Authors: Rafael Tibau Olivan, Brett Levine, Michael A. Mont, Alexus M. Cooper, Maria Tibau Alberdi, Anton Khlopas, Nipun Sodhi

QUESTION 1: Does preoperative skin cleansing at home prior to orthopaedic surgery have a role in the reduction of subsequent surgical site infection/periprosthetic joint infection (SSI/PJI)?

RECOMMENDATION: Yes. Preoperative skin cleansing at home prior to orthopaedic surgery does have a role in the reduction of subsequent SSIs/PJIs. Specifically, chlorhexidine gluconate (CHG) has been shown to have excellent results in preventing PJIs/SSIs.

LEVEL OF EVIDENCE: Moderate

DELEGATE VOTE: Agree: 92%, Disagree: 5%, Abstain: 3% (Super Majority, Strong Consensus)

RATIONALE

As noted by the Centers for Disease Control and Prevention, preoperative skin cleansing with an antiseptic agent can substantially decrease skin microbial counts [1,2]. Studies examining this practice and its role in the reduction of SSI and PJI rates have produced conflicting findings. To determine the utility of preoperative skin cleansing in preventing SSIs/PJIs, the effectiveness and logistics of the practice must be taken into account.

Preoperative skin cleansing can be executed using a variety of agents. Garibaldi et al. performed a prospective trial on over 700 patients and found rates of positive intraoperative wound cultures to be 4% for patients who showered and scrubbed with CHG, 9% for those who used povidone-iodine, and 14% for those who used medicated soap and water [3]. Several other published studies supported a connection between preoperative skin shower and CHG with decreasing overall culture rates [4–8].

Chlorhexidine bathing at home prior to surgery involves the use of either a 4% solution or a 2% cloth for a varying number of days based on the literature. Low-level evidence recommends the use of CHG cloths over bathing in its soap form [9]. Regardless of application methodology, CHG can either be bacteriostatic or bactericidal based on the concentration used for cleansing and its efficacy has been known to improve with frequency and duration of use [5,10,11]. The applicability of the aforementioned findings to SSI/PJI prevention in patients undergoing orthopaedic surgery remains unclear due to contradictory findings in the literature.

Kapadia et al. studied 3,717 patients who underwent primary or revision total knee arthroplasties. The group found that the use of a pre-admission chlorhexidine protocol was associated with a reduced relative risks of PJIs after total knee arthroplasty (TKA), when compared to patients who did not receive a CHG protocol (0.3% vs. 1.9%; rate ratio (RR): 6.3, 95% confidence interval (CI) 1.9 to 20.1, p = 0.002) [12]. Similar results were seen even when the two patient cohorts were risk-stratified. A review of modern papers from 2009 to 2015 also showed a reduction in infection rates with preoperative chlorhexidine preparation [13].

A systematic review by Webster et al. of over 10,000 patients in the Cochrane Database also concluded chlorhexidine washes were better than not bathing at all. However, the use of chlorhexidine washes did not seem to change infection rates [11]. Nevertheless, the review reported a lower relative risk for SSIs in patients who used CHG compared to those who used placebo (RR: 0.91, 95% CI 0.8 to 1.40). Farber et al. reported on over 3,700 total joint cases with 1,891 using 2% cloth wipes at the surgical site one hour prior to their procedure [12]. They also found no differences in infection rates at the one-year follow-up for either group.

As described above, the literature cannot affirm emphatically that skin cleansing at home prior to orthopaedic surgery has a role in reduction of subsequent SSIs or PJIs. There has yet to be any reports on the negative effects of preoperative skin cleansing at home prior to arthroplasty surgery and concerns for skin hypersensitivity associated with use of CHG are minor [4]. With really no downside and some potential upside (Table 1), it seems reasonable to consider some form of preoperative skin cleansing at home. Moreover, well-controlled trials are required to truly assess the efficacy of the preoperative skin baths. Initial cost data seems promising but may be institutionally-related with a potential net savings of $0.78 to $3.1 billion [14]. A true cost-assessment is necessary to understand if this low-risk means of infection prevention is cost-effective and whether it should be the standard of care prior to any orthopaedic/arthroplasty surgical procedure.

