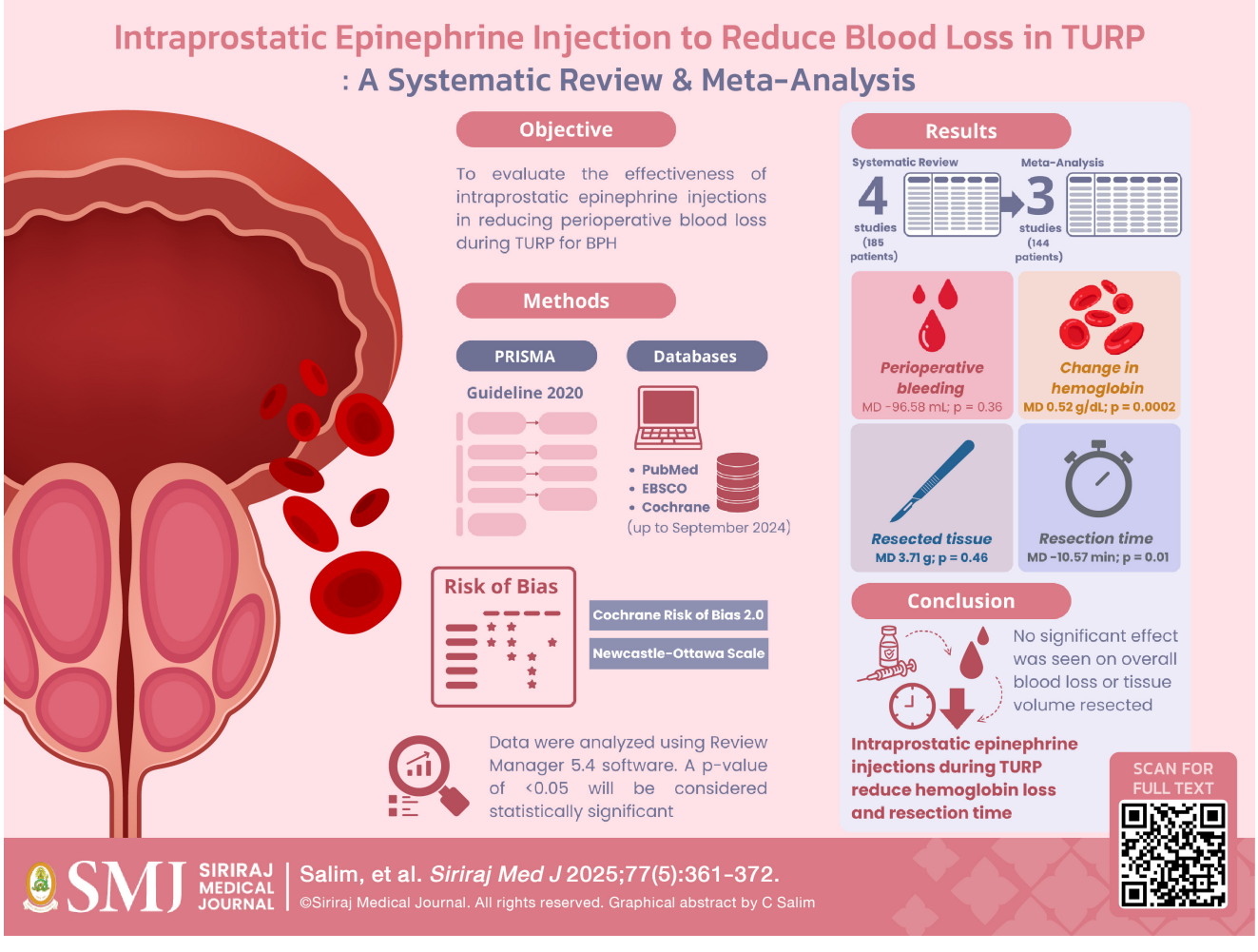
The Role of Intraprostatic Injection of Epinephrine in Reducing Perioperative Blood Loss during Transurethral Resection of the Prostate (TURP) in Patients with Benign Prostatic Hyperplasia (BPH): A Systematic Review & Meta-Analysis

Cecilia Noviyanti Salim, M.D.[1,*], Akhmad Raumulfaro Akbar, M.D.[2], Nicholas Andrian Singgih, M.D.[3], Raden Honggo Pranowo Sampurno Secodiningrat, M.D.[1], William Adipurnama, M.D.[1], Egi Edward Manuputty, M.D.[1]

[1]Department of Urology, Primaya Hospital PGI Cikini, Jakarta, Indonesia, [2]Bun Hospital, Tangerang, Indonesia, [3]Department of Urology, Hasan Sadikin General Hospital, Padjadjaran University, Bandung, Indonesia.



*Corresponding author: Cecilia Noviyanti Salim
E-mail: ceciliasalim98@gmail.com
Received 23 December 2024 Revised 14 January 2025 Accepted 17 January 2025
ORCID ID:http://orcid.org/0009-0004-6190-9178
https://doi.org/10.33192/smj.v77i5.272825

All material is licensed under terms of the Creative Commons Attribution 4.0 International (CC-BY-NC-ND 4.0) license unless otherwise stated.

ABSTRACT

Objective: This systematic review and meta-analysis aims to evaluate the effectiveness of intraprostatic epinephrine injections in reducing perioperative blood loss during TURP for BPH.

Materials and Methods: A systematic review and meta-analysis was conducted by searching the PubMed, EBSCO, and Cochrane databases up to September 2024. Randomized controlled trials (RCTs) and observational studies involving the use of intraprostatic epinephrine during TURP were included. The primary outcome assessed was perioperative blood loss, while secondary outcomes included hemoglobin changes, resected tissue volume, and resection time. Data analysis was performed using Review Manager 5.4 software.

Results: A total of 185 patients from three RCTs and one comparative retrospective study were included in the systematic review. Among these, 144 patients from the RCTs were included in the meta-analysis. Intraprostatic epinephrine was associated with a significant reduction in hemoglobin decline (mean difference [MD]: 0.52 g/dL, $p = 0.0002$) and shorter resection time (MD: -10.57 minutes, $p = 0.01$). However, no significant differences were observed in perioperative blood loss (MD: -96.58 mL, $p = 0.36$) or the volume of resected tissue (MD: 3.71 g, $p = 0.46$).

