Original Article

Evaluation of the Role of Povidone-Iodine and Hydrogen Peroxide Mouth Rinse/Gargle on Streptococcus Pyogenes Biofilm-Producing Bacteria in Children with Recurrent Tonsillitis

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ABSTRACT

Introduction: Recurrent tonsillitis is a common pediatric condition characterized by frequent episodes of pharyngeal inflammation, often associated with Streptococcus pyogenes (Group A Streptococcus) infections. The aim of this work was to evaluate the role of 0.5% Povidone-Iodine and H_2O_2 mouth rinse/gargle on streptococcus pyogenes biofilm-producing bacteria in recurrent tonsillitis in children between 4-18 years.

Methods: This interventional study was carried out on 90 patients aged from 6 to 18 years old, both sexes, with recurrent exacerbations of chronic tonsillitis. Patients were divided in to three equal groups: Group (A): Chronic tonsilitis patients scheduled for tonsillectomy, received 0.5% povidone-iodine mouth rinse/gargle. Group (B): Chronic tonsilitis patients scheduled for tonsillectomy, received H_2O_2 solution. Group (C): Chronic tonsilitis patients scheduled for tonsillectomy as control group.

Results: There were no significant differences in the distribution of Grade III and Grade IV hypertrophy among the groups. However, bacterial analysis revealed a significant difference in the prevalence of Streptococcus pyogenes, Staphylococcus aureus, and Streptococcus agalactiae, with Streptococcus pyogenes being most frequently isolated, particularly in the H_2O_2 group. Spectrophotometric assessment demonstrated a highly significant difference in biofilm mass, with the untreated control group exhibiting much higher optical density values compared to the treated groups.

Conclusion: Povidone iodine and hydrogen peroxide mouth rinses may effectively diminish biofilm formation and bacterial colonization in the management of recurrent tonsillitis, particularly against Streptococcus pyogenes, and it is recommended to integrate antiseptic mouth rinses into treatment protocols and postoperative care.

Key Words: Bacterial biofilm, mouthwash, povidone-iodine, streptococcus pyogenes, tonsillitis.

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INTRODUCTION

Streptococcus pyogenes (Group A Streptococcus) is a major bacterial pathogen responsible for a variety of infections, including recurrent tonsillitis. This bacterium is particularly significant in tonsillitis cases due to its ability to form biofilms, which protect it from both host immune responses and antibiotic treatments. The persistence of these infections contributes to the chronic nature of tonsillitis in children, leading to long-term health consequences such as airway obstruction, difficulty swallowing, and missed school days. Understanding the role of S. pyogenes in biofilm formation in recurrent tonsillitis is crucial for developing more effective treatments that target both the bacteria and their protective biofilms[1].

Chronic infections of the ear, nose, and throat are becoming more resistant to common antimicrobial therapies due to the ability of bacteria to persist through the formation of biofilms, bacteria are present in biofilms, which are encased communities of bacteria in a self-produced matrix (also called glycocalyx) and which adhere to, divide, and persist on surfaces. The general process of biofilm formation comprises adhesion of free-living or planktonic bacteria to a surface, which subsequently develop into microcolonies and form a biofilm[2].

It has been estimated that more than 65% of all human bacterial infections are associated with biofilms. Moreover, bacteria in the biofilm are 1000 times more resistant to antibiotics than their free-living counterparts, which may lead to discrepancies between the in vitro and in vivo antimicrobial susceptibility results. It has been demonstrated that several bacterial species are able to

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develop a biofilm, including the most frequent organisms responsible for otorhinolaryngologic disorders such as *Haemophilus influenzae (H. influenzae), Pseudomonas aeruginosa, Streptococcus pneumoniae and Staphylococcus aureus, strept pyogenes*[3].

The presence of biofilm may play a major role in bacterial resistance, it may have a significant contribution to the morbidity associated with adenotonsillar diseases[4].

Thus, biofilms by virtue of their ability to provide protection to the bacteria against host defenses and antimicrobial therapy may serve as a carriage. This may explain the presence of greater numbers of pathogenic bacteria on hypertrophied adenoids and tonsils than on normal ones[5].

