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A COMPARATIVE STUDY OF PREVALENCE OF SURGICAL SITE INFECTION USING POVIDONE IODINE VS CHLORHEXIDINE ALCOHOL IN PREOPERATIVE SKIN PREPARATION IN ABDOMINAL HERNIAS

Original Research

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ABSTRACT

Background: Surgical site infections (SSIs) are among the most common complications following abdominal surgeries, including hernia repairs. These infections significantly contribute to patient morbidity and healthcare burden, especially in resource-limited settings. Preoperative skin antisepsis is a critical factor in SSI prevention, with agents such as povidone iodine (PI) and chlorhexidine alcohol (CA) frequently used. However, their comparative efficacy in reducing SSI rates remains an area of clinical interest, necessitating further exploration.

Objective: To compare the prevalence of SSIs in patients undergoing preoperative skin preparation with povidone iodine versus chlorhexidine alcohol during abdominal hernia repair.

Methods: This comparative non-randomized controlled trial was conducted at CMH, Rawalpindi, from May 2022 to February 2023. A total of 300 patients scheduled for hernia repair were enrolled and divided equally into two groups: group A (PI) and group B (CA). Group allocation was performed using a single-blinded technique to minimize bias. Preoperative skin preparation was conducted with a 10% PI solution for group A and a CA solution (2% chlorhexidine in 70% alcohol) for group B. Patients were followed up for 30 days post-surgery to evaluate the presence of SSIs, defined as purulent discharge, fever, elevated white blood cell count, swelling, or erythema at the surgical site. Data were analyzed using SPSS version 22, with statistical significance set at $p \leq 0.05$.

Results: The study included 300 patients with a mean age of 40.42 ± 8.71 years, of whom 124 (41.30%) were male and 176 (58.70%) were female. The overall SSI frequency was 69 (23.00%). SSI was significantly higher in the PI group compared to the CA group, with rates of 34.00% (51/150) versus 12.00% (18/150), respectively ($p < 0.001$).

Conclusion: Chlorhexidine alcohol is significantly more effective than povidone iodine in reducing the prevalence of SSIs in abdominal hernia surgeries. Its use should be preferred for preoperative skin antisepsis to improve surgical outcomes.

Keywords: Abdominal Hernia, Chlorhexidine, Povidone-Iodine, Preoperative Care, Skin Preparation, Surgical Site Infection, Wound Infection.

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INTRODUCTION

Abdominal hernias, characterized by abnormal swelling or defects along the Linea Alba near the umbilicus, pose significant health challenges, including pain, hospitalization, and potential mortality in severe cases (1,2). Factors such as a history of prior abdominal surgery or trauma, repetitive stress, obesity, and cyclical weight fluctuations weaken the abdominal wall, rendering it vulnerable to herniation (3). Despite remarkable advancements in surgical techniques, approaches, and equipment, complications such as surgical site infections (SSI) remain prevalent and contribute significantly to patient morbidity and mortality (4).

Surgical site infections arise through a complex interplay of biochemical processes, often involving intrinsic microbiota from the skin, mucous membranes, and internal organs. These microorganisms can lead to infections when microbial contamination surpasses a critical threshold (5). Several patient-specific factors, including advanced age, comorbidities, smoking, obesity, immune suppression, malnutrition, and cancer, elevate the risk of SSIs (6). Addressing this issue requires a multi-faceted approach, including improved operating theatre conditions with adequate ventilation, reduced operative time, and refined surgical techniques (7, 8).

Skin preparation at the intended incision site plays a critical role in reducing microbial burden and preventing SSIs. Among the various antiseptics available, chlorhexidine alcohol (CA) and povidone iodine (PI) are widely used. Chlorhexidine alcohol, particularly at a concentration of 0.5% or higher, has shown substantial efficacy in reducing SSIs (9). Similarly, formulations of povidone iodine are regarded as highly effective antiseptics for surgical site preparation (10). However, determining which antiseptic agent offers superior efficacy remains a subject of ongoing debate among surgeons.

