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Preoperative Systemic Corticosteroids and Intraoperative Outcomes for Endoscopic Sinus Surgery: A Meta-Analysis of Randomized Controlled Trials

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Abstract

Background: Chronic rhinosinusitis with nasal polyps (CRSwNP) often requires endoscopic sinus surgery (ESS) when medical therapy fails. Preoperative systemic corticosteroids are commonly administered to reduce mucosal inflammation and polyp size; however, their effects on intraoperative outcomes remain uncertain.

Objective: To evaluate the effects of preoperative systemic corticosteroids on surgical field quality, intraoperative blood loss, and operative time during ESS for CRSwNP.

Methods: A systematic review and meta-analysis of randomized controlled trials was conducted in accordance with PRISMA 2020 guidelines and registered in PROSPERO (CRD420241330602). Electronic databases were searched from inception to March 10, 2026. Eligible studies included adults with CRSwNP undergoing ESS who received preoperative systemic corticosteroids. The primary outcome was surgical field quality, while secondary outcomes included intraoperative blood loss and operative time. Two reviewers independently performed study selection, data extraction, and risk-of-bias assessment. Random-effects meta-analysis was used to pool standardized mean differences (SMDs) and mean differences (MDs).

Results: Five randomized controlled trials involving 242 participants were included. Preoperative corticosteroids significantly reduced intraoperative blood loss (MD −80.42 mL; 95% CI, −158.47 to −2.37; $p = 0.04$) and operative time (MD −10.84 minutes; 95% CI, −19.57 to −2.10; $p = 0.02$). Surgical field quality showed a favorable but non-significant improvement (SMD −1.12; 95% CI, −2.35 to 0.11; $p = 0.08$). Considerable heterogeneity was observed for blood loss and surgical field quality.

Conclusion: More intensive or prolonged preoperative systemic corticosteroid regimens may improve intraoperative outcomes during ESS by reducing blood loss and operative time, although their effect on surgical field quality remains uncertain. Because most included trials compared different corticosteroid regimens rather than corticosteroid treatment versus placebo, the overall effectiveness of systemic corticosteroids remains uncertain. Further high-quality randomized trials are needed to determine the optimal corticosteroid regimen.

Keywords: *chronic rhinosinusitis with nasal polyps; endoscopic sinus surgery; systemic corticosteroids; intra operative bleeding; meta-analysis*

Background

Chronic rhinosinusitis with nasal polyps (CRSwNP) is a chronic inflammatory disorder of the sinonasal mucosa characterized by persistent mucosal edema, polyp formation, and impaired sinus ventilation. Patients commonly experience nasal obstruction, hyposmia, facial pressure, and reduced quality of life. Although most patients respond to medical therapy, a substantial proportion require endoscopic sinus surgery (ESS) to

restore sinus ventilation and improve symptoms.[1-3]

Optimal visualization during ESS is essential for surgical precision and patient safety. The highly vascular and inflamed nature of nasal polyps predisposes patients to intraoperative bleeding, which may obscure anatomical landmarks, prolong operative time, and increase the risk of surgical complications. Consequently, strategies that minimize mucosal inflammation and improve surgical field visualization are integral components of perioperative management in patients with CRSwNP.[4,5]

Systemic corticosteroids possess potent anti-inflammatory properties by suppressing inflammatory cytokines, reducing eosinophilic infiltration, and decreasing mucosal edema. Short-term preoperative corticosteroid therapy has been shown to reduce polyp size and inflammatory burden, providing a biological rationale for improving intraoperative visualization and reducing blood loss during ESS. However, corticosteroid regimens vary considerably in dose, duration, and timing of administration, resulting in inconsistent evidence regarding their intraoperative effectiveness.[6,7]

Several randomized controlled trials have evaluated the effects of preoperative systemic corticosteroids on intraoperative outcomes in patients undergoing ESS for CRSwNP. Although many studies reported reductions in intraoperative bleeding and improvements in surgical field quality, the available evidence is limited by small sample sizes, heterogeneous corticosteroid protocols, and variability in outcome assessment methods. Furthermore, previous studies have predominantly focused on postoperative outcomes, whereas the intraoperative benefits of corticosteroid therapy have not been comprehensively synthesized.[7-9]