Conclusion: Intraprostatic epinephrine injections during TURP effectively reduce hemoglobin loss and resection time, improving surgical efficiency. However, no significant effects were observed on total perioperative blood loss or tissue volume resected. Variability in surgical techniques and patient factors likely contributed to inconsistent outcomes, underscoring the need for standardized protocols in future research.

Keywords: Benign prostatic hyperplasia; intraprostatic epinephrine; meta-analysis; perioperative blood loss; TURP
(Siriraj Med J 2025; 77: 361-372)

INTRODUCTION

Benign prostatic hyperplasia (BPH) is a common condition in older men, significantly affecting their quality of life. Approximately 50% of men in their 50s and 60s and up to 90% of men in their 70s experience lower urinary tract symptoms (LUTS) associated with BPH.[1,2] While medical treatments, such as alpha-1-adrenoceptor antagonists, are the first-line options for managing moderate-to-severe symptoms, many patients eventually require surgical intervention, particularly those with larger prostate glands (>80 g) who do not respond adequately to medication.[3]

Transurethral resection of the prostate (TURP) has long been considered the gold standard for the surgical treatment of LUTS caused by BPH.[4] However, TURP is associated with a 15-20% complication rate, with hematuria and perioperative blood loss being among the most common complications.[5] Blood transfusion rates during TURP have been reported to reach as high as 2.9%.[6] Additionally, excessive bleeding can obstruct the surgeon's view, complicating the procedure and increasing the risk of other complications, including fluid absorption and hyponatremia, which can lead to transurethral resection (TUR) syndrome.[7]

To address these challenges, various technologies and techniques have been developed to minimize bleeding during TURP. Among these advancements is the bipolar resection technique, which reduces the risks of fluid absorption and TUR syndrome compared to the traditional monopolar method. However, evidence regarding its effectiveness in reducing bleeding remains inconsistent.[8-10]

A promising adjunctive approach for controlling bleeding during TURP is the intraprostatic injection of epinephrine, a vasoconstrictor that effectively reduces blood flow to the prostate, helping to manage perioperative blood loss.[11] This approach has been successfully utilized in other surgical fields, such as ear, nose, and throat (ENT) surgery, where epinephrine is routinely employed to minimize bleeding during tissue resection.[4]

This systematic review aims to evaluate the effectiveness of intraprostatic epinephrine injections in reducing perioperative blood loss. By synthesizing the available evidence, this review will also explore whether the use of epinephrine as a hemostatic agent can improve surgical efficiency by increasing the amount of tissue resected and reducing resection time, while minimizing the need for blood transfusion and perioperative complications, and ensuring safety compared to conventional TURP.

MATERIALS AND METHODS

Protocol registration and literature search

This systematic review and meta-analysis was registered in PROSPERO under the registration number CRD42024588452 and adhered to the PRISMA 2020 guidelines. A comprehensive literature search was conducted

across electronic databases, including PubMed, EBSCO, and Cochrane, up to September 2024. The search strategy employed a combination of MeSH terms and keywords, such as "epinephrine" OR "adrenaline" AND "transurethral resection of prostate" AND "prostatic hyperplasia" OR "benign prostatic obstruction" AND "surgical blood loss" OR "postoperative blood loss." Only studies published in English were included.

Eligibility criteria

The inclusion criteria comprised studies involving patients who underwent transurethral resection of the prostate (TURP) for benign prostatic hyperplasia (BPH) and received intraprostatic epinephrine injections to reduce perioperative blood loss. Eligible studies included randomized controlled trials (RCTs), observational studies, cohort studies, and case-control studies published in English. Studies were excluded if they lacked sufficient data, were unavailable as full texts, or were categorized as case reports, letters to the editor, or conference abstracts.

Data extraction

Data extraction was independently performed by three reviewers. Extracted information included study details (authors, publication year, country, and study design), participant characteristics (inclusion/exclusion criteria, sample size, and median/mean age), and intervention details. Outcome measures collected included perioperative blood loss, changes in hemoglobin levels, resected tissue volume, resection time, and the number of blood transfusions required. Complications, irrigation methods, prostate volume, and statistical significance of intergroup differences were also recorded. This meticulous process ensured comprehensive data collection and comparability across studies.

Quality assessment

The risk of bias in the included studies was independently assessed by four reviewers. For the three RCTs, the Cochrane Risk of Bias Tool 2.0 was utilized, evaluating five key domains: randomization process, deviations from intended interventions, incomplete outcome data, outcome measurement, and reporting bias. For the comparative retrospective study, the Newcastle-Ottawa Scale (NOS) was applied to assess the quality of non-randomized studies. This rigorous assessment ensured high methodological standards across all included studies.

Statistical analysis

Quantitative data analysis was conducted using the Cochrane Collaboration's Review Manager 5.4 software. Data reported as medians and ranges were converted into means and standard deviations (SDs) using formulas provided by Luo et al. (2018) and Wan et al. (2014).

$$\bar{X}(w) \approx \left(\frac{4}{4+n^{0.75}}\right)\frac{a+b}{2} + \left(\frac{n^{0.75}}{4+n^{0.75}}\right)m$$

$$S \approx \frac{b-a}{2\Phi^{-1}\left(\frac{n-0.375}{n+0.25}\right)}.$$

a = the minimum value, b = the maximum value, m = median, n = sample size

When data were reported as medians and interquartile ranges (IQRs), these were also converted to means and SDs. Since the study providing the IQR data explicitly mentioned that the data were skewed, we assumed that this dataset might exhibit right-skewness. Therefore, we approximated the first ($q1$) and third quartiles ($q3$) from the IQR using the following formulas:

$$q1 \approx m - \frac{IQR}{3}$$

$$q3 \approx m + \frac{2 \times IQR}{3}$$

These approximations are consistent with the general approaches in applied statistics, particularly for skewed data distributions, where the median and IQR are robust statistical measures. The formulas serve as approximations when the data are not symmetric, aiming to better estimate the quartiles by adjusting for skewness. The values of $q1$ and $q3$ were then substituted into the formula below to estimate the mean:

$$\bar{X}(w) \approx \left(0.7 + \frac{0.39}{n}\right)\frac{q_1+q_3}{2} + \left(0.3 - \frac{0.39}{n}\right)m$$

