

## مجموعه مقالات نشست بین‌المللی «هم‌رأیی» درباره عفونت مفاصل مصنوعی

رؤسای جلسه:

دکتر جواد پرویزی، دکتر تورستن گرک

### Proceedings of the International Consensus Meeting on Periprosthetic Joint Infection

#### Chairmen:

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#### قسمت دوم:

#### آماده‌سازی قبل از عمل پوست

#### Question 1A: Is there a role for preoperative skin cleansing with an antiseptic?

**Consensus:** Yes. Preoperative cleansing of the skin with chlorhexidine gluconate (CHG) should be implemented. In the presence of a sensitivity to CHG, or when it is unavailable, it is our consensus that antiseptic soap is appropriate.

**Delegate Vote:** Agree: 90%, Disagree: 8%, Abstain: 2% (Strong Consensus)

#### Question 1B: What type and when should preoperative skin cleansing with an antiseptic be implemented?

**Consensus:** We recommend that whole-body skin cleansing should start at least the night prior to elective arthroplasty. It is a consensus that after bathing patients are advised to sleep in clean garments and bedding without the application of any topical products.

**Delegate Vote:** Agree: 85%, Disagree: 10%, Abstain: 5% (Strong Consensus)

#### Justification:

##### Preoperative showering or cleansing

Two meta-analyses of 7 randomized control trials (RCT) performed by the Cochrane group found that preoperative showering with CHG did not reduce the rate of surgical site infection (SSI) when compared to no shower (3 RCTs) or placebo (4 RCTs).<sup>1</sup> Two observational studies using CHG wipes in total joint arthroplasty patients demonstrated a non-statistically significant reduction in the incidence of SSI.<sup>2,3</sup> Johnson et al. found in a prospective consecutive series that patients who used CHG wipes one day preoperatively and the morning of the operation had a lower incidence of SSI than patients who did not comply with this protocol prior to total hip

arthroplasty.<sup>2</sup> These results were reproduced using a similar protocol in total knee arthroplasty patients.<sup>3</sup> In neither study were patients randomized to receive treatment or no treatment; however, the authors compared patients who completely complied with the protocol to patients who did not comply. Patients with partial compliance were excluded from both studies.

##### Chlorhexidine and methicillin-resistant organisms

A systematic review of the literature conducted by Karki et al. reported on a meta-analysis of two before-and-after studies that showed non-rinse skin cleansing with CHG washcloths was effective in reducing the risk of methicillin-resistant *Staphylococcus aureus* (MRSA) skin colonization in the setting of the intensive care unit. However, a meta-analysis of 4 before-and-after studies showed no evidence that CHG washcloths reduce the risk of MRSA infection.<sup>4</sup> Other studies have shown that CHG cleansing leads to a lower rate of MRSA colonization in the hospital setting.<sup>5,6</sup> One case-control study evaluating a protocol of a 5-day course of intranasal mupirocin and daily CHG cloths (beginning one day before surgery and continuing the day of surgery and postoperative days 1-3) in a non-general surgery population reported statistically significant decreases in the rate of MRSA SSI in the two years following implementation of this protocol.<sup>7</sup> However, in these studies CHG washcloths were used as part of a broader *Staphylococcus aureus* decolonization protocol. Therefore, it is not possible to determine the impact on SSI of decolonization or CHG wash clothes, independently.

##### Timing of preoperative shower or cleansing

No studies have focused on the impact of the time or duration of preoperative cleansing with an antiseptic agent. Some studies have implemented protocols of washing the surgical site once on the night prior to surgery and on the morning of the operation,<sup>3,8,9</sup> while other protocols have continued washing through post-

operative day 3.<sup>7</sup> One study conducted with a small sample size of volunteers noted decreased microbial colonization with a CHG wash over the course of a 5 day period.<sup>37</sup> Currently, the Centers for Disease Control (CDC) recommends that preoperative showering begin at least the night prior to surgery.<sup>10</sup> Caution should be exercised to ensure that patients do not use preoperative CHG wash excessively, as studies suggest no benefit for such practice that may also lead to skin irritation.<sup>11,12</sup>

#### Whole body cleansing vs localized surgical site-specific cleansing

One large RCT showed that whole-body cleansing was more effective at reducing the rate of SSI than surgical site-specific washing.<sup>13</sup> We recommend that whole body preoperative skin cleansing be undertaken preoperatively.

