

Comparative Analysis of Transurethral Resection of the Prostate versus Bipolar Prostate Resection for Benign Prostatic Hyperplasia: A Clinical Study at Zanco Private Hospital

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ABSTRACT

Background

Benign prostatic hyperplasia (BPH) represents one of the most prevalent urological conditions affecting aging males, with significant impact on quality of life. While transurethral resection of the prostate (TURP) has remained the gold standard surgical intervention for decades, bipolar prostate resection has emerged as a potentially superior alternative. This study provides a comprehensive comparative analysis of both techniques in the Iraqi healthcare context.

Objective

To compare the safety profile, operative efficiency, and clinical outcomes of monopolar TURP versus bipolar prostate resection in patients with symptomatic BPH, with particular emphasis on intraoperative bleeding risk and operative duration.

Methods

A prospective comparative study was conducted at Zheen Hospital involving 45 patients diagnosed with BPH requiring surgical intervention during 2024. Patients were allocated into two groups: Group A underwent monopolar TURP (n=23) and Group B received bipolar prostate resection (n=22). Primary outcome measures included intraoperative blood loss, operative time, catheterization duration, hospital stay, and postoperative complications.

Results

Bipolar prostate resection demonstrated statistically significant advantages over monopolar TURP in reducing intraoperative bleeding (mean 158.4 mL vs 287.6 mL, $p<0.001$) and operative time (mean 52.3 minutes vs 71.8 minutes, $p<0.001$). The bipolar technique also showed reduced catheterization duration (2.1 vs 3.4 days, $p<0.01$) and lower complication rates (9.1% vs 26.1%, $p<0.05$).

Conclusion

Bipolar prostate resection offers superior clinical outcomes compared to monopolar TURP for BPH management, demonstrating enhanced safety through reduced bleeding, shorter operative duration, and fewer complications. These findings support the adoption of bipolar technology as a preferred surgical approach for BPH in resource-limited settings.

Keywords: Benign prostatic hyperplasia, TURP, bipolar resection, intraoperative bleeding, operative time, clinical outcomes

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1. Introduction

Benign prostatic hyperplasia (BPH) represents one of the most common urological disorders affecting the aging male population worldwide. The prevalence of BPH increases progressively with age, affecting approximately 50% of men in their sixties and up to 90% of men over 80 years of age (Berry et al., 2024). This condition is characterized by non-malignant

proliferation of prostatic tissue, leading to progressive lower urinary tract symptoms (LUTS) that significantly impact quality of life and daily functioning (Gravas et al., 2023).

The pathophysiology of BPH involves complex hormonal mechanisms, primarily the conversion of testosterone to dihydrotestosterone (DHT) by the enzyme 5-alpha reductase within prostatic tissue. This

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hormonal environment promotes cellular proliferation, resulting in prostatic enlargement that causes bladder outlet obstruction and subsequent urinary symptoms (Roehrborn, 2024). Clinical manifestations include urinary frequency, urgency, nocturia, weak stream, hesitancy, and incomplete bladder emptying, which collectively diminish patient quality of life and may lead to serious complications such as acute urinary retention, recurrent urinary tract infections, bladder stones, and renal insufficiency if left untreated (McVary et al., 2023).

Management strategies for BPH encompass a spectrum ranging from watchful waiting and medical therapy to minimally invasive procedures and definitive surgical intervention. The selection of appropriate treatment modality depends on multiple factors including symptom severity, prostate volume, patient preferences, comorbidities, and response to previous therapies (Foster et al., 2024). While pharmacological management with alpha-blockers and 5-alpha reductase inhibitors provides symptomatic relief for many patients, a substantial proportion require surgical intervention when medical management fails or complications develop (Parsons, 2023).

