Chlorhexidine and Alcohol Versus Povidone-Iodine for Antisepsis in Gynecological Surgery

Ishai Levin, M.D., Jonia Amer-Alshiek, M.D., Amiram Avni, M.D., Joseph B. Lessing, M.D., Abed Satel, B.Sc., R.N., and Benny Almog, M.D.

Abstract

Background: Surgical site infections (SSIs) cause severe morbidity and are associated with tremendous health costs. Skin antisepsis (cleansing) with chlorhexidine and alcohol solutions has demonstrated superiority to povidone-iodine in a variety of surgical interventions. Our objective was to determine if chlorhexidine and alcohol antisepsis protocol reduces the rate of SSIs in elective gynecological laparotomies compared with povidone-iodine antisepsis.

Methods: This retrospective study was carried out at the Department of Gynecology in a tertiary medical center in Tel Aviv. Patients undergoing elective gynecological laparotomies during two periods of time and who were treated with two different antisepsis protocols were included. The protocols for antisepsis were povidone-iodine 10% scrub followed by 10% povidone-iodine in 65% alcohol (n = 145) and chlorhexidine 2% followed by 70% alcohol (n = 111). The rate of SSIs as defined by the Centers for Disease Control and Prevention (CDC), and the risk factors for the occurrence of SSIs were calculated.

Results: Antisepsis with chlorhexidine and alcohol was associated with a reduction in the overall rate of SSIs from 14.6% to 4.5% compared with the povidone-iodine protocol (p = 0.011). The two groups of patients were similar in regard to baseline characteristics and medical history. Surgical procedures as well as the type of cut, drains, and tension suture use were similar in the two groups. Patients with SSIs tended to be older and heavier. Risk factors found to be associated with SSIs were hypertension, noninsulin-dependent diabetes mellitus (NIDDM), immunodeficiency, and the use of the povidone-iodine antisepsis protocol.

Conclusions: This retrospective study demonstrates that antisepsis with chlorhexidine and alcohol was associated with a significant reduction in the rate of SSIs compared to povidone-iodine antisepsis in patients undergoing elective gynecological laparotomies. This is of extreme clinical importance, as a change in antisepsis protocol can significantly reduce the morbidity and healthcare costs associated with patients undergoing elective gynecological surgery.

Introduction

Surgical site infections (SSIs) cause significant morbidity and mortality in hospitalized patients undergoing surgery. The reported increase in length of hospital stay and the associated costs are attributable to infections of the surgical site after surgery. Kirkland et al. found that a reported 6.5 additional days of hospitalization, carrying an extra cost of $3089, were attributable to SSIs. The Centers for Disease Control and Prevention (CDC) states that “SSIs are the third most frequently reported nosocomial infection, accounting for 14% to 16% of all nosocomial infections among hospitalized patients.” In surgical patients, SSIs account for 38% of nosocomial infections. A recent article published in the New England Journal of Medicine reported a significant decrease in SSIs with the use of chlorhexidine and alcohol-based preoperative skin antisepsis vs. povidone-iodine cleansing in clean-contaminated surgery.

A new policy based on the cited reports was issued by our Epidemiology Department. In accordance with the policy, in May 2008, we changed our antisepsis protocols from a 10% povidone-iodine scrub followed by 10% povidone-iodine in
65% alcohol solution to a 2% chlorhexidine scrub followed by 70% alcohol solution. No other change in patient care before or after surgery was instituted. Our primary aim in this study was to examine the SSI rate after this change of protocol. We also wished to assess different risk factors for SSIs in our patients and other parameters, such as the change in length of hospital stay before and after implementation of the new protocol.

Materials and Methods

We studied groups of patients undergoing elective gynecological surgery before and after the change of protocol. This study was approved by the local ethics committee.

We collected data from patients’ charts during two periods before and after the change in our antisepsis protocol. The first group of patients comprised of all patients (145) undergoing elective gynecological laparotomies during the year 2007 (group 1, povidone-iodine group). The second group included all patients undergoing elective gynecological laparotomies between January 1, 2009, and the end of August of that year (111 patients) (group 2, chlorhexidine and alcohol group). All patients in the two groups received preoperative per protocol prophylactic I.V. antibiotic with 750 mg of cefuroxime axetil.

