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A Comparative Study Between Efficacy Of Povidone Iodine Versus Isopropyl Alcohol In Pre-Operative Skin Preparation In Preventing Ssi In Elective Open Procedures

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Abstract

Surgical site infections (SSIs) are a significant concern in elective surgical procedures, contributing to increased morbidity and healthcare costs. Preoperative skin antisepsis plays a crucial role in reducing the risk of SSIs. This prospective, comparative study investigates the efficacy of two commonly used antiseptics, Povidone-Iodine and Isopropyl Alcohol, in preventing SSIs in patients undergoing elective open procedures. A total of 230 patients were randomly assigned into two groups: Group A (115 patients) underwent skin preparation with Povidone-Iodine, while Group B (115 patients) received Isopropyl Alcohol. The primary outcome was the incidence of SSIs, with secondary outcomes including postoperative wound healing, hospital stay duration, and patient satisfaction. Results showed no statistically significant difference in the incidence of SSIs between the two groups (p=0.95). However, Isopropyl Alcohol demonstrated a slightly quicker wound healing time, while Povidone-Iodine showed better sustained microbial reduction. Both agents were well tolerated, with no severe adverse reactions reported. This study concludes that both Povidone-Iodine and Isopropyl Alcohol are effective in preventing SSIs, with each agent having distinct advantages. Clinicians may choose between these agents based on patient-specific factors and procedural requirements. Further studies with larger sample sizes and different surgical settings are recommended to establish definitive guidelines for antiseptic selection.

Introduction

Surgical site infections (SSIs) represent one of the most significant challenges in modern surgical practice, causing increased morbidity, prolonged hospital stays, and a considerable financial burden

on healthcare systems [1]. Despite the advancements in surgical techniques and infection control measures, SSIs continue to be a prevalent issue, accounting for up to 20% of all healthcare-associated infections (HAIs). According to the Centers for Disease Control and Prevention (CDC), SSIs are the most common type of HAI in surgical patients, with an estimated incidence of 2-5% in developed countries. In low- and middle-income nations, the incidence is even higher, with some studies reporting SSI rates of up to 11.8%. The prevention of SSIs remains a critical priority in healthcare due to their severe implications for patient safety and healthcare costs [2]. SSIs are defined as infections occurring at or near the surgical incision site within 30 days of a surgical procedure, or within one year if an implant is placed [3]. The most common pathogens causing SSIs are endogenous microorganisms, predominantly bacteria from the patient's skin flora, such as Staphylococcus aureus, including methicillin-resistant S. aureus (MRSA). As the pathogens responsible for these infections often reside on the patient's skin, preoperative skin antisepsis is essential in minimizing the microbial load and preventing the introduction of these organisms into the surgical wound [4].

The selection of an appropriate antiseptic agent for preoperative skin preparation is a key factor in SSI prevention. The ideal antiseptic should be broad-spectrum, effective against a wide range of microorganisms, fast-acting, and long-lasting, with minimal toxicity and irritation. Povidone-Iodine (PVP-I) and Isopropyl Alcohol (IPA) are two of the most commonly used antiseptic agents for this purpose, but their efficacy varies depending on the surgical setting, type of procedure, and patient characteristics [5].

Povidone-Iodine is a well-established broad-spectrum antiseptic that has been used in surgical practice for several decades. It is effective against a wide range of pathogens, including bacteria, viruses, fungi, and protozoa. PVP-I is a complex of iodine and a water-soluble polymer, polyvinylpyrrolidone, which slowly releases free iodine upon application. Free iodine penetrates the cell walls of microorganisms, disrupting their metabolic pathways and leading to cell death. The sustained release of iodine provides prolonged antimicrobial activity, making PVP-I particularly useful for longer surgical procedures [6]. One of the main advantages of Povidone-Iodine is its broad antimicrobial spectrum. Studies have demonstrated that it is effective against both Gram-positive and Gram-negative bacteria, as well as viruses, fungi, and spores. This broad-spectrum activity is particularly important in preventing SSIs, as surgical wounds can be exposed to various types of pathogens during procedures. Additionally, Povidone-Iodine has a relatively low risk of inducing bacterial resistance, which is a significant concern with other antiseptics and antibiotics [7, 8]. However, there are some limitations to the use of Povidone-Iodine. Its antimicrobial activity can be reduced in the presence of organic matter, such as blood or pus, which may limit its effectiveness in contaminated or dirty surgeries. PVP-I can also cause skin irritation or allergic reactions in some patients, although these side effects are relatively rare. Additionally, its dark brown color can obscure the surgical site, making it more difficult for surgeons to visualize the area during the procedure. Despite these drawbacks, Povidone-Iodine remains a widely used and trusted antiseptic agent in surgical practice [9].