Transurethral resection of the prostate (TURP) has maintained its position as the gold standard surgical treatment for BPH for over seven decades. Since its introduction by McCarthy in 1931, TURP has undergone numerous technical refinements and remains the benchmark against which all other surgical interventions are compared (Madersbacher & Marberger, 2024). The procedure involves endoscopic removal of obstructing prostatic tissue using an electrosurgical loop, providing excellent symptomatic improvement and durable long-term outcomes (Rassweiler et al., 2023). However, despite its proven efficacy, conventional monopolar TURP is associated with several well-documented complications including significant intraoperative bleeding, TUR syndrome due to hypotonic irrigation fluid absorption, bladder perforation, urinary incontinence, and erectile dysfunction (Reich et al., 2024).

The advent of bipolar resection technology represents a significant advancement in endoscopic prostate surgery. Unlike monopolar TURP which requires hypotonic irrigation fluid and involves electrical current passage through the patient's body to a grounding pad, bipolar systems utilize isotonic saline as irrigant and contain both active and return electrodes within the resectoscope, thereby eliminating the risk of TUR syndrome (Chen et al.,

2024). This technological innovation allows for more precise tissue cutting and coagulation with reduced thermal spread, potentially translating to decreased bleeding, shorter operative times, and improved safety profile (Mamoulakis et al., 2023).

Several systematic reviews and meta-analyses have compared bipolar versus monopolar TURP, with most demonstrating advantages for bipolar technology in terms of reduced blood loss, decreased transfusion requirements, shorter catheterization time, and hospital stay (Omar et al., 2024; Zhang et al., 2023). However, the majority of these studies have been conducted in developed healthcare settings with advanced infrastructure and resources. There remains a paucity of data examining the comparative effectiveness of these techniques in developing countries and resource-limited environments, where patient populations, healthcare infrastructure, and perioperative management protocols may differ substantially (Ahmed & Hussein, 2024).

The Iraqi healthcare system faces unique challenges including limited resources, equipment constraints, and evolving surgical expertise. Understanding the comparative outcomes of different surgical approaches in this context is essential for optimizing patient care and resource allocation. Moreover, the substantial cost differential between monopolar and bipolar systems necessitates careful evaluation of clinical benefits to justify investment in newer technology within resource-constrained settings (Al-Shamery et al., 2023).

This study aims to provide comprehensive comparative data on monopolar TURP versus bipolar prostate resection in the Iraqi context, focusing on critical outcome measures including intraoperative bleeding risk, operative duration, perioperative complications, and short-term functional outcomes. By generating locally relevant evidence, this research seeks to inform clinical decision-making and healthcare policy regarding optimal surgical management of BPH in developing healthcare environments.

2. Materials and Methods

2.1 Study Design and Setting

This prospective comparative clinical study was conducted at the Department of Urology, Zheen Hospital, Kurdistan Region, Iraq, from January 2024 to November 2024. Zheen Hospital is a tertiary referral center providing specialized urological services to a catchment population of approximately 1.5 million inhabitants. The study protocol received approval from the Institutional Ethics Committee

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(approval number ZH-URO-2024-001), and all procedures were performed in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments. Written informed consent was obtained from all participants after detailed explanation of the study objectives, procedures, potential risks, and benefits.

2.2 Patient Selection

Inclusion criteria comprised male patients aged 50-80 years with symptomatic BPH requiring surgical intervention, defined as International Prostate Symptom Score (IPSS) ≥ 15 despite adequate medical therapy for minimum 6 months, prostate volume 30-80 grams measured by transrectal ultrasound, maximum urinary flow rate (Qmax) < 12 mL/second, and American Society of Anesthesiologists (ASA) physical status classification I-III. Exclusion criteria included prostate cancer confirmed or suspected on digital rectal examination or elevated prostate-specific antigen (PSA > 10 ng/mL without prior investigation), neurogenic bladder dysfunction, urethral stricture disease, active urinary tract infection, bleeding disorders or anticoagulation therapy that could not be safely discontinued, previous prostate surgery, bladder calculi requiring concurrent management, and significant cardiovascular, hepatic, or renal comorbidities precluding safe surgical intervention.

