TUMI Oral health

ORIGINAL RESEARCH **Open Access**

Effect of subgingival irrigation on post-scaling bacteremia in periodontal therapy: Systematic review and meta-analysis.

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Received: April 16, 2026
Revised: April 18, 2026
Accepted: April 28, 2026

Academic Editor
Yovana Gutierrez, MSc

Abstract

Periodontal procedures such as scaling and root planing may induce transient bacteremia, representing a potential systemic risk, particularly in medically compromised patients. Subgingival irrigation has been proposed as an adjunctive strategy to reduce microbial dissemination; however, its effectiveness remains uncertain. This systematic review and meta-analysis aimed to compare the efficacy of subgingival irrigation versus no irrigation in reducing bacteremia following periodontal therapy. A comprehensive electronic search was conducted in PubMed, Scopus, Cochrane Library, Embase, Web of Science, and BVS up to August 2024, following the PRISMA 2020 guidelines. The protocol was prospectively registered in PROSPERO (CRD42025636563). Randomized clinical trials were included, and the primary outcome was the presence of bacteremia, analyzed using risk ratios (RR) with 95% confidence intervals under a random-effects model. Seven studies comprising 318 participants were included. The pooled analysis showed a non-significant reduction in bacteremia risk in the subgingival irrigation group (RR = 0.65; 95% CI: 0.37–1.13; p = 0.06), with moderate heterogeneity (I^2 = 41%). Among the evaluated agents, povidone-iodine and azithromycin demonstrated greater reductions in bacteremia. The certainty of evidence was assessed using the GRADE approach and rated as high. Although statistical significance was not reached, a consistent trend suggests that subgingival irrigation, particularly with povidone-iodine, may contribute to reducing bacteremia after periodontal treatment and could be considered in patients at increased systemic risk.

Keywords: Scaling and Root Planing, Bacteremia, Povidone-Iodine, Chlorhexidine, Periodontal Therapy.

TUMI ORAL HEALTH
ISSN (Online): 3119-7701

Introduction

Periodontal diseases have been consistently associated with several systemic conditions, particularly cardiovascular disease and cerebrovascular events, through mechanisms involving chronic inflammation and bacteremia derived from the oral cavity [1–4]. The identification of periodontal pathogens in atheromatous plaques, abdominal aortic aneurysms, and occluded arteries further supports the biological plausibility that periodontal infection may contribute to vascular pathology [5–7]. In this context, transient bacteremia has become a clinically relevant issue in periodontology. Although it is often self-limited in healthy individuals [8], it may represent a significant risk in susceptible patients, especially those with conditions predisposing them to infective endocarditis or other distant infectious complications [9]. Periodontal procedures, including probing, scaling, and root planing, have been associated with bacteremia and systemic inflammatory responses [10–13]. Recent evidence has shown that bacteremia may occur after different oral procedures, with scaling and root planing remaining among the interventions of greatest clinical interest because of their routine use in periodontal care [14].

Scaling and root planing is the cornerstone of non-surgical periodontal therapy and is primarily intended to eliminate subgingival biofilm, calculus, and bacterial byproducts that sustain periodontal inflammation [15]. However, complete mechanical elimination of periodontal pathogens may not always be achieved, and residual microorganisms can persist after treatment [16,17].

Earlier investigations documented bacteremia after periodontal scaling even in patients with clinically healthy-appearing gingiva [18], whereas later microbiological studies confirmed the presence of periodontopathic microorganisms in peripheral blood after scaling and root planing and demonstrated genotypic similarity between organisms isolated from subgingival plaque and blood samples in bacteremic subjects with periodontitis [19,20]. Although bacteremia has also been widely studied after toothbrushing, dental extraction, and other invasive dental procedures [21,22], evidence specifically focused on preventive approaches for bacteremia following scaling and root planing remains limited. Among the proposed strategies, subgingival irrigation with antiseptic or antimicrobial agents has attracted interest because of its potential to reduce the microbial burden before or during periodontal instrumentation [23–27]. Clinical trials evaluating this approach have shown inconsistent findings. Some studies reported no significant reduction in bacteremia with local germicides or chlorhexidine-based irrigation protocols [28-33], whereas others observed reductions after povidone-iodine rinsing, preprocedural antiseptic irrigation, or adjunctive azithromycin administration [29–31]. These discrepancies may be related to differences in antimicrobial agents, administration protocols, periodontal conditions, and microbiological sampling methods.