Regardless the important of antimicrobial therapies, the Povidone iodine (PVP-I) is a broad-spectrum antimicrobial that has been used in infection control and prevention for over 60 years and is available in various preparations for use as a disinfectant for the skin, hands and mucosal surfaces, as well as for wound treatment and eye applications. Recent in vitro studies have demonstrated rapid virucidal effect, when the mucus in your mouth comes into contact with the 1.5% Hdrogen pexoide mouth gargle, it creates a foam, this foam makes the mucus less sticky and easier to drain. It can also help to loosen the mucus in your throat and change the medium for bacteria and formation of its biofilm[6].

The aim of this work was to evaluate the role of 0.5% Povidone-Iodine and H_2O_2 mouth rinse/gargle on streptococcus pyogenes biofilm-producing bacteria in recurrent tonsillitis in children between 4-18 years.

PATIENTS AND METHODS

This interventional study was carried out on 90 patients aged from 6 to 18 years old, both sexes, with inclusion criteria of (recurrent exacerbations of chronic tonsillitis defined as severe recurrent tonsillar infections, chronic tonsillar hypertrophy defined by a grade of tonsillar hypertrophy (GTH)≥ grade +3(III) according to Brodsky[7], obstructive sleep apnea with symptoms like nocturnal snoring with partial upper airway obstruction, complete cessation of airflow with gas exchange abnormalities and severe disturbance of sleep).

The study was done after approval from the Ethical Committee Benha University Hospitals (approval No: us-36-7-2023). An informed written consent was obtained from the relatives of the patients.

Exclusion criteria were adult patients, history of infection who received antimicrobial therapy within one month prior to surgery, patients undergoing tonsillectomy for emergency conditions such as peritonsillar abscess or other deep neck space infections, and suspected benign or malignant tonsillar tumor.

Patients were divided in to three equal groups:

Group (A): Chronic tonsilitis patients scheduled for tonsillectomy, received 0.5% povidone-iodine mouth rinse/gargle.

Group (B): Chronic tonsilitis patients scheduled for tonsillectomy, received H_2O_2 solution.

Group (C): Chronic tonsilitis patients scheduled for tonsillectomy as control group.

All patients were subjected to: Personal and demographic data, including age, sex, residence area, occupation, complete health history taken, clinical Examination: General condition, vital data, assessment for recurrent exacerbations of chronic tonsillitis signs and symptoms and assessment for obstructive sleep apnea symptoms.

Local examination: Inspection for throat, ears and nose, assessment for the tonsillar hypertrophy that was classified in grades as follows[7]:

• Grade I: Tonsils limited to their pillar.

• Grade II: Occupation of 25–50% of the oropharynx space.

• Grade III: Occupation of 50–75% of the oropharynx space.

• Grade IV: Tonsils that touch the uvula.

Study procedure:

For Group (1): Chronic tonsilitis patients scheduled for tonsillectomy, received 0.5% povidone-iodine mouth rinse/gargle as: gargling with 10ml of pvp-i 1% mouthwash solution (undiluted) (9ml of the 0.5% solution) for 1–2 min. The solution was heled for at least 30 s and then gently gargled or held at the back of the throat for another 30s (at least), then spit out. 2ml of the solution was retained and absorbed, giving an anticipated maximum total dose of 1.1mg of iodine daily for one week.

Group (2): Chronic tonsilitis patients scheduled for tonsillectomy, received H_2O_2 solution at concentration of 1.5% diluted with sterile water and was used as mouth rinse/gargle for 15 seconds to 30 seconds contact time, then spit out daily for one week.

Group (3): Chronic tonsiltis patients scheduled for tonsillectomy as control group without use of any rinse or gargle.

Intervention and specimen collection:

Bilateral tonsillar biopsies was performed during tonsillectomy under general anaesthesia for streptococcal

pyogens Biofilm producing bactreria searches and identification of Povidin Iodine 0.5 & 1.5% H_2O_2 0n its formation. In the case of acute infection, tonsillectomy was postponed until its complete clinical resolution (at least 14 days after remission).

Bacterial growth and identification:

All the biopsy samples were inoculated into Stuart transport medium tubes (Venturi Transystem, Brescia, Italy) and processed within two hours by the Clinical Microbiology Laboratory. They were diluted in 1.6 or 0.5 mL of sterile normal saline, and 100mL of these solutions was plated on mannitol salt agar (MSA), chocolate agar (CA), MacConkey agar (MC), and tryptic soy agar (TSA) with the addition of 5% sheep blood. The TSA and CA-plates were incubated at 37°C in a 10% CO^2-enriched atmosphere for 18h; the MSA and MC plates were incubated at 37°C for 18h.