The SD was estimated using the formula provided by Wan et al. (2014):

$$S \approx \frac{q_3 - q_1}{2\Phi^{-1}\left(\frac{0.75n-0.125}{n+0.25}\right)}.$$

**$q1$ = the first quartile, $q3$ = the third quartile, m = median, IQR = interquartile range, n = sample size

Outcomes were analyzed by calculating mean differences (MDs) with 95% confidence intervals (CIs). A p-value of <0.05 was considered statistically significant. Heterogeneity was assessed using I^2 statistics and categorized as high ($I^2 > 50\%$), moderate ($26\% < I^2 \leq 50\%$), or low ($I^2 \leq 26\%$).

RESULTS

Literature search

Fig 1 illustrates the detailed flow of study selection, outlining the exclusion process throughout the review. A total of 94 studies were identified through searches across three databases. After removing duplicates, 60 unique records were screened, and 19 were further assessed for eligibility. Ultimately, four full-text from three countries (Sweden, Mexico, and Pakistan) were included in the systematic review, all of which were published in English. Of these, three studies were incorporated into the meta-analysis.

Data extraction

This systematic review included three randomized controlled trials (RCTs) and one comparative retrospective study, encompassing a total of 185 participants. The intervention involved intraprostatic epinephrine injections during TURP, compared to control groups undergoing TURP without epinephrine.

Stenmark et al. observed a 40% reduction in bleeding per resected weight, with no significant differences in overall bleeding, hemoglobin levels, resected tissue volume, or complications. Lira-Dale et al. reported significantly lower blood loss in the epinephrine group, although resection time and resected tissue volume were similar between the groups. Zohaib et al. found reduced blood loss, shorter operative times, and increased tissue resection in the epinephrine group. Schelin demonstrated a 70% reduction in perioperative and total blood loss with minimal impact on operative time and no adverse events attributed to epinephrine use.

Risk of bias assessment

Fig 2 provides the risk of bias assessment for the included RCTs. Two studies demonstrated a low risk of bias, while one study had some concerns.

The comparative retrospective study's risk of bias assessment, conducted using Newcastle-Ottawa Scale (NOS), indicated a low risk of bias (Table 2).

Meta analysis

Data conversion

Table 3 presents the mean and standard deviation (SD) values for the analyzed variables. These values were derived from various reported statistics, including

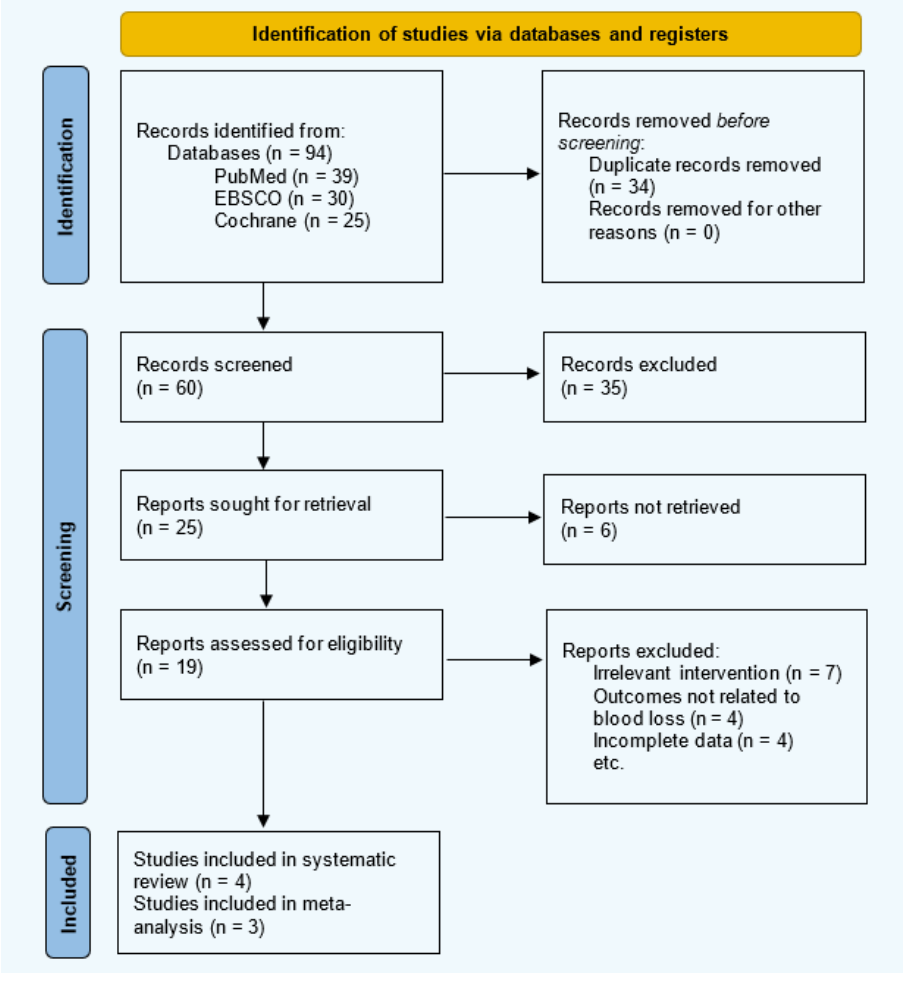


Fig 1. PRISMA flowchart 2020 depicting the selection process of included studies.

TABLE 1. Characteristics of the included studies and outcomes of the intervention using intraprostatic epinephrine during TURP compared to controls.