This comparative non-randomized controlled trial was undertaken to address this critical clinical question by evaluating the prevalence of SSIs following preoperative skin preparation with either povidone iodine or chlorhexidine alcohol in abdominal hernia surgeries. The objective was to provide evidence-based insights into the optimal choice of antiseptic, thereby improving patient outcomes and reducing the burden of surgical complications.

METHODS

After obtaining approval from the institutional ethical review board of CMH, Rawalpindi, a comparative non-randomized controlled trial was conducted from May 2022 to February 2023. The study aimed to compare the prevalence of surgical site infections (SSI) in patients undergoing preoperative skin preparation with either povidone iodine (PI) or chlorhexidine alcohol (CA). A sample size of 300 patients was calculated using the WHO sample size calculator, based on a 5% level of significance, 80% power, an anticipated frequency of SSI of 13% in the PI group, and 4% in the CA group (11). The formula utilized for sample size calculation was standardized and appropriate (12). Patients were equally divided into two groups, with 150 participants in each group.

Inclusion criteria comprised adult patients over 18 years of age scheduled for abdominal hernia repair, capable of providing informed consent. Patients with chronic diseases or comorbidities—such as diabetes (HbA1C > 6.5%) (13), hypertension, thyroid dysfunction, morbid obesity, or smoking habits—were excluded, as were those with immune system disorders, coagulation disorders, or unfitness for abdominal surgery under anesthesia. A non-probability consecutive sampling method was employed to select eligible patients. Before enrollment, each patient was informed of the study objectives and assured of confidentiality, with data anonymized using randomly generated identifiers.

After confirming eligibility, baseline characteristics, including age and gender, were recorded. Patients were then divided into two equal groups: in group A, skin at the surgical site was prepared with a 10% solution of PI, while in group B, skin was prepared with CA (2% + 70%). All surgeries were performed by the same surgical team under standard conditions. Preoperative antibiotic prophylaxis included intravenous ciprofloxacin (0.2 g) and metronidazole (500 mg), per institutional protocol.

Postoperative care involved intravenous analgesics (paracetamol 1 g thrice daily and ketorolac 30 mg as needed) and antibiotics (ciprofloxacin 0.2 g twice daily and metronidazole 500 mg thrice daily for five days). Patients were monitored during their hospital stay and instructed to return for a follow-up 30 days post-discharge. SSI was defined as the presence of purulent discharge, pain, fever,

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elevated white blood cell count (>11,000), swelling, or erythema at the surgical site (14). Patients diagnosed with SSI received appropriate treatment, including extended antibiotic therapy and wound care, depending on the severity of the infection.