Biofilm Evaluation:

The biofilms of Streptococcus pyogenes were evaluated using spectrophotometric methods in which A microtiter plate assay was used to observe bacterial adherence to a surface as the following: Biofilms were formed according to a customization of a static biofilm culture model[8]. In short, portions of frozen stock cultures were first plated on sheep blood agar (SBA) and incubated overnight. A single colony from this first subculture was streaked on a fresh SBA plate and incubated for 18±1.5h. Colonies from second cultures were suspended in Tryptic Soy Broth containing 1% glucose (TSBG). The suspension was adjusted to a turbidity equivalent to a bacterial cell density of approximately 108 colony forming units per ml (CFU/ml). Wells of flat bottomed, 96 well, microtiter plates (Nunc A/S, Roskilde, Denmark, catalog no. 167008) were inoculated with 200µl of a 10−1 dilution of this suspension. Inoculated microtiter plates were covered by a lid and placed at 4°C for 4h (±20 min) in order to let the bacteria sediment without significant multiplication. The plates were then incubated at 37°C in ambient air for 18h (±25min).

Quantifying biofilm formation through using of Crystal violet staining:

It works because both Gram-positive and Gram-negative bacterial cells can absorb crystal violet. The dye was then released from the cell during decolorization, allowing for quantification via spectroscopy.

It was performed as the following:

• After biofilm growth in a microtiter plate, the plate was rinsed with distilled water.

• 125µL of 0.1% crystal violet was added into each well.

• After about 10 minutes, the plate was rinsed again with distilled water.

• 200µL of 30% acetic acid was added to each well 1.

• The absorbance was then measured using a plate reader. For example, 100µL of the solution can be transferred to a flat bottom 96 well plate, and the absorbance can be measured at OD. Then the biofilms of Streptococcus pyogenes were confirmed by Polymerase chain reaction (PCR) techniques as the following:

PCR:

To perform PCR, total RNA was extracted, and 0.5µg of total RNA was used to synthesize first-strand cDNA in a 20µL reaction mixture containing 200U M-MLV reverse transcriptase, 0.25 mM DTT, and 250 µM each of dATP, dCTP, dGTP, and dTTP. The reverse transcription PCR conditions were as follows: initial incubation at room temperature (~25°C) for 10min, followed by 12 cycles at 25°C for 30s, 45°C for 4 min, and a gene-specific annealing step for 30 s, and a final step of 5 min heating at 95°C and storage at 4°C. The cDNA was then amplified using AccuPower GreenStar PCR PreMix (Bioneer, Daejeon, Republic of Korea) in a MyGenie 96/384 thermal cycler. Gene expression analysis was performed targeting clfA, icaA, icaB, icaD, icaR, and the 16S rRNA gene, with the 16S rRNA gene used as the housekeeping gene for normalization and assessment (Bioneer, Daejeon, Republic of Korea)[9,10,11]. All reactions were performed in triplicate.

Sample Size:

The sample size was calculated using G* power software version 3.1.9.2, with test family (X^2-tests), statistical test (Goodness-of-fit tests: Contingency tables), type of power analysis (A priori: Compute required sample size - given αββ, power and effect size), input parameters, effect size w= 0.47, α error= 0.05, power(1-β)= 0.95, resulting output parameter was total sample size of 90 (30 patients in each group).

Statistical analysis:

Statistical analysis was done by SPSS *v*16. Quantitative variables were presented as mean and standard deviation (SD). Qualitative variables were presented as frequency and percentage(%). Shapiro-Wilk test was applied to assess the normality of data distribution. Student's *T*-Test: Used to evaluate the statistical significance of the difference between means of two groups for normally distributed numerical data. Mann-Whitney *U* Test: Applied to assess differences in non-parametric variables between two groups. Chi-Square Test: Employed to examine relationships between two categorical variables. A two tailed *P value* <0.05 was considered significant.

RESULTS

Among the study groups, there was no statistically significant Among the study groups, there was no statistically significant difference observed (p= 0.464 for age and p= 0.561 for gender). Regarding age, the

mean±SD values were 11.83±2.85 for the Povidone Iodine group, 10.97±3.12 for the H_2O_2 group, and 10.93±3.27 for the Case Control group, showing similar distributions. The gender distribution revealed 53.3% females and 46.7% males in the Povidone Iodine group, 40.0% females and 60.0% males in the H_2O_2 group, and 50.0% females and 50.0% males in the Case Control group, with percentages showing no significant differences between groups (Table1).