No	Author (year)	Country	Study design	Inclusion criteria	Exclusion criteria	Sample size
1	Stenmark F, et al. (2023)	Sweden	RCT	Patients with verified prostate enlargement deemed suitable for TURP, TRUS >30 mL, IPSS >12, Qmax <13 mL/s	Known intolerance of mepivacaine or adrenaline or patients unfit to tolerate TURP (e.g. severe bleeding disorders or high ASA score)	81
2	Lira-Dale A, et al. (2012)	Mexico	RCT	Patients with diagnosis of obstructive BPH that were surgery candidates and patients programmed for TURP	• Past history of high blood pressure • Heart disease • Blood dyscrasia • Anticoagulant medications • Treatment in the last 3 months with 5-ARIs • Genitourinary cancer • Urinary tract lithiasis • Urological surgery within the last 3 months	23
3	Zohaib A, et al. (2023)	Pakistan	RCT	All symptomatic males with BPH requiring TURP	• Abnormally high blood pressures • Ischemic heart disease • Blood dyscrasia • Urinary lithiasis • Anticoagulant medications • Any urological surgical intervention in the previous 3 months	40
4	Schelin S (2009)	Sweden	Comparative retrospective study	Consecutive and unselected TURP patients, compared with the previous consecutive regular TURP patients, performed by the same doctor. Indication for surgery: outflow obstruction by prostate enlargement due to BPH	N/A	41

TABLE 1. Characteristics of the included studies and outcomes of the intervention using intraprostatic epinephrine during TURP compared to controls (Continued).

No	Group	Irrigation	Sample	Age (years)	Prostate volume (g)	Perioperative bleeding (mL)	*p*
1	**Control:** regular TURP	Mannitol + ethanol	41	68 (54-90)[a]	50.0 (31.0-98.0)[a]	100 (15-595)[a]	0.247
	Case: TURP with intraprostatic injections of mepivacaine/adrenaline - 40 mL of Carbocaine-Adrenaline 0.5% (= 200 mg of mepivacaine and 200 mcg of epinephrine) - Infiltrating injections using the Schelin catheter to 8, 11, 1, 4 o'clock positions (10 mL at each)		40	73 (57-90)[a]	51.0 (35.0-90.0)[a]	90 (10-700)[a]	
2	**Control:** 20 mL of saline solution	Sterile water	10	62.2 ± 9.75[b]	65.08 ± 13.4[b]	336.63 ± 185.6[b]	<0.05
	Case: intraprostatic epinephrine, 200 mcg in 20 mL of saline solution - 10 mL was applied at the prostatic floor level, 5 mL in each lateral lobe (total 20 mL) - Williams endoscopic needle		13	66.23 ± 9.89[b]	68.9 ± 16.1[b]	127.48 ± 77[b]	
3	**Control:** 20 mL of 0.9% normal saline injection	Not described	20	65.65 ± 7.43[b]	64.00, 21[c]	NA	NA
	Case: intraprostatic epinephrine injection, 200 mcg in 20 mL normal saline - 10 mL was injected into the median lobe, 5 mL in both lateral lobes (total 20 mL) - 20G metal needle		20	66.30 ± 9.24[b]	68.00, 15[c]	NA	
4	**Control:** former, regular, and consecutive TURP	Mannitol + alcohol	30	NA	NA	354 (67-1500)[d]	NA
	Case: TURP with intraprostatic injections of mepivacaine epinephrine (as in study 1)		11	NA	NA	108 (<20-302)[d]	

a = median (range), b = mean ± standard deviation (SD), c = median with interquartile range (IQR), d = mean (range)

TABLE 1. Characteristics of the included studies and outcomes of the intervention using intraprostatic epinephrine during TURP compared to controls (Continued).

No	Group	Change in hemoglobin (g/dL)	*p*	Bleeding per resected weight (mL/g)	*p*	Resected tissue (g)	*p*	Resection time	*p*
1	Control Case	– 1.1 (–2.7-1.1)[a] – 0.6 (–2.1-0.8)[a]	0.254	5.2 (0.4-31.4)[a] 3.5 (0.4-17.6)[a]	0.030	19 (8-69)[a] 25 (10-60)[a]	0.067	NA NA	NA
2	Control Case	NA NA	NA	NA NA	NA	26.2 ± 23.6[b] 14 ± 8.2[b]	not reported (no statistically significant differences)	45.1 ± 21.1[b] (min) 40.92 ± 20.3[b] (min)	not reported (no statistically significant differences)
3	Control Case	– 1.87 ± 1.04[b] – 1.15 ± 0.42[b]	0.007	NA NA	NA	30.00, 12[c] 41.00, 18[c]	0.017	42.50, 19[c] (min) 30.00, 19[c] (min)	0.024
4	Control Case	NA NA	NA	15.4 (5.6-44.4)[d] 4.8 (0-8.3)[d]	NA	23.6 (5-54)[d] 21.3 (15-37)[d]	NA	2.2 (1-5)[d] (min/g) 2.0 (1.5-3.0)[d] (min/g)	NA

a = median (range), b = mean ± standard deviation (SD), c = median with interquartile range (IQR), d = mean (range)

No	Group	Transfusion (n)	*p*	Complications	*p*
1	**Control**	0	NA	4 - 1 resorbed minor volumes of irrigation fluid during surgery (no TUR syndrome) - 1 resorbed minor volumes of irrigation fluid during surgery (no TUR syndrome) + urinary tract infection - 1 urinary tract infection only - 1 pancreatitis and prolonged bladder irrigation (>48 h) which extended his hospital stay	0.349
	Case	0		1 (an episode of hypertension and bradycardia during surgery that resolved spontaneously)	
2	**Control**	NA	NA	0	NA
	Case	NA		1 (transitory high blood pressure up to 190/110 mmHg that was managed with oral nifedipine, resulting in remission at 30 min	
3	**Control**	6	0.010	NA	NA
	Case	0		NA	
4	**Control**	NA	NA	1	NA
	Case	NA		0	