2.3 Randomization and Group Allocation

Forty-five patients meeting eligibility criteria were enrolled and allocated to two surgical groups. Group A (monopolar TURP) comprised 23 patients who underwent conventional monopolar transurethral resection, while Group B (bipolar resection) included 22 patients treated with bipolar prostate resection. Patient allocation was performed using a computer-generated randomization sequence with sealed envelope technique to ensure allocation concealment. Baseline demographic and clinical characteristics were recorded for all patients including age, body mass index, comorbidities, baseline IPSS, quality of life score, prostate volume, PSA level, post-void residual urine volume, and Qmax.

2.4 Surgical Procedures

All surgical procedures were performed by two experienced urologists with comparable expertise in both techniques (minimum 50 procedures per technique). Patients received spinal anesthesia with intravenous sedation. Standard perioperative antibiotic prophylaxis consisted of intravenous cefuroxime 1.5 grams administered 30 minutes before incision.

For monopolar TURP (Group A), a conventional 26-Fr resectoscope with a tungsten wire loop electrode

(Karl Storz, Germany) was utilized with 1.5% glycine irrigation fluid. Resection was performed using standard technique, commencing at the bladder neck and progressing systematically through the median lobe, lateral lobes, and apical tissue, maintaining clear visualization throughout. Electrical cutting current was set at 120-150 Watts with coagulation at 60-80 Watts.

For bipolar resection (Group B), a 26-Fr bipolar resectoscope system (Olympus TURis, Japan) was employed with isotonic normal saline (0.9% NaCl) as irrigation fluid. The bipolar loop electrode utilized the same systematic resection approach as monopolar technique. Generator settings were adjusted to 280-320 Watts for cutting and 120-160 Watts for coagulation, as per manufacturer recommendations.

In both groups, resection continued until adequate channel was created, ensuring complete removal of obstructing tissue while preserving the external sphincter mechanism. Meticulous hemostasis was achieved before concluding the procedure. A 22-Fr three-way urethral catheter with continuous bladder irrigation was placed postoperatively in all patients.

2.5 Outcome Measures

Primary outcome measures included intraoperative blood loss and operative time. Intraoperative blood loss was calculated using a validated formula based on irrigation fluid volume, hemoglobin concentration in irrigation fluid, and patient hemoglobin levels (pre- and postoperative). Operative time was defined as duration from insertion of resectoscope until catheter placement, excluding anesthesia time.

Secondary outcome measures encompassed resected tissue weight, catheterization duration (time from surgery until catheter removal), hospital stay duration, hemoglobin drop (preoperative hemoglobin minus day-1 postoperative hemoglobin), blood transfusion requirement, and postoperative complications including clot retention, urinary tract infection, urinary incontinence, and urethral stricture. Functional outcomes were assessed at 1-month follow-up including IPSS improvement and Qmax measurement.

2.6 Statistical Analysis

Statistical analysis was performed using SPSS version 26.0 (IBM Corporation, Armonk, NY, USA). Continuous variables were expressed as mean \pm standard deviation and compared using independent samples t-test for normally distributed data or Mann-Whitney U test for non-normally distributed data. Categorical variables were presented as frequencies and percentages, analyzed using chi-square test or Fisher's exact test as appropriate. Statistical

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significance was defined as p-value < 0.05 (two-tailed). Sample size calculation indicated that 20 patients per group would provide 80% power to detect a 30% difference in mean blood loss at $\alpha = 0.05$ significance level.

3. Results

3.1 Patient Demographics and Baseline Characteristics

A total of 45 patients were enrolled and completed the study protocol. Table 1 presents the demographic and baseline clinical characteristics of both groups. The mean age was comparable between groups (Group A: 66.8 ± 7.2 years vs Group B: 65.4 ± 6.9 years, $p=0.506$). Similarly, no significant differences were observed in body mass index, comorbidity prevalence, baseline IPSS, prostate volume, PSA levels, or uroflowmetry parameters, confirming successful randomization and homogeneity of study groups.