From a clinical and public health perspective, reducing procedure-related bacteremia is particularly relevant in patients at elevated systemic risk. Bacteremia may be transient, intermittent, or continuous [34,35], and although blood cultures remain the reference standard for detection [36,37], their sensitivity may be influenced by previous antibiotic exposure, timing of collection, and blood volume obtained [38]. In susceptible individuals, transient bacteremia may have serious consequences, including infective endocarditis, reinforcing the importance of optimizing preventive measures in dental practice [39]. At the same time, scaling and root planing remains an essential therapeutic procedure in periodontology [40,41] and may be performed using manual or ultrasonic instrumentation, sometimes combined with adjunctive systemic antimicrobials to improve outcomes in selected patients [42–44]. Because mechanical debridement alone may allow persistence or recolonization of periodontal pathogens, subgingival irrigation has been proposed as an adjunct to improve microbial control [45,46].

Antiseptics used for this purpose offer broad antimicrobial activity and multiple intracellular targets, reducing the probability of bacterial resistance, although their clinical utility depends on efficacy, safety, and host tolerance [47]. Povidone-iodine has been described as water-soluble, broadly antimicrobial, and less likely than chlorhexidine to cause tooth staining or taste alteration [48].

Sodium hypochlorite has also demonstrated bactericidal activity and has been investigated as a subgingival irrigant in periodontal lesions [49,50]. Chlorhexidine remains the best-known adjunct because of its broad-spectrum action and prolonged antibacterial effect, and its clinical efficacy as an adjunct to scaling and root planing has been supported in systematic reviews and meta-analyses [51]. Nevertheless, it also presents relevant limitations, including tooth and prosthesis staining and potential adverse effects on host cells and periodontal healing with prolonged or concentrated use [52].

The objective of this systematic review and meta-analysis was to evaluate the efficacy of subgingival irrigation compared with no subgingival irrigation in reducing bacteremia after scaling and root planing. This study is justified by its contribution to the clinical and methodological understanding of preventive strategies aimed at minimizing systemic complications associated with periodontal therapy, with direct implications for evidence-based dental practice.

Methods

Study Design and Protocol Registration

This study was conducted as a systematic review and meta-analysis of randomized controlled trials (RCTs). The protocol was prospectively registered in the International Prospective Register of Systematic Reviews (PROSPERO; CRD42025636563). The manuscript was prepared in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement [53].

Eligibility Criteria

Randomized controlled trials evaluating the effect of subgingival irrigation on bacteremia following scaling and root planing were included. No restrictions were applied regarding publication year. Studies were included if they: (1) were randomized controlled trials; (2) evaluated subgingival irrigation as an intervention; (3) reported bacteremia outcomes assessed through blood analysis or culture methods; and (4) included a comparison group consisting of sterile water, distilled water, saline solution, or no irrigation.

Studies were excluded if they were observational designs (cohort, case-control, or cross-sectional), case reports or case series, editorials, letters to the editor, conference abstracts, or non-peer-reviewed publications. The primary outcome was the presence of bacteremia (presence versus absence).

Information Sources and Search Strategy

A comprehensive electronic search was conducted in PubMed/MEDLINE, Scopus, Web of Science, Embase, BVS, and the Cochrane Central Register of Controlled Trials from database inception until August 2024. The search strategy combined Medical Subject Headings (MeSH) terms and free-text keywords related to scaling and root planing, bacteremia, subgingival irrigation, and randomized controlled trials, using Boolean operators.