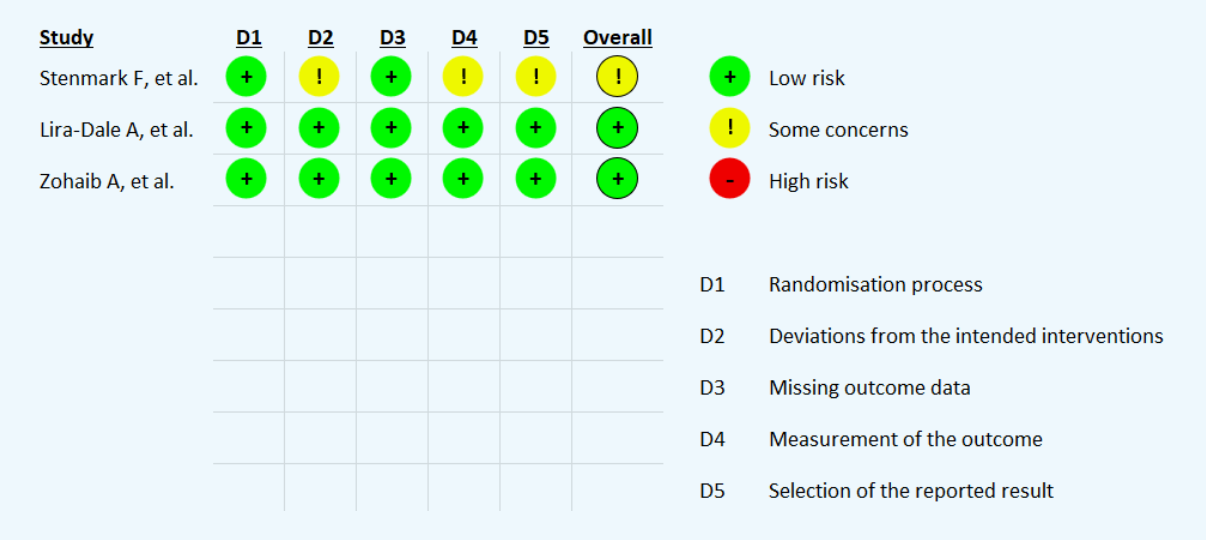


Fig 2. Risk of bias assessment for three studies using the Cochrane Risk of Bias Tool (RoB 2).

TABLE 2. Risk of bias assessment for the comparative retrospective study using the Newcastle-Ottawa Scale (NOS)

Study	Selection				Comparability	Outcome			Total Score
	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Outcome of interest not present at start	Comparability of cohorts	Assessment of outcome	Follow-up long enough	Adequacy of follow-up	
Schelin S	1	1	1	1	1	1	1	1	8/9

TABLE 3. Mean ± SD values comparing intraprostatic epinephrine (case) versus control groups after data conversion.

No	Group	Sample	Perioperative bleeding (mL) (Mean ± SD)	Change in hemoglobin (g/dL) (Mean ± SD)	Resected tissue (g) (Mean ± SD)	Resection time (min) (Mean ± SD)
1	**Control**	41	140.588 ± 133.880	– 1.040 ± 0.877	22.860 ± 14.080	NA
	Case	40	143.251 ± 159.992	– 0.61 ± 0.672	27.860 ± 11.593	NA
2	**Control**	10	336.63 ± 185.6	NA	26.2 ± 23.6	45.1 ± 21.1
	Case	13	127.48 ± 77	NA	14 ± 8.2	40.92 ± 20.3
3	**Control**	20	NA	– 1.87 ± 1.04	31.439 ± 9.574	44.778 ± 15.159
	Case	20	NA	– 1.15 ± 0.42	43.158 ± 14.361	32.278 ± 15.159

median with range, median with interquartile range (IQR), and mean with range. Data conversions followed established statistical methods outlined in the Materials and Methods section, ensuring consistency across studies for inclusion in the meta-analysis.

Perioperative bleeding

Two studies compared perioperative bleeding between intraprostatic epinephrine and control groups. Although the epinephrine group exhibited lower perioperative bleeding (MD -96.58; 95% CI, -303.74 to 110.58), the difference was not statistically significant (p = 0.36). High heterogeneity was observed (I^2 = 89%). A detailed analysis of perioperative bleeding is shown in Fig 3A, with the funnel plots for bias illustrated in Fig 4A.

Change in hemoglobin

Two studies evaluated changes in hemoglobin levels between the two groups. The epinephrine group showed a significantly smaller reduction in hemoglobin compared to the control group, with a mean difference of 0.52 g/dL (95% CI, 0.24 to 0.80; p = 0.0002). No heterogeneity was detected (I^2 = 0%). A detailed analysis of hemoglobin changes is presented in Fig 3B, with corresponding funnel plots in Fig 4B.

Resected tissue

Three studies assessed the amount of resected tissue. The pooled analysis indicated a mean difference of 3.71 g (95% CI, -6.06 to 13.48), slightly favoring the epinephrine group, though this difference was not statistically significant (p = 0.46). Substantial heterogeneity was noted (I^2 = 74%). Detailed results are shown in Fig 3C, with funnel plots for bias in Fig 4C.

Resection time

Two studies analyzed resection time during TURP procedures. The epinephrine group exhibited a significantly shorter resection time, with a mean difference of -10.57 minutes (95% CI, -18.81 to -2.34; p = 0.01). No heterogeneity was observed (I^2 = 0%), indicating consistency in findings. The detailed analysis of resection time is illustrated in Fig 3D, with the funnel plot presented in Fig 4D.

