

CLINICAL QUESTION:

A 50-year-old male presents to the office with complaints of hesitancy, postvoid dribbling, and sensation of incomplete bladder emptying. He reports recurrent urinary tract infection with gross hematuria. DRE reveals a smooth, firm, enlarged prostate. The patient requires surgical intervention. The PA wants to know if transurethral resection of the prostate is more effective than prostate artery embolization in treating BPH?

PICO QUESTION:

In the adult population, is transurethral resection of the prostate (TURP) more effective than prostate artery embolization (PAE) in treating benign prostate hyperplasia?

PICO SEARCH TERMS:

P	I	C	O
Adults	TURP	PAE	Improved BPH
Benign prostate hypertrophy	Transurethral resection of prostate	Prostate artery embolization	Improved urinary symptoms
Adults with BPH			Improved BPH symptoms
			No change in symptoms

SEARCH STRATEGY:

Database Results:

1. PubMed
 - Transurethral resection of the prostate versus prostate artery embolization → 145
 - Filters: 5 years, meta-analysis, systematic review, RCT → 23
 - Filters: 10 years, meta-analysis, systematic review, RCT → 29
 - Comparing TURP versus PAE for BPH → 13
 - Filters: 5 years, meta-analysis, systematic review, RCT → 6
 - Filters: 10 years, meta-analysis, systematic review, RCT → 9
2. Google Scholar
 - Transurethral resection of the prostate versus prostate artery embolization → 1,420
 - Filters: 5 years, sort by relevance, review article → 621
 - Comparing TURP versus PAE for BPH → 9,550
 - Filters: 5 years, sort by relevance, review article → 486
3. ScienceDirect
 - Transurethral resection of the prostate versus prostate artery embolization → 384
 - Filters: 5 years, sort by relevance, research article → 103
 - Comparing TURP versus PAE for BPH → 54
 - Filters: 5 years, sort by relevance, research article → 25
4. Wiley Online Library
 - Transurethral resection of the prostate versus prostate artery embolization → 296
 - Filters: 5 years, journal articles → 71

Selection Process:

I narrowed down the results by looking for studies that focused on the efficacy of transurethral resection of the prostate versus prostate artery embolization. I aimed to make sure the articles gave special attention the adult male patient population with benign prostate hyperplasia so that it is more relevant to my clinical scenario. To further narrow down my results, I checked for articles that were recent within the last 5 years and were either meta-analysis, systematic review, or RCT. I further narrowed down the choices by selecting articles with relevant titles and briefly assessing the abstract. I wanted studies that were relevant to my scenario, therefore I focused on studies that were performed in the U.S. with a concentration on the BPH patient population. My selection process was directed to include the most relevant and highest level of evidence to determine if TURP or PAE results in more successful outcomes for the treatment of BPH.

ARTICLES CHOSEN:

Article #1 Systematic Review and Meta-analysis Comparing Prostatic Artery Embolization to Gold-Standard Transurethral Resection of the Prostate for Benign Prostatic Hyperplasia

Citation: Knight GM, Talwar A, Salem R, Mouli S. Systematic Review and Meta-analysis Comparing Prostatic Artery Embolization to Gold-Standard Transurethral Resection of the Prostate for Benign Prostatic Hyperplasia. *Cardiovasc Intervent Radiol.* 2021;44(2):183-193. doi:10.1007/s00270-020-02657-5

Type of Study: Meta-Analysis, Systematic Review

Abstract:

Purpose: To report a comparative systematic review and meta-analysis of prostatic artery embolization (PAE) and transurethral resection of the prostate (TURP) for the management of benign prostatic hyperplasia (BPH).

Methods: A multi-database search for relevant literature was conducted on 15 July 2020 to include studies published on or before that date. Search terms used were: (prostate embolization OR prostatic embolization OR prostate embolization OR prostatic embolization) AND (prostatic hyperplasia OR prostatic obstruction). Risk of bias was assessed using Cochrane Collaboration and ROBINS-I criteria. Random-effects meta-analysis was performed using RevMan 5.3.

Results. Six studies with 598 patients were included. TURP was associated with significantly more improvement in maximum urinary flow rate (Qmax) (95% CI [2.66,7.38]; $p < 0.0001$; $I^2 = 89\%$), prostate volume (95% CI [7.93,23.25]; $p < 0.00001$; $I^2 = 88\%$), and prostate-specific antigen (PSA) (95% CI [0.14,1.89]; $p = 0.02$; $I^2 = 71\%$) compared to PAE. No significant difference between PAE and TURP was observed for changes in International Prostate Symptoms Score (IPSS), IPSS quality of life (IPSS-QoL), International Index of Erectile Function (IIEF-5), and post-void residual (PVR). PAE was associated with fewer adverse events (AEs) (39.0% vs. 77.7%; $p < 0.00001$) and shorter hospitalization times ($p < 0.00001$), but longer procedural times ($p = 0.004$).