The clinical examination data of the patients across the groups was represented at (Table 2).

Table 1: Patient Demographics in study groups:

Parameter	Category	Povidone Iodine (*n*= 30)	H_2O_2 (*n*= 30)	Case Control (*n*= 30)	*p-value*	Significance
Age (years)	Mean±SD	11.83±2.85	10.97±3.12	10.93±3.27	0.464	NS
	Median (Min-Max)	12.50 (6.00-16.00)	12.00 (6.00-16.00)	10.50(6.00-16.00)		
Gender	Female	16(53.3%)	12(40.0%)	15(50.0%)	0.561	NS
	Male	14(46.7%)	18(60.0%)	15(50.0%)		

Table 2: Clinical Examination in study groups:

Parameter	Category	Povidone Iodine (*n*= 30)	H_2O_2 (*n*= 30)	Case Control (*n*= 30)	*p-value*	Significance
Nasal Obstruction	Present	18(60.0%)	16 (53.3%)	20(66.7%)	0.574	NS
	Absent	12(40.0%)	14 (46.7%)	10(33.3%)		
Secretion Characteristics	Mucopurulent	18(60.0%)	15 (50.0%)	19(63.3%)	0.553	NS
	Serous	12(40.0%)	15 (50.0%)	11(36.7%)		
Number of Colds/Year	Mean±SD	8.87±1.04	8.47±1.14	8.67±1.18	0.396	NS
	Median (Min-Max)	9.00(7.00-10.00)	8.50(7.00-10.00)	9.00(7.00-10.00)		
Apnea Presence	18 (60.0%)	17(56.7%)	14(46.7%)	18(60.0%)	0.559	NS
	12 (40.0%)	13(43.3%)	16(53.3%)	12(40.0%)		
Cervical lymphadenopathy	Present	18(60.0%)	21(70.0%)	15(50.0%)	0.287	NS
	Absent	12(40.0%)	9(30.0%)	15(50.0%)		

Regarding to tonsillar hypertrophy grades, there was no statistically significant difference observed (*p*= 0.325). Grade III hypertrophy was observed in 50.0% of the Povidone Iodine group, 66.7% of the H_2O_2 group, and 50.0% of the Case Control group, while Grade IV hypertrophy was seen in 50.0%, 33.3%, and 50.0% of these groups, respectively (Table 3).

According to the data on isolated organisms, there was a significant difference in the distribution among the groups. In terms of Streptococcus pyogenes, it was isolated in 80.0% of the Povidone Iodine group, 100.0% of the H_2O_2 group, and 90.0% of the Case Control group, with a significant difference found between the Povidone Iodine and H_2O_2 groups (*p*2= 0.010). Regarding Staphylococcus aureus, it was detected in 10.0% of both the Povidone Iodine and Case Control groups, and absent in the H_2O_2 group, but no significant differences were observed across the comparisons. For Streptococcus agalactiae, it was only found in 10.0% of the Povidone Iodine group and absent in the other groups; (*p*= 0.105), (Table 4).

Table 3: Tonsillar Hypertrophy Grades in study groups:

Parameter	Category	Povidone Iodine (*n*= 30)	H_2O_2 (*n*= 30)	Case Control (*n*= 30)	*p-value*	Significance
Tonsillar hypertrophy grades	Grade III	15(50.0%)	20(66.7%)	15(50.0%)	0.325	NS
	Grade IV	15(50.0%)	10(33.3%)	15(50.0%)		

Table 4: Isolated Organism in study groups:

Parameter	Category	Povidone Iodine (*n*= 30)	H_2O_2 (*n*= 30)	Case Control (*n*= 30)	*p-value*	Significance
Isolated organism	Strept pyogenes	24(80.0%)	30(100.0%)	27(90.0%)	**0.037**	*p*2: 0.010, *p*3: 0.278, *p*4: 0.076
	Staph aureus	3(10.0%)	0 (0.0%)	3(10.0%)	0.200	-
	Strept agalactia	3(10.0%)	0 (0.0%)	0(0.0%)	0.105	-

*p*2: Povidone Iodine vs H_2O_2; *p*3: Povidone Iodine vs case control; *p*4: H_2O_2 vs case control.