To our knowledge, no previous meta-analysis has specifically evaluated intraoperative surgical field quality as the primary outcome while simultaneously assessing intraoperative blood loss and operative time in patients undergoing ESS for CRSwNP. Therefore, this systematic review and meta-analysis aimed to synthesize evidence from randomized controlled trials to determine the effects of preoperative systemic corticosteroids on surgical field quality, intraoperative blood loss, and operative time, thereby providing evidence to support perioperative decision-making in endoscopic sinus surgery.[9,10]

Methods

This systematic review and meta-analysis was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement. The study protocol was prospectively registered in the International Prospective Register of Systematic Reviews (PROSPERO) (CRD420241330602). Eligibility criteria were established a priori according to the Population, Intervention, Comparator, Outcomes, and Study design (PICOS) framework.

Eligible studies were randomized controlled trials (RCTs) enrolling adults (≥18 years) with chronic rhinosinusitis with nasal polyps (CRSwNP) undergoing endoscopic sinus surgery (ESS). The intervention consisted of preoperative or perioperative systemic corticosteroids administered orally or intravenously, regardless of dose or duration. Comparators included placebo, no corticosteroid treatment, or alternative systemic corticosteroid regimens that differed in dose, duration, or timing of administration. Because most eligible trials compared different corticosteroid regimens rather than corticosteroid treatment versus placebo or no treatment, the review included both types of comparisons. The primary outcome was intraoperative surgical field quality assessed using validated endoscopic grading systems, whereas secondary outcomes included intraoperative blood loss and operative time. Observational studies, quasi-randomized trials, case series, conference abstracts without full-text publications, and non-English articles were excluded.

A comprehensive literature search was performed in PubMed/MEDLINE, Scopus, Web of Science, Google Scholar, and the Cochrane Central Register of Controlled Trials (CENTRAL) from database inception to March 10, 2026. The search strategy combined controlled vocabulary and free-text terms related to chronic rhinosinusitis, nasal polyps, endoscopic sinus surgery, systemic corticosteroids, and randomized controlled trials. Reference lists of eligible studies were manually screened to identify additional publications. All retrieved records were imported into reference management software, and duplicate records were removed before screening. Two reviewers independently screened titles, abstracts, and full-text articles. Disagreements were resolved through discussion until consensus was reached. The study selection process was documented using a PRISMA flow diagram.

Data extraction was independently performed by two reviewers using a standardized data collection form. Extracted data included study characteristics, participant demographics, corticosteroid regimen (type, dose, duration, route, and timing of administration), comparator characteristics, and

intraoperative outcomes. For continuous variables, means and measures of dispersion were extracted. When necessary, missing summary statistics were estimated using established statistical methods to facilitate quantitative synthesis. For studies with multiple intervention arms, appropriate statistical adjustments were applied to avoid double-counting participants.

Methodological quality was independently assessed by two reviewers using the original Cochrane Risk of Bias tool (RoB 1), as described in the Cochrane Handbook for Systematic Reviews of Interventions. The following domains were evaluated: random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other potential sources of bias. Each domain was judged as having a low, unclear, or high risk of bias. Any disagreements between reviewers were resolved through discussion until consensus was reached.

Meta-analysis was performed using a random-effects model to account for anticipated clinical and methodological heterogeneity. For surgical field quality, pooled effect estimates were calculated as standardized mean differences (SMDs; Hedges' g) with 95% confidence intervals (CIs) because different grading systems were used across studies. For intraoperative blood loss and operative time, pooled estimates were calculated as mean differences (MDs) with 95% CIs. Statistical heterogeneity was assessed using the I^2 statistic. Publication bias was not formally assessed because fewer than ten studies were available for each outcome, making funnel plot interpretation unreliable in accordance with Cochrane recommendations.

Results

Study selection

The systematic search identified 494 records from electronic databases, comprising Scopus (n = 9), CENTRAL (n = 8), PubMed (n = 5), Web of Science (n = 375), and Google Scholar (n = 97). No additional records were identified through other sources. After removal of 62 records (15 manually identified duplicates, 28 duplicates identified by Covidence, and 19 removed by automation tools), 432 unique records remained for title and abstract screening.

Of these, 394 records were excluded based on title and abstract evaluation. Thirty-eight full-text articles were assessed for eligibility. All full-text articles were successfully retrieved. Following detailed evaluation, 33 studies were excluded for the following reasons: wrong setting (n = 1), wrong outcomes (n = 1), wrong comparator (n = 1), wrong indication (n = 1), wrong study design (n = 6), wrong population (n = 12), wrong route of administration (n = 4), and other reasons as specified (n = 7).