Study Selection

Two reviewers (W.P.L. and E.P.L.) independently screened titles and abstracts according to predefined eligibility criteria. Potentially relevant studies underwent full-text assessment. Discrepancies were resolved through discussion or consultation with a third reviewer (J.L.R.). The selection process was conducted using Rayyan® systematic review software to facilitate study screening and organization. Additionally, manual searches were performed in the reference lists of all included studies.

Data Extraction

Data were independently extracted by two reviewers (W.P.L. and E.P.L.) using standardized data collection forms. Information was obtained from the methods, results, discussion, and conclusions sections of the included studies. Extracted data included study characteristics (author, year, and country), participant characteristics, sample size, type of subgingival irrigant, control intervention, and bacteremia outcomes. Any disagreements during the extraction process were resolved through consultation with a third reviewer (J.L.R.).

Risk of Bias Assessment and Certainty of Evidence

The methodological quality of the included randomized controlled trials was assessed using the Cochrane Risk of Bias 2 (RoB 2) tool. The domains evaluated included random sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete outcome data, selective reporting, and other sources of bias.

Two reviewers (W.P.L. and E.P.L.) independently assessed the risk of bias, classifying each domain as low risk, some concerns, or high risk of bias. Discrepancies were resolved by consensus. The certainty of the evidence was evaluated using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach.

Statistical Analysis

Meta-analyses were performed using Review Manager (RevMan) version 5.4 (Cochrane Collaboration). A random-effects model (DerSimonian–Laird method) was applied to account for expected clinical and methodological heterogeneity among studies. For dichotomous outcomes, risk ratios (RR) with 95% confidence intervals (CI) were calculated. Statistical heterogeneity was assessed using the Chi-square (Q) test and the I^2 statistic. I^2 values were interpreted as low (0–30%), moderate (30–60%), or high (>60%). A p-value < 0.05 was considered statistically significant. Data organization and management were performed using Microsoft Excel version 2021.

Ethical Considerations

As this study synthesized data exclusively from previously published studies, ethical approval and informed consent were not required. The study adhered to the principles of the Declaration of Helsinki.

Results

Study Selection

The study selection process is presented in the PRISMA 2020 flow diagram. A total of 546 records were identified through database searching. After removal of duplicates and screening of titles and abstracts, 9 studies were assessed for full-text eligibility. Of these, 2 studies were excluded due to incomplete results and methodological limitations. Finally, 7 studies met the inclusion criteria and were included in the qualitative synthesis and meta-analysis (Figure 1).

Characteristics of Included Studies

A total of 7 randomized controlled trials involving 318 participants were included. Three studies were conducted in the United States, while the remaining studies were carried out in Australia, Japan, Switzerland, and Germany (Table 1). The interventions evaluated consisted of different subgingival irrigation protocols using antimicrobial agents such as chlorhexidine, povidone-iodine, antiseptic solutions, or systemic antibiotics, compared with control conditions including sterile water, saline solution, or no irrigation. The primary outcome assessed across studies was the incidence of bacteremia following scaling and root planing.

Rik of Bias

The overall risk of bias assessment across methodological domains is presented in Figure 2.