Regarding optical density (OD) values measured across the study groups there was a highly significant difference observed (p<0.001). The mean±SD OD values were 0.65±0.05 for the Povidone Iodine group, 0.66±0.05 for the H_2O_2 group, and 1.06±0.08 for the Case Control group, indicating a much higher biofilm mass in the untreated Case Control group. The median OD values showed a similar trend, with 0.65 (0.55–0.79) in the Povidone Iodine group, 0.67 (0.54–0.76) in the H_2O_2 group, and 1.02 (1.001.29) in the Case Control group (Table 5).

According to positive and negative biofilm formation by Streptococcus pyogenes across the study groups there was a highly significant difference observed (p<0.001). Positive biofilm formation was detected in 20.0% of the Povidone Iodine group, 30.0% of the H_2O_2 group, and 90.0% of the Case Control group. Conversely, negative biofilm formation was noted in 80.0%, 70.0%, and 10.0% of the respective groups (Table 6).

Table 5. Spectrophotometric Assessment in study groups:

Parameter	Category	Povidone Iodine (n=30)	H_2O_2 (n=30)	Case Control (n=30)	*p-value*	Significance
Spectrophotometric Assessment (OD Value)	Mean±SD	0.65±0.05	0.66±0.05	1.06±0.08	**<0.001*** **	**HS**
	Median (Min-Max)	0.65(0.55-0.79)	0.67(0.54-0.76)	1.02(1.00-1.29)		

OD Value: Optical density value.

Table 6: Biofilm Formation in study groups (detected by crystal violet and confirmed by PCR):

Parameter	Category	Povidone Iodine (n=30)	H_2O_2 (n=30)	Case Control (n=30)	*p-value*	Significance
Biofilm formation by strept	Positive	6(20.0%)	9(30.0%)	27(90.0%)	**<0.001*** **	**HS**
	Negative	24(80.0%)	21(70.0%)	3(10.0%)		

DISCUSSION

Recently, antiseptic mouth rinses and gargles had gained attention for their potential role in reducing bacterial colonization in oropharyngeal region, with less effect on symptom relief[12]. Management of sore throat should be multifaceted, incorporating symptomatic relief, infection control, and immune support rather than relying solely on antimicrobial interventions[13].

Although Povidone Iodine and H_2O_2 have demonstrated significant antimicrobial effects, their inability to significantly alter these clinical symptoms suggests that factors beyond bacterial load, such as immune response, environmental triggers, and individual susceptibility, play a crucial role in the persistence and severity of pharyngotonsillitis symptoms[14].

The study results show no statistically significant differences regarding tonsillar hypertrophy graded throughout studied groups, and this is consistent with Andaloro *et al.*,[15] findings that showed bacteriotherapy did not significantly reduce tonsillar size in children with recurrent infections[15]. However, our study contrasts with Motter and Abbas[16], who indicated that certain antiseptic agents may reduce tonsillar inflammation over extended periods. The study can owe this to other factors such as immunological response, environmental triggers, and individual susceptibility, which may also affect tonsillar size in those children with recurrent infections.

The lack of significant differences in tonsillar hypertrophy grades in the current study (p= 0.325) suggested that bacterial reduction alone does not necessarily impact the physical enlargement of tonsils, which may be driven by immune response rather than direct bacterial colonization.

This aligns with SHAH,[17], who explained that chronic tonsillar hypertrophy often results from prolonged immune stimulation, not just bacterial infection and noted that biofilm formation plays a key role in recurrent tonsillitis by shielding bacteria from the host immune system and antibiotics.

The study finding support that Povidone Iodine and H_2O_2 significantly reduced biofilm formation but did not significantly alter clinical symptoms align with Tahirova and Shernazarov[18], as their research emphasized that sore throat can result from bacterial, viral, and environmental factors, meaning that while reducing bacterial colonization is crucial, it does not immediately translate into symptomatic relief. This helps explain why, in our study, there were no significant differences in nasal obstruction, secretion characteristics, apnea presence, or cervical adenopathy across groups despite clear reductions in bacterial biofilm formation.

The results of the current study a statistically significant differences in bacterial prevalence across groups, particularly the reduction in Staphylococcus aureus in the H_2O_2 group and the exclusive presence of Streptococcus agalactiae in the Povidone Iodine group also H_2O_2 achieved complete eradication of Staphylococcus aureus, support

findings by Abdelgader *et al*.[19]. Their study demonstrated emerging antibiotic resistance, reinforcing the need for non-antibiotic interventions such as Povidone Iodine and H_2O_2 rinses, also highlighted the importance of targeted bacterial suppression.