#### **Question 2: Which agent, if any, is the optimal agent for surgical skin preparation?**

**Consensus:** There is no clear difference between various skin preparation agents. There is some evidence that combinations of antiseptic agents with alcohol may be important for skin antiseptics.

**Delegate Vote:** Agree: 89%, Disagree: 8%, Abstain: 3% (Strong Consensus)

#### **Justification:**

While CHG is the recommended agent for preventing intravenous catheter-related infections,<sup>14</sup> the CDC currently does not recommend one agent over another for prevention of SSI.<sup>10</sup> When compared directly, results are conflicted as to whether CHG or povidone-iodine provides superior skin antiseptics and lowers the rate of SSI. In a large, multicenter RCT, Darouiche et al. showed that CHG in alcohol showed a significant reduction in the rate of SSI when compared to aqueous povidone-iodine scrub and paint; however, the iodine preparation did not use alcohol as a solvent.<sup>15</sup> Conversely, in a single-institution, observational, non-concurrent control study of general surgery patients, Swenson et al. found that when alcohol was used (either as a solvent or a scrub following iodine paint), patients prepped with povidone-iodine had a lower rate of SSI.<sup>16</sup> Other studies have shown that there is no difference in the rate of SSI between patients prepped with either CHG or iodophors.<sup>17,18</sup> To date, there are no prospective randomized studies comparing skin preps in patients undergoing total joint arthroplasty. We therefore have insufficient evidence to recommend a preferred agent for preventing SSI in elective arthroplasty procedures.

Alcohol is used as an antiseptic because of its rapid antimicrobial action.<sup>10</sup> One systematic review of 5 RTCs found that CHG-alcohol formulations were more effective at preventing SSI than aqueous povidone-iodine solutions, and in other studies there was no conclusive evidence that CHG-alcohol solutions were more effective than povidone-iodine products dissolved in alcohol or aqueous solutions.<sup>19</sup> While we cannot make a claim about

the superiority of CHG over iodine-based antiseptics, it is suggested that whichever agent is chosen, it be dissolved in alcohol. However, caution should be taken to allow time for adequate drying of alcohol-based products, as operating room fires have been reported.<sup>10,20</sup>

#### **Question 3A: What is the proper method of hair removal?**

**Consensus:** Clipping, as opposed to shaving, is the preferred method for hair removal. We cannot advise for or against the use of depilatory cream for removal of hair.

**Delegate Vote:** Agree: 92%, Disagree: 3%, Abstain: 5% (Strong Consensus)

#### **Question 3B: When should hair removal be performed?**

**Consensus:** If necessary, hair removal should be performed as close to the time of the surgical procedure as possible.

**Delegate Vote:** Agree: 94%, Disagree: 4%, Abstain: 2% (Strong Consensus)

#### **Justification:**

Clipping is the best form of hair removal: Concern over shaving has been raised because abrasions formed from the shaving process can become sites of bacterial growth. A recent systematic review of randomized and quasi-RCTs showed that clipping lowered the rate of SSI when compared to shaving.<sup>21</sup> Many other studies have shown the superiority of clipping over shaving, using postoperative SSI as the primary endpoint.<sup>22-24</sup> Some institutions utilize depilatory agents as skin preparation.

Hair removal should be performed close to the time of surgery: There is currently no evidence in the literature that shows the most appropriate setting and time in which to remove hair from the surgical site. One study investigated the effects of hair removal the night before surgery compared to hair removal on the day of surgery and found that clipping on the morning of surgery was associated with a lower SSI rate.<sup>25</sup> Another retrospective review demonstrated that shaving immediately before a surgical procedure was associated with a lower SSI rate than shaving 24 hours or greater prior to surgery. However, this study did not include patients who used clipping to remove hair and was designed to test the effect of shaving versus depilatory removal.<sup>26</sup> The CDC recommends not removing hair preoperatively unless the hair at or around the incision site will interfere with the operation. If hair removal is necessary, it should be performed immediately prior to the operation and preferably with electric clippers.<sup>10</sup> Given the overall lack of research specific to the environment in which preoperative hair removal should take place, we recommend that hair removal be performed in the hospital as close to the time of surgery as possible by

either the surgical team or the trained nursing staff. If practical, we suggest that this removal take place outside of the operating room.