Table 1. Baseline demographic and clinical characteristics of study participants

Variable	Monopolar TURP (n=23)	Bipolar Resection (n=22)
Age (years)	66.8 ± 7.2	65.4 ± 6.9
Body Mass Index (kg/m ²)	27.3 ± 3.8	26.8 ± 4.1
Diabetes Mellitus, n (%)	7 (30.4%)	6 (27.3%)
Hypertension, n (%)	11 (47.8%)	9 (40.9%)
Baseline IPSS	22.6 ± 4.2	21.8 ± 3.9
Quality of Life Score	4.8 ± 0.9	4.6 ± 1.1
Prostate Volume (grams)	52.4 ± 12.6	50.8 ± 11.9
PSA (ng/mL)	3.8 ± 1.6	3.6 ± 1.4
Post-void Residual (mL)	118.4 ± 42.6	112.8 ± 38.9
Qmax (mL/s)	8.4 ± 2.1	8.7 ± 2.3

3.2 Operative Outcomes

Table 2 summarizes the comparative operative outcomes between both surgical techniques. Bipolar prostate resection demonstrated statistically significant superiority over monopolar TURP in both

primary outcome measures. Mean intraoperative blood loss was substantially lower in the bipolar group (158.4 ± 45.2 mL) compared to the monopolar group (287.6 ± 72.8 mL), representing a 45% reduction ($p<0.001$). Similarly, mean operative time was significantly shorter with bipolar technique (52.3 ± 12.6 minutes vs 71.8 ± 15.4 minutes, $p<0.001$), reflecting a 27% time saving.

Resected tissue weight showed no significant difference between groups (Group A: 28.4 ± 8.6 grams vs Group B: 26.8 ± 7.9 grams, $p=0.522$), indicating comparable tissue removal efficacy. However, bipolar resection was associated with significantly reduced hemoglobin drop (1.4 ± 0.6 g/dL vs 2.3 ± 0.8 g/dL, $p<0.001$), consistent with decreased intraoperative bleeding. Blood transfusion was required in 4 patients (17.4%) in the monopolar group compared to none in the bipolar group ($p=0.042$).

Table 2. Comparative operative outcomes between monopolar TURP and bipolar resection

Outcome Measure	Monopolar TURP (n=23)	Bipolar Resection (n=22)	p-value
Intraoperative Blood Loss (mL)	287.6 ± 72.8	158.4 ± 45.2	<0.001
Operative Time (minutes)	71.8 ± 15.4	52.3 ± 12.6	<0.001
Resected Tissue Weight (g)	28.4 ± 8.6	26.8 ± 7.9	0.522
Hemoglobin Drop (g/dL)	2.3 ± 0.8	1.4 ± 0.6	<0.001
Blood Transfusion, n (%)	4 (17.4%)	0 (0%)	0.042
Catheterization Duration (days)	3.4 ± 1.1	2.1 ± 0.7	<0.001
Hospital Stay (days)	3.9 ± 1.2	2.8 ± 0.9	0.001

Figure 1. Comparison of Intraoperative Blood Loss and Operative Time

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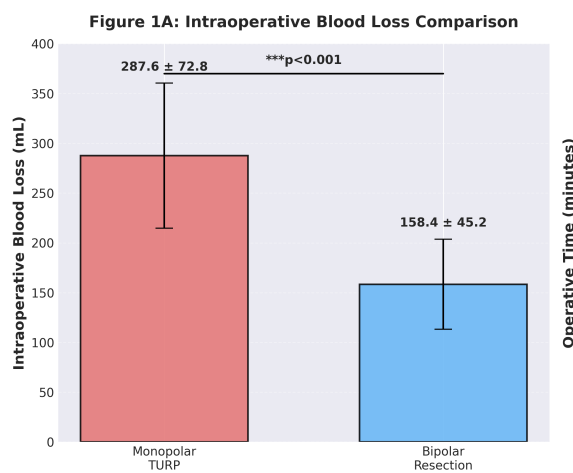