Conclusions: Subjective symptom improvement was equivalent between TURP and PAE. While TURP demonstrated larger improvements for some objective parameters, PAE was associated with fewer AEs and shorter hospitalization times.

Link: <https://link.springer.com/article/10.1007/s00270-020-02657-5>

Article #2 Randomized Comparison of Prostatic Artery Embolization versus Transurethral Resection of the Prostate for Treatment of Benign Prostatic Hyperplasia

Citation: Insausti I, Sáez de Ocáriz A, Galbete A, et al. Randomized Comparison of Prostatic Artery Embolization versus Transurethral Resection of the Prostate for Treatment of Benign Prostatic Hyperplasia. *J Vasc Interv Radiol.* 2020;31(6):882-890. doi:10.1016/j.jvir.2019.12.810

Type of Study Randomized Controlled Trial

Abstract:

Purpose: To compare clinical and functional outcomes of prostatic artery embolization (PAE) with those of transurethral resection of the prostate (TURP) for the treatment of lower urinary tract symptoms (LUTS) secondary to benign prostatic hyperplasia (BPH).

Methods: Noninferiority randomized trial was conducted involving men over 60 years of age with LUTS secondary to BPH. From November 2014 to January 2017, 45 patients were randomized to PAE (n = 23) or to TURP (n = 22). PAE was performed with 300- to 500- μ m microspheres with the patient under local anesthesia, whereas bipolar TURP was performed with the patients under spinal or general anesthesia. Primary outcomes were changes in peak urinary flow (Q_{max}) and international prostate symptoms score (IPSS) from baseline to 12 months. Quality of life (QoL), and prostate volume (PV) changes from baseline to 12 month were secondary outcomes. Adverse events were compared using the Clavien classification.

Results: Mean Q_{max} increased from 6.1 mL/s in the PAE group and from 9.6 mL/s in the TURP patients (P = .862 for noninferiority), and mean IPSS reduction was 21.0 points for PAE and 18.2 points for TURP subjects (P = .080) at 12 months. A greater QoL improvement was reported in the PAE group (3.78 points for PAE and 3.09 points for TURP; P = .002). Mean PV reduction was 20.5 cm³ (34.2%) for PAE subjects and 44.7 cm³ (71.2%) for TURP subjects (P < .001). There were fewer adverse events reported in the PAE group than in the TURP group (n = 15 vs n = 47; P < .001).

Conclusions: Reduction of LUTS in the PAE group was similar to that in the TURP group at 12 months, with fewer complications secondary to PAE. Long-term follow-up is needed to compare the durability of the symptomatic improvement from each procedure.

Link: <https://pubmed.ncbi.nlm.nih.gov/32249193/>

Article #3 Comparison of Prostatic Artery Embolization (PAE) Versus Transurethral Resection of The Prostate (TURP) for Benign Prostatic Hyperplasia: Randomized, Open Label, Non-Inferiority Trial

Citation: D, Hechelhammer L, Mullhaupt G, Markart et al. Comparison of prostatic artery embolization (PAE) versus transurethral resection of the prostate (TURP) for benign prostatic hyperplasia: randomized, open label, non-inferiority trial *BMJ* 2018; 361:k2338 doi:10.1136/bmj.k2338

Type of Study: Randomized Controlled Trial

Abstract:

Objectives: To compare prostatic artery embolization (PAE) with transurethral resection of the prostate (TURP) in the treatment of lower urinary tract symptoms secondary to benign prostatic hyperplasia in terms of patient reported and functional outcomes.

Results: Mean reduction in IPSS from baseline to 12 weeks was -9.23 points after PAE and -10.77 points after TURP. Although the difference was less than 3 points (1.54 points in favour of TURP (95% confidence interval -1.45 to 4.52)), non-inferiority of PAE could not be shown (P=0.17). None of the

patient reported secondary outcomes differed significantly between treatments when tested for superiority; IPSS also did not differ significantly (P=0.31). At 12 weeks, PAE was less effective than TURP regarding changes in maximum rate of urinary flow (5.19 v 15.34 mL/s; difference 10.15 (95% confidence interval -14.67 to -5.63); P<0.001), postvoid residual urine (-86.36 v -199.98 mL; 113.62 (39.25 to 187.98); P=0.003), prostate volume (-12.17 v -30.27 mL; 18.11 (10.11 to 26.10); P<0.001), and deconstructive effectiveness according to pressure flow studies (56% v 93% shift towards less obstructive category; P=0.003). Fewer adverse events occurred after PAE than after TURP (36 v 70 events; P=0.003).

