses did not identify a negative trend of TURP on erectile function [13,25]. There are even reports of improved erectile function after TURP—presumably because of an improved quality of life (QoL) and sleep [11].

6. Outcome

6.1. Symptoms and quality of life

Symptom scores improve substantially after TURP, although the extent of decline varies dramatically. In a semi-quantitative meta-analysis, we reviewed 29 RCTs published between 1986 and 1998 [1]. The mean decrease in symptom score was 70.6%. In all studies, the symptom score more than halved, and in 58%, this decrease was >70% [1].

In two systematic reviews of RCTs, Lourenco et al compared TURP to various laser devices, transurethral vaporesction, TUMT, and transurethral needle ablation (TUNA) [13,25]. In these recent meta-analyses, symptom score improvement after TURP was comparable to holmium laser ($p = 0.09$), laser vaporisation ($p = 0.12$), transurethral vaporesction ($p = 0.45$), bipolar TURP ($p = 0.69$), transurethral vaporisation ($p = 0.48$), and laser coagulation ($p = 0.15$) [13]. TURP was superior to TUMT ($p = 0.09$) and TUNA ($p = 0.004$) [25]. We analysed symptom score improvement in 25 RCTs with a TURP arm published more recently between 1996 and 2006 (Fig. 2). This figure contains the data of 1144 men. Despite considerable differences among these trials, all showed a dramatic improvement in symptom scores postoperatively (Fig. 2). On average, the American Urological Association (AUA)/International Prostate Symptom Score (IPSS) declined preoperatively from 18.8 to 7.2 (–62%) after 12 mo (Fig. 2). QoL changes, when reported, were consistent with symptom improvement.

6.2. Maximum flow rate and postvoid residual volume

The most frequently used objective variables to assess clinical efficacy are Q_{\max} and PVR volume. The mean increase in Q_{\max} in 29 RCTs published by Madersbacher was 9.7 ml/s, indicating a mean increase of 120% [1]. In Lourenco's meta-analysis, the rate of Q_{\max} improvement of TURP was equivalent to laser vaporisation ($p = 0.15$), transurethral vaporesction ($p = 0.15$), bipolar TURP ($p = 0.70$), and transurethral vaporisation ($p = 0.97$) [13]. In this meta-analysis, only holmium enucleation of the prostate (HoLEP) resulted in a higher improvement in Q_{\max} (difference: 1.48 ml/s,

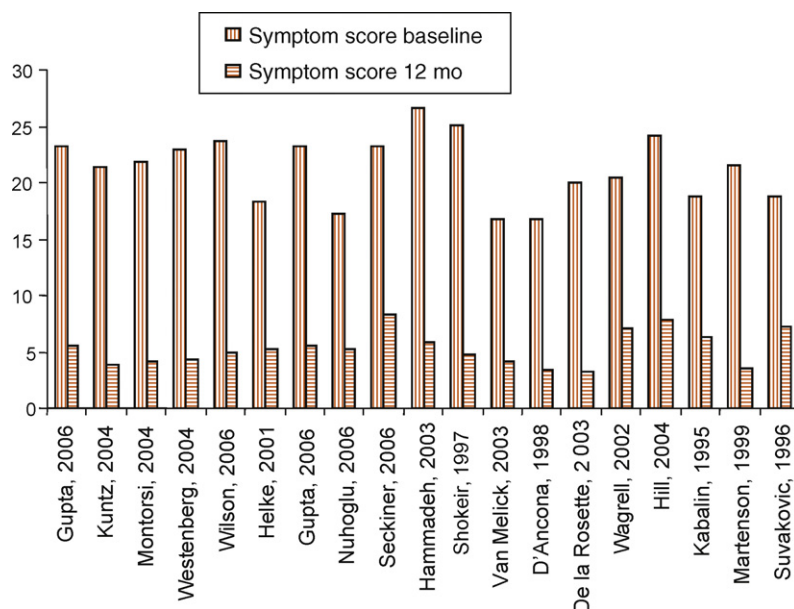


Fig. 2 – Improvement of symptom scores 12 mo after transurethral resection of the prostate (TURP). Only randomised controlled trials with a TURP arm were included (the majority of trials were published in 2000 or later). Data were extracted from two recent systematic meta-analyses [13,25]; the listed studies were cited in these two publications.

$p = 0.002$) [13]. TUMT ($p = 0.002$), TUNA ($p = 0.002$), and laser coagulation ($p = 0.01$) yielded significantly lower uroflow improvements compared to TURP [25]. Fig. 3 demonstrates Q_{\max} improvement in 25 RCTs within a TURP arm. Comparable to symptom scores, there was a considerable variance; yet Q_{\max} substantially improved in all series, from 8.3 ml/s at baseline to 20.7 ml/s (± 12.4 ml/s; $\pm 149\%$).