Patient preparation

Patients in the povidone-iodine group were scrubbed by the surgeon preoperatively with an applicator that contained 10% povidone-iodine scrub solution (three consecutive applications), followed by drying with a sterile towel and three applications of 10% povidone-iodine in 65% alcohol solution. In the chlorhexidine group, patients were prepared similarly by three applications of 2% chlorhexidine solution followed by drying with a sterile towel and three applications of 70% alcohol. In both groups, the area scrubbed was from the xiphoid to the upper thigh level, reaching the midaxillar line laterally.

Patients with gynecological infections, such as pelvic inflammatory disease (PID) or tubo-ovarian abscesses, or patients undergoing nonelective surgery were not included in order to minimize bias.

Patient characteristics

Patient characteristics are presented in Table 1. Risk factors for SSIs included ischemic heart disease, diabetes, hypertension, immunocompromise, smoking status, weight, and previous chemotherapy. Also, previous surgical procedures were noted. We recorded such variables as the main diagnosis and the type of surgery. We evaluated the type of skin incision as well as the type of suture material for fascia and skin closure and the use of tension sutures.

Surgical site infection

The occurrence of SSI was determined by the attending gynecologist during hospitalization and included superficial incisional SSI involving only the skin, deep incisional SSI involving the subcutaneous tissues and fascia, and organ/space SSI in cases of generalized infection or burst abdomen. These definitions were comparable to and based on the criteria determined by the CDC.²

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Group 1 povidone-iodine</th>
<th>Group 2 chlorhexidine and alcohol</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, years ± SD</td>
<td>52.9 ± 15.1</td>
<td>51.2 ± 14.3</td>
<td>0.371</td>
</tr>
<tr>
<td>Weight (kg ± SD)</td>
<td>69.7 ± 15.8</td>
<td>69.5 ± 15.0</td>
<td>0.931</td>
</tr>
<tr>
<td>Additional characteristics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>35.9</td>
<td>27.9</td>
<td>0.225</td>
</tr>
<tr>
<td>NIDDM (%)</td>
<td>12.4</td>
<td>8.1</td>
<td>0.309</td>
</tr>
<tr>
<td>Obesity (%)</td>
<td>38.6</td>
<td>36.9</td>
<td>0.796</td>
</tr>
<tr>
<td>Smoking (%)</td>
<td>24.8</td>
<td>16.2</td>
<td>0.122</td>
</tr>
<tr>
<td>Ischemic heart disease (%)</td>
<td>4.1</td>
<td>3.6</td>
<td>1.000</td>
</tr>
<tr>
<td>MI (%)</td>
<td>4.1</td>
<td>1.8</td>
<td>0.472</td>
</tr>
<tr>
<td>Immunodeficiency (%)</td>
<td>15.9</td>
<td>12.7</td>
<td>0.591</td>
</tr>
<tr>
<td>Previous chemotherapy (%)</td>
<td>6.9</td>
<td>7.2</td>
<td>1.000</td>
</tr>
<tr>
<td>Cut type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low transverse</td>
<td>53.5</td>
<td>48.2</td>
<td>0.356</td>
</tr>
<tr>
<td>Longitudinal</td>
<td>40.3</td>
<td>48.2</td>
<td></td>
</tr>
<tr>
<td>Both</td>
<td>6.2</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Presence of drain (%)</td>
<td>31.9</td>
<td>27.0</td>
<td>0.338</td>
</tr>
<tr>
<td>Tension sutures (%)</td>
<td>7.6</td>
<td>9.0</td>
<td>0.819</td>
</tr>
</tbody>
</table>

MI, myocardial infarction; NIDDM, noninsulin-dependent diabetes mellitus; SD, standard deviation.

Patients were evaluated 3 weeks after discharge during the scheduled postoperative clinic visit for complications. This postoperative visit permitted us to evaluate patients for SSIs after their discharge from the hospital. This gave us the benefit of evaluating medium-term SSI complications and not only short-term intrahospital infections.