Conclusions: The improvement in lower urinary tract symptoms secondary to benign prostatic hyperplasia seen 12 weeks after PAE is close to that after TURP. PAE is associated with fewer complications than TURP but has disadvantages regarding functional outcomes, which should be considered when selecting patients. Further comparative study findings, including longer follow-up, should be evaluated before PAE can be considered as a routine treatment.

Link: <https://www.bmj.com/content/361/bmj.k2338>

Article #4 Efficacy and Safety of Prostatic Artery Embolization for Benign Prostatic Hyperplasia: A Systematic Review and Meta-Analysis of Randomized Controlled Trials

Citation: Xiang P, Guan D, Du Z, et al. Efficacy and safety of prostatic artery embolization for benign prostatic hyperplasia: a systematic review and meta-analysis of randomized controlled trials. *Eur Radiol.* 2021;31(7):4929-4946. doi:10.1007/s00330-020-07663-2

Type of Study: Meta-Analysis

Abstract:

Objective: To investigate the efficacy and safety of prostatic artery embolization (PAE) vs. transurethral resection of the prostate (TURP) in patients affected by benign prostatic hyperplasia (BPH). We also reviewed mean changes from baseline in PAE at selected follow-up points.

Methods: PubMed, Web of Science, and Embase were searched up to May 1, 2020. Randomized controlled trials on PAE were collected according to specific inclusion and exclusion criteria. Meta-analyses were performed using RevMan 5.3, STATA 14, and GraphPad Prism 8. Pooled patient-reported scores and functional outcomes were calculated by using a fixed or random-effect model.

Results: Eleven articles met our selection criteria and ten independent patient series were included in the final analysis. Pooled estimates suggested no significant difference between TURP and PAE for patient-reported outcomes including International Prostate Symptom Score (2.32 (- 0.44 to 5.09)) and quality of life (0.18 (- 0.41 to 0.77)) at 12 months. PAE was less effective regarding improvements in most functional outcomes such as maximum flow rate, prostate volume, and prostate-specific antigen. Moreover, PAE may be associated with relatively fewer complications, lower cost, and shorter hospitalization. After the PAE procedure, the overall weighted mean differences for all outcomes.

Conclusion: PAE is non-inferior to TURP with regard to improving patient-reported outcomes, though most functional parameters undergo more changes after TURP than after PAE. Moreover, PAE can significantly continue to relieve symptoms for 24 months without causing serious complications.

Link: <https://pubmed.ncbi.nlm.nih.gov/33449181/>

Article #5 Prostatic Arterial Embolization for the Treatment of Lower Urinary Tract Symptoms in Men with Benign Prostatic Hyperplasia

Citation: Jung JH, McCutcheon KA, Borofsky M, et al. Prostatic arterial embolization for the treatment of lower urinary tract symptoms in men with benign prostatic hyperplasia. *Cochrane Database Syst Rev.* 2020;12(12):CD012867. Published 2020 Dec 19. doi:10.1002/14651858.CD012867.pub2

Type of Study: Meta-Analysis

Abstract:

Background: A variety of minimally invasive surgical approaches are available as an alternative to transurethral resection of the prostate (TURP) for management of lower urinary tract symptoms (LUTS) in men with benign prostatic hyperplasia (BPH). Prostatic arterial embolization (PAE) is a relatively new, minimally invasive treatment approach.

Methods: We performed a comprehensive search the Cochrane Library, MEDLINE, Embase, three other databases, trials registries, other sources of grey literature, and conference proceedings with no restrictions on language of publication or publication status, up to 8 November 2021.

Results: We found data to inform two comparisons: PAE versus TURP (six RCTs and two NRSs), and PAE versus sham (one RCT). Mean age was 66 years, International Prostate Symptom Score (IPSS) was 22.8, and prostate volume of participants was 72.8 mL. This abstract focuses on the comparison of PAE versus TURP as the primary topic of interest.

Conclusion: Compared to TURP, PAE may provide similar improvement in urologic symptom scores and quality of life. While we are very uncertain about major adverse events, PAE likely increases retreatment rates. While erectile function may be similar, PAE may reduce ejaculatory disorders. Certainty of evidence for the outcomes of this review was low or very low except for retreatment (moderate-certainty evidence), signaling that our confidence in the reported effect size is limited or very limited, and that this topic should be better informed by future research.

Link: <https://pubmed.ncbi.nlm.nih.gov/33368143/>

Article #6 Prostatic Artery Embolization Versus Transurethral Resection of the Prostate for Benign Prostatic Hyperplasia: 2-Yr Outcomes of a Randomized, Open-Label, Single-Centre Trial

Citation: Abt D, Müllhaupt G, Hechelhammer L, et al. Prostatic Artery Embolization Versus Transurethral Resection of the Prostate for Benign Prostatic Hyperplasia: 2-yr Outcomes of a Randomized, Open-label, Single-centre Trial. *Eur Urol.* 2021;80(1):34-42. doi:10.1016/j.eururo.2021.02.008

Type of Study: Randomized Controlled Trial

Abstract:

Objective: To compare the efficacy and safety of PAE and transurethral resection of the prostate (TURP) in the treatment of LUTS/BPO at 2 yr of follow-up.