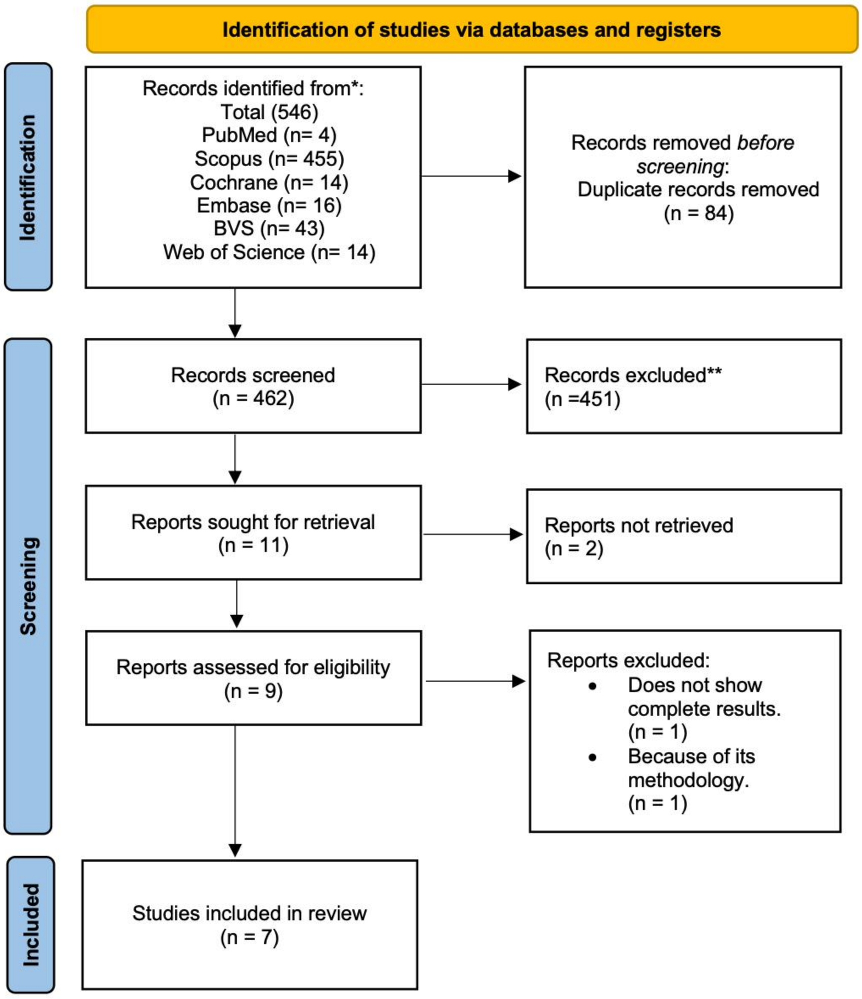

Figure 1. PRISMA 2020 flow diagram of the study selection process.

Most studies were classified as low risk of bias in the domain of random sequence generation. In contrast, allocation concealment and blinding domains showed a higher proportion of studies classified as some concerns or high risk of bias. The domain of incomplete outcome data was predominantly rated as low risk, whereas selective reporting and other bias domains showed variability across studies (Figure 2).

The risk of bias for each included study is presented in Figure 3. Variability was observed across studies in several domains, particularly in allocation concealment and blinding of participants, personnel, and outcome assessment. Some studies were classified as high risk of bias in specific domains, while others were rated as low risk or some concerns (Figure 3).

Quantitative Synthesis

Effect of subgingival irrigation on bacteremia

Seven studies were included in the quantitative synthesis. The pooled analysis using a random-effects model showed a risk ratio (RR) of 0.65 (95% CI: 0.37–1.13). The heterogeneity analysis revealed a Chi-square value of 10.13 with 6 degrees of freedom ($p = 0.12$), and an I^2 value of 41%, indicating moderate heterogeneity (Figure 4).

Certainty of Evidence

Based on the included studies, the risk of bacteremia was 463 per 1000 in the control group and 301 per 1000 in the subgingival irrigation group, with a relative risk (RR) of 0.65 (95% CI: 0.37–1.13). The certainty of the evidence was rated as high (Table 2).

