Best evidence topic - Cardiac general

Should surgeons scrub with chlorhexidine or iodine prior to surgery?

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Summary

A best evidence topic was written according to a structured protocol. The question addressed was whether chlorhexidine gluconate is equivalent or superior to the use of povidone-iodine during surgical hand scrub. A total of 593 papers were found using the reported searches of which eight represented the best evidence to answer the clinical question. The authors, date, journal, study type, population, main outcome measures and results are tabulated. We conclude that whilst both chlorhexidine and povidone-iodine reduce bacterial count after scrubbing, the effect of chlorhexidine is both more profound and longer lasting. The studies found analysed the difference in reduction in colony forming units or bacterial count following surgical scrub in order to conclude that chlorhexidine was superior. Four studies went further to analyse cumulative and residual activity by testing for bacterial reduction after using a scrub solution for a number of days, an area in which chlorhexidine showed consistent advantages over povidone-iodine. These findings are given more credibility by the clinical finding of a recent meta-analysis of over 5000 patients in which chlorhexidine as an antiseptic skin preparation was associated with significantly reduced surgical site infection (SSI) in clean-contaminated surgery. Despite this, there is no evidence suggesting the use of chlorhexidine during hand scrub reduces SSI, which perhaps explains why guidelines from the World Health Organization, the Centers for Disease Control and Prevention and the Association for Perioperative Practice do not recommend one specific antimicrobial over another for hand scrub.

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Keywords: Chlorhexidine; Povidone-iodine

1. Introduction

A best evidence topic was constructed according to a structured protocol. This protocol is fully described in the ICVTS [1].

2. Clinical scenario

Whilst scrubbing for a theatre list your third-year medical student asks whether it is better to scrub with chlorhexidine or betadine. The scrub nurse says confidently that betadine produces a better lather and is thus superior. You resolve to check the literature yourself.

3. Three-part question

In [patients undergoing an aseptic surgical procedure] is hand scrubbing with [chlorhexidine] or [povidone-iodine] the best solution for [hand asepsis].

4. Search strategy

Medline from 1948 to January 2011 using the OVIDSP interface with the terms (exp betadine/OR betadine.mp or iodine.mp) AND (chlorhexidine.mp. OR exp Chlorhexidine)/.

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5. Search outcome

Five hundred and ninety-three papers were found using the reported search on Medline. From these, eight papers were identified that provided the best evidence to answer the question. These are presented in Table 1.

6. Results

Tanner et al. [2] conducted a systematic review in which 10 trials were included. Of these, three compared chlorhexidine and povidone-iodine [3–5]. Evidence from these studies suggests that chlorhexidine is significantly more effective than povidone-iodine based scrubs in terms of the reduction in the number of colony formed units (CFUs) on the hands both immediately after scrubbing, 2 h after scrubbing and at the end of the surgical procedure. The authors of systematic review suggest that in ‘In the absence of information regarding the clinical impact of CFUs on surgical site infection (SSI), it is tentatively suggested that aqueous scrub solutions of chlorhexidine should be used in preference to aqueous povidone-iodone scrubs for surgical hand antisepsis’.

Noorani et al. [6] conducted a meta-analysis aiming to assess whether preoperative anti-sepsis with chlorhexidine or povidone-iodine reduced SSI. Six trials were identified containing a total of 5031 patients in which using a random-
### Table 1. Best evidence papers