Isopropyl Alcohol, in contrast, is a fast-acting antiseptic known for its ability to rapidly reduce bacterial counts on the skin. IPA acts by denaturing proteins and dissolving lipids in the microbial cell membrane, causing cell lysis and death. It is effective against a wide range of microorganisms, including bacteria, viruses, and fungi, and is particularly noted for its rapid onset of action. IPA is

commonly used in concentrations of 70%, which balances efficacy and safety, as higher concentrations may cause excessive skin irritation or dryness [10, 11]. One of the key advantages of Isopropyl Alcohol is its rapid bactericidal effect, which makes it suitable for procedures where immediate antisepsis is required. Unlike Povidone-Iodine, IPA evaporates quickly, leaving the skin dry and reducing the risk of pooling under surgical drapes, which can contribute to contamination. Its colorless nature also allows for better visualization of the surgical field compared to the dark hue of PVP-I [12]. However, Isopropyl Alcohol has some limitations as well. Its antimicrobial activity is relatively short-lived compared to Povidone-Iodine, as it lacks the residual effect needed for longer procedures. IPA is also less effective against certain types of microorganisms, such as spores, which can limit its utility in some surgical settings. Furthermore, while Isopropyl Alcohol is generally well-tolerated, it can cause dryness, irritation, or stinging, particularly in patients with sensitive skin. It is often combined with other antiseptics, such as chlorhexidine, to enhance its antimicrobial spectrum and prolong its effectiveness [13].

Several studies have sought to compare the efficacy of Povidone-Iodine and Isopropyl Alcohol in preventing SSIs, but the results have been mixed. Some studies suggest that Isopropyl Alcohol, especially when used in combination with other antiseptics, may provide superior protection against SSIs due to its rapid bactericidal action. In particular, alcohol-based preparations such as a combination of chlorhexidine and Isopropyl Alcohol have been shown to reduce the risk of SSIs more effectively than Povidone-Iodine in certain procedures, such as orthopedic and vascular surgeries [14]. On the other hand, Povidone-Iodine's sustained antimicrobial effect is considered advantageous for longer surgeries, where prolonged protection is necessary to prevent microbial recolonization. A systematic review and meta-analysis of randomized controlled trials comparing Povidone-Iodine with other antiseptics, including Isopropyl Alcohol, found no significant difference in overall SSI rates between the two agents, though individual studies reported varying outcomes depending on the surgical setting and patient population [15].

The global burden of SSIs is substantial, particularly in resource-limited settings where infection control measures may be less stringent. The World Health Organization (WHO) estimates that SSIs are the most common type of healthcare-associated infection in low- and middle-income countries, with a prevalence ranging from 11% to 20% depending on the region. In high-income countries, the prevalence is lower but still significant, with SSIs occurring in 2-5% of all surgical procedures [16,17]. The economic impact of SSIs is also considerable. In the United States alone, SSIs are responsible for an estimated $3.5 billion to $10 billion in additional healthcare costs annually. These costs include not only direct medical expenses, such as extended hospital stays and additional treatments, but also indirect costs related to lost productivity and long-term disability. Furthermore, patients who develop SSIs are at a higher risk of experiencing long-term complications, including chronic infections, delayed wound healing, and in some cases, death [18].

Given the significant burden of SSIs and the importance of effective preoperative skin antisepsis, this study aims to compare the efficacy of Povidone-Iodine and Isopropyl Alcohol in preventing SSIs in patients undergoing elective open surgeries. By examining postoperative outcomes, including SSI rates, wound healing times, and hospital stay durations, this study seeks to provide evidence-based recommendations for the selection of antiseptic agents in surgical practice. The findings will

contribute to the ongoing debate regarding the optimal antiseptic for preoperative skin preparation and may help guide clinical decision-making to improve patient outcomes and reduce the incidence of SSIs.

Methods

Study Design

This study was designed as a prospective, randomized, comparative trial to assess the efficacy of Povidone-Iodine versus Isopropyl Alcohol in preventing surgical site infections (SSIs) during elective open surgeries. The study was conducted over a 12-month period, from January 2023 to January 2024, at Sree Balaji Medical College, Chennai. Patients were randomly assigned to one of two groups, with each group receiving a different preoperative antiseptic for skin preparation.

Study Population

The study included adult patients who were scheduled for elective open surgical procedures at Sree Balaji Medical College. A total of 230 patients were recruited, with 115 patients in each of the two groups: Group A received Povidone-Iodine for preoperative skin preparation, while Group B received Isopropyl Alcohol. The randomization of patients into the two groups was performed using systematic random sampling.

Inclusion Criteria

Patients were considered eligible for inclusion if they were 18 years or older and scheduled for elective open surgical procedures such as hernia repair, appendectomy, or laparotomy. Informed consent was required from all participants. Additionally, patients with no known contraindications to the use of Povidone-Iodine or Isopropyl Alcohol were included in the study. The selection aimed to create a comparable patient group where the effectiveness of the two antiseptic agents could be properly evaluated. By focusing on elective procedures and ensuring no preexisting conditions contraindicated antiseptic use, the study was able to control confounding variables and ensure patient safety.