Methods: A randomized, open-label trial was conducted. There were 103 participants aged ≥ 40 yr with refractory LUTS/BPO. International Prostate Symptoms Score (IPSS) and other questionnaires, functional measures, prostate volume, and adverse events were evaluated. Changes from baseline to 2 yr were tested for differences between the two interventions with standard two-sided tests.

Results: The mean reduction in IPSS after 2 yr was 9.21 points after PAE and 12.09 points after TURP (difference of 2.88 [95% confidence interval 0.04-5.72]; $p = 0.047$). Superiority of TURP was also found

for most other patient-reported outcomes except for erectile function. PAE was less effective than TURP regarding the improvement of maximum urinary flow rate (3.9 vs 10.23 ml/s, difference of -6.33 [-10.12 to -2.54]; $p < 0.001$), reduction of postvoid residual urine (62.1 vs 204.0 ml; 141.91 [43.31-240.51]; $p = 0.005$), and reduction of prostate volume (10.66 vs 30.20 ml; 19.54 [7.70-31.38]; $p = 0.005$). Adverse events were less frequent after PAE than after TURP (total occurrence $n = 43$ vs 78 , $p = 0.005$), but the distribution among severity classes was similar. Ten patients (21%) who initially underwent PAE required TURP within 2 yr due to unsatisfying clinical outcomes, which prevented further assessment of their outcomes and, therefore, represents a limitation of the study.

Conclusion: Inferior improvements in LUTS/BPO and a relevant re-treatment rate are found 2 yr after PAE compared with TURP. PAE is associated with fewer complications than TURP. The disadvantages of PAE regarding functional outcomes should be considered for patient selection and counselling.

Link: <https://pubmed.ncbi.nlm.nih.gov/33612376/>

SUMMARY OF THE EVIDENCE:

Author (Date)	Level of Evidence	Sample/Setting (# of subjects/studies, cohort definition etc.)	Outcome(s) studied	Key Findings	Limitations and Biases
Article 1: Knight GM, et al. (2021)	Systematic Review	Authors used a combination of RCTs and non-randomized studies comparing PAE and TURP outcomes. Studies were included if they were (1) direct comparative analyses of PAE and TURP in the treatment of lower urinary tract symptoms secondary to BPH and (2) published in the English language.	Outcomes: (1) International Prostate Symptoms Score (IPSS) (2) IPSS quality of life (IPSS-QoL) (3) International Index of Erectile Function (IIEF-5) (4) maximum urinary flow rate (Qmax) (5) post-void residual (PVR) (6) prostate volume (7) prostate-specific antigen (PSA)	While <u>TURP afforded significantly increased improvement compared to PAE</u> in most objective BPH parameters assessed (Qmax, prostate volume, and PSA), equivalent results were observed between PAE and TURP in rates of subjective improvement in patient-reported symptoms. PAE was associated with significantly fewer AEs compared to TURP PAE was associated with <u>increased procedural time but decreased hospitalization time compared to TURP</u> . Compared with past meta-analyses comparing PAE and TURP for management of BPH, the results of the present meta-analysis	The principal limitation of this meta-analysis was the <u>relatively small number of studies available</u> comparing PAE and TURP—particularly, because only studies which evaluated both PAE and TURP in the same analysis could be include. Thus, review articles that solely evaluated one procedure or the other were not included in the present analysis