**Question 4: What special considerations should be given to a patient with skin lesions?**

**Consensus:** Elective arthroplasty should NOT be performed in patients with active ulceration of the skin in the vicinity of the surgical site. It is our consensus that incisions should not be placed through active skin lesions. For certain lesions, such as those due to eczema and psoriasis, surgery should be delayed in these patients until their lesions have been optimized.

**Delegate Vote:** Agree: 96%, Disagree: 2%, Abstain: 2% (Strong Consensus)

**Justification:**

Elective arthroplasty in patients with active skin ulcerations: The orthopaedic literature is deficient in studies evaluating SSI in patients with active skin ulcerations. However, one prospective audit showed that active ulceration of the skin was a significant risk factor for wound infection.<sup>27</sup> Therefore, we recommend that elective arthroplasty should not be carried out in patients with active skin ulcerations of the surgical field (active ulcerations defined as breaks in the skin barrier, excluding superficial scratches).

Surgical incisions through eczematous or psoriatic lesions: Likewise, there are no existing studies evaluating the risk of SSI when incisions are placed through eczematous or psoriatic lesions. Some retrospective studies have reported high rates of SSI and periprosthetic joint infection (PJI) in patients with a diagnosis of psoriasis or eczema.<sup>28,29</sup> However, the latter studies did not evaluate whether it was the placement of incision through the affected skin or the overall immunosuppressed status of these patients with psoriasis or eczema that increased the risk of SSI. Given reported poor outcomes as well as increased bacterial load on psoriatic skin,<sup>30</sup> placing surgical incisions through eczematous or psoriatic lesions should be avoided if possible. Surgery should be delayed in these patients until these lesions are optimized.

**Question 5A: How should the surgeon and assistants wash their hands?**

**Consensus:** The surgeon and operating room personnel should mechanically wash their hands with an antiseptic agent for a minimum of 2 minutes for the first case. A shorter period may be appropriate for subsequent cases.

**Delegate Vote:** Agree: 71%, Disagree: 24%, Abstain: 5% (Strong Consensus)

**Question 5B: With what agent should the surgeon and assistants wash their hands?**

**Consensus:** There is no clear difference among various antiseptic agents for hand washing.

**Delegate Vote:** Agree: 80%, Disagree: 15%, Abstain: 5% (Strong Consensus)

**Justification:**

Duration of hand washing: A review of the literature performed by Tanner et al. found 4 RCTs comparing different durations of surgical team skin antisepsis.<sup>31-34</sup> All of the studies used colony forming units (CFU) present on the surgical staff's hands, not SSI, as the primary endpoint. One study found no difference between a 2 or a 3 minute scrub and a 1 minute hand washing with soap and water.<sup>34</sup> Another group found that a 1 minute hand washing followed by a 3 minute hand rub using alcohol was more effective in reducing CFUs than a 5 minute hand rub.<sup>31</sup> Pereira et al. found that both a 5 and 3 minute initial scrub with either CHG or povidone-iodine were equally as effective in reducing CFUs.<sup>32,35</sup> Current recommendations vary on the duration of hand antisepsis; the CDC recommends 2-5 minutes,<sup>10</sup> while the Association of Perioperative Registered Nurses states that a 3-4 minute scrub is as effective as a 5 minute scrub.<sup>36</sup> Based on the variability present in the current literature, we recommend that the duration of surgical hand antisepsis last for a minimum of 2 minutes. For the first case, we recommend a mechanical washing (either a scrub or soap-and-water washing) for a minimum of 2 minutes. There is no clear evidence supporting the utility of a particular hand washing method for subsequent cases. If there is a chance of contamination, the process for the first case should be repeated.