Table 1. Characteristics of included randomized controlled trials

Author	Year	Country	Study Design	Sample Size (n)	Intervention	Control	Patient Characteristics	Clinical Parameters	Follow-up	Main Findings
Sahrmann et al.	2015	Switzerland	Randomized controlled trial	38	Subgingival irrigation with PVP-I 10%	Water	Adults >18 years with chronic periodontitis, sites ≥5 mm pockets	Prevalence of oral bacteremia (UFC), anaerobic and aerobic bacteria	Immediate	Significant reduction in bacteremia in PVP-I group (p=0.0133)
Morozumi et al.	2010	Japan	Randomized controlled trial	30	Subgingival irrigation with EO antiseptic + oral azithromycin	No intervention	Patients ≥20 teeth, moderate–severe periodontitis, pockets ≥5 mm	Incidence of bacteremia after SRP	Immediate	Reduction of bacteremia incidence (90% control vs 70% EO vs 20% azithromycin), significant (p<0.01)
Cherry et al.	2007	Australia	Randomized controlled trial	60	Preprocedural irrigation with PVP-I 7.5%	Saline solution	Patients with plaque-induced gingivitis	Incidence and magnitude of bacteremia	Immediate	80% reduction in bacteremia in PVP-I group vs saline (OR=0.189, p=0.03)
Løffhus et al.	1991	Germany	Randomized controlled trial	30	Subgingival irrigation with CHX 0.12%	Water irrigation / no irrigation	Periodontal maintenance patients, ≥1 site ≥4 mm with bleeding	Incidence of bacteremia after irrigation and SRP	Immediate	No significant differences between groups.
Waki et al.	1990	USA	Randomized controlled trial	60	Subgingival irrigation with CHX 0.12% + home irrigation CHX 0.04%	Water or no irrigation	Maintenance patients, ≥3 sites ≥4 mm with bleeding	I Incidence of bacteremia after SRP	3 months	No significant differences between treatment groups.
Reinhardt et al.	1982	USA	Crossover clinical trial	60	Irrigation with sterile water	No intervention	Systemically healthy patients, ≥6 teeth per mandibular quadrant	Incidence and severity of bacteremia	Immediate	No significant differences between sterile water and tap water
Witzenberger et al.	1982	USA	Crossover clinical trial	40	Irrigation with povidone-iodine 10%	No irrigation	Male patients with chronic periodontitis, ≥3 teeth per quadrant	Incidence of bacteremia after SRP	Immediate	No reduction in bacteremia incidence with irrigation

Abbreviations: CHX = chlorhexidine; PVP-I = povidone-iodine; EO = essential oils.

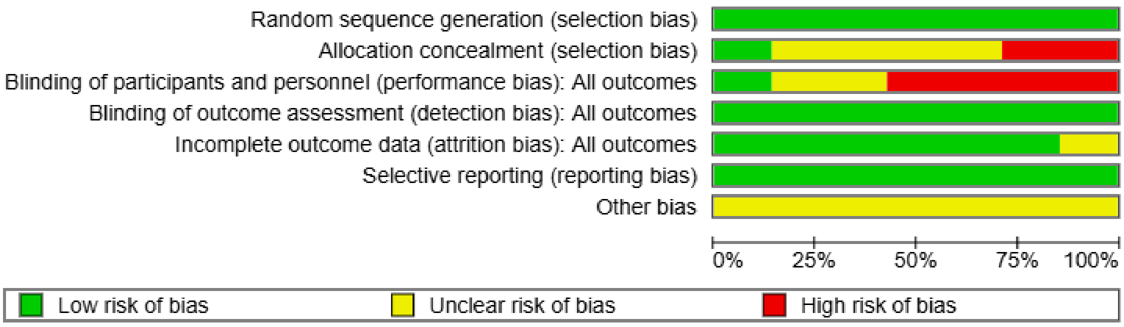

Figure 2. Overall risk of bias assessment across included studies using the Cochrane RoB 2 tool.