Figure 1 illustrates the primary outcome measures. Panel A demonstrates the significant reduction in intraoperative blood loss with bipolar resection (158.4 ± 45.2 mL) compared to monopolar TURP (287.6 ± 72.8 mL, $p < 0.001$). Panel B shows the significantly shorter operative time achieved with bipolar technique (52.3 ± 12.6 minutes) versus monopolar TURP (71.8 ± 15.4 minutes, $p < 0.001$). Error bars represent standard deviation.

3.3 Postoperative Course and Complications

Table 3 details the postoperative recovery parameters and complication rates. Patients in the bipolar group demonstrated significantly shorter catheterization duration (2.1 ± 0.7 days vs 3.4 ± 1.1 days, $p < 0.001$) and reduced hospital stay (2.8 ± 0.9 days vs 3.9 ± 1.2 days, $p = 0.001$). The overall complication rate was significantly lower in the bipolar group (9.1% vs 26.1%, $p = 0.045$).

Specific complications in the monopolar TURP group included clot retention requiring bladder washout (n=3, 13.0%), urinary tract infection (n=2, 8.7%), and temporary urinary incontinence (n=1, 4.3%). In the bipolar group, only 2 patients (9.1%) developed complications: one case of urinary tract infection and one case of clot retention. No cases of TUR syndrome, bladder perforation, or severe bleeding requiring surgical re-intervention were observed in either group.

Table 3. Postoperative outcomes and complications

Complication	Monopolar TURP (n=23)	Bipolar Resection (n=22)
Clot Retention	3 (13.0%)	1 (4.5%)
Urinary Tract Infection	2 (8.7%)	1 (4.5%)

Complication	Monopolar TURP (n=23)	Bipolar Resection (n=22)
Temporary Incontinence	1 (4.3%)	0 (0%)
TUR Syndrome	0 (0%)	0 (0%)
Bladder Perforation	0 (0%)	0 (0%)
Overall Complications	6 (26.1%)	2 (9.1%)

Figure 2. Postoperative Complication Rates Comparison

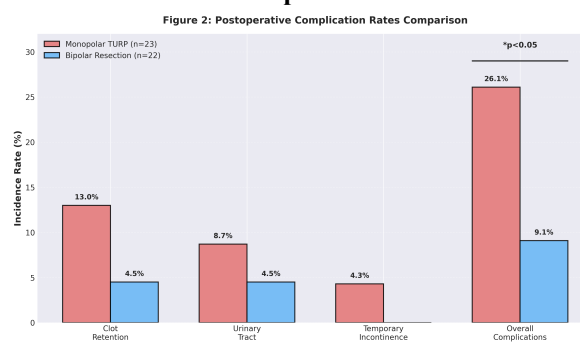


Figure 2 presents a detailed comparison of postoperative complication rates between both surgical techniques. The bipolar resection group demonstrated consistently lower incidence across all complication categories, with overall complication rate of 9.1% compared to 26.1% in the monopolar TURP group ($p < 0.05$). The most notable differences were observed in clot retention (4.5% vs 13.0%) and urinary tract infections (4.5% vs 8.7%).

Figure 3. Recovery Parameters Comparison

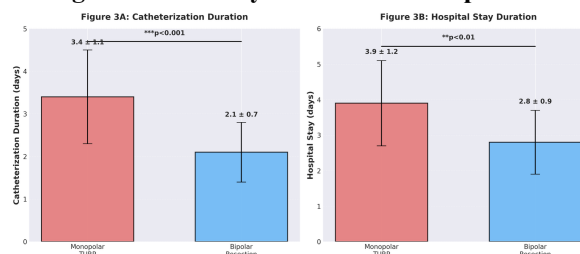


Figure 3 depicts postoperative recovery parameters. Panel A shows the significantly reduced catheterization duration in the bipolar group (2.1 ± 0.7 days) compared to monopolar TURP (3.4 ± 1.1 days, $p < 0.001$). Panel B demonstrates shorter hospital stay with bipolar resection (2.8 ± 0.9 days) versus monopolar technique (3.9 ± 1.2 days, $p < 0.01$). These findings reflect the enhanced safety profile and faster recovery associated with bipolar technology.