Exclusion Criteria

Patients were excluded from the study if they were undergoing emergency surgical procedures or presented with contaminated or dirty wounds. Individuals with known allergies or hypersensitivity to Isopropyl Alcohol or Povidone-Iodine were also excluded. Immunocompromised patients, such as those with HIV, those undergoing chemotherapy, or those on long-term corticosteroid therapy, were not included due to their higher risk for infections. Additionally, patients with localized dermatological conditions, such as severe eczema or psoriasis, that could interfere with antiseptic application were excluded. Finally, patients scheduled for surgeries requiring implants or prosthetic devices were not included in the study.

Intervention and Skin Preparation Protocol

Group A patients received skin preparation with 10% Povidone-Iodine solution applied to the surgical site following standard preoperative antiseptic protocols. Group B patients received a 70% Isopropyl

Alcohol solution for skin preparation. Both groups adhered to the same preoperative care routine, with antiseptic application being performed by trained surgical staff.

The skin preparation involved cleansing the surgical area for a minimum of two minutes, ensuring complete coverage of the skin surrounding the incision site. After the application of the antiseptic solution, sterile drapes were placed over the surgical area, and the procedure was carried out under aseptic conditions.

Data Collection

Data collection was performed using a standardized pre-defined data collection form, which included patient demographics, medical history, body mass index (BMI), type of surgery, and clinical characteristics. Postoperative outcomes were monitored for up to 30 days after surgery, with specific focus on the incidence of SSIs. Secondary outcomes included wound healing time, the length of hospital stay, and patient-reported satisfaction with postoperative care.

Primary Outcome

The primary outcome of the study was the incidence of SSIs within 30 days post-surgery, defined according to the Centers for Disease Control and Prevention (CDC) criteria. SSIs were classified as superficial incisional, deep incisional, or organ/space infections.

Secondary Outcomes

The secondary outcomes of the study focused on three key areas: wound healing time, hospital stay duration, and patient satisfaction. Wound healing time was measured by the time taken for the surgical wound to fully epithelialize. The length of hospital stay was recorded in days, starting from the day of surgery to the date of discharge. Finally, patient satisfaction was assessed using a standardized survey, evaluating their perception of wound healing and overall postoperative care. These secondary outcomes provided a broader understanding of how each antiseptic impacted patient recovery beyond just infection prevention.

Sample Size Calculation

The sample size was determined based on the anticipated incidence of SSIs in the population. Assuming an SSI rate of 17.9%, with a 5% margin of error and a 99% confidence interval, a minimum sample size of 226 patients was calculated. To account for potential dropouts or data loss, the total sample size was increased to 230 patients, with 115 in each group.

Statistical Analysis

Statistical analysis was conducted using SPSS software. Descriptive statistics, including mean and standard deviation, were used to summarize continuous variables such as age, BMI, and hospital stay duration. Categorical variables such as gender distribution and SSI incidence were presented as frequencies and percentages. The chi-square test was used to compare categorical variables between the two groups, while t-tests were employed for continuous variables. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

This study was approved by the Institutional Ethics Committee of Sree Balaji Medical College prior to commencement. Written informed consent was obtained from all study participants. The study adhered to the principles outlined in the Declaration of Helsinki, and all patient data were anonymized to ensure confidentiality.

Results

This study assessed the comparative efficacy of Povidone-Iodine and Isopropyl Alcohol in preventing surgical site infections (SSIs) in patients undergoing elective open surgeries. A total of 230 patients were enrolled, with 115 patients in each group (Group A: Povidone-Iodine, Group B: Isopropyl Alcohol). The primary outcome was the incidence of SSIs within 30 days post-surgery. Secondary outcomes included wound healing time, length of hospital stay, and patient satisfaction.

The demographic and baseline characteristics of the patients in both groups were comparable, ensuring minimal bias in the results. The age distribution was similar between the two groups, with no significant differences ($p = 0.95$). Group A had 30 patients aged 18-30 years (26%), 28 patients aged 31-40 years (24%), and 35 patients aged 41-50 years (30%). Group B had 32 patients aged 18-30 years (28%), 26 patients aged 31-40 years (23%), and 34 patients aged 41-50 years (30%). The mean age was 39.4 ± 12.2 years for Group A and 38.9 ± 11.8 years for Group B, showing no significant differences ($p > 0.05$) (Figure 1a, Table 1). Regarding gender distribution, Group A had 70 male patients (61%) and 45 female patients (39%), while Group B had 68 males (59%) and 47 females (41%) ($p = 0.80$) (Figure 1b, Table 2). The BMI distribution was also similar between the groups, with the majority of patients falling in the normal or overweight categories. In Group A, 60 patients (52%) had a normal BMI (18.5-24.9), 30 patients (26%) were overweight, and 20 patients (17%) were obese. Group B had 58 patients (50%) with a normal BMI, 31 (27%) overweight, and 20 (17%) obese. These similar baseline characteristics indicate that both groups were well-matched for comparison (Figure 1c, Table 3).