Optimum agent for hand washing: Results are inconclusive regarding the most effective agent for surgical hand antisepsis. Only one of 10 RCTs in the systematic review performed by Tanner et al.<sup>33</sup> reported SSI as the primary outcome. One large, multicenter, prospective, equivalence-cluster, randomized crossover study demonstrated that traditional (5 minute) scrubbing methods and aqueous agents (4% CHG or 4% povidone-iodine) were equally as effective at reducing the incidence of SSI compared to a single hand wash for 1 minute with non-antiseptic soap at the start of the day followed by alcohol-only rubs. The efficacy of CHG compared to povidone-iodine was not directly tested as each institution was able to choose which scrub agent they incorporated into their protocol.<sup>37</sup> A retrospective, observational study that used wound infection as the primary endpoint found no difference between an alcohol-based rub product and a traditional 6 minute brush hand scrubbing; however, the authors did not describe the protocol or agent used for the traditional scrub group arm.<sup>38</sup>

## References

1. Webster J, Osborne S. Preoperative bathing or showering with skin antiseptics to prevent surgical site infection. *Cochrane Database Syst Rev*. 2012;9:CD004985.
2. Johnson AJ, Daley JA, Zywiell MG, Delanois RE, Mont MA. Preoperative chlorhexidine preparation and the incidence of surgical site infections after hip arthroplasty. *J Arthroplasty*. 2010;25(6 Suppl):98-102.
3. Zywiell MG, Daley JA, Delanois RE, Naziri Q, Johnson AJ, Mont MA. Advance pre-operative chlorhexidine reduces the incidence of surgical site infections in knee arthroplasty. *Int Orthop*. 2011;35(7):1001-6.
4. Karki S, Cheng AC. Impact of non-rinse skin cleansing with chlorhexidine gluconate on prevention of healthcare-associated infections and colonization with multi-resistant organisms: a systematic review. *J Hosp Infect*. 2012;82(2):71-84.
5. Mehta S, Hadley S, Hutzler L, Slover J, Phillips M, Bosco JA, 3rd. Impact of preoperative MRSA screening and decolonization on hospital-acquired MRSA burden. *Clin Orthop Relat Res*. 2013;471(7):2367-71.
6. Simor AE, Phillips E, McGeer A, et al. Randomized controlled trial of chlorhexidine gluconate for washing, intranasal mupirocin, and rifampin and doxycycline versus no treatment for the eradication of methicillin-resistant *Staphylococcus aureus* colonization. *Clin Infect Dis*. 2007; 44(2):178-85.
7. Thompson P, Houston S. Decreasing methicillin-resistant *Staphylococcus aureus* surgical site infections with chlorhexidine and mupirocin. *Am J Infect Control*. 2013; 41(7):629-33.
8. Eiselt D. Presurgical skin preparation with a novel 2% chlorhexidine gluconate cloth reduces rates of surgical site infection in orthopaedic surgical patients. *Orthop Nurs*. 2009;28(3):141-5.
9. Halpern CH, Mitchell GW, Paul A, et al. Self-administered preoperative antiseptic wash to prevent postoperative infection after deep brain stimulation. *Am J Infect Control*. 2012;40(5):431-3.
10. Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. *Am J Infect Control*. 1999;27(2):97-132; quiz 133-134; discussion 196.
11. Lilly HA, Lowbury EJ, Wilkins MD. Limits to progressive reduction of resident skin bacteria by disinfection. *J Clin Pathol*. 1979;32(4):382-5.
12. Lowbury EJ, Lilly HA. Use of 4 per cent chlorhexidine detergent solution (Hibiscrub) and other methods of skin disinfection. *Br Med J*. 1973;1(5852):510-5.
13. Wihlborg O. The effect of washing with chlorhexidine soap on wound infection rate in general surgery. A controlled clinical study. *Ann Chir Gynaecol*. 1987;76(5):263-5.
14. O'Grady NP, Alexander M, Burns LA, et al. Guidelines for the prevention of intravascular catheter-related infections. *Clin Infect Dis*. 2011;52(9):e162-93.
15. Darouiche RO, Wall MJ, Jr., Itani KM, et al. Chlorhexidine-Alcohol versus Povidone-Iodine for Surgical-Site Antisepsis. *N Engl J Med*. 2010;362(1):18-26.
16. Swenson BR, Hedrick TL, Metzger R, Bonatti H, Pruett TL, Sawyer RG. Effects of preoperative skin preparation on postoperative wound infection rates: a prospective study of 3 skin preparation protocols. *Infect Control Hosp Epidemiol*. 2009;30(10):964-71.
17. Saltzman MD, Nuber GW, Gryzlo SM, Marecek GS, Koh JL. Efficacy of surgical preparation solutions in shoulder surgery. *J Bone Joint Surg Am*. 2009;91(8):1949-53.
18. Sistla SC, Prabhu G, Sistla S, Sadasivan J. Minimizing wound contamination in a 'clean' surgery: comparison of chlorhexidine-ethanol and povidone-iodine. *Chemotherapy*. 2010;56(4):261-7.
19. Dumville JC, McFarlane E, Edwards P, Lipp A, Holmes A. Preoperative skin antiseptics for preventing surgical wound infections after clean surgery. *Cochrane Database Syst Rev*. 2013;3:CD003949.
20. Apfelbaum JL, Caplan RA, Barker SJ, et al. Practice advisory for the prevention and management of operating room fires: an updated report by the American Society of Anesthesiologists Task Force on Operating Room Fires. *Anesthesiology*. 2013;118(2):271-90.
21. Tanner J, Norrie P, Melen K. Preoperative hair removal to reduce surgical site infection. *Cochrane Database Syst Rev*. 2011(11):CD004122.
22. Balthazar ER, Colt JD, Nichols RL. Preoperative hair removal: a random prospective study of shaving versus clipping. *South Med J*. 1982;75(7):799-801.
23. Ko W, Lazenby WD, Zelano JA, Isom OW, Krieger KH. Effects of shaving methods and intraoperative irrigation on suppurative mediastinitis after bypass operations. *Ann Thorac Surg*. 1992;53(2):301-5.
24. Sellick JA, Jr., Stelmach M, Mylotte JM. Surveillance of surgical wound infections following open heart surgery. *Infect Control Hosp Epidemiol*. 1991;12(10):591-6.
25. Alexander JW, Fischer JE, Boyajian M, Palmquist J, Morris MJ. The influence of hair-removal methods on wound infections. *Arch Surg*. 1983;118(3):347-52.
26. Seropian R, Reynolds BM. Wound infections after preoperative depilatory versus razor preparation. *Am J Surg*. 1971;121(3):251-4.
27. Penington A. Ulceration and antihypertensive use are risk factors for infection after skin lesion excision. *ANZ J Surg*. 2010;80(9):642-5.
28. Menon TJ, Wroblewski BM. Charnley low-friction arthroplasty in patients with psoriasis. *Clin Orthop Relat Res*. 1983(176):127-8.
29. Stern SH, Insall JN, Windsor RE, Inglis AE, Dines DM. Total knee arthroplasty in patients with psoriasis. *Clin Orthop Relat Res*. 1989(248):108-10; discussion 111.