				<u>confirm the clinical benefit of PAE, and are less uniformly in favor of TURP.</u>	
Article 2: Insausti I, et al. (2020)	Randomized Controlled Trial	<p>Authors conducted a randomized trial that included 45 participants who were men over 60 years of age with LUTS secondary to BPH.</p> <p>Selection criteria: (1) >60 years (2) BPH-related LUTS refractory to medical treatment for at least 6 months or the patient could not tolerate medical treatment (3) TURP was indicated (4) International Prostate Symptom Score (IPSS) > 8 (5) quality of life (QoL) related to LUTS was > 3 (6) the peak flow rate (Qmax) was < 10 mL/s or urinary retention</p>	<p>Primary outcomes: (1) changes in peak urinary flow (Qmax) (2) international prostate symptoms score (IPSS) from baseline to 12 months</p> <p>Secondary outcomes: (1) Quality of life (QoL) (2) Prostate volume (PV) changes from baseline to 12 month</p> <p>Adverse events were compared using the Clavien classification.</p>	<p>Prostatic artery embolization (PAE) is emerging globally as a minimally invasive alternative to surgical therapy for the treatment of bladder outlet obstruction caused by benign prostatic hyperplasia (BPH).</p> <p><u>In this randomized comparison of PAE and TURP for the treatment of LUTS secondary to BPH, no significant differences were found between PAE and TURP in terms of Q-max improvements.</u></p> <p><u>This clinical trial adds to the evidence that PAE is an effective and safe technique in the treatment of LUTS secondary to BPH, with clinical outcomes comparable to TURP.</u></p> <p>In addition, because it can be performed with only local anesthesia, many individuals with surgical comorbidities who previously were restricted to medical management, now have an additional option for bladder outlet obstruction treatment.</p> <p><u>Pain after the procedure was significantly less and patient satisfaction was significantly better in the PAE group.</u></p>	<p>There were more exclusions than planned because of the initial inclusion of patients with prostates up to 120 g, who exceeded the limit established in the medical literature for TURP (100 g).</p> <p>Further limitations included the single-center design, the inability to blind patients in the enrolment arm, the medium-term follow-up period, and the prostate volume measurement by transabdominal ultrasonography rather than by prostate MR imaging</p>

<p>Article 3: Hechelham mer D, et al. (2018)</p>	<p>Randomized Controlled Trial</p>	<p>Authors performed a single center, randomized controlled clinical trial that included participants a with refractory BPH-LUTS that is typically treated with TURP in everyday clinical practice.</p> <p>Selection criteria: (1) men at least 40 years (2) TURP indicated (3) refractory to medical treatment or not willing to continue medical treatment (4) Prostate size 25-80 mL as measured by TAUS (5) IPS of at least 8 (6) QoL of at least 3 (7) Max urinary flow rate of less than 12 mL/s or urinary retention.</p>	<p>Primary outcome was change in IPSS from baseline to 12 weeks after surgery.</p> <p>Secondary outcomes included further questionnaires, functional measures, magnetic resonance imaging findings, and adverse events</p>	<p>PAE for the treatment of benign prostatic hyperplasia has been introduced into clinical practice without high level evidence and is now increasingly performed worldwide as it has a favorable side effect profile</p> <p>Surgery for benign prostatic hyperplasia is usually performed for refractory symptoms <u>associated with reduced quality of life</u>. But TURP has a more pronounced, pure urodynamic deconstructive effect than PAE.</p> <p>Considerably fewer and <u>less severe adverse events were found after PAE</u>, which could be performed under local anesthesia and was associated with reduced blood loss and shorter duration of hospital stay and catheterization than TURP.</p>	<p>Limitations of this study include the number of patients was not high enough to conclusively determine non-inferiority or inferiority of PAE versus TURP</p> <p>Blinding of patients and physicians was not feasible in the framework of our trial. Therefore, both patients and physicians might have been biased in favor of or against a new treatment.</p>
<p>Article 4: Xiang P, et al. (2020)</p>	<p>Meta-Analysis</p>	<p>Authors searched PubMed, Embase, and Web of Science databases for this meta-analyssis</p> <p>Selection criteria: RCTs that reported PAE treatment for BPH, evaluating patient-reported</p>	<p>Primary outcomes (1) IPSS (2) quality of life (3) postvoid residual volume (PVR)</p>	<p>This systematic review and meta-analysis presents the latest summary of available RCTs of PAE vs. TURP at 12 months and simultaneously indicates outcome changes from baseline after the PAE procedure during the 24-month follow-up period.</p>	<p>No limitations or bias reported.</p>