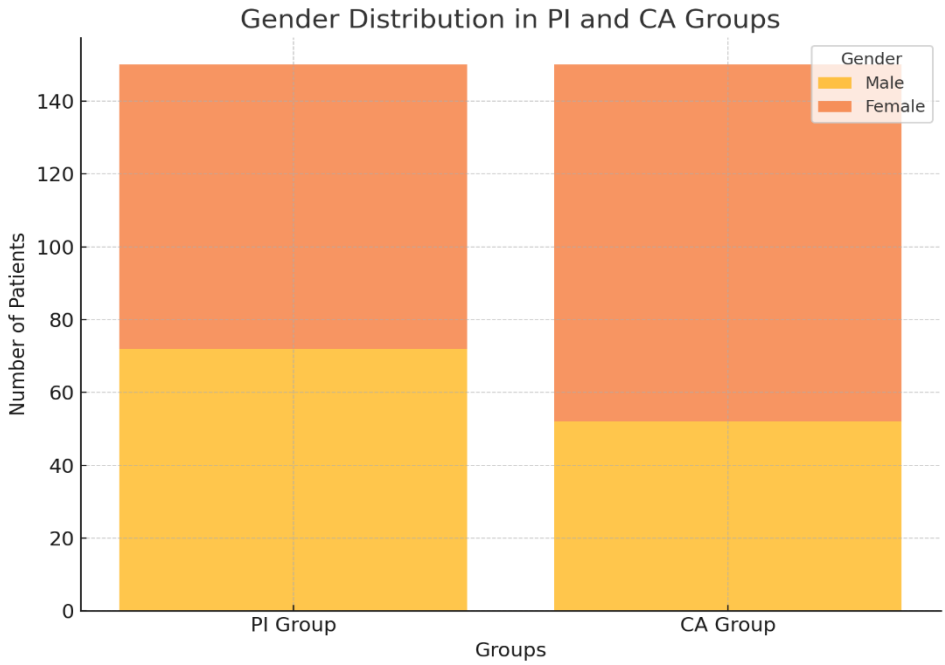
Data analysis was conducted using SPSS version 22. Normality of data distribution was assessed using the Shapiro-Wilk test (15). Quantitative data, such as age, were presented as mean ± standard deviation or median (IQR), while qualitative variables, such as gender and SSI presence, were expressed as frequencies and percentages. Comparative analysis was performed using the Chi-square test for categorical variables and unpaired t-tests for continuous variables, with a p-value ≤ 0.05 considered statistically significant.

RESULTS

The study included a total of 300 patients undergoing abdominal hernia repair, divided equally into two groups based on the skin preparation agent used: 150 patients received preoperative skin preparation with povidone iodine (PI) and 150 with chlorhexidine alcohol (CA). The composite mean age of the study population was 40.42 ± 8.71 years, with the PI group having a mean age of 45.21 ± 6.21 years and the CA group 35.62 ± 8.21 years, a difference that was statistically significant ($p < 0.001$). Gender distribution showed that 124 patients (41.30%) were male and 176 (58.70%) were female. Within the PI group, 72 patients (48.00%) were male and 78 (52.00%) were female, whereas in the CA group, 52 patients (34.67%) were male and 98 (65.33%) were female, demonstrating a statistically significant difference ($p = 0.019$).

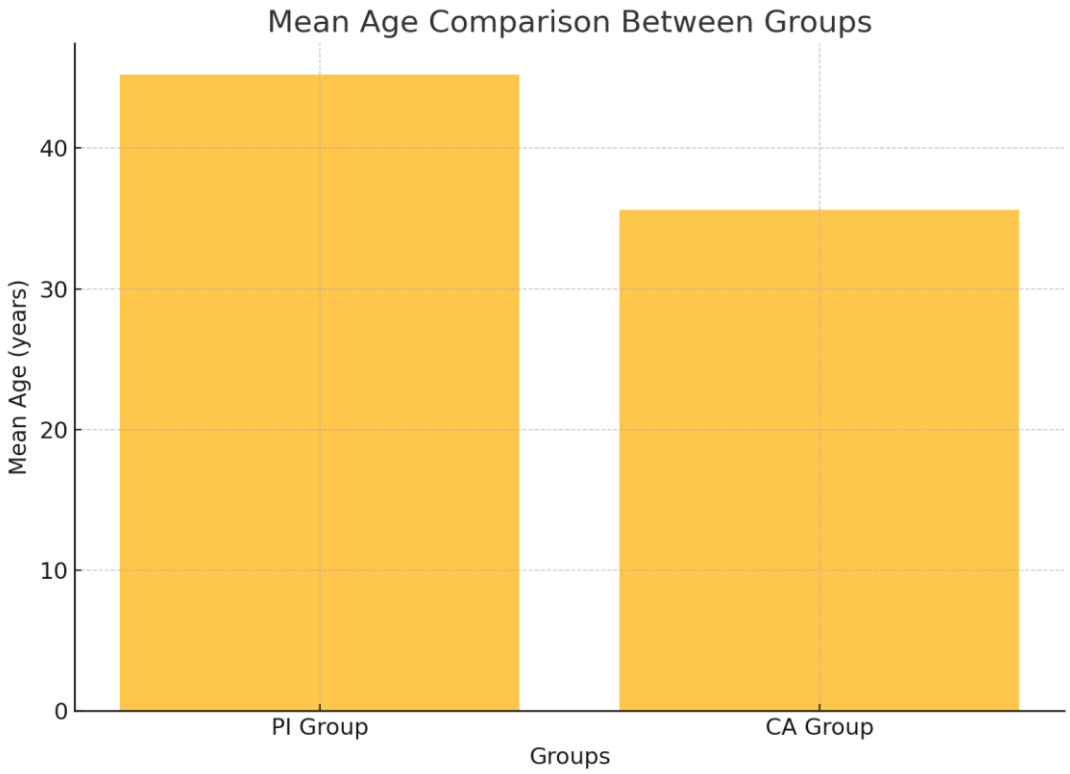
The overall frequency of surgical site infections (SSI) in the study cohort was 69 cases (23.00%). Notably, the incidence of SSI was significantly higher in the PI group compared to the CA group, with 51 cases (34.00%) versus 18 cases (12.00%), respectively, and this difference was statistically significant ($p < 0.001$). These findings suggest that chlorhexidine alcohol was associated with a considerably lower risk of postoperative wound infection compared to povidone iodine.