<table>
<thead>
<tr>
<th>Author, date and country</th>
<th>Patient group</th>
<th>Outcomes</th>
<th>Key results</th>
<th>Comments</th>
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</thead>
<tbody>
<tr>
<td>Tanner et al., (2008), Cochrane Database Syst Rev, UK, [2]</td>
<td>Ten trials were included, of which three compared chlorhexidine and povidone-iodine</td>
<td>Reduction in number of colony forming units (CFUs)</td>
<td>Five minutes scrub group: chlorhexidine significantly more effective than povidone-iodine in reducing the number of CFUs immediately after scrubbing (WMD: −0.34: 95% CI: −0.64 to −0.04) and 2 h after scrubbing (WMD: −0.75: 95% CI: −1.06 to −0.44)</td>
<td>All three studies, which were randomized in design, revealed chlorhexidine was significantly more effective immediately and residually at reducing CFUs. No mention of blinding of laboratory staff in any of the studies.</td>
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<td>Pereira et al. (1990)</td>
<td>Three minutes scrub group: No difference in CFUs between the groups immediately post scrubbing, but significantly fewer CFUs in the chlorhexidine group 2 h after the initial scrub (WMD: −0.40: 95% CI: −0.71 to −0.09)</td>
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<td>Furukawa et al. (2005)</td>
<td>Three minutes scrub group: No difference in CFUs between the groups immediately post scrubbing, but significantly fewer CFUs in the chlorhexidine group 2 h after the initial scrub (WMD: −0.40: 95% CI: −0.71 to −0.09)</td>
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<td>Herruzo-Cabrera et al. (2000)</td>
<td>Significantly fewer CFUs in the chlorhexidine group immediately after scrubbing (WMD: −2.40: 95% CI: −3.26 to −1.54)</td>
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<td>Noorani et al., (2010), Br J Surg, UK, [6]</td>
<td>Significantly fewer CFUs in the chlorhexidine group immediately after scrubbing (WMD: −2.40: 95% CI: −3.26 to −1.54)</td>
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<td>Meta-analysis (level 1 evidence)</td>
<td>Six eligible studies were identified containing 5031 patients of whom 2539 received chlorhexidine and 2492 received povidone-iodine</td>
<td></td>
<td>Chlorhexidine reduced postoperative surgical site infection compared with povidone-iodine (odds ratio 0.68, 95% CI 0.50–0.94; P = 0.019)</td>
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<table>
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<tr>
<th>Author, date and country, Study type (level of evidence)</th>
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<tr>
<td>Faoagali et al., (1995), Am J Infect Control, Australia, [7] Randomized controlled trial (level 2 evidence)</td>
<td>Thirty-three non-clinical hospital staff randomly divided into groups by Latin square design. Each subject required to use a handwash product for five days using a standardised method</td>
<td>Log$_{10}$ reduction in bacterial count (mean ± S.D.)</td>
<td>Immediate Chlorhexidine: 1.0572 ± 0.5785 Povidone-iodine: 1.0957 ± 0.5218 Three hours residual Chlorhexidine: 0.4036 ± 0.7073 Povidone-iodine: 0.2851 ± 0.7387</td>
<td>Both chlorhexidine and povidone-iodine showed statistically significant reduction in bacterial count immediately after washing (both P &lt; 0.05). There was no statistically significant difference between the two at this stage</td>
</tr>
<tr>
<td>Cre´mieux et al., (1989), Appl Environ Microbiol, France, [8] Randomized controlled trial (level 2 evidence)</td>
<td>One hundred and twenty-five non-clinical volunteers took part in a multi-centre trial comparing two scrub solutions</td>
<td>Mean log reduction of bacteria (pooled results)</td>
<td>Day 1 Chlorhexidine: 1.08 ± 0.57 Povidone-iodine: 0.94 ± 0.57 No significant difference between groups Day 5 Chlorhexidine: 2.42 ± 0.81 Povidone-iodine: 1.67 ± 0.78 Statistically significant difference (P = 0.0000) Day 8 Chlorhexidine: 0.45 ± 0.58 Povidone-iodine: 0.20 ± 0.74 Statistically significant trend (P = 0.077)</td>
<td>Results suggest chlorhexidine has a cumulative and residual effect</td>
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<tr>
<td>Aly and Maibach, (1988), Am J Infect Control, USA, [9] Randomized controlled trial (level 2 evidence)</td>
<td>Thirty-nine adult volunteers were randomly assigned to a particular scrub solution</td>
<td>Bacterial count</td>
<td>Chlorhexidine achieved consistent mean log$_{10}$ bacterial count reductions from the baseline count immediately after scrubbing and at 3 h and 6 h later Povidone-iodine achieved consistent reductions from the baseline count immediately after scrubbing but not at 3 and 6 h later</td>
<td>Chlorhexidine produced a statistically significant reduction (P &lt; 0.01) in bacterial count compared with povidone-iodine at all sampling times At 6 h, all povidone-iodine bacterial counts exceeded the baseline counts, showing a lack of residual activity Specific bacterial counts not given in paper</td>
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<td>Nineteen clinical hospital staff, taking part in 48 operations</td>
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<td>Average reduction of bacteria</td>
<td>Immediately after scrubbing: Chlorhexidine – 98.3% Povidone-iodine – 78.9%</td>
<td>Chlorhexidine showed increased reduction in bacteria count immediately after scrubbing and at the end of the operations compared with povidone-iodine, but this was not statistically significant</td>
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<td>Five clinical hospital staff involved in a total of 89 orthopedic surgical procedures in a crossover trial</td>
<td>Participants scrubbed for 3 min with a brush</td>
<td>Fall in bacterial count after scrubbing for case 1 of the day (pooled data)</td>
<td>Chlorhexidine: 4.7×10^6 to 9.1×10^4 (paired t-test, P&lt;0.001) Povidone-iodine: 1.6×10^6 to 5.3×10^4 (paired t-test, P&lt;0.001) Overall, the chlorhexidine group gave a 52-fold reduction, povidone-iodine group gave a three-fold reduction (unpaired t-test, P&lt;0.001)</td>
<td>Chlorhexidine showed a cumulative and persistent effect during the day. Pre-scrubbing levels were seven-fold (1.86 log) lower prior to case 2 compared to case 1 (unpaired t-test, P&lt;0.01). Povidone-iodine did not show a cumulative effect</td>
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<tr>
<td>Seventy non-clinical male hands, subjected to one of five different scrub solutions</td>
<td>Hand and subungal bacterial count measured before and after 3 min standardised scrub with brush</td>
<td>Reduction in bacterial count</td>
<td>Chlorhexidine: Percentage reduction in bacterial hand count: 99.6% Log reduction in subungal bacterial count: 4.78 Povidone-iodine: Percentage reduction in bacterial count: 96.1% Log reduction in subungal bacterial count: 4.62</td>
<td>Allocation to scrub solutions not explained. Laboratory staff not blinded</td>
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</tbody>
</table>

