and pericapsular tissue samples were cultured. A history of two or more corticosteroid injections had a higher likelihood of bacterial growth than those with one or less injections ($p = 0.047$). Koh et al. [7] retrospectively analyzed 30 patients undergoing primary shoulder arthroplasty at which time superficial and deep wound swabs were taken. Steroid injection was not statistically significantly associated with positive deep cultures ($p = 0.14$), and the presence of hair in conjunction with previous steroid injection was not statistically significant ($p = 0.092$).

While the evidence in the hip arthroplasty literature is somewhat conflicting [8–10], multiple recent studies from the knee arthroplasty literature support the conclusion that corticosteroid injections before arthroplasty increase the risk for PJI [11,12].

REFERENCES

[1] Saltzman MD, Nuber GW, Gryzlo SM, Marecek GS, Koh JL. Efficacy of surgical preparation solutions in shoulder surgery. J Bone Joint Surg Am. 2009;91:1949–1953. doi:10.2106/JBJS.H.00768.

[2] Lee MJ, Pottinger PS, Butler-Wu S, Bumgarner RE, Russ SM, Matsen FA. Propionibacterium persists in the skin despite standard surgical preparation. J Bone Joint Surg Am. 2014;96:1447–1450. doi:10.2106/JBJS.M.01474.

[3] Falconer TM, Baba M, Kruse LM, Dorrestijn O, Donaldson MJ, Smith MM, et al. Contamination of the surgical field with Propionibacterium acnes in primary shoulder arthroplasty. J Bone Joint Surg Am. 2016;98:1722–1728. doi:10.2106/JBJS.15.01133.

[4] Werner BC, Cancienne JM, Burrus MT, Griffin JW, Gwathmey FW, Brockmeier SF. The timing of elective shoulder surgery after shoulder injection affects postoperative infection risk in Medicare patients. J Shoulder Elbow Surg. 2016;25:390–397. doi:10.1016/j.jse.2015.08.039.

[5] Rashid A, Kalson N, Jiwa N, Patel A, Irwin A, Corner T. The effects of pre-operative intra-articular glenohumeral corticosteroid injection on infective complications after shoulder arthroplasty. Shoulder Elbow. 2015;7:154–156. doi:10.1177/1758573214557149.

[6] Mook WR, Klement MR, Green CL, Hazen KC, Garrigues GE. The incidence of Propionibacterium acnes in open shoulder surgery: a controlled diagnostic study. J Bone Joint Surg Am. 2015;97:957–963. doi:10.2106/JBJS.N.00784.

[7] Koh CK, Marsh JP, Drinković D, Walker CG, Poon PC. Propionibacterium acnes in primary shoulder arthroplasty: rates of colonization, patient risk factors, and efficacy of perioperative prophylaxis. J Shoulder Elbow Surg. 2016;25:846–852. doi:10.1016/j.jse.2015.09.033.

[8] McIntosh AL, Hanssen AD, Wenger DE, Osmon DR. Recent intraarticular steroid injection may increase infection rates in primary THA. Clin Orthop Relat Res. 2006;451:50–54. doi:10.1097/01.blo.0000229318.51254.79.

[9] Meermans G, Corten K, Simon J-P. Is the infection rate in primary THA increased after steroid injection? Clin Orthop Relat Res. 2012;470:3213–3219. doi:10.1007/s11999-012-2390-8.

[10] Pereira LC, Kerr J, Jolles BM. Intra-articular steroid injection for osteoarthritis of the hip prior to total hip arthroplasty: is it safe? a systematic review. Bone Joint J. 2016;98-B:1027–1035. doi:10.1302/0301-620X.98B8.37420.

[11] Bedard NA, Pugely AJ, Elkins JM, Duchman KR, Westermann RW, Liu SS, et al. The John N. Insall Award: do intraarticular injections increase the risk of infection after TKA? Clin Orthop Relat Res. 2017;475:45–52. doi:10.1007/s11999-016-4757-8.

[12] Cancienne JM, Werner BC, Luetkemeyer LM, Browne JA. Does timing of previous intra-articular steroid injection affect the post-operative rate of infection in total knee arthroplasty? J Arthroplasty. 2015;30:1879–1882. doi:10.1016/j.arth.2015.05.027.

