Clinical evaluation of preoperative skin preparation with aqueous povidone iodine only and in combination with alcoholic chlorhexidine in patients undergoing clean elective surgeries

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Abstract

Background: Surgical site infections (SSIs) is a dangerous condition posing a heavy burden on the patient and social health system. Adequate pre-operative skin preparation helps in reducing the SSIs and this study is undertaken to compare the efficacy of povidone-iodine alone and in combination with chlorhexidine.

Methods: This is an observational study in which 100 patients admitted for elective clean surgery in Government Medical College, Kota during the period of 2 years from November 2020 – October 2022 studied in two groups where preoperative skin preparation is done using povidone-iodine alone and in combination with alcoholic chlorhexidine. The surgical wounds were examined for presence of any infections.

Results: In Group I, 6 patients whereas in Group II, only 2 patients had microbial colonization of the site of incision. Of the patients with positive culture results from site of incision, 4 patients in Group I developed wound infection whereas in Group II none of the patients developed wound infection.

Conclusion: Preoperative skin preparation with chlorhexidine gluconate 2.5% v/v in 70% propanol followed by aqueous povidone-iodine is an ideal regime as it has a broader antimicrobial spectrum and the rate of post operative wound infections is much lower as compared to povidone iodine alone.

Keywords: Surgical site infections; Chlorhexidine; Propanol; Povidone-iodine; Bacterial colonization; Wound infection.

Abbreviations: SSI: Surgical Site Infections, CHX: Chlorhexidine gluconate, PVP-I: Povidone-iodine, SD: Standard Deviation.

Introduction

Skin is the primary barrier against bacterial invasion. Following a skin incision, microorganisms of the standard skin flora may contaminate exposed tissues and cause an SSI. Despite many recent advances in surgical techniques in the past few years, post-operative wound sepsis remains a significant problem. SSIs are associated with longer hospital and intensive care unit stays, increased re admission to hospital after discharge, and a two-fold increase in mortality. Many factors contribute to the development of post-operative wound infections, some...
relating to the patient and some relating to the procedure itself [1].

The terms asepsis and antisepsis denote two policies whereby access to a wound and its consequent infection is halted. Moynihan [2] (1920) conducted his bacteriological experiment with one of the two intentions:

1. The exclusion of all organisms from the wound;
2. The destruction of all micro-organisms reaching the wound by a bactericide applied to the wound surface.

Preoperative skin antisepsis has been proven to rapidly reduce local microorganism counts in the operational field. Of many techniques for skin preparation before surgery, initially with antiseptic soap solution, followed by painting the prepared area with sterile paint solution is most common. Degerming of the skin done with antiseptics used for less than a minute is as effective as a five-minute scrub with a germicidal soap solution followed by painting with antiseptics [3]. Commonly used agents for skin antisepsis are chlorhexidine gluconate (CHX) or povidone-iodine (PVP-I).

The 2017 Centre for Disease Control and Prevention Guidelines for Prevention of SSIs recommends, with high-quality evidence, the use of intraoperative skin preparation with an alcohol-based antiseptic agent; however, due to a lack of conclusive randomized controlled trials (RCTs), no specific antiseptic agent is endorsed [4].

Other institutions, such as Health Protection Scotland and the Canadian Patient Safety Institute, recommend the use of CHX [5,6]. These recommendations are based on the remnant effect against bacterial regrowth and thus prolonged activity that can be attributed to CHX [7,8]. Furthermore, CHX remains activated in the presence of organic fluids such as blood or pus, in contrast to iodophors, which become inactivated [9]. This study is undertaken to compare the efficacy of povidone-iodine alone and in combination with alcoholic chlorhexidine against bacterial flora on the skin of the operation site under conditions, encountered in operating rooms.

**Aim and objectives**

1. To evaluate the efficacy of povidone-iodine alone and in combination with an antiseptic agent containing alcoholic chlorhexidine on preoperative skin preparation by taking swab culture.
2. To compare the rate of postoperative wound infection in both groups.

**Inclusion criteria**

Patients of all age groups undergoing elective surgery in the Department of General Surgery with a clean wound.