WMD, weighted mean difference.

effects model, they demonstrated that chlorhexidine significantly reduced postoperative SSI (pooled odds ratio 0.68, 95% confidence interval 0.50–0.94).

Faooagali et al. [7] conducted a prospective randomized trial in which 33 subjects all sequentially rotated in using particular scrub solution to assess the immediate, 3 h residual and five-day cumulative effects on the bacterial count. This study showed that immediately after scrubbing there was no statistically significant difference in bacterial count between chlorhexidine and povidone-iodine, but at 3 h post-scrubbing, chlorhexidine showed a statistically significant (0.001<P<0.01) reduction in bacterial count whilst povidone-iodine showed a significant bacterial regrowth (0.02<P<0.05).

Crémieux et al. [8] conducted a multicentre prospective randomized trial in which 125 non-clinical volunteers each spent eight days using a particular scrub solution. In order to test immediate, cumulative and residual effect, the protocol consisted of five daily hand washings and a single wash on day 8 after three days interruption. Chlorhexidine showed no difference in immediate effect (day 1), but produced a statistically significant reduction in bacterial count on day 5 (cumulative effect) and a statistically significant trend in reduction on day 8 (residual effect).
Aly and Maibach [9] conducted a prospective randomized trial in which 39 normal healthy volunteers were assigned to scrub in a standardised fashion with either chlorhexidine, povidone-iodine and chloroxylenol. Bacterial counts were taken immediately after scrubbing and at 3 and 6 h later on days 1, 2, and 5. Chlorhexidine produced a statistically significant reduction in bacterial count at all sampling times when compared with povidone-iodine. Povidone-iodine showed a lack of residual activity, since at 6 h after scrubbing all bacterial counts exceeded the baseline counts.

Noparat et al. [10] conducted a prospective non-randomized trial in which 19 members of staff took part in 48 surgical procedures. Bacterial colony count reduction after scrubbing and persistent killing effects of bacteria at the surgical procedures. Bacterial colony count reduction after scrubbing all bacterial counts exceeded the baseline counts.

Grabsch et al. [11] conducted a prospective non-randomized trial in which five members of staff took part in a total of 89 surgical procedures. They showed that immediately after scrubbing chlorhexidine gave a 52-fold reduction in bacteria whereas povidone-iodine only gave a three-fold reduction, which was a statistically significant difference. In addition, chlorhexidine showed a cumulative and persistent effect evidenced by persistent bacterial reduction prior to scrubbing for subsequent cases of the day.

Namura et al. [12] conducted a prospective non-randomized trial in which 14 participants trialled different scrub solutions using a standardised scrub method. Whilst chlorhexidine produced a greater reduction in bacterial and subungal bacterial count than povidone-iodine after scrubbing, they detected no statistically significant difference.

7. Clinical bottom line

Both chlorhexidine and povidone-iodine cause an immediate reduction in bacteria, however, the reduction when using chlorhexidine is more dramatic. In addition, povidone-iodine shows a lack of cumulative and residual activity in comparison to chlorhexidine. Although the strong residual activity of chlorhexidine is described in the Centers for Disease Control and Preventions ‘Guideline for Hand Hygiene in Health-Care Settings’ [13], they do specifically recommend one form of antimicrobial soap over another. The Association for Perioperative Practice ‘Surgical Hand Antisepsis’ guidelines reference evidence that chlorhexidine is associated with a greater reduction in CFUs but again does not recommend any antimicrobial over another [14].

References