Statistical analysis

The statistical analysis was carried out using the SPSS software package (SPSS Inc., Chicago, IL). Differences between parameters in the different patient groups were evaluated using Fisher exact test and Student’s t test where appropriate. Differences between proportions were evaluated using the chi-square test. Stepwise logistic regression analysis were performed to pinpoint and reveal odd ratios (OR) for contributing factors to SSIs.

Results

We collected data from 145 patients undergoing gynecological elective laparotomies using a povidone-iodine protocol for antisepsis and 111 patients undergoing elective gynecological laparotomies using a chlorhexidine and alcohol antisepsis protocol. There was no statistical difference in patients’ age and weight between the two groups. The proportion of patients in the two groups with risk factors for SSIs did not reveal any statistical difference (Table 1). Risk factors studied were ischemic heart disease or previous myocardial infarction (MI), noninsulin-dependent diabetes mellitus (NIDDM), hypertension, obesity, and a history of chemotherapy. The proportion of patients with midline skin incisions and the proportion of patients with tension sutures and drains were not different statistically in the two groups (Table 1).

SSI occurrences in the two groups are summarized in Table 2. We used the anatomic classification for surgical site infec-
The infection rate for the 10% povidone-iodine protocol was 14.6% vs. 4.5% SSI rate for the 2% chlorhexidine protocol \( (p = 0.011) \). When grouped for all types of SSIs, patients with infections in both groups were significantly older \( (59.8 \pm 14.2 \text{ years}, p = 0.005) \) and heavier \( (78.4 \pm 17.1 \text{ kg}, 68.6 \pm 15.0 \text{ kg}, p = 0.003) \). As expected, the hospital stay was significantly longer in patients with SSIs \( (11.8 \pm 7.7 \text{ days}, 6.3 \pm 3.2 \text{ days}, p = 0.002) \).

A logistic regression analysis aimed at pinpointing risk factors for SSI’s revealed that the risk factors for developing these complications were immunodeficiency status \( (OR 3.28, 95\% \text{ confidence interval} \ [CI] 1.20-8.98) \), hypertension \( (OR 2.69, 95\% \text{ CI} 1.04-6.93) \), and the use of tension sutures \( (OR 3.70, 95\% \text{ CI} 1.10-12.48) \). The use of povidone-iodine 10% for skin antisepsis was also found to be a significant risk factor for SSIs \( (OR 3.25, 95\% \text{ CI} 1.13-9.30) \).

### Discussion

We found a significant decrease in the rate of SSIs when using chlorhexidine 2% and 70% alcohol for surgical site cleansing compared to 10% povidone-iodine scrub and alcohol solution in patients undergoing elective gynecological laparotomies.

A significant amount of research has dealt with methods aimed at reducing the rates of SSIs in gynecology as well as other surgical programs. Maintaining normothermia as opposed to mild hypothermia has been shown to decrease the SSI rate from 19% to 6% and to decrease hospital stay in colorectal surgical patients. A Cochrane review by Tanner et al. demonstrated that hair clipping or the application of a depilatory cream before surgery as opposed to no hair removal does not change the rate of SSIs. Two randomized studies examining supplemental perioperative oxygen in colorectal surgical patients reduced the rate of SSIs to a significant extent.

Perioperative antibiotic prophylaxis has been shown to reduce infection rates in surgical patients. This has been demonstrated in colorectal patients as well as in gynecology patients. Fujita et al. demonstrated that three-dose cefmetazole administration is effective in reducing rates of SSIs as opposed to a single dose in elective colorectal surgical patients. In gynecological laparoscopic procedures, Litta et al. found that antibiotic prophylaxis is not needed; however Matkaris et al. demonstrated a reduction in infection rate and hospital costs in patients undergoing gynecological surgery with prophylactic antibiotic therapy.

Presurgery cleansing methods with different antisepsis preparations have been studied before a recent publication in the New England Journal of Medicine. Chlorhexidine and alcohol solutions for skin preparation demonstrated superiority in the prevention of SSIs as opposed to povidone-iodine cleansing. This has been demonstrated in nongynecology invasive procedures, such as intravascular catheter related infections and foot and ankle surgery. In fact, the CDC has adopted this method of cleansing because of its superiority over the use of povidone-iodine solutions and has issued guidelines for the prevention of intravascular catheter-related infections.