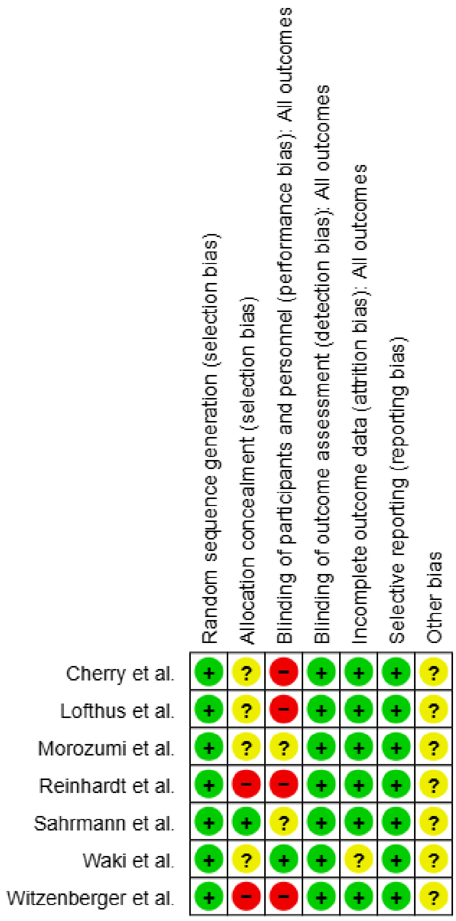

Figure 3. Risk of bias assessment for individual studies using the Cochrane RoB 2 tool.

Discussion

The present systematic review and meta-analysis evaluated the effectiveness of subgingival irrigation in reducing bacteremia following scaling and root planing. The pooled results showed a relative risk reduction (RR = 0.65; 95% CI: 0.37–1.13), indicating a 35% lower risk of bacteremia in the irrigation group compared to controls; however, this difference did not reach statistical significance ($p = 0.06$). The heterogeneity was moderate ($I^2 = 41\%$), supporting the use of a random-effects model. These findings are consistent with previous evidence indicating that bacteremia is a frequent event after periodontal procedures, particularly scaling and root planing [10–14].

Previous studies evaluating preventive strategies for procedure-induced bacteremia have reported heterogeneous results. Studies using povidone-iodine have shown favorable outcomes, such as those reported by Sahrmann et al. and Cherry et al. [29], where significant reductions in bacteremia were observed. Similarly, Morozumi et al. [30] demonstrated that both antiseptic irrigation and systemic azithromycin reduced bacteremia, with a greater effect observed for the antibiotic. These findings support the potential role of adjunctive antimicrobial strategies in reducing microbial dissemination during periodontal therapy.

In contrast, other studies using chlorhexidine-based irrigation protocols have not demonstrated significant reductions in bacteremia [32,33]. Likewise, earlier investigations reported no differences between irrigation and control conditions [28]. These discrepancies may be explained by differences in irrigant type, concentration, application timing, and methodological variability in bacteremia detection techniques, including the use of conventional blood cultures versus more sensitive diagnostic approaches [36–38]. Additionally, persistence of periodontal pathogens after mechanical therapy may contribute to the continued risk of bacteremia despite adjunctive interventions [16,17].