**Exclusion criteria**

1. Patients undergoing emergency surgery.
2. Immunocompromised patients and patients on long-term steroids.
3. Patients with sepsisemia and having a focus of infection somewhere on the body manifested clinically with fever and increased total and differential counts.
4. Patients suffering from malignancies or undergoing chemotherapy or radiation therapy.
5. Clean contaminated and contaminated surgeries in which viscous was opened were excluded from the study.
6. Patients with comorbid medical conditions like diabetes, hypertension, etc.

**Methodology**

This is an observational study in which 100 patients admitted for elective clean surgery in the Department of General Surgery of Government Medical College, Kota, Rajasthan, India during the period of 2 years from November 2020 – October 2022 was studied in two groups. Cases were selected at random irrespective of each case preoperatively, shaving of the parts was done at the same time on the previous evening for all the patients. The preoperative skin preparation in each group was done with the respective antiseptic regimen. For Group-1 antiseptic regimen used was three coats of aqueous povidone-iodine IP 5% w/v. For Group-2 antiseptic regimen used was a single coat of agent containing chlorhexidine gluconate 2.5% v/v in 70% propanol followed by two coats of aqueous povidone-iodine IP 5% w/v. The pre-operative antibiotic used was Cefotaxime 1 gram IV given following a test dose; one hour prior to incision. A sterile saline swab culture and sensitivity was done from the site of incision immediately in both the groups was transferred to microbiology department to determine whether any microorganisms were left behind and hence to compare the efficacy of both the regimes of skin preparation. Post operatively, first dressing was done on third postoperative day with aqueous solution of povidone iodine alone and patients were followed up till the time of sutures removal (7-10 days) to look for any signs of wound infection according to Southampton wound grading system. If any purulent discharge was seen, pus culture and antibiotic sensitivity tests were done to know whether causative organisms were same which were left behind preoperatively after skin preparation and hence incomplete disinfection was the cause for wound infection or whether the infection was acquired in the ward. Statistical analysis was performed using SPSS Statistics V22.0. Results were represented with frequencies and percentages. The Chi-square test and Fisher exact test were applied to find significance. P< 0.05 was considered statistically significant.

**Results**

A total of 100 patients who were planned for clean elective surgery were studied in two groups (50 in each group). The Age distribution of subjects is shown in Table 1. The Mean (SD) value of the age for group I was 39.46 ±18.28 and that for group II was 41.6±18.85 years and the difference was not statistically significant as shown in Table 2. There were 64 males (Group I - 30; Group II – 34) and 36 females (Group I - 20; Group II –16) as shown in Table 3. Duration of surgeries varied from 45 minutes to 3 hours and since all the surgeries were clean and elective, the duration of surgery had no effect on the number of cases with positive culture swabs. The diagnosis and nature of operations were variable and thus site of incisions also varied to some extent.
The use of PVP-iodine in surgeries dates to 1955. Chlorhexidine gluconate with its increased efficiency has been recently made available all over as an antiseptic and disinfectant. In this study, we compared the efficacy of povidone-iodine alone and in combination with alcoholic chlorhexidine in elective clean surgeries for the prevention of surgical site infections. The present study was done on 100 patients who were to undergo elective clean cases in the Department of General Surgery, Government Medical College, Kota with the aims of evaluating the efficacy of povidone-iodine alone and in combination with an antiseptic agent containing alcoholic chlorhexidine on preoperative skin preparation, and to compare the rate of postoperative wound infections in both the groups. In present study 12% in group-I and 4% in group-II had colonization of site of incision even after skin disinfection whereas the values in study by Julia L et al. [10] were 35.3% and 4.7% and by Ajay et al.[11] were 20.8% and 3.3% respectively. This shows that when compared

Table 1: Age distribution of study subjects.