In patients undergoing vaginal hysterectomy, Culligan et al. demonstrated that cleansing with chlorhexidine as opposed to povidone-iodine reduced the rate of bacterial colonization in the operative field. Sowapat et al. did not find a significant difference in febrile mortality in patients undergoing total abdominal hysterectomy after cleansing with chlorhexidine or povidone-iodine solutions. Our study demonstrates the superiority of an antisepsis protocol preceding gynecological laparotomies using chlorhexidine 2% soap solution followed by alcohol 70%.

In this retrospective study, we were able to demonstrate the advantage of chlorhexidine antisepsis in a large group of patients undergoing elective surgery. The two groups of patients were comparable in terms of baseline characteristics and risk factors for SSIs. As our antisepsis protocol was determined by the institutional Epidemiology Department and not decided upon by our department and as other parameters in preoperative and postoperative surgical care were not changed, our bias was minimized. To further minimize bias, we excluded patients with infectious conditions, such as PID and tubo-ovarian abscesses. We did not encounter infected tissues during surgery, and no spillage of infected material or alimentary tract content occurred. Thus, all SSIs were classified as clean-contaminated wounds. The anatomic distribution of SSIs is given in Table 2. Moreover, our study design, unlike some studies cited, examined medium-term SSI rate rather than short-term intrahospital occurrences of SSIs.

Most important, there was a significant difference between the rate of SSIs in the two groups of patients. Patients treated with the older protocol of 10% scrub solution followed by 10% povidone-iodine in 65% alcohol had an infection rate of 14.6% vs. 4.5% \( (p = 0.011) \) in the 2% chlorhexidine solution and 70% alcohol groups. In fact, the risk of developing SSIs with the use of povidone-iodine compared to chlorhexidine is 3.2 higher \( (OR 3.2, 95\% \text{ CI} 1.13-9.30) \).

Regression analysis demonstrated that risk factors for SSIs are older age, immunodeficiency status, hypertension, use of tension sutures, and obesity. Similar to our findings, CDC guidelines for prevention of SSIs list age, diabetes, obesity, and an altered immune response as risk factors for SSIs.

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**Table 2. Surgical Site Complications**

<table>
<thead>
<tr>
<th>Number of patients (%)</th>
<th>Superficial incisional SSI</th>
<th>Deep incisional SSI</th>
<th>Organ/Space SSI</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1 Povidone-iodine ( n = 145 )</td>
<td>10 (6.9)</td>
<td>10 (6.9)</td>
<td>1 (0.7)</td>
<td>21 (14.6)</td>
</tr>
<tr>
<td>Group 2 Chlorhexidine and alcohol ( n = 111 )</td>
<td>3 (2.7)</td>
<td>2 (1.8)</td>
<td>0 (0)</td>
<td>5 (4.5)</td>
</tr>
</tbody>
</table>

Complications as defined by the Centers for Disease Control and Prevention.2

SSI, surgical site infection.
Hypertension and the use of tension sutures are not mentioned, although the presence of foreign bodies (e.g., tension sutures) increases SSIs.2

In conclusion, we believe that the use of an antisepsis protocol of 2% chlorhexidine and 70% alcohol solution is superior to one of 10% povidone-iodine scrub followed by 10% povidone-iodine in alcohol and carries a significantly lower risk of developing SSIs. This antisepsis protocol has demonstrated superiority in other operative interventions, and we were able to demonstrate this in elective gynecological laparotomies. The design of the study was retrospective, but the significance of the results is of extreme clinical importance, as the impact of SSIs on morbidity and mortality and on healthcare costs is tremendous.

The findings of this study in conjunction with previous reports of general surgery and gynecology further support our belief that the use of an antisepsis protocol of 2% chlorhexidine and 70% alcohol solution should be adopted as routine antisepsis protocol.

Disclosure Statement

The authors have no financial, professional, legal, religious, or other interests to disclose.

References


Address correspondence to:

Ishai Levin, M.D.
Department of Gynecology
Lis Maternity Hospital
Tel Aviv Sourasky Medical Center
Tel Aviv
Israel

E-mail: ilevin@post.tau.ac.il
ishai.levin@gmail.com