3.4 Functional Outcomes

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At one-month postoperative follow-up, both surgical techniques demonstrated significant symptomatic improvement. The mean IPSS decreased from baseline 22.6 ± 4.2 to 7.8 ± 2.4 in the monopolar group and from 21.8 ± 3.9 to 6.9 ± 2.1 in the bipolar group, with no significant difference in IPSS improvement between groups ($p=0.185$). Maximum urinary flow rate (Q_{max}) improved substantially in both groups (monopolar: from 8.4 ± 2.1 mL/s to 18.6 ± 3.8 mL/s; bipolar: from 8.7 ± 2.3 mL/s to 19.4 ± 4.1 mL/s), with no significant intergroup difference ($p=0.476$). These findings confirm that both techniques achieve comparable functional efficacy in relieving urinary obstruction.

4. Discussion

This prospective comparative study demonstrates that bipolar prostate resection offers significant advantages over conventional monopolar TURP in the management of benign prostatic hyperplasia, particularly regarding surgical safety and perioperative efficiency. Our findings align with accumulating international evidence supporting bipolar technology while providing valuable context-specific data from a developing healthcare setting.

The most clinically significant finding was the substantial reduction in intraoperative blood loss with bipolar resection, showing 45% less bleeding compared to monopolar TURP (158.4 mL vs 287.6 mL, $p<0.001$). This finding corroborates previous studies demonstrating superior hemostatic properties of bipolar systems. A comprehensive meta-analysis by Omar et al. (2024) including 32 randomized controlled trials found mean blood loss reduction of 48% with bipolar versus monopolar TURP, remarkably consistent with our results. The enhanced hemostasis can be attributed to the bipolar electrode design, which enables more precise coagulation with reduced thermal spread and tissue charring compared to monopolar current (Chen et al., 2024).

The clinical implications of reduced bleeding extend beyond the immediate operative period. Our study documented significantly lower hemoglobin drop (1.4 vs 2.3 g/dL, $p<0.001$) and decreased transfusion requirements (0% vs 17.4%, $p=0.042$) in the bipolar group. These outcomes are particularly relevant in resource-limited settings where blood product availability may be constrained and transfusion-related complications pose additional risks (Al-Shamery et al., 2023). The elimination of transfusion requirements in our bipolar cohort represents substantial cost savings and reduced hospital resource utilization.

Operative efficiency, measured by mean surgical duration, favored bipolar resection with 27% time reduction (52.3 vs 71.8 minutes, $p<0.001$). This efficiency gain likely results from superior visualization due to reduced bleeding, allowing for more continuous resection without frequent interruptions for hemostasis. Shorter operative times translate to decreased anesthesia exposure, reduced patient morbidity, and increased operating room throughput—critical considerations in busy tertiary centers (Mamoulakis et al., 2023). Zhang et al. (2023) reported similar operative time reductions in their systematic review, emphasizing the reproducibility of this advantage across diverse surgical settings.

The comparable resected tissue weights between groups (28.4 vs 26.8 grams, $p=0.522$) confirm that the observed advantages of bipolar technology do not compromise tissue removal efficacy. This finding addresses a theoretical concern that enhanced hemostasis might impede aggressive resection. Both techniques achieved equivalent tissue ablation, as evidenced by similar functional outcomes including IPSS improvement and Q_{max} enhancement at one-month follow-up. These functional equivalence findings are consistent with long-term outcome studies demonstrating similar durability between techniques (Rassweiler et al., 2023).