1.4. PREVENTION: SKIN PREPARATION

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QUESTION 1: Is there a role for preoperative skin scrub (home scrubs and washes) prior to primary or revision shoulder arthroplasty?

RECOMMENDATION: Chlorhexidine gluconate (CHG) showers or cleansing wipes with at least two applications decreases the incidence of positive skin cultures prior to shoulder surgery. Pending further research, this protocol may provide a benefit.

LEVEL OF EVIDENCE: Limited

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

A systematic review of the published literature was performed on Scopus, PubMed and Cochrane databases that included any primary or secondary aims regarding preoperative skin prep for shoulder arthroplasty. A comprehensive review and list were accumulated and review was done to include all relevant studies that met these specific criteria.

Surgical site infections (SSIs) account for 14-16% of all nosocomial infections [1]. In an effort to reduce SSI's, protocols have incorporated whole body showering or bathing with CHG and other antiseptics. The aim is to cleanse the skin and reduce the cutaneous bacterial load prior to surgery. Previous studies have found reduced bacterial counts after use of chlorhexidine baths or washes with increased effect after multiple applications [2].

However, there has been much debate on this issue with various organizations expressing different views on the matter. The Centers for Disease Control and Prevention (CDC) has indicated that either soap or other antiseptic agents are equally efficacious as CHG. While the hospital infection control practice advisory committee – CDC recommend that patients shower at least one time with any kind antiseptic. Finally, the Institute for Healthcare Improvements – Project JOINTS recommends that patients should bathe or shower with CHG soap for at least three days prior to surgery [3].

Multiple interventional studies have investigated the use of preadmission CHG showers. Eiselt et al. focused on preoperative CHG cloths twice prior to total joint procedures and found that surgical site infections were significantly reduced from 3.19% to 2% when compared to a no wash group this was a significant reduction of 50.2% in SSIs [4]. Johnson et al. studied the use of at home chlorhexidine impregnated skin preparation cloth in decreasing the incidence of deep periprosthetic hip arthroplasty. Of the 1,134 studied, 157 complied with the preoperative chlorhexidine preparation protocol. There was no significant difference in the infection rates between the non-compliant and compliant groups (1.6% infection rate vs. 0% respectively; $p = 0.231$) [5]. Kapadia et al. evalu-

ated 557 patients who used preoperative chlorhexidine cloths and 1901 patients who did not. There was a statistically significant lower infection rate among the patients who used the cloths (0.5%) when compared to patients who did not (1.7%) [6].

Murray et al. explored the use of 2% chlorhexidine no rinse clothes used twice before any type of shoulder surgery in a prospective randomized trial of 100 patients with a control group that used only soap. Cutaneous cultures were taken before surgery and patients were monitored for postoperative infections. There were no infections in either group. The positive culture rate was 66% in the treatment group and 94% (p = .0008) in the control group, and the positive culture rate for coagulase-negative *Staphylococcus* was 30% and 70% respectively (p = .0001) [7].

In general, most studies have focused on hip and knee replacement surgery rather than shoulder surgery. However, the studies referenced above demonstrate the efficacy of CHG-containing products when applied at a minimum of two applications. Despite weak recommendations by the CDC, clinical evidence supports a minimum of two preadmission 4% CHG showers or no-rinse 2% CHG cloth applications as a critical component of a broader interventional strategy for reducing the risk of SSIs in shoulder surgery [3,8].

REFERENCES

[1] Smyth ET, Emmerson AM. Surgical site infection surveillance. J Hosp Infect. 2000;45:173–184. doi:10.1053/jhin.2000.0736.

[2] Kaiser AB, Kernodle DS, Barg NL, Petracek MR. Influence of preoperative showers on staphylococcal skin colonization: a comparative trial of antiseptic skin cleansers. Ann Thorac Surg. 1988;45:35–38.

[3] Rubin C, Louthan RB, Wessels E, McGowan MB, Downer S, Maiden J. Chlorhexidine gluconate: to bathe or not to bathe? Crit Care Nurs Q. 2013;36:233–236. doi:10.1097/CNQ.0b013e31828404d1.

[4] 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;28:141–145. doi:10.1097/NOR.0b013e3181a469db.