DISCUSSION

This meta-analysis provides valuable insights into the use of intraprostatic epinephrine during transurethral resection of the prostate (TURP). While the pooled analysis reveals a significant advantage for the epinephrine group in terms of changes in hemoglobin and resection time, no statistically significant differences were observed

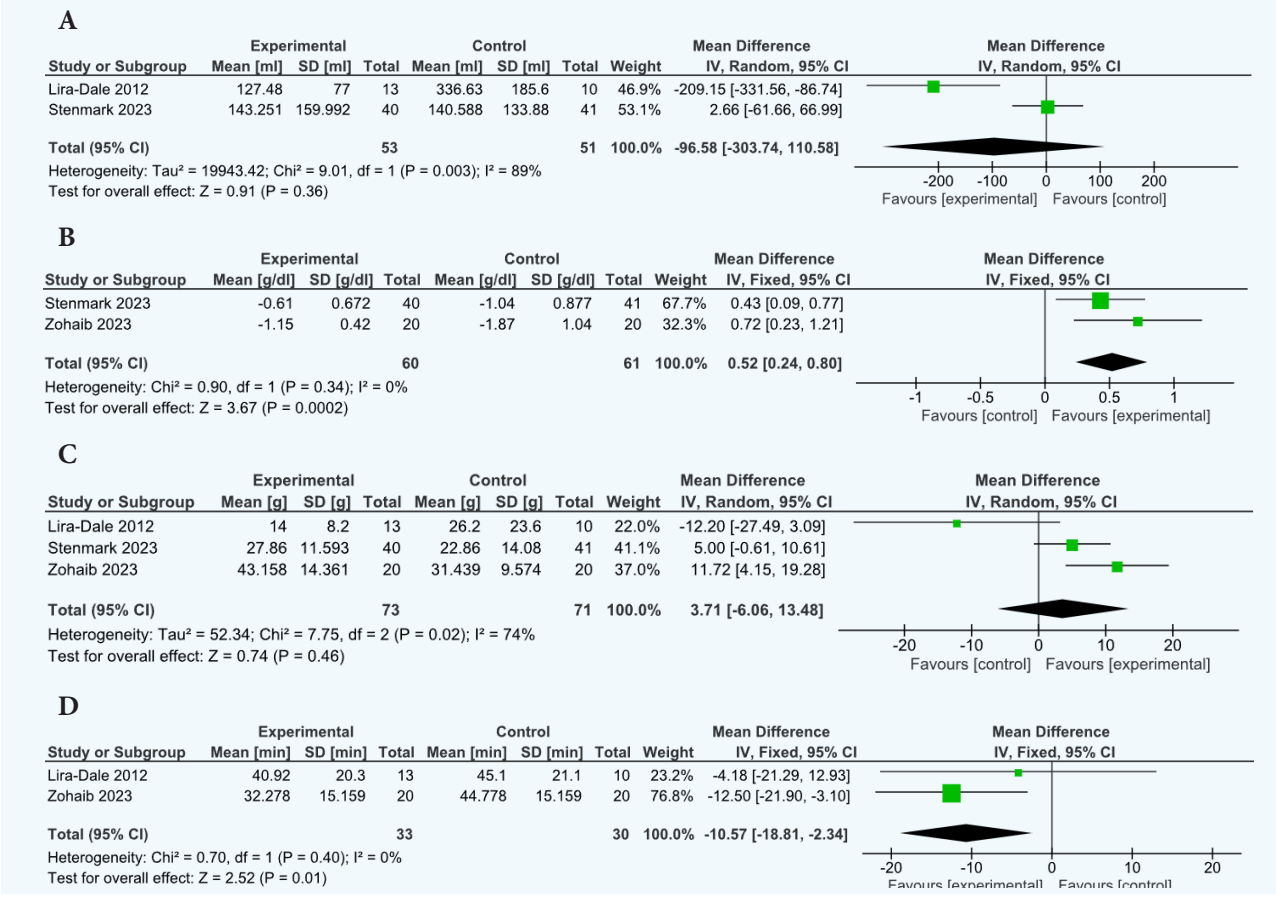


Fig 3. Forest plot comparing intraprostatic epinephrine during TURP versus control. A: Perioperative bleeding; B: Change in hemoglobin; C: Resected tissue; D: Resection time.