Ultimately, five randomized controlled trials fulfilled the predefined inclusion criteria and were included in the qualitative and quantitative synthesis. The overall study selection process, including the identification, screening, eligibility assessment, and final inclusion of studies, is illustrated in Figure 1.

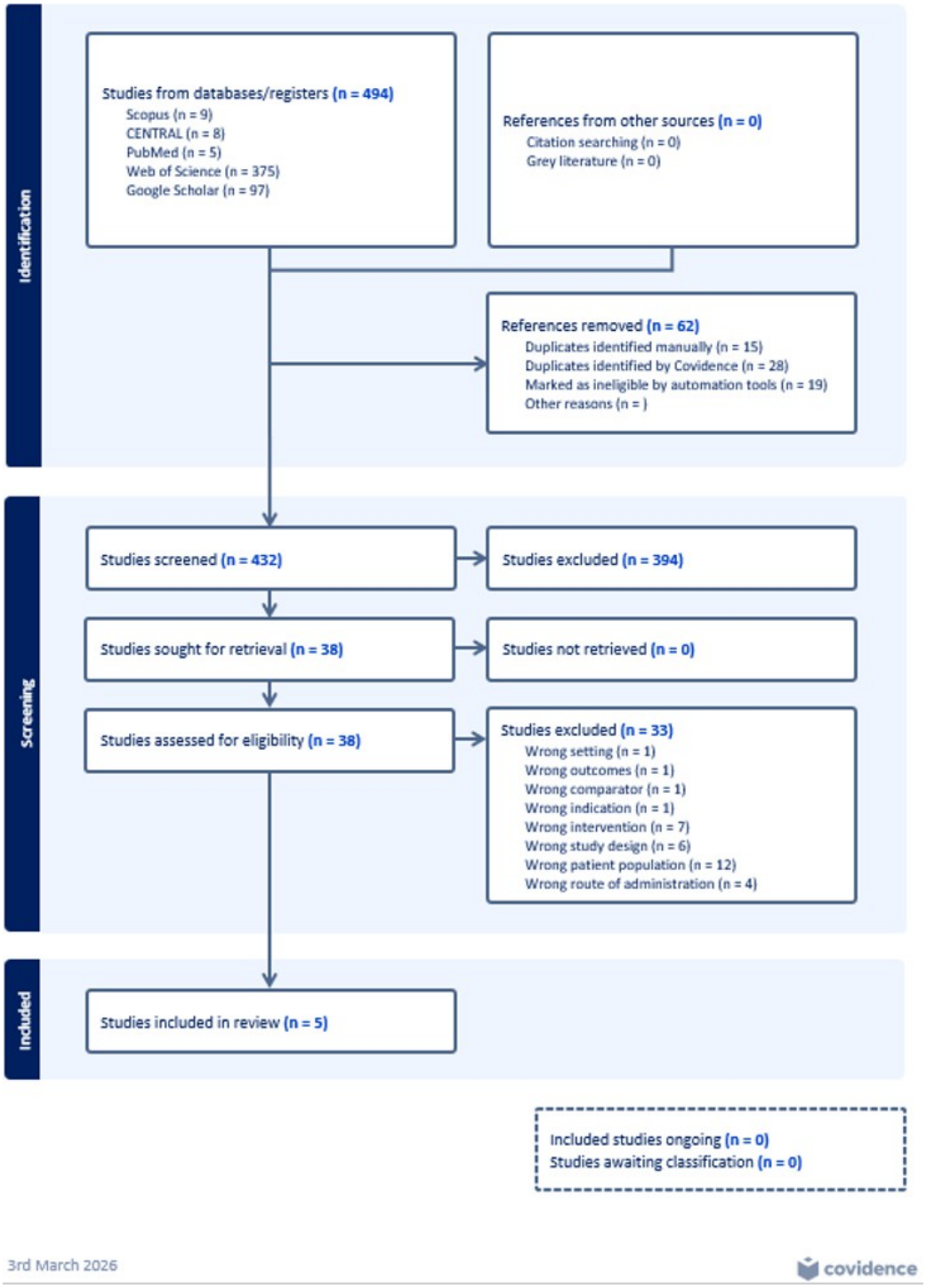

Figure 1. PRISMA 2020 Flow Diagram of Study Selection

Study Characteristics

The five studies included in the final analysis were published between 2015 and 2025 and were conducted in four countries: the United States, Egypt, India, and Turkey. Four studies were designed as double-blind randomized controlled trials, while one study used a randomized comparative design. All trials evaluated the role of preoperative systemic corticosteroids administered orally in patients undergoing ESS for chronic rhinosinusitis with nasal polyps.