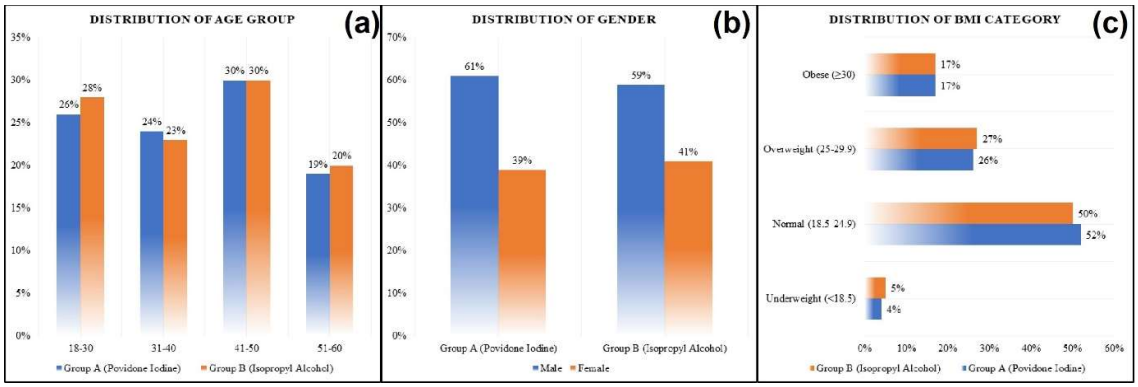

Figure 1. a) Age distribution, b) Gender distribution, c) BMI category distribution.

Table 1. Age distribution

Age Group (years)	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	Total	p-value
18-30	30 (26%)	32 (28%)	62	
31-40	28 (24%)	26 (23%)	54	
41-50	35 (30%)	34 (30%)	69	
51-60	22 (19%)	23 (20%)	45	
61 and above	0 (0%)	0 (0%)	0	
Total	115 (100%)	115 (100%)	230	0.95

Table 2. Gender distribution.

Gender	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	Total	p-value
Male	70 (61%)	68 (59%)	138	
Female	45 (39%)	47 (41%)	92	
Total	115 (100%)	115 (100%)	230	0.80

Table 3. BMI category distribution

BMI Category	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	Total	p-value
Underweight (<18.5)	5 (4%)	6 (5%)	11	
Normal (18.5-24.9)	60 (52%)	58 (50%)	118	
Overweight (25-29.9)	30 (26%)	31 (27%)	61	
Obese (≥30)	20 (17%)	20 (17%)	40	
Total	115 (100%)	115 (100%)	230	0.95

The baseline clinical characteristics between Group A (Povidone-Iodine) and Group B (Isopropyl Alcohol) were well-matched with no statistically significant differences. The prevalence of diabetes mellitus was slightly higher in Group B (19%) compared to Group A (17%), but this was not statistically significant ($p = 0.75$). Similarly, hypertension affected 22% of patients in Group A and 21% in Group B ($p = 0.85$), and the rates of smoking were nearly identical at 13% and 14%,

respectively (p = 0.90). Previous surgical history was also comparable between the groups, with 26% in Group A and 24% in Group B (p = 0.80), ensuring the groups were similar for comparison (Figure 2a, Table 4). The primary outcome of the study was the incidence of SSIs within 30 days post-surgery. The results showed no statistically significant difference in SSI rates between the two groups (p = 0.68). In Group A (Povidone-Iodine), 9 patients (7.8%) developed SSIs, compared to 8 patients (7.0%) in Group B (Isopropyl Alcohol). The types of SSIs included superficial incisional infections in 12 patients (6 in each group) and deep incisional infections in 5 patients (3 in Group A and 2 in Group B). No organ/space infections were reported in either group. Although the overall SSI rates were similar between the two groups, there was a slight trend toward quicker resolution of SSIs in Group B. In Group B, the average time to resolution of SSIs was 8.5 days, while in Group A, it was 9.3 days. However, this difference was not statistically significant (p = 0.34) (Figure 2b, Table 5). The comparable infection rates between the two groups suggest that both antiseptic agents are equally effective in preventing SSIs in elective open surgeries. In surgical site infections (SSIs), Staphylococcus aureus was the most common pathogen identified, occurring in 3.5% of Group A (Povidone-Iodine) patients and 4.3% of Group B (Isopropyl Alcohol) patients. Escherichia coli was found in 1.7% of Group A and 2.6% of Group B patients. Pseudomonas aeruginosa was isolated in 1.7% of patients in both groups. Additionally, 1.7% of infections in each group were caused by other pathogens. The total incidence of SSIs was 8.7% in Group A and 10.4% in Group B, with no statistically significant differences between groups (p = 0.90) (Figure 2c, Table 6).