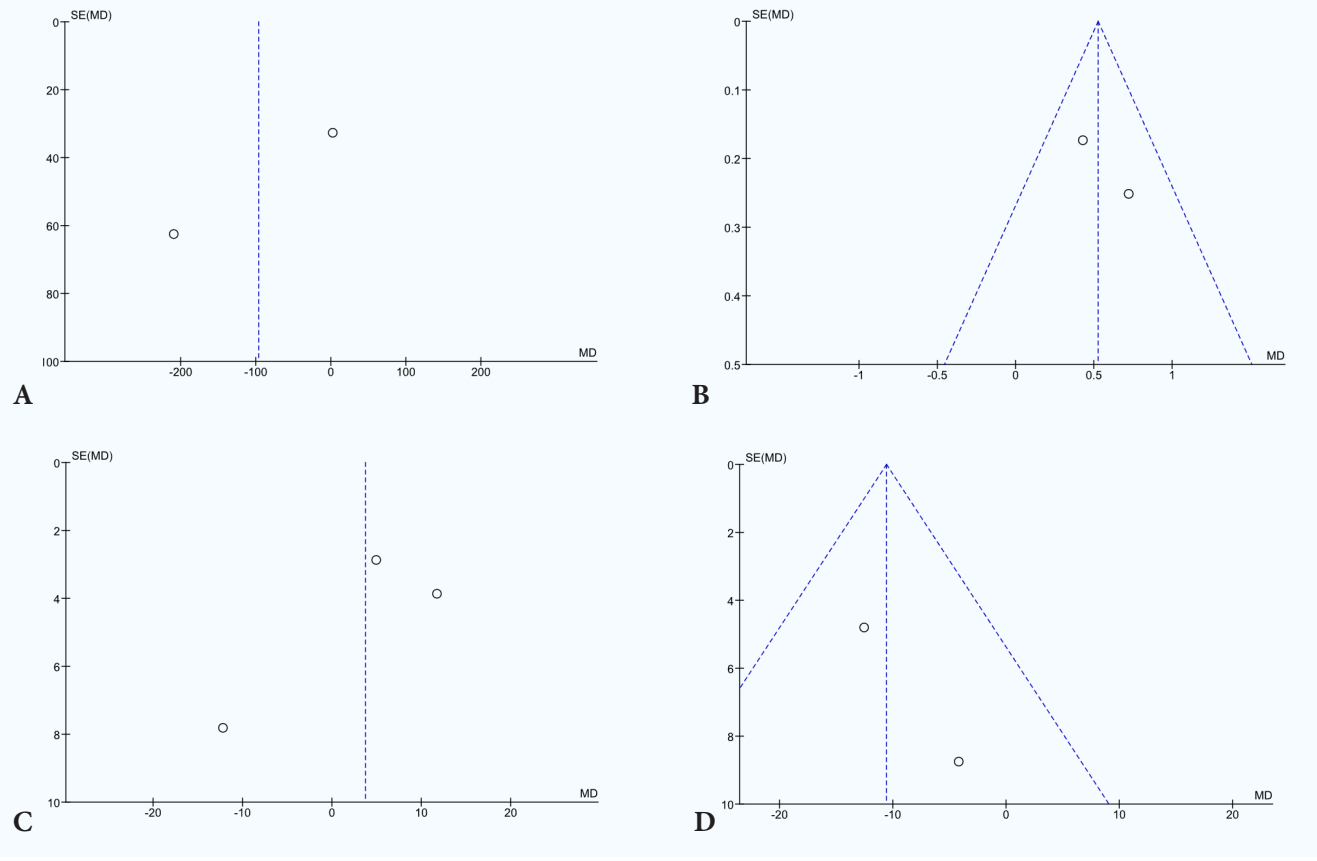


Fig 4. Funnel plot comparing intraprostatic epinephrine during TURP versus control. A: Perioperative bleeding; B: Change in hemoglobin; C: Resected tissue; D: Resection time.

between the epinephrine and control groups regarding perioperative bleeding or the amount of resected tissue in grams.

The significant reduction in hemoglobin decline in the epinephrine group suggests that intraprostatic epinephrine effectively minimizes hemoglobin loss during TURP. This reduction may lower the risk of postoperative anemia and decrease the need for blood transfusions. Additionally, the shorter resection time observed in the epinephrine group may reflect enhanced surgical efficiency, potentially due to improved visibility and reduced coagulation requirements, as suggested by Schelin et al.[4]

However, the lack of significant differences in perioperative bleeding and resected tissue volume warrants further discussion. High heterogeneity among the included studies likely contributed to variability in these outcomes. One plausible explanation is the variation in surgical experience across studies. Inexperienced urologists typically have a bleeding rate of 25-30 mL per gram of resected tissue, compared to approximately 15 mL/g for experienced urologists.[12,13] The studies by Stenmark et al. and Zohaib et al. involved multiple surgeons with varying preferences, potentially influencing outcomes.[3,7] In contrast, Lira-Dale et al. did not provide details on surgeon experience, further complicating the interpretation of findings.[14]

Moreover, the inclusion of patients taking medications such as 5-alpha reductase inhibitors (5-ARIs) or nonsteroidal anti-inflammatory drugs (NSAIDs) may have confounded the results. These medications are known to influence bleeding risk. For instance, 5-ARIs reduce prostate size and vascular density, which might independently decrease bleeding.[15] NSAIDs, on the other hand, impair platelet function and could exacerbate perioperative bleeding, skewing outcomes.[16]

The lack of correlation between perioperative bleeding and changes in hemoglobin may also be attributed to perioperative fluid irrigation and intraoperative intravenous fluid administration, which dilute blood and mask immediate hemoglobin changes. Hahn et al. have described how hemodilution and fluid redistribution complicate the assessment of blood loss based on hemoglobin levels.[17] Additionally, the timing of postoperative hemoglobin measurement may obscure the relationship between blood loss and hemoglobin changes. Blandy and Notley

emphasized that compensatory mechanisms during surgery further delay hemoglobin changes.[12]

Furthermore, Tantanate's review of bleeding time tests underscores how preanalytical variables, such as patients' hematological status and test methods, can affect bleeding assessments, highlighting the importance of standardized diagnostic approaches to reduce variability.[18] The variability in perioperative bleeding during TURP highlights the challenges in standardizing hemostatic interventions. Advanced diagnostic tools like thromboelastography (TEG) and rotational thromboelastometry (ROTEM) offer more accurate coagulation assessments. Wannatoop et al.'s pilot study showed that these tools enable goal-directed therapy based on real-time parameters, which could improve bleeding management in variable settings like TURP. Integrating these methods into TURP protocols may reduce outcome inconsistencies and enhance patient care.

The lack of correlation between resected tissue and resection time can be explained by variability in surgical techniques and patient-specific factors. Surgeon experience greatly influences resection efficiency, with experienced surgeons often able to remove more tissue in less time.[12] Prostate characteristics such as size, density, and vascularity also affect resection difficulty. Larger or more vascular prostates may require additional time for resection regardless of the tissue volume. Aus et al. highlighted that prostate morphology significantly impacts the relationship between resected weight, blood loss, and operative time.[13]

Differences in injection techniques across studies may also have influenced outcomes. Stenmark et al. and Schelin used the Schelin catheter for epinephrine delivery, injecting into all four quadrants of the prostate for consistent distribution.[4,7] In contrast, Lira-Dale employed a Williams endoscopic needle, delivering 10 mL at the prostatic floor and 5 mL into each lateral lobe.[14] Zohaib utilized a 20G metal needle, administering 10 mL to the median lobe and 5 mL to both lateral lobes.[3] Although all studies used a fixed dose of 200 mcg of epinephrine, these differences in technique and injection sites likely impacted the hemostatic effect.

These limitations underscore the need for more rigorous study designs and standardized protocols. Future research should control for confounding factors, such as preoperative medication use, and provide detailed information on surgeon experience and technique to improve the consistency and applicability of outcomes. Additionally, the fixed epinephrine dose of 200 mcg warrants future investigation to determine whether dose adjustments based on prostate volume could enhance treatment efficacy, particularly in patients with larger glands.

In terms of safety, none of the included studies reported significant adverse events associated with epinephrine use, suggesting that the intervention is both effective and safe for managing perioperative bleeding in TURP. Nonetheless, larger studies are necessary to confirm these findings and explore the long-term effects of intraprostatic epinephrine in a broader TURP patient population.