		<p>scores, and functional outcomes.</p> <p>10 studies with data were ultimately included.</p> <p>Study inclusion did not depend on the number of patients, follow-up period, and outcome parameters</p>	<p>(4) maximum flow rate (Qmax)</p> <p>(5) prostate volume (PV)</p> <p>(6) International Index of Erectile Function 5 (IIEF-5)</p> <p>(7) prostate-specific antigen (PSA)</p> <p>(8) Duration of intervention, hospital stay</p> <p>(9) Adverse events</p>	<p><u>Main finding was that PAE is non-inferior to TURP with respect to improving patient-reported outcomes, including IPSS, QoL, and IIEF-5 at 12 months.</u></p> <p>However, the improvement of most <u>functional outcomes</u> such as Q-max, PV, and PSA, <u>TURP was superior to PAE</u></p> <p>Further comparative trials with standardized PAE procedures, longer follow-up periods, and cost-effectiveness analyses are needed to confirm these promising clinical results.</p>	
<p>Article 5: Jung JH, et al. (2022)</p>	<p>Systematic Review</p>	<p>Authors conducted a systematic review that nine studies (seven RCTs: 21 records two non-randomized: 6 records) among patients with BPH needing treatment.</p> <p>Selection criteria: (1) Men over the age of 40 years</p> <p>(2) prostate volume of 20 mL or greater</p> <p>(3) LUTS as determined by an IPSS of 8 or over,</p> <p>(4) Qmax less than 15 mL/second, as</p>	<p>Primary outcomes: (1) Urologic symptom scores</p> <p>(2) Quality of life</p> <p>(3) Major adverse events</p> <p>Comparisons: (1) PAE vs. sham control (or no intervention)</p> <p>(2) PAE vs. TURP</p> <p>(3) PAE vs. laser ablation of the prostate</p> <p>(4) PAE vs laser enucleation of the prostate.</p>	<p>Based on up to 24 months' follow-up, PAE and TURP may work similarly well in helping to relieve symptoms. Men's quality of life may be also improved similarly. <u>We are very uncertain about differences in major unwanted effects.</u></p> <p>PAE likely increases the need for being treated again for the same problem. PAE may work similarly with regard to erection problems, but may reduce problems with ejaculation</p> <p>Compared to TURP and based on short-term and long-term follow-up, the impact on <u>urologic symptoms and quality of life improvement as perceived by patients</u></p>	<p>No limitations or bias reported.</p>

		measured by non-invasive uroflowmetry, invasive pressure flow studies, or both	(5) PAE versus other minimally invasive therapies.	<u>appears to be similar</u> . This review did reveal major uncertainty as to how major adverse events compare. <u>Prostatic arterial embolization (PAE) likely increases retreatment rates</u> . PAE may have similar effects on erectile function.	
Article 6: Abt D, et al. (2021)	Randomized Controlled Trial	<p>Authors conducted a randomized, open-label trial to compare PAE versus TURP among 103 participants aged 40 years or older with refractory LUTS/BPH.</p> <p>Selection criteria: (1) LUTS/BPH in men aged > 40 yr (2) Indication of TURP (3) being refractory to medical treatment or unwilling to undergo (further) medical treatment, (4) Prostate size of 25–80 (5) IPSS of at least 8 (6) IPSS-related quality of life score of at least 3 (7) Max urinary flow rate of <12 ml/s or urinary retention</p>	<p>Primary outcome included patient reported scores that were the <u>change from baseline to 3 mo in the IPSS questionnaire score</u>.</p> <p>Secondary outcomes comprised (1) maximum urinary flow rate (Qmax) (2) postvoid residual (PVR) (3) QoL of LUTS (4) Chronic Prostatitis Symptom Index (CPSI) (5) International Index of Erectile Function Short Form 5 (IIEF) (6) prostate-specific antigen (PSA) (7) adverse events</p>	<p>A marked improvement of LUTS/BPH <u>can be found 24 mo after PAE, and the procedure is associated with fewer adverse events than TURP</u>.</p> <p>Improvements of subjective and objective <u>outcomes are superior after TURP</u>, and PAE does not represent a definitive treatment for a relevant proportion of patients.</p> <p>Advantages of PAE in both subjective and objective outcome measures are most likely to be caused by the inferior relief of bladder outlet obstruction achieved by PAE.</p>	<p>Limitations included how many participants refused to undergo invasive urodynamic assessment at 24 mo, which hampers the informative value regarding midterm urodynamic efficacy.</p> <p>Authors correct for multiple testing as the purpose of the present analysis was to identify any relevant differences between the two treatments in an exploratory sense. Therefore, individual p values must be interpreted with due caution.</p>

CONCLUSIONS:

Article 1:

Subjective symptom improvement was equivalent between TURP and PAE. While TURP demonstrated larger improvements for some objective parameters, PAE was associated with fewer AEs and shorter hospitalization times.

Article 2:

Reduction of LUTS in the PAE group was similar to that in the TURP group at 12 months, with fewer complications secondary to PAE. Long-term follow-up is needed to compare the durability of the symptomatic improvement from each procedure.

Article 3:

The improvement in lower urinary tract symptoms secondary to benign prostatic hyperplasia seen 12 weeks after PAE is close to that after TURP. PAE is associated with fewer complications than TURP but has disadvantages regarding functional outcomes, which should be considered when selecting patients.

Article 4:

PAE is non-inferior to TURP with regard to improving patient-reported outcomes, though most functional parameters undergo more changes after TURP than after PAE. Moreover, PAE can significantly continue to relieve symptoms for 24 months without causing serious complications.

Article 5:

Compared to TURP and based on short-term and long-term follow-up, the impact on urologic symptoms and quality of life improvement as perceived by patients appears to be similar. Prostatic arterial embolization (PAE) likely increases retreatment rates.