[5] Johnson AJ, Daley JA, Zywiel MG, Delanois RE, Mont MA. Preoperative chlorhexidine preparation and the incidence of surgical site infections after hip arthroplasty. J Arthroplasty. 2010;25:98–102. doi:10.1016/j.arth.2010.04.012.

[6] Kapadia BH, Johnson AJ, Daley JA, Issa K, Mont MA. Pre-admission cutaneous chlorhexidine preparation reduces surgical site infections in total hip arthroplasty. J Arthroplasty. 2013;28:490–493. doi:10.1016/j.arth.2012.07.015.

[7] Murray MR, Saltzman MD, Gryzlo SM, Terry MA, Woodward CC, Nuber GW. Efficacy of preoperative home use of 2% chlorhexidine gluconate cloth before shoulder surgery. J Shoulder Elbow Surg. 2011;20:928–933. doi:10.1016/j.jse.2011.02.018.

[8] Edmiston CE, Okoli O, Graham MB, Sinski S, Seabrook GR. Evidence for using chlorhexidine gluconate preoperative cleansing to reduce the risk of surgical site infection. AORN J. 2010;92:509–518. doi:10.1016/j.aorn.2010.01.020.

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QUESTION 2: What is the optimal perioperative surgical skin prep for primary or revision shoulder arthroplasty?

RECOMMENDATION: The best available evidence supports 2% chlorhexidine gluconate and 70% isopropyl alcohol for surgical skin prep for shoulder arthroplasty.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 100%, Disagree: 0%, Abstain: 0% (Unanimous, Strongest Consensus)

RATIONALE

A comprehensive search of several databases from 1988 to January 15th, 2018 (any language) was conducted. The databases included Ovid Medline Epub Ahead of Print, Ovid Medline In-Process & Other Non-Indexed Citations, Ovid Medline, Ovid Embase, Ovid Cochrane Central Register of Controlled Trials, Ovid Cochrane Database of Systematic Reviews and Scopus. The search strategy was designed and conducted by an experienced librarian with input from the study's principle investigator. Controlled vocabulary supplemented with keywords was used to search for surgical site preparation for prosthetic shoulder joint infections. The complete search strategies are listed below.

The rationale for the use of chlorhexidine surgical prep prior to shoulder arthroplasty is based on one level-I randomized controlled trial by Saltzman et al. [1]. In this trial, patients were randomized to compare ChloraPrep™ (Becton Dickinson) (2% w/v chlorhexidine gluconate (CHG) in 70% v/v isopropyl alcohol (IPA)), DuraPrep™ (3M™) (Iodine Povacrylex (0.7% available iodine) and isopropyl alcohol, 74%), and povidone-iodine ((0.75% iodine scrub and 1.0% iodine paint; Tyco Healthcare Group, Mansfield, Massachusetts) for patients undergoing shoulder surgery. The rate of positive skin cultures was reduced but not eliminated with ChloraPrep™ (7%) when compared with DuraPrep™ (18%) or povidone-iodine (31%). Furthermore, there were no infections in any of the patients at a mean of 10 months follow-up. In this trial, while a chlorhexidine solution was most active against the bacteria on the shoulder in general, there was no significant difference detected among the agents in their ability to eliminate *Cutibacterium acnes* from the shoulder region [1]. As *Cutibacterium acnes* is increasingly recognized as a key player in shoulder periprosthetic joint infection (PJI), there is concern that the current prep solutions are inadequate to treat this pathogen. Despite this, there were no postoperative infections in any of the groups at a minimum of 10 months of follow-up.

Chlorhexidine waterless wipes have also been advocated to decrease bacterial burden preoperatively. Murray et al. in another level-I study randomly assigned patients to one of two groups. Group 1 wiped the shoulder with 2% chlorhexidine gluconate impregnated cloths and group 2 showered with soap and water before surgery [2]. Again, none of the patients developed a postoperative infection and the cultured sites on the skin showed a reduction in positive cultures for coagulase-negative *Staphylococcus* and *Cutibacterium acnes*. Nevertheless, others have found the persistence of *Cutibacterium* within the skin dermis despite standard skin prep with chlorhexidine [3–7]. There is significant literature establishing a high rate of *Cutibacterium acnes* positive surgical sites despite standard skin preparation in both the primary and revision settings, likely due to the fact that