In conclusion, Table 1 summarizes studies that have been completed regarding chlorhexidine preoperative bathing and its effects on SSIs/PJIs. The heterogeneity of skin cleansing regimens and varying compliance rates make it difficult to isolate preoperative preparation as the main determinant for infection prevention in patients undergoing orthopaedic surgery. Despite the data listed, it is important to understand that compliance is always a concern with this protocol as one study found 78% noncompliance despite focused pre-surgery education efforts [15].

TABLE 1. Studies related to preoperative skin cleansing protocols in TJA

Author	Number of Patients	Treatment	Outcomes	Level of Evidence
Webster [11]	10,157 all surgeries	Chlorhexidine, bar soap and no wash	No evidence that chlorhexidine was better	I
Farber [16]	3,715 TJAs THA—845 CHG; 815 no CHG	2% chlorhexidine wipes	No reduction in infection at 1 year follow-up; 1.0% v. 1.3% infection overall; THA 1.2% v. 1.5%; TKA 0.8% v. 1.2%	III

	TKA—1,046 CHG; 1,009 no CHG			
Chlebicki [17]	17,932 all surgeries	Chlorhexidine, bar soap and no wash	No evidence that chlorhexidine was better	III
Eiselt [18]	1,463 TJAs	2% chlorhexidine wipes	50.2 % reduction in SSIs (3.19% down to 1.59%)	III
Johnson [19]	954 TJAs	2% chlorhexidine wipes	1.6% infection among noncompliant and 0% in the compliant cohort	III
Kapadia [12]	3,844 THAs; 998 with CHG and 2,846 without	2% chlorhexidine wipes	Decreased infection rate with CHG wipes; 0.6% v. 1.62%	III
Zywiel [20]	136/912 TKAs	2% chlorhexidine wipes	0% infection in CHG wipe group v. 3.0% in 711 other TKAs	III
Wang [21]	8,787 TKAs (2,615 CHG; 6,172 controls)	Variable	1.69% reduction in infection overall as well as in moderate and high risk patients	III
Cai [22]			6 studies reviewed and found a reduction in the risk of infection, revision surgery and length of stay	III
Kapadia [23]	564 TJAs (275 CHG and 279 Controls)	2% chlorhexidine wipes	CHG with 0.4% v. Controls with 2.9%; no adverse events—RCT	I
Kapadia [12]	3,717 primary or rev TKA (991 with CHG and 2,726 without)	2% chlorhexidine wipes	Risk reduction of infection from 0.3% compared to 1.9%, better reduction in medium risk compared to low risk	III

CHG, chlorhexidine gluconate; RCT, randomized control trial; THA, total hip arthroplasty; TJA, total joint arthroplasty; TKA, total knee arthroplasty

REFERENCES

[1] 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;27:97–132; quiz 133–4; discussion 96.

[2] Parvizi J, Cavanaugh PK, Diaz–Ledezma C. Periprosthetic knee infection: ten strategies that work. Knee Surg Relat Res. 2013;25:155–164. doi:10.5792/ksrr.2013.25.4.155.

[3] Garibaldi RA. Prevention of intraoperative wound contamination with chlorhexidine shower and scrub. J Hosp Infect. 1988;11 Suppl B:5–9.

[4] 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.

[5] Colling K, Statz C, Glover J, Banton K, Beilman G. Pre–operative antiseptic shower and bath policy decreases the rate of S. aureus and methicillin–resistant S. aureus surgical site infections in patients undergoing joint arthroplasty. Surg Infect (Larchmt). 2015;16:124–132. doi:10.1089/sur.2013.160.

