G-30 – What is the most optimal intra-operative skin preparation agent for patients undergoing major orthopedic procedures?

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Response/Recommendation: There does not appear to be a superior intra-operative skin preparation agent for patients undergoing major orthopaedic procedures. Rather, the decision to use a particular agent (chlorhexidine gluconate versus iodine-based preparations) should be based on the most likely pathogens of a particular surgical site and should be combined with isopropyl alcohol.

Strength of Recommendation: Moderate

Delegate Vote:

Rationale:

Surgical site infection (SSI) prevention has been extensively investigated, and several steps are recommended for peri-operative skin preparation, including pre-operative washing, appropriate hair removal from incision site, and reducing skin recolonization [1]. Cleansing the surgical site using a chlorhexidine gluconate (CHG) or povidone-iodine (PI) solution prior to incision is considered routine and reduces bacterial load at the surgical site [2-5]. Bacterial cell membranes are disrupted by CHG, whereas PI acts through bacterial protein denaturation [6]. In the most recent Cochrane meta-analysis regarding preoperative skin antisepsis, the authors concluded that the current literature lacked evidence to support the use of a particular solution [7]. However, the consensus was that the skin preparation agent should contain alcohol based on recommendations from the Centers for Disease Control, International Consensus Group Meeting, and prior studies [5, 7-13].

Since this meta-analysis, Charehbili et al. published their cluster-randomized crossover trial consisting of 3,665 patients who underwent breast, vascular, colorectal, gallbladder, or orthopaedic surgery. Patients received either 0.5% CHG or 1% PI in an alcohol-based solution. The authors noted no statistically significant difference between the overall incidence of SSI between groups [14]. The Prep-it Investigators published two randomized controlled trials evaluating the optimal preoperative antiseptic solution for patients who suffered fractures. One study evaluated 1,638 patients who received either 4% CHG or 1% PI and underwent fixation for open fractures. The authors found no statistically significant difference in rates of SSI between groups [15]. The authors' subsequent multicenter randomized controlled trial consisted of 6,785 patients with closed fractures who received eithr 2% CHG or 0.7% PI for skin preparation. The authors noted that skin antisepsis with PI in alcohol resulted in a lower proportion of SSIs than those who received CHG in alcohol [16]. In contrast, Ritter et al. published a prospective randomized trial of 279 consecutive patients who were randomized to receive 2% CHG with alcohol or 1% PI with alcohol for skin preparation intraoperatively. The authors found that skin antisepsis with CHG for surgery for closed trauma of the lower leg and foot led to statistically significant fewer complications of wound healing compared to PI [17]. While a randomized

controlled trial by Shadid et al. demonstrated no statistically significant differences in postoperative wound complications or SSIs in 49 patients undergoing clean foot surgery who received skin preparation with either 0.5% CHG or 1% PI, both with alcohol [18].

Regarding spine surgery, Patrick et al. published their randomized controlled trial of 407 patients who received 2% CHG in alcohol or 1% PI in alcohol for intraoperative skin preparation prior to spine surgery. The authors found that the sequential application of PI and CHG more effectively reduced contamination of surgical wounds than PI alone based on intraoperative skin cultures [10].

Regarding hip and knee arthroplasty, three randomized controlled trials have been published since the prior Cochrane meta-analysis. Cho et al. performed a randomized controlled trial of 150 patients undergoing primary total knee arthroplasty who received intraoperative skin antisepsis with either 10% PI, 2% CHG after 1% PI, or 1% PI after 2% CHG, all with alcohol. Based on rates of bacterial cultures after skin preparation, the authors noted that CHG after PI or PI after CHG were superior to PI alone [19]. Peel et al. published their cluster randomized controlled trial of 780 patients undergoing primary total knee or hip arthroplasty who received either 0.5% CHG in alcohol or 1% PI in alcohol for intraoperative preparation. The authors noted no differences in superficial wound complications between the two groups, but on secondary analysis, the PI group had greater efficacy for preventing SSI [20]. Droll et al. published their randomized controlled trial of 105 patients undergoing primary total hip arthroplasty who received either 2% CHG or 0.7% PI for intraoperative skin preparation. Using intraoperative cultures, the authors noted that PI was more effective than CHG at eliminating skin flora at the hip on initial application, but the two solutions were equally effective by time of closure [21].

Regarding the shoulder, Blonna et al. published their randomized controlled trial of 40 patients with proximal humerus fractures who underwent intraoperative skin preparation with either 1% PI or 4% CHG followed by PI. The authors noted that although both approaches reduced *Staphylococcus aureus* and *Propionibacterium acnes* skin burden, the double skin preparation was more effective against coagulase-negative *Staphylococcus aureus* [22]. Additionally, Dorfel et al. found that 3.2% PI in alcohol showed benefits over 2% CHG in alcohol in aerobic and anaerobic flora culture positivity of the shoulder based on their randomized cross-over study [23]. A randomized controlled trial of 22 patients by Hancock et al. found no statistically significant reduction in growth of Propionibacterium acnes over 14 days with CHG + benzoyl peroxide compared with CHG alone [24].

Given the heterogeneity of data based on surgical site, there does not appear to be an optimal intra-operative skin preparation agent for all patients undergoing major orthopaedic procedures. In accordance with the review by Dockery et al. on preoperative skin preparation agents and surgical sites, the decision to use a particular skin preparation agent should be based on the most likely pathogens of a surgical site and be combined with isopropyl alcohol [25].

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