Article 6:

Inferior improvements in LUTS/BPO and a relevant re-treatment rate are found 2 years after PAE compared with TURP. A marked improvement of LUTS/BPO can be found 24 months after PAE, and the procedure is associated with fewer adverse events than TURP.

Overarching:

Benign prostatic hyperplasia is one of the most common diseases in men and is often associated with bladder outlet obstruction and lower urinary tract symptoms. TURP is still the surgical gold standard in most patients. However, it is associated with high morbidity, and 40% of patients have residual lower urinary tract symptoms that require drug treatment within five years after surgery. These drawbacks have led to a continuous search for less invasive treatments. Overall, the articles overarchingly concluded that PAE improves BPH symptoms just as well as TURP does.

CLINICAL BOTTOM LINE:

The clinical bottom line is prostatic arterial embolization (PAE) is found to be a **comparable valuable method** to TURP in the treatment of BPH. All the articles presented were of high-quality evidence (2 systematic reviews and 2 RCTs), thereby providing the clinical implication that PAE should be considered a viable option in resolving lower urinary tract symptoms secondary to BPH. According to the presented research, advantages of PAE seem to be related to its minimally invasive nature, including relatively few complications and shorter hospital stays. However, given the limited available literature and safety concerns regarding radiation exposure, postembolization syndrome, vascular access, technical feasibility, and adverse events the American Urological Association (AUA) BPH clinical guidelines state that currently PAE should only be performed in the context of an experimental clinical trial. Therefore, TURP is still considered the gold standard for treatment of BPH. As shown in the data, TURP is superior to PAE in regard to functional outcomes such as maximum flow rate and PSA values. Overall, the evidence at hand is applicable to my clinical scenario. I would clinically recommend PAE to TURP in the

treatment to improve BPH symptoms because there is an overwhelming amount of evidence demonstrating patient favorability for the simpler procedure, PAE.

Weight of Evidence:

Article 1:

This 2021 meta-analysis and systematic review that examined the efficacy the outcomes of prostatic artery embolization to transurethral resection of the prostate for BPH treatment. This study inspected 6 studies with 598 patients and focused on 3 outcomes of interest which were maximum urinary flow rate, prostate volume, prostate-specific antigen. Overall, this article carries weight because it thoroughly discussed the significant differences in symptom improvement between TURP and PAE.

Article 2:

This 2019 randomized controlled trial was chosen because it investigated the efficacy the outcomes of prostatic artery embolization to transurethral resection of the prostate for treatment of lower urinary tract symptoms related to BPH. The study was performed in a single center hospital in 2017 which included 45 patients. The group was randomized into receiving TURP or PAE. The authors assessed different outcomes which included maximum urinary flow rate and patient rated prostate symptoms, prostate volume, erectile function, blood tests for PSA, and many more. Overall, this article carries weight because it examined postoperative pulmonary function and complications with the use of incentive spirometry versus positive airway pressure intervention.

Article 3:

This 2018 internationally performed randomized controlled trial was chosen because it compares PAE with TURP in the treatment of lower urinary tract symptoms secondary to benign prostatic hyperplasia in terms of patient reported and functional outcomes. It addresses the lack of high-quality evidence comparing PAE and TURP is a crucial knowledge gap in urology prior to this study. This RCT involved 103 patients aged ≥ 40 years with BPH. Overall, this article carries weight because it reflects my clinical scenario and demonstrated reliable comparative data that enhance the so far inconsistent and low-quality evidence available for PAE, and outlines its advantages and disadvantages compared with TURP.

Article 4:

This 2020 meta-analysis and systemic review was selected because it is a comprehensive review examining 11 articles reporting PAE versus TURP for BPH. Outcomes of this study include Qmax, PVR, PV, PSA, quality of life, and Prostate Symptom Score. Additionally, the authors systematically performed a meta-analysis to review mean changes from baseline at selected follow-up intervals after the PAE procedure. Overall, this article carries weight because it is a meta-analysis for evaluating the clinical efficacy and safety of PAE vs. TURP in patients affected by LUTS-BPH.

Article 5:

This 2022 meta-analysis from the Cochrane was selected since it evaluated the effects of PAE compared to other procedures for treatment of LUTS in men with BPH. As such, the evidence is certainly current. Compared to TURP and based on short-term and long-term follow-up, the impact on urologic symptoms and quality of life improvement as perceived by patients appears to be similar. Overall, this RCT carries weight because it is relevant to the target population and it determined the clinical efficacy of PAE versus TURP in the treatment of BPH.

Article 6:

This 2021 randomized controlled trial was selected because it evaluated the long-term efficacy of PAE and TURP at a 2 year follow up. A reduction of LUTS/BPO defined as “marked” previously is still found 24 months after PAE, and PAE is associated with significantly fewer adverse events than TURP. However, improvements of patient-reported outcomes and functional parameters are more pronounced after TURP. Overall, this RCT carries weight because it is relevant to the target population and it determined the clinical efficacy of PAE versus TURP in the treatment of BPH.