- 30. Aly R, Maibach HE, Mandel A.** Bacterial flora in psoriasis. *Br J Dermatol.* 1976;95(6):603-6.
- 31. Kappstein I, Schulgen G, Waninger J, Daschner F.** [Microbiological and economic studies of abbreviated procedures for surgical hand disinfection]. *Chirurg.* 1993;64(5):400-5.
- 32. Pereira LJ, Lee GM, Wade KJ.** The effect of surgical handwashing routines on the microbial counts of operating room nurses. *Am J Infect Control.* 1990;18(6):354-64.
- 33. Tanner J, Swarbrook S, Stuart J.** Surgical hand antisepsis to reduce surgical site infection. *Cochrane Database Syst Rev.* 2008(1):CD004288.
- 34. Wheelock SM, Lookinland S.** Effect of surgical hand scrub time on subsequent bacterial growth. *AORN J.* 1997;65(6):1087-1092; 1094-1088.
- 35. Pereira LJ, Lee GM, Wade KJ.** An evaluation of five protocols for surgical handwashing in relation to skin condition and microbial counts. *J Hosp Infect.* 1997;36(1):49-65.
- 36.** Recommended practices for surgical hand antisepsis/hand scrubs. *AORN J.* 2004;79(2):416-8, 421-6, 429-31.
- 37. Parienti JJ, Thibon P, Heller R, et al.** Hand-rubbing with an aqueous alcoholic solution vs traditional surgical hand-scrubbing and 30-day surgical site infection rates: a randomized equivalence study. *JAMA.* 2002;288(6):722-7.
- 38. Weight CJ, Lee MC, Palmer JS.** Avagard hand antisepsis vs. traditional scrub in 3600 pediatric urologic procedures. *Urology.* 2010;76(1):15-17.