Although the results provide a clear comparative analysis of the effectiveness of the two antiseptic agents, additional data on potential confounding factors, such as differences in adherence to postoperative care protocols or any unreported patient-specific risks, could have strengthened the findings further. Incorporating an analysis of other complications or side effects associated with each antiseptic agent might have added further depth to the conclusions.



The gender distribution chart shows that in the PI group, 48.00% of patients (72 out of 150) were male and 52.00% (78 out of 150) were female. In contrast, the CA group had a lower percentage of males at 34.67% (52 out of 150) and a higher percentage of females at 65.33% (98 out of 150). This distribution highlights a statistically significant difference in gender proportions between the two groups ($p = 0.019$).

Figure 1 Gender Distribution in PI and CA Groups



The mean age comparison chart reveals a significant difference between the two groups, with the PI group having a higher mean age of 45.21 ± 6.21 years compared to the CA group, which had a mean age of 35.62 ± 8.21 years. This age difference was statistically significant ($p < 0.001$), indicating a potential demographic disparity between the groups.

Figure 2 Mean Age Comparison Between Groups

Table 1 Baseline characteristics

Sr. No.	Characteristics	Value (n = 300)
1	Mean age	40.42 ± 8.71 years
2	Gender	
	Male	124 (41.30%)
	Female	176 (58.70%)

The baseline in Table 1 characteristics of the study participants included a composite mean age of 40.42 ± 8.71 years. In terms of gender distribution, 124 participants (41.30%) were male, while 176 participants (58.70%) were female. This data provides a comprehensive demographic overview of the study cohort, ensuring a clear understanding of participant diversity in age and gender.

Table 2 Comparison of Baseline Characteristics between Groups (n = 300)

Characteristic	PI group (A) (n = 150)	CA group (B) (n = 150)	Chi-square test/p-value
Age	45.21 ± 6.21 years	35.62 ± 8.21 years	p < 0.001
Gender			
Male	72 (48.00%)	52 (34.67%)	X2 = 5.499
Female	78 (52.00%)	98 (65.33%)	P = 0.019

Comparison of age between our study groups was performed using Student t-test and we found that mean age in PI group was 45.21 ± 6.21 years while in CA group it was 35.62 ± 8.21 years, ($p < 0.001$). To compare gender distribution between study groups we used Chi-

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square test and found that in PI group, 72 (48.00%) were male patients and 78 (52.00%) were female patients while in CA group, 52 (34.67%) were male and 98 (65.33%) were female, (p = 0.019). This comparison of baseline characteristics between the two groups is tabulated in table 2.