Additionally, Motter and Abbas,[16] warned that persistent bacterial colonization post-tonsillectomy could prolong recovery time and increase the risk of secondary infections. Given our study's findings that untreated control patients exhibited significantly higher biofilm formation (90%) compared to the Povidone Iodine (20%) and H_2O_2 (30%) groups, incorporating antiseptic mouth rinses into post-tonsillectomy care protocols could be beneficial in reducing secondary infections and complications like hemorrhagic tonsillitis.

A significant difference was observed in bacterial prevalence, with Streptococcus pyogenes being most frequently isolated (100% in the H_2O_2 group), while Staphylococcus aureus was absent in the H_2O_2-treated patients. The ability of H_2O_2 to eliminate Staphylococcus aureus aligns with Vaillancourt *et al*.[20], who found that H_2O_2-producing streptococci exert an antagonistic effect against Actinobacillus pleuropneumoniae, a pathogen that shares some resistance mechanisms with Staphylococcus aureus.

However, the presence of Streptococcus agalactiae exclusively in the Povidone Iodine group raises concerns about selective bacterial suppression, which could lead to opportunistic colonization. This was supported by Urakawa *et al*.[21], who demonstrated that saliva and organic matter could influence the antimicrobial efficacy of Povidone Iodine, allowing certain microbes to persist despite its broad-spectrum activity.

The significantly lower biofilm mass in both treatment groups compared to the control ($p<0.001$) supports the hypothesis that antiseptic rinses effectively disrupt biofilm formation. These findings strongly align with Eggers[22], who highlighted the role of Povidone Iodine in biofilm prevention, particularly against Streptococcus pyogenes and Staphylococcus aureus. However, Murugesan and Venkat[23], warned that prolonged use of Povidone Iodine could potentially affect thyroid function, particularly in individuals with pre-existing thyroid disorders or those prone to iodine sensitivity.

The significant reduction in biofilm-positive cases among treated groups (20% in Povidone Iodine, 30% in H_2O_2, vs. 90% in the control) suggests that both agents effectively limit bacterial persistence. These findings are consistent with Monstrey *et al.*[24] who reported that Povidone Iodine reduces bacterial adhesion to surgical sites, lowering the risk of postoperative infections.

However, Suyono & Wihanto[25] found that alcohol-based antiseptics were more effective than both Povidone Iodine and H_2O_2 in combating Streptococcus pyogenes, raising important questions about whether alternative antiseptics might offer superior antimicrobial efficacy. Additionally, Williamson *et al*.[26] suggested that infection-related post-tonsillectomy hemorrhage might be less associated with bacterial biofilms and more influenced by surgical factors, emphasizing the multifactorial nature of recurrent tonsillitis management.

While our study supports Povidone Iodine and H_2O_2 as effective antiseptics, the concern regarding bacterial adaptation cannot be ignored. Menschner *et al.*[27] showed that group A Streptococcus survives better under desiccated conditions, implying that while antiseptic rinses may temporarily reduce bacterial loads, residual bacteria could re-establish colonization once treatment ceases. Additionally, Rahman and MP[28] suggested that Povidone Iodine exhibits antiviral properties, potentially offering a broader prophylactic role beyond bacterial infections. However, Baty *et al*.[29] raised concerns that oral commensal streptococci play a crucial protective role against pathogenic colonization, meaning as a gatekeepers of the oral cavity that aggressive antiseptic use could disrupt the natural microbiome, potentially leading to secondary infections or microbial imbalances.

The findings of this study align with previous research[26,29] supporting the antimicrobial efficacy of Povidone Iodine and H_2O_2 in managing recurrent tonsillitis. Both agents significantly reduced biofilm formation and bacterial colonization, particularly for Streptococcus pyogenes suggesting their uses in post-operative care protocol.

LIMITATIONS:

The high cost of PCR kits posed a challenge, limiting the ability to conduct more extensive testing. The sample size was relatively small. Additionally, the availability of tests was another limitation.

CONCLUSION

Povidone Iodine and H_2O_2 mouth rinses have potential benefits in reducing biofilm formation and bacterial colonization during management of recurrent tonsillitis, particularly Streptococcus pyogenes and suggested that incorporating antiseptic mouth rinses into the treatment protocols and on post-operative care. Further studies in large scale needed.

CONFLICT OF INTERESTS

There are no conflict of interests.

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