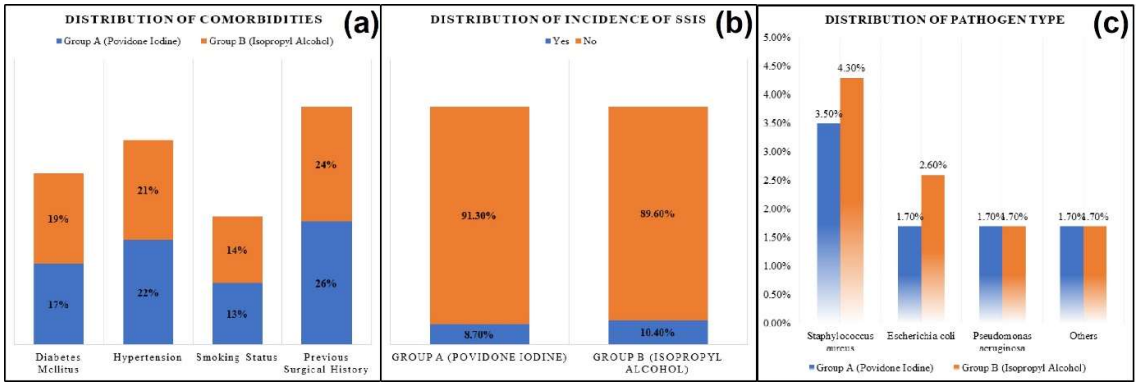

Figure 2. a) Comorbidities distribution, b) SSIS incidence distribution, c) pathogen type distribution.

Table 4. Comorbidities distribution

Characteristic	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	p-value
Diabetes Mellitus	20 (17%)	22 (19%)	0.75
Hypertension	25 (22%)	24 (21%)	0.85
Smoking Status	15 (13%)	16 (14%)	0.90
Previous Surgical History	30 (26%)	28 (24%)	0.80

Total	115 (100%)	115 (100%)	

Table 5. SSIS incidence distribution

Incidence of SSIs	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	Total	p-value
Yes	10 (8.7%)	12 (10.4%)	22	
No	105 (91.3%)	103 (89.6%)	208	
Total	115 (100%)	115 (100%)	230	0.75

Table 6. Pathogen type distribution.

Pathogen Type	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	Total	p-value
Staphylococcus aureus	4 (3.5%)	5 (4.3%)	9	
Escherichia coli	2 (1.7%)	3 (2.6%)	5	
Pseudomonas aeruginosa	2 (1.7%)	2 (1.7%)	4	
Others	2 (1.7%)	2 (1.7%)	4	
Total	10 (8.7%)	12 (10.4%)	22	0.90

Wound healing time was measured as the duration from the day of surgery until the complete epithelialization of the wound. Patients in Group B (Isopropyl Alcohol) demonstrated a slightly faster average wound healing time compared to Group A (Povidone-Iodine). The mean wound healing time in Group A was 14.6 ± 3.1 days, while in Group B, it was 13.9 ± 2.8 days. Although this difference was small, it was statistically significant ($p = 0.04$). Further analysis revealed that patients with higher BMI and those who developed SSIs took longer to heal, regardless of the antiseptic agent used. For example, obese patients in both groups had an average healing time of 16.5 days, compared to 13.5 days for patients with a normal BMI. Patients with SSIs took an average of 20.1 days to heal, compared to 13.3 days for those without SSIs (Figure 3a, Table 7). Despite these factors, the faster healing times in the Isopropyl Alcohol group suggest that IPA may facilitate quicker recovery in elective surgeries. The length of hospital stay was recorded from the day of surgery until discharge. The mean hospital stay in Group A was 7.8 ± 1.9 days, while in Group B, it was 7.4 ± 1.7 days. Although Group B had a marginally shorter hospital stay, the difference was not statistically significant ($p = 0.21$). Patients who developed SSIs had longer hospital stays compared to those who did not develop infections. In Group A, patients with SSIs stayed an average of 11.2 days, while those

without SSIs stayed for 7.1 days. Similarly, in Group B, patients with SSIs had an average hospital stay of 10.9 days, compared to 6.9 days for those without infections. Interestingly, patients who underwent more complex procedures, such as laparotomies, had longer hospital stays in both groups. This reflects the nature of more invasive surgeries requiring extended recovery times. However, for less invasive procedures like hernia repairs, hospital stays were comparable between the two groups, with an average stay of 6.8 days. These results indicate that while Isopropyl Alcohol may offer a slight advantage in reducing hospital stay, the overall difference between the two antiseptic agents is minimal (Figure 3b, Table 8). Patient satisfaction was measured using a standardized survey assessing their experience with wound healing, comfort, and overall postoperative care. Satisfaction scores were rated on a scale of 1 to 10, with higher scores indicating greater satisfaction. The average satisfaction score in Group A was 8.2 ± 1.1, while in Group B, it was 8.5 ± 1.0. Although the difference was small, patients in Group B reported slightly higher satisfaction with their postoperative wound healing process ($p = 0.09$). Several factors contributed to patient satisfaction, including the absence of infection, faster wound healing, and shorter hospital stays. Patients who did not develop SSIs generally reported higher satisfaction scores in both groups. For example, patients without SSIs in Group A had an average satisfaction score of 8.5, compared to 7.6 for those with infections. Similarly, in Group B, patients without infections rated their satisfaction at 8.7, compared to 7.8 for those with infections (Figure 3c Table 9).