6.3. Retreatment

The retreatment rate is the strongest indicator of long-term efficacy for any procedure aimed at relieving BPE or BPO. The issue of long-term reoperation after TURP (compared to open prostatectomy) was first raised by the landmark study of Roos et al [25]. In this large retrospective analysis,

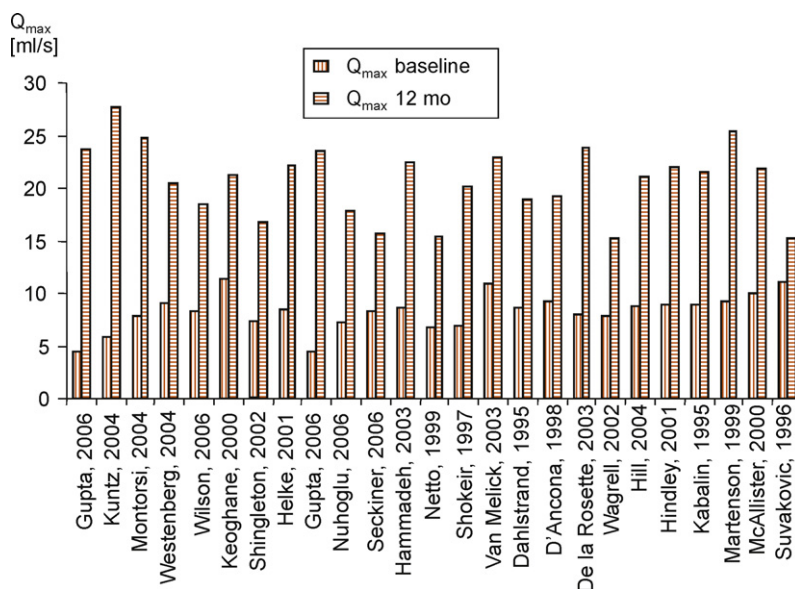


Fig. 3 – Improvement of maximum flow rate 12 mo after transurethral resection of the prostate (TURP). Only randomised controlled trials with a TURP arm were included (the majority of trials were published in 2000 or later). Data were extracted from two recent systematic meta-analyses [13,25]; the listed studies were cited in these two publications. Q_{\max} = maximum flow rate.

patients operated on in Denmark ($n = 36\,703$); Oxfordshire, England ($n = 5,284$); and Manitoba, Canada ($n = 12,090$) were analysed [5]. Surgery was performed between 1963 and 1985 [26]. After initial TURP, 12–15% of all patients had to undergo a secondary TURP within 8 yr, compared with only 1.8–4.5% after open surgery [26]. Semmens et al studied trends in repeat prostatectomy in the Western Australian Health Services Research Linked Database (TURP: $n = 18\,464$; open prostatectomy: 1134) [26]. Primary surgery was performed between 1980 and 1995 [27]. The incidence rate of the first repeat TURP was up to 2.3 times higher after initial TURP than for initial open prostatectomy [26]. The absolute risk of retreatment at 8 yr for TURP was 6.6% and 3.3% for open prostatectomy [27]. Wasson et al reported on the long-term outcome of Medicare beneficiaries who underwent TURP between 1984 and 1997 [28]. Within 5 yr, approximately 5% had to undergo an additional resection [28].

Our group investigated this issue in a nationwide study. A total of 20 671 patients operated on in Austria between 1992 and 1996 were followed for up to 8 yr [17]. Actuarial cumulative incidences of a secondary TURP at 1, 5, and 8 yr were 2.9%, 5.8%, and 7.4%, respectively [17]. The overall incidence of a secondary endourologic procedure (TURP, urethrotomy, bladder neck incision) within 8 yr was 14.7% after TURP [17]. Many minimally invasive procedures reach the 8-yr TURP retreatment rate within the first year [1].

6.4. Myocardial infarction and long-term mortality

There is a long-standing debate regarding an increased incidence of myocardial infarction (MI) and mortality after TURP compared to open prostatectomy [17]. In Roos's landmark study, higher mortality after transurethral compared to open prostatectomy has largely attributed to the higher rate of acute MI (relative risk: 2.5) [26]. Several factors have been suggested to account for this observation, including selection of older and less healthy men for TURP or cytotoxic effects of glycine on the myocardium absorbed during TURP [29]. More recent studies, however, have not reported a higher incidence of MI after TURP. In the Austria-wide analysis mentioned above, a higher age-adjusted incidence of MI after TURP compared to open prostatectomy was not observed. Hence, the majority of studies on this issue do not suggest a higher cardiac morbidity after TURP [17].

Probably the most provocative finding of Roos's study was higher mortality after TURP compared to open prostatectomy [26]. Subsequent studies yielded conflicting results, yet the majority reported

on similar mortality rates after open and transurethral prostatectomy [17]. Shalev et al, for instance, observed no statistically significant difference in overall mortality between TURP and open prostatectomy (14.4% and 8.5%) at 7–8 yr [30]. Similarly, Holman et al reported a 10-yr mortality of 31.8% after TURP and 35.0% after open prostatectomy [31]. In summary, the majority of studies do not suggest an increased risk of death after TURP compared to open prostatectomy.

7. Conclusions

TURP remains the gold-standard therapy for advanced cases with LUTS resulting from BPE and BPO. It is still unsurpassed for long-term outcome: Currently, only HoLEP reaches the TURP niveau. A state-of-the-art technique including videoresection and continuous-flow instruments ensures excellent long-term results with low morbidity. The advent of bipolar resection has abandoned the (rare) TUR syndrome and enables safe endoscopic treatment of larger glands. Despite an intensive 20 yr of research for alternatives, TURP remains the reference standard and is unlikely to be replaced in the near future.

Conflicts of interest

The authors have nothing to disclose.

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