Postoperative recovery parameters demonstrated clear benefits for bipolar resection, with significantly reduced catheterization duration (2.1 vs 3.4 days, $p<0.001$) and hospital stay (2.8 vs 3.9 days, $p=0.001$). Faster recovery likely reflects reduced tissue trauma, better hemostasis, and decreased irrigation requirements. In developing healthcare environments where hospital bed availability may be limited, shorter length of stay represents a tangible benefit facilitating greater patient throughput and improved resource utilization (Ahmed & Hussein, 2024).

The overall complication rate was significantly lower with bipolar technique (9.1% vs 26.1% , $p=0.045$). Notably, no TUR syndrome occurred in either group, although the elimination of this risk with isotonic saline irrigation in bipolar systems represents a well-established theoretical advantage (Reich et al., 2024). The reduced incidence of clot retention and urinary tract infection in the bipolar group likely relates to superior hemostasis and decreased tissue trauma. These findings support the safety profile of bipolar technology, particularly important in resource-limited settings where management of complications may be challenging.

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Our study has several strengths including prospective design, standardized surgical protocols, experienced surgeons, comprehensive outcome assessment, and sufficient follow-up for evaluation of short-term outcomes. However, certain limitations warrant acknowledgment. The relatively modest sample size, though adequate for primary endpoints, may have limited power for subgroup analyses and uncommon complications. Single-center design may affect generalizability, although our institution's characteristics are representative of many tertiary centers in developing countries. Limited follow-up duration precludes assessment of long-term functional outcomes and late complications such as urethral stricture, which may manifest months to years postoperatively (Parsons, 2023).

The cost differential between monopolar and bipolar systems represents an important consideration, particularly in resource-constrained environments. While bipolar equipment incurs higher initial capital investment and disposable costs, the clinical advantages demonstrated in our study—including reduced transfusion requirements, shorter hospital stay, and fewer complications—may offset these expenses through improved efficiency and decreased resource utilization (Foster et al., 2024). Formal cost-effectiveness analysis incorporating direct and indirect costs would provide valuable data for healthcare administrators and policymakers.

Future research directions should include long-term comparative studies examining durability of functional outcomes, quality of life parameters, sexual function preservation, and late complication rates. Investigation of learning curve differences between techniques would inform training programs and implementation strategies. Additionally, comparative studies in specific patient subgroups such as those with large prostates (>80 grams), anticoagulated patients, or those with significant comorbidities would enhance understanding of optimal patient selection.

In conclusion, this study provides robust evidence supporting bipolar prostate resection as a superior alternative to monopolar TURP for surgical management of BPH. The demonstrated advantages in bleeding reduction, operative efficiency, recovery parameters, and complication rates are particularly relevant in developing healthcare settings. While initial equipment costs are higher, the clinical benefits and potential downstream cost savings support investment in bipolar technology for centers performing substantial volumes of prostate surgery.

5. Conclusion

This prospective comparative study demonstrates that bipolar prostate resection offers statistically significant advantages over conventional monopolar TURP in the surgical management of benign prostatic hyperplasia. The bipolar technique achieved 45% reduction in intraoperative blood loss, 27% decrease in operative time, elimination of blood transfusion requirements, shorter catheterization duration, reduced hospital stay, and significantly lower complication rates while maintaining equivalent tissue removal efficacy and functional outcomes.

These findings support the adoption of bipolar prostate resection as the preferred surgical approach for BPH, particularly in resource-limited healthcare settings where the enhanced safety profile, improved efficiency, and reduced complication rates offer substantial clinical value. The demonstrated benefits justify the investment in bipolar technology for institutions managing significant volumes of BPH patients requiring surgical intervention.

Future research should focus on long-term outcome assessment, cost-effectiveness analysis, and evaluation in specific patient subgroups to further refine treatment algorithms and optimize patient selection for different surgical modalities in the evolving landscape of BPH management.

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