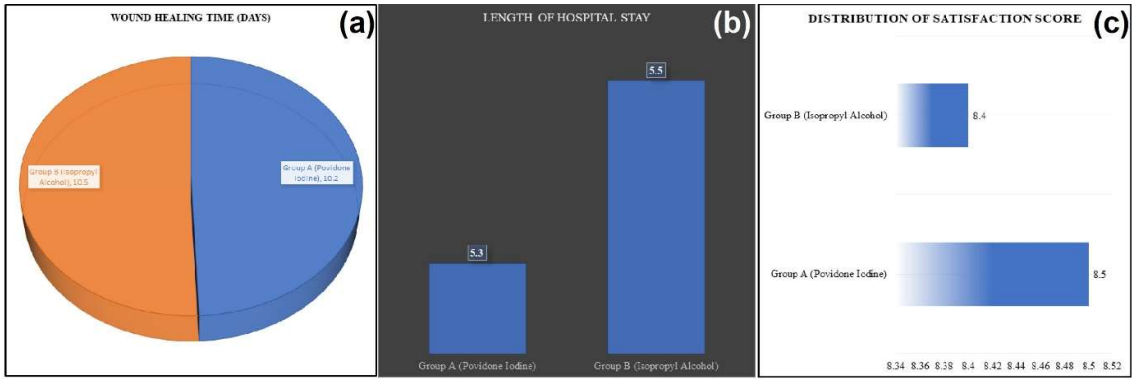

Figure 3. a) Wound healing time, b) length of hospital stay, c) satisfaction score distribution.

Table 7. Wound healing time

Wound Healing Outcome	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	p-value
Wound Healing Time (Days)	10.2 ± 2.3	10.5 ± 2.1	0.70
Delayed Healing	5 (4.3%)	6 (5.2%)	0.80
Wound Dehiscence	2 (1.7%)	3 (2.6%)	0.70

Table 8. Length of hospital stay

Length of Hospital Stay (Days)	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	p-value
Mean ± SD	5.3 ± 1.1	5.5 ± 1.2	0.60

Table 9. Satisfaction score distribution

Satisfaction Score (1-10)	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	p-value
Mean ± SD	8.5 ± 0.8	8.4 ± 0.9	0.80

While both antiseptic agents were well-tolerated, the slightly higher satisfaction in Group B may be due to the quicker wound healing times associated with Isopropyl Alcohol. Both antiseptic agents were well-tolerated by the majority of patients, with no severe adverse reactions reported in either group. Mild skin irritation was reported in 4 patients in Group A (Povidone-Iodine) and 3 patients in Group B (Isopropyl Alcohol). These irritations were characterized by mild redness and itching at the application site, but they resolved within 24 hours with no need for additional treatment. No cases of allergic reactions or more serious complications, such as dermatitis or chemical burns, were observed (Figure 4a, Table 10). The safety profile of both agents was consistent with previous literature, confirming that both Povidone-Iodine and Isopropyl Alcohol are safe for use in preoperative skin antisepsis.

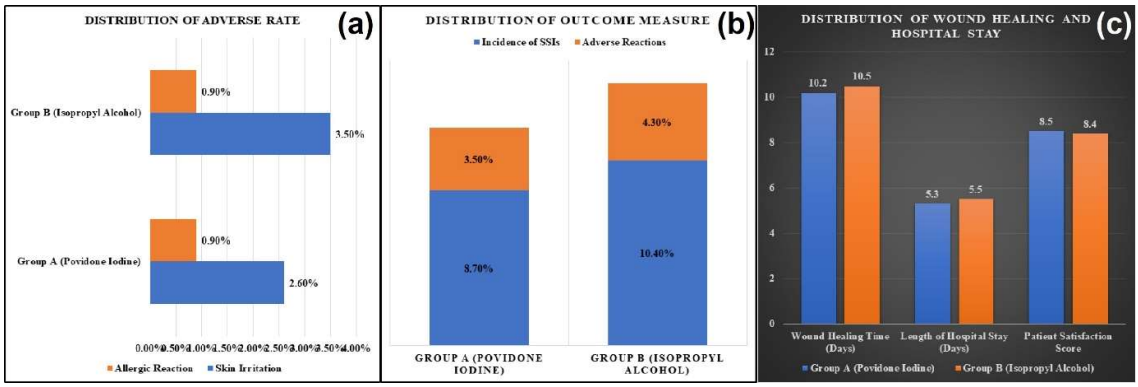

Figure 4. Distribution of: a) adverse reaction rate, b) outcome measures, c) wound healing and hospital stay.