Across the included trials, a total of 247 participants were initially reported. However, 242 participants were included in the quantitative synthesis. This difference arose from the study by Kominsky et al., which employed a three-arm design comparing 10 mg, 30 mg, and 60 mg prednisone regimens. To maintain methodological consistency with the other included trials—which primarily compared low- to moderate-dose regimens—only the 10 mg and 30 mg groups were incorporated into the pooled analysis, while the 60 mg arm (n = 5) was excluded.

All studies administered oral corticosteroids, either prednisone or prednisolone, prior to surgery. The corticosteroid regimens varied across trials. Two studies evaluated different durations of the same daily dose (e.g., 5 vs 10 days or 5 vs 15 days), while another compared single-dose versus short- course regimens8,9. One study used a weight-based dosing strategy (1 mg/kg/day), and another applied fixed-dose regimens ranging from 10 mg to 30 mg per day11–13. The duration of preoperative corticosteroid therapy ranged from a single preoperative dose to 15 days, with most studies evaluating short courses of 5–10 days.
Despite differences in dosing strategies and treatment duration, all trials examined comparable surgical outcomes related to intraoperative bleeding, surgical field quality, and operative time, allowing for meaningful comparison across studies.

Risk of Bias
The methodological quality of the included studies was assessed using the original Cochrane Risk of Bias tool (RoB 1). Overall, the included trials demonstrated predominantly low to unclear risk of bias across most domains. Adequate random sequence generation was reported in several studies, whereas others lacked sufficient methodological detail and were therefore judged as having an unclear risk of bias.

Most studies implemented blinding of participants and personnel, reflecting their double-blind design and indicating a low risk of performance bias. However, reporting of allocation concealment and blinding of outcome assessment was often insufficient, resulting in several domains being judged as having an unclear risk of bias.

Incomplete outcome data were generally well addressed across the studies, although one study was judged to have a high risk of bias due to incomplete outcome data. Selective reporting was commonly judged as having an unclear risk of bias because study protocols were unavailable. Overall, the included trials were considered to have acceptable methodological quality for inclusion in the meta-analysis.