CONCLUSION

This systematic review and meta-analysis demonstrates that the use of intraprostatic epinephrine during TURP significantly reduces hemoglobin decline and resection time, contributing to improving surgical efficiency. However, it does not significantly decrease perioperative bleeding or the volume of resected tissue. The high variability among studies highlights the need for standardized techniques and better control of confounding factors to ensure consistency in outcomes. The safety profile of intraprostatic epinephrine is favorable, with no significant adverse events reported. Future research should focus on conducting larger, well-designed studies to confirm these findings and optimize the use of intraprostatic epinephrine in TURP.

Data Availability Statement

The data supporting the findings of this study are available from the corresponding author upon reasonable request. All data extracted for the systematic review and meta-analysis were obtained from previously published studies, which are cited accordingly in the reference list.

ACKNOWLEDGEMENTS

We extend our sincere appreciation to our colleagues and mentors for their invaluable insights and constructive feedback during the development of this study. We are also deeply grateful to the participants and researchers whose studies were included in this review, as their contributions have been instrumental in advancing knowledge in this field.

DECLARATION

Grant and Funding Information

None.

Conflict of Interest

None.

Registration Number of Clinical Trial

This systematic review and meta-analysis was registered with the International Prospective Register of Systematic Reviews (PROSPERO) under the registration number CRD42024588452.

Author Contributions

Conceptualization and methodology, C.S., and N.S. ; Selection and data extraction, C.S., N.S., and A.R. ; Formal analysis, C.S., W.A., and R.H. ; Visualization and writing – original draft, C.S., A.R., W.A., and R.H. ; Writing – review and editing, C.S., N.S., A.R., R.H., W.A. ; Supervision, E.M. All authors have read and agreed to the final version of the manuscript.

REFERENCES

1. Abdel-Aziz AM, El-Tahawy NFG, Abdel Haleem MAS, Mohammed MM, Ali AI, Ibrahim YF. Amelioration of testosterone-induced benign prostatic hyperplasia using febuxostat in rats: The role of VEGF/TGFβ and iNOS/COX-2. Eur J Pharmacol. 2020;889:173631.
2. Qian S, Sheng X, Xu D, Shen H, Qi J, Wu Y. Variation of prostatic morphology in Chinese benign prostatic hyperplasia patients of different age decades. Aging Male. 2019;23:457-63.
3. Zohaib A, Siddiq A, El Khalid S, Mithani S, Hassan W, Saleem M. Intra-Prostatic Injection of Epinephrine during Transurethral Resection of Prostate Reduces Blood Loss and Need for Blood Transfusions. Pak J Med Health Sci. 2023;17(05):38.
4. Schelin S. Transurethral resection of the prostate after intraprostatic injections of mepivacain and epinephrine: a preliminary communication. Scand J Urol Nephrol. 2009;43(1):63-67.
5. Mebust WK, Holtgrewe HL, Cockett AT, Peters PC. Transurethral prostatectomy: immediate and postoperative complications. Cooperative study of 13 participating institutions evaluating 3885 patients. J Urol. 1989;141:243-7.
6. Reich O, Gratzke C, Bachmann A, Seitz M, Schlenker B, Hermanek P, et al. Morbidity, mortality and early outcome of transurethral resection of the prostate: a prospective multicenter evaluation of 10,654 patients. J Urol. 2008;180(1):246-9.
7. Stenmark F, Brundin L, Gunnarsson O, Kjölhede H, Lekås E, Peeker R, et al. A randomised study of TURP after intraprostatic injection of mepivacaine/adrenaline versus regular TURP in patients with LUTS/BPO. Scand J Urol. 2023;58:46-51.
8. Stucki P, Marini L, Mattei A, Xafis K, Boldini M, Danuser H. Bipolar versus monopolar transurethral resection of the prostate: a prospective randomized trial focusing on bleeding complications. J Urol. 2015;193(4):1371-5.
9. Fagerström T, Nyman CR, Hahn RG. Bipolar transurethral resection of the prostate causes less bleeding than the monopolar technique: a single-centre randomized trial of 202 patients. BJU Int. 2010;105(11):1560-4.
10. Fagerström T, Nyman CR, Hahn RG. Complications and clinical outcome 18 months after bipolar and monopolar transurethral resection of the prostate. J Endourol. 2011;25(6):1043-9.
11. Schelin S, Claezon A, Sundin A, Wagrell L. Effects of intraprostatic and periprostatic injections of mepivacaine and epinephrine on intraprostatic blood flow during transurethral microwave thermotherapy: correlation with (15O) H2O-PET. J Endourol. 2004;18(10):965-70.
12. Blandy JP, Notley RG. Transurethral resection. Boston, MA: Butterworth-Heinemann; 1992.
13. Aus G, Bergdahl S, Hugosson J, Norlén L. Volume determination of the whole prostate and adenomas by transurethral ultrasound in patients with clinically benign hyperplasia: correlation of resected weight, blood loss and duration of operation. Br J Urol. 1994;73(6):659-63.
14. Lira-Dale A, Maldonado-Avila M, Gil-Garcia JF, Mues-Guizar EH, Nerubay-Toiber R, Guzmán-Esquivel J, et al. Effect of intraprostatic epinephrine on intraoperative blood loss reduction during transurethral resection of the prostate. Int Urol Nephrol. 2012;44(2):365-9.
15. Kloping YP, Yogiswara N, Azmi Y. The role of preoperative dutasteride in reducing bleeding during transurethral resection of the prostate: A systematic review and meta-analysis of randomized controlled trials. Asian J Urol. 2022;9:18-26.
16. Schafer AI. Effects of nonsteroidal anti-inflammatory therapy on platelets. Am J Med. 1999;106(5):25S-36S.
17. Hahn RG. Perioperative fluid therapy and fluid responsiveness. Anesthesiol Clin. 2006;24(2):333-49.
18. Tantanate C. The bleeding time: review of basic principle, clinical applications, and laboratory pitfalls. Siriraj Med J. 2016;68(1):24-9.
19. Wannatoop T, Kittivorapart J, Kittisares K, Werawatakul W, Ruchutrakool T, Permpikul P, et al. Implementation of viscoelastic hemostatic assay-guided therapy to evaluate and manage trauma-related bleeding: A pilot study from a Level 1 trauma center in Bangkok, Thailand. Siriraj Med J. 2022;74(5):294-304.