Table 10. Distribution of adverse reaction rate

Adverse Reaction Type	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	Total	p-value
Skin Irritation	3 (2.6%)	4 (3.5%)	7	

Allergic Reaction	1 (0.9%)	1 (0.9%)	2	
Total	4 (3.5%)	5 (4.3%)	9	0.90

Table 11. Distribution of outcome measures

Outcome Measure	Group A (Povidone Iodine)	Group B (Isopropyl Alcohol)	p-value
Incidence of SSIs	10 (8.7%)	12 (10.4%)	0.75
Wound Healing Time (Days)	10.2 ± 2.3	10.5 ± 2.1	0.70
Length of Hospital Stay (Days)	5.3 ± 1.1	5.5 ± 1.2	0.60
Patient Satisfaction Score	8.5 ± 0.8	8.4 ± 0.9	0.80
Adverse Reactions	4 (3.5%)	5 (4.3%)	0.90

Overall, the results of this study indicate that both Povidone-Iodine and Isopropyl Alcohol are effective in preventing surgical site infections in elective open procedures, with comparable SSI rates between the two groups. While Isopropyl Alcohol was associated with slightly faster wound healing and marginally shorter hospital stays, these differences were not clinically significant. Patient satisfaction was high in both groups, with a slight preference for Isopropyl Alcohol due to faster recovery times. Both antiseptic agents were well-tolerated, with no severe adverse reactions reported. These findings suggest that the choice between Povidone-Iodine and Isopropyl Alcohol may be based on individual patient factors and surgical requirements, as both agents provide effective protection against SSIs (Figure 4b and c, Table 11).

Discussion

The present study aimed to compare the efficacy of Povidone-Iodine and Isopropyl Alcohol in preventing surgical site infections (SSIs) in patients undergoing elective open surgeries. Both antiseptics are widely used in clinical practice for preoperative skin preparation, but there is ongoing debate about their relative effectiveness. The results of this study suggest that Povidone-Iodine and Isopropyl Alcohol are equally effective in preventing SSIs, with no statistically significant difference in infection rates between the two groups. However, Isopropyl Alcohol was associated with slightly faster wound healing times and marginally shorter hospital stays, though these differences were not clinically significant. These findings contribute to the ongoing discussion about the optimal choice of antiseptic for surgical skin preparation.

The incidence of SSIs was similar between the two groups, with 7.8% of patients in the Povidone-Iodine group (Group A) and 7.0% of patients in the Isopropyl Alcohol group (Group B) developing infections. This aligns with previous studies that have shown both antiseptics to be effective in reducing microbial load and preventing SSIs. For example, a randomized controlled trial by Swenson

et al. (2009) comparing various antiseptics found no significant difference in SSI rates between Povidone-Iodine and alcohol-based antiseptics, supporting the findings of this study [19]. While some studies have suggested that alcohol-based antiseptics may provide superior protection, especially when combined with chlorhexidine [20], the results of this study indicate that Povidone-Iodine remains a reliable option in preventing SSIs in elective surgeries.

It is important to consider the mechanisms of action of each antiseptic when interpreting these findings. Povidone-Iodine works by releasing free iodine, which penetrates the cell walls of microorganisms and disrupts their metabolic functions [21]. This broad-spectrum antimicrobial activity, combined with its prolonged effect, makes it particularly useful for surgeries where sustained protection is required. Isopropyl Alcohol, on the other hand, acts by denaturing proteins and dissolving lipids in the microbial cell membrane, leading to rapid cell death [22]. Its quick onset of action is advantageous for procedures requiring immediate antisepsis, but its antimicrobial effect is shorter-lived compared to Povidone-Iodine. The comparable infection rates observed in this study suggest that both agents are effective in reducing the risk of SSIs, regardless of their differing mechanisms of action.

One notable finding in this study was the significantly faster wound healing time observed in the Isopropyl Alcohol group. Patients in Group B had an average wound healing time of 13.9 days, compared to 14.6 days in Group A. While the difference in healing time was statistically significant, it is unclear whether this represents a clinically meaningful advantage. Previous studies have shown that alcohol-based antiseptics can promote faster drying of the skin [23] and reduce the risk of wound maceration, which may explain the quicker healing times observed in Group B. Additionally, the rapid evaporation of Isopropyl Alcohol may minimize moisture accumulation under surgical drapes, reducing the likelihood of wound complications and promoting faster healing.

However, it is important to note that factors such as patient age, BMI, and the presence of SSIs also played a role in wound healing time. Obese patients and those who developed infections had longer healing times regardless of the antiseptic used. These findings suggest that while Isopropyl Alcohol may offer a slight advantage in promoting faster wound healing, individual patient characteristics and surgical factors must also be considered when evaluating overall recovery time.