Magnitude of Any Effects:

Article 1:

The principal findings of this review were: (1) while TURP afforded significantly increased improvement compared to PAE in most objective BPH parameters assessed (Qmax, prostate volume, and PSA), equivalent results were observed between PAE and TURP in rates of subjective improvement in patient-reported symptoms; (2) PAE was associated with significantly fewer AEs compared to TURP; and (3) PAE was associated with increased procedural time but decreased hospitalization time compared to TURP.

Article 2:

The PAE group showed similar results to the TURP group in terms of clinical results and QoL, presenting fewer adverse events compared with the surgery. This clinical trial adds to the evidence that PAE is an effective and safe technique in the treatment of LUTS secondary to BPH, with clinical outcomes comparable to TURP. Satisfaction and pain at 24 hours are related to the procedure itself, and PAE patients reported less pain and higher satisfaction than those in the TURP group.

Article 3:

All 48 patients receiving PAE and 51 patients receiving TURP were available for the 12-week follow-up visit that included the primary outcome assessment. The mean change in IPSS from baseline to 12 weeks was -9.23 points after PAE and -10.77 points after TURP, and the difference of 1.54 points in favor of TURP was not significant. By contrast, functional outcomes after 12 weeks were clearly in favor of TURP. After PAE and TURP, we saw an improvement in maximum rates of free urinary flow by 5.19 mL/s versus 15.34 mL/s (difference 10.15 in favor of TURP).

Article 4:

The main finding of this systematic review was that PAE is non-inferior to TURP with respect to improving patient-reported outcomes, including IPSS, QoL, and IIEF-5 at 12 months. Nonetheless, for the improvement of most functional outcomes such as Qmax, PV, and PSA, TURP was superior to PAE. Indeed, the average improvement in IPSS ranged from -16.33 to -13.1 points during 24 months of follow-up. TURP and PVP have been shown to result in excellent improvements in IPSS up to 14.9 points at 12 months [2, 9, 28]. Therefore, combined with the literature, our meta-analysis demonstrated that PAE is as effective as TURP in improving patient-reported symptoms.

Article 5:

Based on short-term data (up to 12 months' follow-up) from both RCTs and prospective comparative NRSs, PAE may result in a somewhat lesser but overall similar improvement in urologic symptom score and quality of life. For longer-term outcomes (greater than 12 months' follow-up), we found that urologic symptom score and quality of life may be similarly improved between these procedures.

Article 6:

Disadvantages of PAE in both subjective and objective outcome measures are most likely to be caused by the inferior relief of bladder outlet obstruction achieved by PAE. A substantial number of patients (21%) require a step-up towards more invasive treatment within 24 months after PAE due to unsatisfying clinical outcomes.

Clinical Significance:

BPH is one of the most common diseases in men and is often associated with bladder outlet obstruction and lower urinary tract symptoms. The incidence of benign prostatic hyperplasia in men aged 50-60 years is 50% and rises with increasing age. Surgical treatment is recommended if conservative treatment fails or for patients with complications related to BPH. Transurethral resection of the prostate (TURP) is still the surgical gold standard in most patients. However, it is associated with high morbidity and 40% of patients have residual lower urinary tract symptoms that require drug treatment within five years after surgery. These drawbacks have led to a continuous search for less invasive treatments. Prostatic artery embolization (PAE) is emerging globally as a minimally invasive alternative to surgical therapy for the

treatment of bladder outlet obstruction caused by BPH. Overall, current literature shows there is not enough rigorous evaluation to exhibit the preference of PAE or TURP in the treatment of BPH. Most research demonstrates that PAE is as effective as TURP in improving patient-reported symptoms. Collective data has shown one apprehension for the use of PAE, in which PAE likely increases retreatment rates compared to TURP. According to the American Urological Association (AUA) BPH clinical guidelines state that currently PAE should only be performed in the context of an experimental clinical trial, given the heterogeneity in the available literature and safety concerns regarding radiation exposure, postembolization syndrome, vascular access, technical feasibility, and adverse events. The evidence gathered here should warrant future implications for PAE because this procedure impacts the entire prostate without exerting any focused and controlled action on the obstruction. In any case, the decision to offer PAE treatment should be based on a multidimensional risk-benefit assessment and a detailed discussion with the patient regarding the adverse effects that are associated.

Other Considerations:

Further research should conduct rigorous studies to assess the true benefits of PAE in the treatment of BPH with standardized PAE procedures, longer follow-up periods, and cost-effectiveness analyses. Current literature should also employ more higher quality articles to include more randomized controlled trials with larger populations.

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