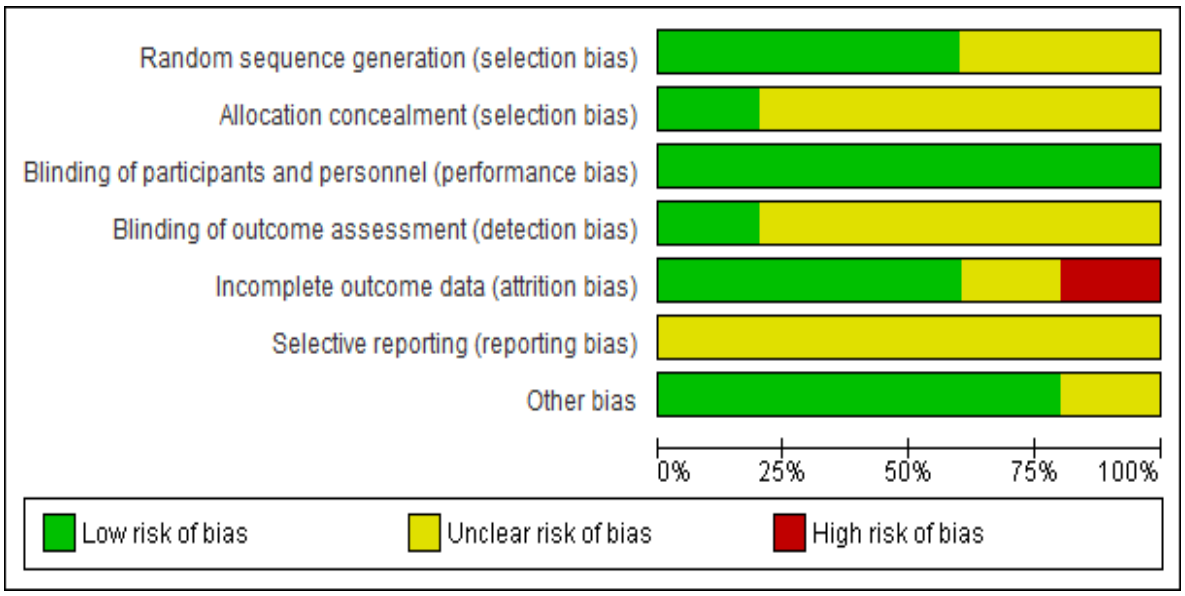

Figure 2. Risk of bias graph (original Cochrane Risk of Bias tool)

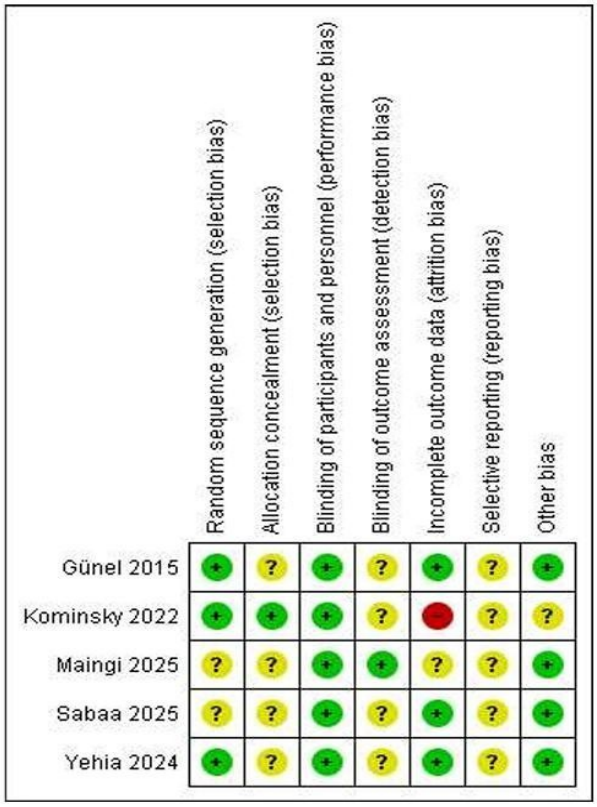

Figure 3. Risk of bias summary (original Cochrane Risk of Bias tool).

Table 1. Study Characteristic

Study	Design	Country	Sample (n)	Intervention	Comparator	Outcomes
Kominsky et al.[9], 2022	Double-blind RCT (3-arm)	USA	23	Oral prednisone (10, 30, 60 mg/day for 5 days)	Different prednisone doses	Surgical field, blood loss, operative time
Sabaa et al.[8], 2025	Double-blind RCT	Egypt	50	Oral prednisone (30 mg/day for 5 or 10 days)	Different treatment duration	Surgical field, blood loss
Yehia et al.[11], 2024	Double-blind RCT	Egypt	74	Oral prednisone (10 mg/day for 5 or 15 days)	Different treatment duration	Surgical field, blood loss, operative time
Maingi et al.[13], 2025	Randomized comparative trial	India	60	Oral prednisolone (1 mg/kg/day for 1 or 5 days)	Single-dose vs short-course	Blood loss, operative time
Günel et al.[12], 2015	Double-blind RCT	Turkey	40	Oral prednisolone (1 mg/kg/day for 7 days)	Placebo	Surgical field, Blood loss, operative time

RCT, randomized controlled trial; **ESS**, endoscopic sinus surgery; **CRSwNP**, chronic rhinosinusitis with nasal polyps.

Surgical Field Quality

Five studies involving 242 participants (122 intervention and 120 control) evaluated intraoperative surgical field quality. Surgical visualization was primarily assessed using validated grading systems such as the Boezaart surgical field score, which measures the degree of bleeding and its impact on operative visibility. The pooled analysis using a random-effects model suggested a trend toward improved surgical field quality among patients receiving preoperative corticosteroids.