Table 3 Comparison of Frequency of Post-operative Wound Infection (n = 300)

Parameter	PI group (A) (n = 150)	CA group (B) (n = 150)	Chi-square test/p-value
Surgical Site Infection	51 (34.00%)	18 (12.00%)	X2 = 20.497 p < 0.001

In our study we found that the composite frequency of SSI was 69 (23.00%). In our study we found that the frequency of SSI was higher in patients who were assorted in group A than in group B [51 (34.00%) vs 18 (12.00%), respectively; p < 0.001] and this comparison of frequency of SSI at thirty days follow up visit after discharge surgery between the two groups is given below in table III.

DISCUSSION

Surgical site infections (SSIs) remain one of the most frequent complications following surgical procedures, including abdominal hernia repairs. The present study focused on comparing the efficacy of povidone iodine (PI) and chlorhexidine alcohol (CA) solutions in reducing SSI prevalence. A statistically significant difference in demographic characteristics, such as age and gender, was observed between the two study groups. Most participants were female, a finding that aligns with the work of Jadhav et al., who noted a higher prevalence of abdominal hernias among women, although it contrasts with Pandya et al., who reported a predominance of hernias in males (16, 17). This variation in gender distribution likely reflects the influence of regional social norms and cultural demographics.

The overall prevalence of SSIs in the study population was 23%, highlighting the substantial burden of this complication despite stringent sterilization efforts in resource-limited settings such as Pakistan. The higher prevalence underscores the challenges faced in achieving optimal sterility during surgical procedures in such environments. Between the two antiseptic solutions studied, CA demonstrated a significantly lower incidence of SSIs compared to PI. This finding aligns with previous research by Elgarf et al., Darouiche et al., and Chen et al., which collectively support the superior efficacy of CA in reducing SSIs (11, 18, 19). The evidence from this study reinforces the recommendation to preferentially use CA for preoperative skin preparation in hernia surgeries.

Contrarily, some studies, including those by Luwang et al. and Rodrigues et al., found no significant difference in SSI outcomes between CA and PI (20, 21). These divergent findings emphasize the necessity of further research to evaluate the superiority of CA comprehensively. Nonetheless, the present study contributes to closing this gap by demonstrating the clear advantages of CA over PI in the studied population.

The study's strengths include its focus on a common yet under-researched complication in hernia surgeries and the standardized methodology used for antiseptic application and data collection. However, the limitations include a relatively small sample size, a short follow-up duration, the inclusion of only one type of surgical procedure, exclusion of patients with comorbidities, and data restricted to a single healthcare facility. These factors may affect the generalizability of the findings and warrant cautious interpretation. Future studies with larger, more diverse populations and extended follow-up periods are recommended to validate these findings and explore additional factors influencing SSI outcomes.

The results strongly support the preferential use of CA over PI for preoperative skin preparation in abdominal hernia surgeries. Incorporating this evidence into clinical practice may significantly reduce the incidence of SSIs, thereby improving surgical outcomes and reducing patient morbidity in similar settings.

CONCLUSION

In conclusion, surgical site infection remains a common and significant complication following surgical procedures, particularly in abdominal hernia repairs. This study demonstrated that chlorhexidine alcohol is more effective than povidone iodine in reducing the prevalence of these infections. These findings underscore the importance of selecting the most effective antiseptic agent for preoperative

skin preparation to enhance surgical outcomes and reduce postoperative morbidity. Incorporating chlorhexidine alcohol as the preferred agent in clinical practice could provide a substantial improvement in patient care and safety.

AUTHOR CONTRIBUTIONS

Author	Contribution
Muhammad Saqlain	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Imran	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Muhammad Danial Yousaf	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Aoun Ayub	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sajid Ali	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Umer Naeem	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Muhammad Farrukh Habib*	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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