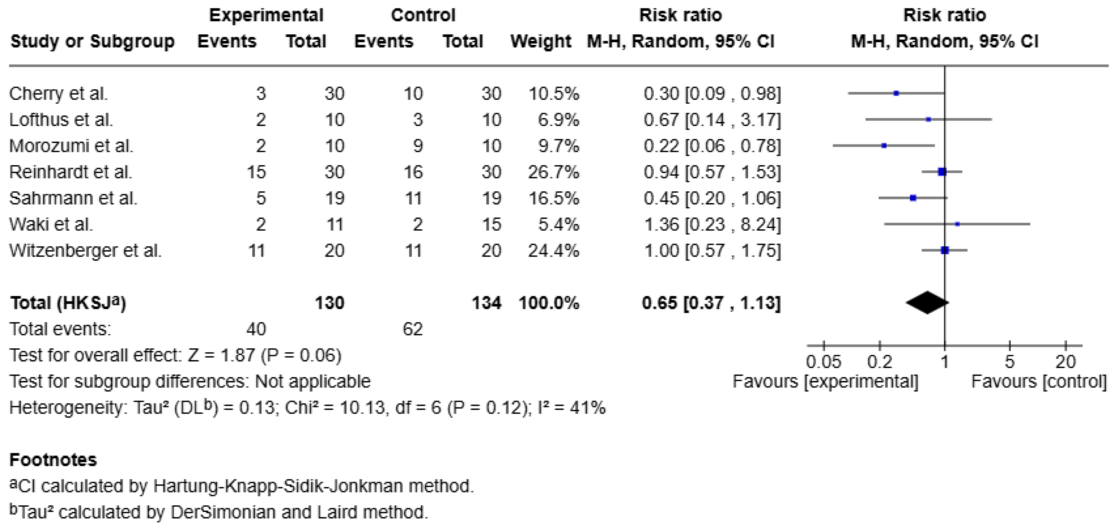

Figure 4. Meta-analysis of the effect of subgingival irrigation on bacteremia.

Outcomes	Anticipated absolute effects* (95% CI)		Relative effect (95% CI)	№ of participants (studies)	Certainty of the evidence (GRADE)	Comments
	Risk with no subgingival irrigant	Risk with subgingival irrigants				
Bacteremia	463 per 1000	**301 per 1000** (171 to 523)	**RR 0.65** (0.37 to 1.13)	264 (7 RCTs)	⊕⊕⊕⊕ High[a,b]	

Table 2. Summary of findings, certainty of the evidence GRADE.

From a clinical perspective, the prevention of bacteremia is particularly relevant in patients at increased systemic risk, such as those with infective endocarditis susceptibility or immunocompromised conditions [9,39]. Although the findings of this meta-analysis were not statistically significant, the observed trend toward reduction suggests that subgingival irrigation, particularly with agents such as povidone-iodine, may have a role as an adjunctive measure in selected patients. This aligns with current clinical approaches that emphasize individualized preventive strategies rather than routine universal interventions.

This study has several strengths, including the inclusion of only randomized controlled trials, adherence to PRISMA guidelines, prospective registration in PROSPERO, and the use of validated tools such as RoB 2 and GRADE. However, limitations should be acknowledged. The relatively small number of included studies and limited sample sizes may reduce statistical power. Additionally, variability in study protocols, including differences in irrigant type, concentration, and timing, as well as inconsistencies in bacteremia detection methods, may have influenced the results. Some studies also presented methodological concerns, particularly related to allocation concealment and blinding.

Future research should focus on well-designed randomized controlled trials with larger sample sizes and standardized irrigation protocols. The use of more sensitive diagnostic methods, such as molecular techniques, may improve bacteremia detection. Furthermore, studies evaluating long-term clinical outcomes are needed to determine the true clinical relevance of reducing transient bacteremia following periodontal procedures.

Conclusions

Subgingival irrigation showed a non-significant reduction in the risk of bacteremia following scaling and root planing, with a consistent trend favoring its use. Although the pooled effect did not reach statistical significance, certain agents such as povidone-iodine demonstrated more favorable outcomes in individual studies. These findings suggest that subgingival irrigation may be considered as an adjunctive strategy in selected patients, particularly those at increased systemic risk; however, its routine use cannot be recommended based on the current evidence.

Author Contributions Statement (CRediT)

WCP: Formal analysis, Data curation, Validation, Visualization, Conceptualization, Methodology, Supervision, Writing – Original Draft, Writing – Review & Editing.

WCP and RA: Investigation, Resources, Project administration, Writing – Review & Editing.

All authors critically reviewed the intellectual content and approved the final version of the manuscript for publication.

Acknowledgments and Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The authors declare no financial, institutional, or personal conflicts of interest that could have influenced the conduct or publication of this study.

Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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