The overall effect estimate demonstrated a standardized mean difference (SMD) of −1.12 (95% CI −2.35 to 0.11, p = 0.08). Although the point estimate favored corticosteroid therapy, the confidence interval crossed the null value, indicating that the improvement in surgical field quality did not reach statistical significance in the pooled analysis. Similar to the findings for intraoperative blood loss, a high level of heterogeneity was observed among the included studies (I^2 = 94%, τ^2 = 1.85, χ^2 = 69.48, p < 0.00001). This variability may reflect differences in corticosteroid regimens, operative techniques, or subjective interpretation of surgical field scoring systems across studies. Nevertheless, the overall direction of effect consistently favored corticosteroid pre-treatment in improving intraoperative visualization.

Intraoperative Blood Loss

All five included studies reported data on intraoperative blood loss and were therefore included in the quantitative synthesis. In total, 242 participants contributed data to this outcome. Pooled analysis using a random-effects model demonstrated that preoperative systemic corticosteroid therapy was associated with a significant reduction in intraoperative blood loss during endoscopic sinus surgery. The combined effect estimate showed a mean difference of −80.42 mL (95% confidence interval [CI] −158.47 to −2.37, p = 0.04), indicating that patients receiving preoperative corticosteroids experienced lower intraoperative bleeding compared with those receiving shorter or less intensive corticosteroid regimens.

Despite the statistically significant reduction in bleeding, a very high degree of heterogeneity was observed among the included studies (I^2 = 99%, τ^2= 7421.99, χ^2 = 268.99, p < 0.00001). This substantial variability suggests that the magnitude of the treatment effect differed considerably across studies. Potential sources of heterogeneity may include differences in corticosteroid dosing strategies, duration of preoperative administration, surgical techniques, and patient characteristics. Nevertheless, the overall pooled estimate consistently favored corticosteroid pretreatment in reducing intraoperative blood loss.