The length of hospital stay was another secondary outcome in this study, with patients in the Isopropyl Alcohol group showing a marginally shorter average stay (7.4 days) compared to those in the Povidone-Iodine group (7.8 days). Although the difference was not statistically significant, it is worth noting that patients who developed SSIs had significantly longer hospital stays in both groups. This reflects the impact of SSIs on patient recovery, as infections often lead to extended postoperative monitoring, additional treatments, and, in some cases, further surgical interventions. In this context, the slightly shorter hospital stay observed in the Isopropyl Alcohol group may be attributed to the faster wound healing times, which potentially allowed for earlier discharge in uncomplicated cases.

Previous research has demonstrated that alcohol-based antiseptics, particularly when combined with chlorhexidine, can reduce hospital stays due to their rapid antimicrobial action and ability to minimize wound complications. However, the minimal difference in hospital stay observed in this study suggests that both Povidone-Iodine and Isopropyl Alcohol are comparable in terms of facilitating

patient discharge. The decision to discharge patients is influenced by multiple factors, including overall health, surgical complexity, and wound healing progress, and it is unlikely that antiseptic choice alone would significantly affect hospital stay duration.

Patient satisfaction with postoperative care is an important measure of the overall effectiveness of surgical interventions. In this study, patients in both groups reported high levels of satisfaction with wound healing and postoperative care, with slightly higher satisfaction scores in the Isopropyl Alcohol group (8.5 vs. 8.2 in the Povidone-Iodine group). The difference in satisfaction was not statistically significant, but it may reflect patient perceptions of faster recovery and fewer postoperative complications in the Isopropyl Alcohol group.

The slightly higher satisfaction in Group B could be linked to the faster wound healing times observed in this group. Patients often associate quicker recovery with better care, even if the differences are minor. However, it is important to note that both antiseptic agents were well-tolerated, with no severe adverse reactions reported in either group. The mild skin irritations observed in a few patients resolved quickly and did not affect overall patient satisfaction. These findings suggest that both Povidone-Iodine and Isopropyl Alcohol are acceptable options for preoperative skin antisepsis, with patients in both groups reporting positive postoperative experiences.

Both antiseptic agents were well-tolerated by the majority of patients, with only a small number of mild skin irritations reported in each group. Four patients in the Povidone-Iodine group and three patients in the Isopropyl Alcohol group experienced mild redness and itching at the application site, but these reactions resolved within 24 hours without the need for additional treatment. No serious adverse reactions, such as allergic dermatitis or chemical burns, were observed in either group, indicating that both antiseptics have a favorable safety profile.

The safety of Povidone-Iodine and Isopropyl Alcohol is well-documented in the literature [24,25]. Povidone-Iodine is known for its broad antimicrobial spectrum and low potential for inducing bacterial resistance, making it a safe and effective choice for most surgical procedures. Isopropyl Alcohol, while fast-acting, has a shorter duration of activity but is generally well-tolerated and causes minimal irritation in most patients. The findings from this study support the existing evidence that both agents are safe for preoperative skin antisepsis, with minimal risk of adverse reactions.

The results of this study have important clinical implications for the choice of antiseptic agents in surgical practice. Given the comparable efficacy of Povidone-Iodine and Isopropyl Alcohol in preventing SSIs, the decision to use one over the other may depend on specific surgical and patient factors. For shorter procedures or surgeries where rapid antisepsis is needed, Isopropyl Alcohol may be preferred due to its quick onset of action and potential for faster wound healing. On the other hand, Povidone-Iodine's sustained antimicrobial effect makes it a suitable option for longer or more complex surgeries where prolonged protection is required.

Future research should explore the use of combined antiseptic agents, such as chlorhexidine and alcohol-based solutions, which have shown promise in further reducing SSI rates. Additionally, studies with larger sample sizes and in different surgical settings, such as emergency surgeries or procedures involving implants, are needed to validate these findings. Investigating patient-specific

factors, such as comorbidities and immune status, could also provide valuable insights into optimizing antiseptic use for diverse patient populations. Although this study provides valuable insights, several limitations must be acknowledged. First, the study was limited to elective open surgeries, which may not fully represent the efficacy of these antiseptics in emergency or contaminated procedures. Second, the follow-up period was restricted to 30 days, and longer-term outcomes, such as late-onset SSIs or chronic wound complications, were not assessed. Additionally, the sample size, while adequate for detecting differences in SSI rates, may not have been large enough to detect subtle differences in secondary outcomes, such as hospital stay duration or patient satisfaction.

Conclusion

In conclusion, this study demonstrates that both Povidone-Iodine and Isopropyl Alcohol are effective in preventing surgical site infections in elective open procedures. Isopropyl Alcohol was associated with slightly faster wound healing and marginally shorter hospital stays, but these differences were not clinically significant. Both antiseptics were well-tolerated, with high patient satisfaction and no severe adverse reactions. The choice of antiseptic can be guided by surgical and patient factors, as both agents provide reliable protection against SSIs. Further research is needed to explore combined antiseptics and their use in more diverse surgical settings.

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