<table>
<thead>
<tr>
<th>Age group (years)</th>
<th>Group I</th>
<th>Group II</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;20</td>
<td>6</td>
<td>12</td>
<td>18</td>
</tr>
<tr>
<td>20-39</td>
<td>22</td>
<td>44</td>
<td>66</td>
</tr>
<tr>
<td>40-59</td>
<td>13</td>
<td>26</td>
<td>39</td>
</tr>
<tr>
<td>60-79</td>
<td>8</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>80-99</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>50</td>
<td>100</td>
<td>150</td>
</tr>
</tbody>
</table>

Chi-square = 1.556 with 4 degrees of freedom; P = 0.817

Table 2: Comparison of mean age (years) among study groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean ± SD</th>
<th>Median (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>50</td>
<td>39.46 ± 18.28</td>
<td>37.5 (3 – 81)</td>
</tr>
<tr>
<td>Group II</td>
<td>50</td>
<td>41.6 ± 18.85</td>
<td>40.5 (3 – 84)</td>
</tr>
</tbody>
</table>

Discussion

The use of PVP-iodine in surgeries dates to 1955. Chlorhexidine gluconate with its increased efficiency has been recently made available all over as an antiseptic and disinfectant. In this study, we compared the efficacy of povidone-iodine alone and in combination with alcoholic chlorhexidine in elective clean surgeries for the prevention of surgical site infections. The present study was done on 100 patients who were to undergo elective clean cases in the Department of General Surgery, Government Medical College, Kota with the aims of evaluating the efficacy of povidone-iodine alone and in combination with an antiseptic agent containing alcoholic chlorhexidine on preoperative skin preparation, and to compare the rate of postoperative wound infections in both the groups. In present study 12% in group-I and 4% in group-II had colonization of site of incision even after skin disinfection whereas the values in study by Julia L et al. [10] were 35.3% and 4.7% and by Ajay et al.[11] were 20.8% and 3.3% respectively. This shows that when compared
Table 6: Sensitivity report.

<table>
<thead>
<tr>
<th>Antibiotic</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Patient 1</td>
<td>Patient 2</td>
</tr>
<tr>
<td>Amoxycillin</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Cefatoxime</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Gentamycin</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Amikacin</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>

*S = Sensitive

Table 7: Relationship between Microbiological report and post-operative wound infection rate.

<table>
<thead>
<tr>
<th>Microbiological report</th>
<th>Group I</th>
<th>Group II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No infection</td>
<td>Infection</td>
</tr>
<tr>
<td>No Growth</td>
<td>42</td>
<td>2</td>
</tr>
<tr>
<td>Growth</td>
<td>2</td>
<td>4*</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>6</td>
</tr>
</tbody>
</table>

Chi-square = 13.86 at 1 df; P < 0.001 (S)
Chi-square = 17.589, 1 df; P < 0.001 (S)

* - Post-operative infections with Positive culture report
# - Ward infections

to povidone-iodine alone, using a combination of povidone-iodine and an alcoholic solution of chlorhexidine, the colonization rates of the sites of incision were reduced significantly. The rate of postoperative wound infections (after excluding ward infections) in group I was 8% and of group II was 0% whereas the respective values in study by Brown et al. [12] were 8.1% and 6.0% and by Ajay et al. [11] were 13.3% and 0%. The difference in the results was not that significant in studies done by Park et al. [13], Sistla et al. [14], and Paoccharoen et al. [15]. The results from the present study show that pre-operative skin preparation using chlorhexidine gluconate 2.5% v/v in 70% propanol followed by aqueous povidone-iodine 5% w/v is effective when compared with aqueous povidone-iodine alone. The limitations of our study include convenient sample size and lack of diversity in patients, as it is a single-center study.

Conclusion

Despite many recent advances in surgical techniques in the past few years, post-operative wound sepsis remains a significant problem. There is now an increase in evidence that a high proportion of SSIs is caused by bacterial access into deeper skin structures during skin incision. Therefore, proper skin antiseptics might be one of the keys to reducing the colonization of the site of incision and thus reducing the incidence of subsequent infection. The present study confirms the superiority of povidone-iodine in combination with alcoholic chlorhexidine over povidone-iodine alone in pre-operative skin preparation and warrants recommendation of it as a preferred antiseptic in skin preparation for elective clean surgery. Since the superiority of this regimen was proved in decreasing incision site colonization and postoperative wound infection, it is prudent to use this regimen in contaminated and emergency surgeries. However, further studies are needed to explore the comparative efficacy of these agents in a larger number of patients with clinically relevant endpoints.

References

6. Health Protection Scotland. Targeted literature review: what are the key infection prevention and control recommendations to inform a surgical site infection (SSI) prevention quality improvement tool?