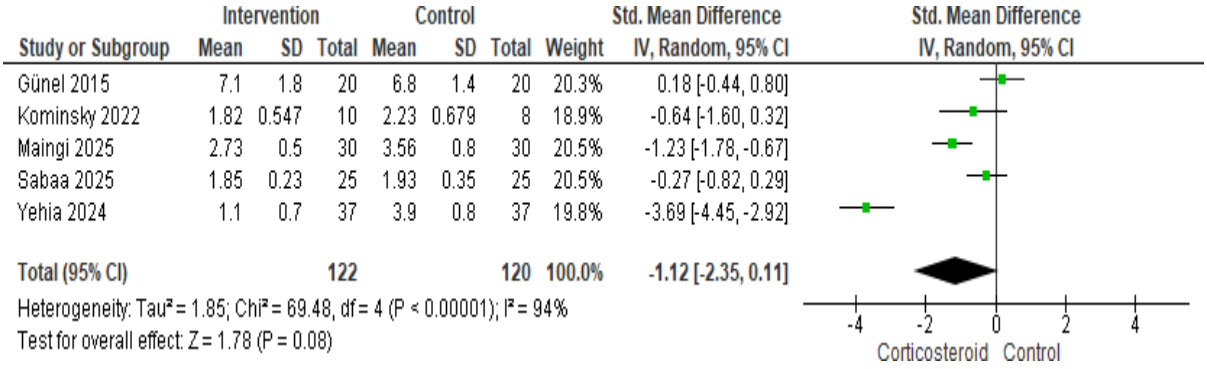

Figure 4. Forest Plot of Surgical Field Quality

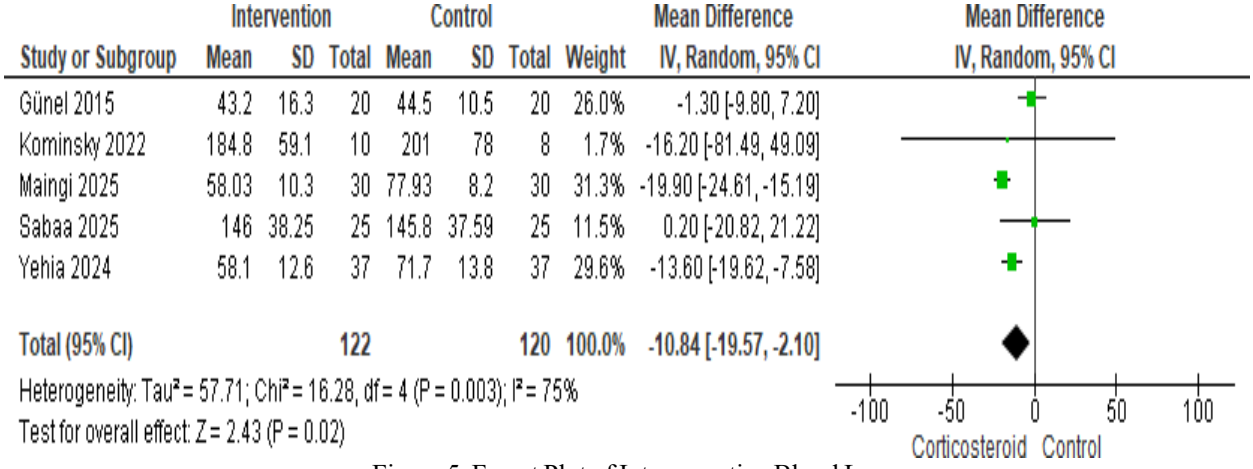

Figure 5. Forest Plot of Intraoperative Blood Los

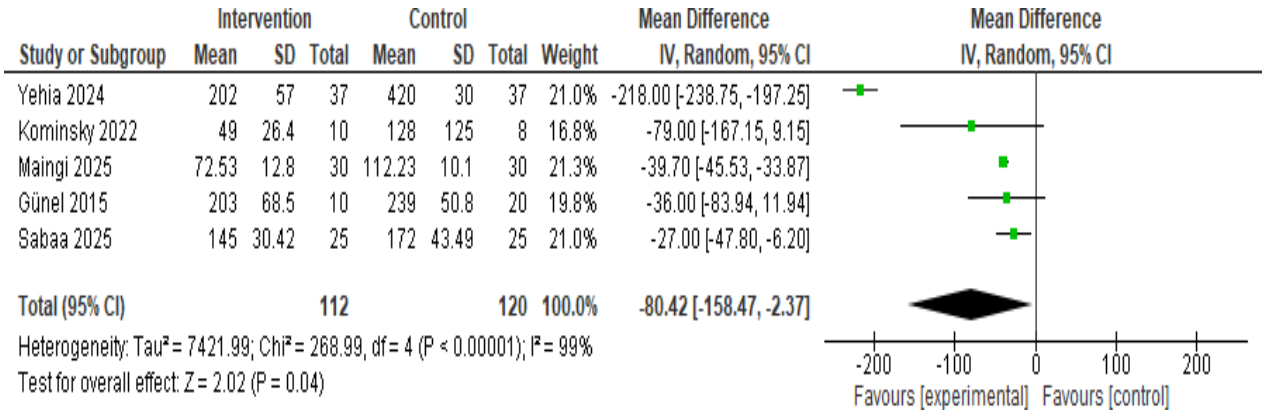

Figure 6. Forest Plot of Operative Time

Operative Time

Operative time was reported in five studies, comprising 242 participants (122 in the intervention group and 120 in the control group). Meta-analysis demonstrated that preoperative systemic corticosteroid therapy was associated with a significant reduction in operative duration compared with control regimens. The pooled effect estimate revealed a mean difference (MD) of −10.84 minutes (95% CI −19.57 to −2.10, p = 0.02), indicating that patients receiving corticosteroids underwent shorter surgical procedures on average. Moderate to substantial heterogeneity was observed among the studies included in this analysis ($I^2 = 75\%$, $\tau^2 = 57.71$, $\chi^2 = 16.28$, p = 0.003). The observed reduction in operative time may reflect improved surgical conditions associated with corticosteroid pretreatment, including reduced mucosal inflammation and decreased intraoperative bleeding, which could facilitate more efficient surgical dissection and visualization.

Heterogeneity

Substantial heterogeneity was observed across several outcomes. The highest heterogeneity was identified for intraoperative blood loss ($I^2 = 99\%$), suggesting considerable variability in effect estimates among studies. Possible sources of heterogeneity include differences in corticosteroid dosing regimens, treatment duration, surgical techniques, and perioperative management protocols. Similarly, surgical field quality demonstrated high heterogeneity ($I^2 = 94\%$), while operative time showed moderate heterogeneity ($I^2 = 75\%$).

Discussion

The present systematic review and meta-analysis synthesized evidence from five randomized controlled trials involving 242 participants to evaluate the effects of preoperative systemic corticosteroids on intraoperative outcomes during endoscopic sinus surgery for chronic rhinosinusitis with nasal polyps. The pooled analysis demonstrated that preoperative corticosteroid therapy significantly reduced intraoperative blood loss by approximately 80 mL and shortened operative time by nearly 11 minutes. Although surgical field quality showed a favorable trend toward improvement, the pooled effect did not reach statistical significance. Collectively, these findings suggest that preoperative systemic corticosteroids may improve selected intraoperative outcomes during endoscopic sinus surgery. Because most included trials compared different corticosteroid regimens rather than corticosteroid treatment versus placebo or no treatment, these findings should be interpreted as reflecting differences between corticosteroid strategies rather than definitive evidence of the overall efficacy of systemic corticosteroids.[8,9,11-13]

The potential beneficial effects of corticosteroids are biologically plausible and consistent with their well-established anti-inflammatory mechanisms. Systemic corticosteroids suppress inflammatory cytokine production, reduce eosinophilic infiltration, and decrease mucosal edema, thereby reducing vascular congestion and intraoperative bleeding. Improved visualization resulting from reduced bleeding may facilitate more precise surgical dissection, minimize the need for repeated suctioning or hemostatic maneuvers, and ultimately shorten operative time. These mechanisms may explain the observed reductions in intraoperative blood loss and operative duration reported in the present analysis.[8,9]

Despite these favorable findings, surgical field quality was not significantly improved in the pooled analysis. This result should be interpreted cautiously because substantial heterogeneity was observed among the

included studies. Differences in corticosteroid dose, treatment duration, timing of administration, anesthetic techniques, surgical expertise, and outcome assessment methods may all have contributed to variability in treatment effects. Furthermore, surgical field quality was evaluated using subjective grading systems, such as the Boezaart score, which may introduce interobserver variability and reduce comparability across studies.[8,9,11] Our findings are generally consistent with previous clinical studies reporting that preoperative systemic corticosteroids reduce intraoperative bleeding and facilitate endoscopic sinus surgery. However, previous investigations have yielded inconsistent estimates of treatment benefit, largely because of variations in corticosteroid regimens and methodological differences between studies. By quantitatively synthesizing evidence from randomized controlled trials, the present meta-analysis provides a more comprehensive summary of the available evidence regarding preoperative systemic corticosteroid regimens. However, substantial heterogeneity across studies and important variations in corticosteroid dose, duration, and timing limit the certainty of the pooled estimates. Consequently, the potential benefits of preoperative systemic corticosteroids should be interpreted cautiously, and further well-designed randomized controlled trials are required to determine the optimal corticosteroid regimen and confirm these findings.[11,13]

This study has several strengths. Only randomized controlled trials were included, providing the highest level of evidence for intervention studies. The review followed the PRISMA 2020 guideline, was prospectively registered in PROSPERO, and applied standardized methods for study selection, risk-of-bias assessment, and quantitative synthesis. However, several limitations should also be acknowledged. The relatively small number of included studies limited statistical power and precluded formal assessment of publication bias and additional exploratory analyses. In addition, substantial heterogeneity across studies, particularly for intraoperative blood loss and surgical field quality, may have influenced the precision of the pooled estimates. Future large, well-designed randomized controlled trials using standardized corticosteroid protocols and uniform outcome measures are needed to establish the optimal perioperative corticosteroid regimen for patients undergoing endoscopic sinus surgery for chronic rhinosinusitis with nasal polyps.

Conclusion

This meta-analysis suggests that differences in preoperative systemic corticosteroid regimens may be associated with improvements in selected intraoperative outcomes, particularly intraoperative blood loss and operative time, whereas the effect on surgical field quality remains uncertain. However, because most included trials compared different corticosteroid regimens rather than corticosteroid treatment versus placebo or no treatment, the overall effectiveness of systemic corticosteroids remains uncertain. Considerable heterogeneity among the included studies and variations in corticosteroid regimens further limit the certainty of the available evidence. Further large, well-designed randomized controlled trials are warranted to establish the optimal corticosteroid dose, duration, and timing of administration while confirming their effects on surgical field quality and other clinically relevant outcomes. These findings may help inform perioperative decision-making for otolaryngologists in optimizing perioperative management of patients undergoing ESS for CRSwNP.

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None.

Author Contributions

All authors act as the guarantor of the manuscript. JE is the main investigator of this study. DP, NR, MIS, IS, BWB, KI participated in the conception, data acquisition, data interpretation, and writing of the study, data analysis, and statistical analysis of the study.

Conflict of Interest

No conflict of interest.

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