[6] Edmiston CE, Leaper D. Should preoperative showering or cleansing with chlorhexidine gluconate (CHG) be part of the surgical care bundle to prevent surgical site infection? J Infect Prev. 2017;18:311–314. doi:10.1177/1757177417714873.

[7] Edmiston CE, Lee CJ, Krepel CJ, Spencer M, Leaper D, Brown KR, et al. Evidence for a standardized preadmission showering regimen to achieve maximal antiseptic skin surface concentrations of chlorhexidine gluconate, 4%, in surgical patients. JAMA Surg. 2015;150:1027–1033. doi:10.1001/jamasurg.2015.2210.
[8] 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.
[9] World Health Organization. Global guidelines for the prevention of surgical site infection. 2016. http://apps.who.int/iris/bitstream/handle/10665/250680/9789241549882-eng.pdf?sequence=1.
[10] Katarincic JA, Fantry A, DePasse JM, Feller R. Local modalities for preventing surgical site infections: an evidence–based review. J Am Acad Orthop Surg. 2018;26:14–25. doi:10.5435/JAAOS–D–16–00033.
[11] Webster J, Osborne S. Preoperative bathing or showering with skin antiseptics to prevent surgical site infection. Cochrane Database Syst Rev. 2015;20:CD004985. doi:10.1002/14651858.CD004985.pub5.
[12] Kapadia BH, Zhou PL, Jauregui JJ, Mont MA. Does preadmission cutaneous chlorhexidine preparation reduce surgical site infections after total knee arthroplasty? Clin Orthop Relat Res. 2016;474:1592–1598. doi:10.1007/s11999–016–4767–6.
[13] Edmiston CE, Assadian O, Spencer M, Olmsted RN, Barnes S, Leaper D. To bathe or not to bathe with chlorhexidine gluconate: is it time to take a stand for preadmission bathing and cleansing? AORN J. 2015;101:529–538. doi:10.1016/j.aorn.2015.02.008.
[14] Kapadia BH, Johnson AJ, Issa K, Mont MA. Economic evaluation of chlorhexidine cloths on healthcare costs due to surgical site infections following total knee arthroplasty. J Arthroplasty. 2013;28:1061–1065. doi:10.1016/j.arth.2013.02.026.
[15] Kapadia BH, Cherian JJ, Issa K, Jagannathan S, Daley JA, Mont MA. Patient compliance with preoperative disinfection protocols for lower extremity total joint arthroplasty. Surg Technol Int. 2015;26:351–354.
[16] Farber NJ, Chen AF, Bartsch SM, Feigel JL, Klatt BA. No infection reduction using chlorhexidine wipes in total joint arthroplasty. Clin Orthop Relat Res. 2013;471:3120–5. doi:10.1007/s11999–013–2920–z.
[17] Chlebicki MP, Safdar N, O'Horo JC, Maki DG. Preoperative chlorhexidine shower or bath for prevention of surgical site infection: a meta–analysis. Am J Infect Control. 2013;41:167–173. doi:10.1016/j.ajic.2012.02.014.
[18] 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.
[19] 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.
[20] Zywiel 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;35:1001–1006. doi:10.1007/s00264–010–1078–5.
[21] Wang Z, Zheng J, Zhao Y, Xiang Y, Chen X, Zhao F, et al. Preoperative bathing with chlorhexidine reduces the incidence of surgical site infections after total knee arthroplasty: a meta–analysis. Medicine (Baltimore). 2017;96:e8321. doi:10.1097/MD.0000000000008321.
[22] Cai Y, Xu K, Hou W, Yang Z, Xu P. Preoperative chlorhexidine reduces the incidence of surgical site infections in total knee and hip arthroplasty: a systematic review and meta–analysis. Int J Surg. 2017;39:221–228. doi:10.1016/j.ijsu.2017.02.004.
[23] Kapadia BH, Elmallah RK, Mont MA. A randomized, clinical trial of preadmission chlorhexidine skin preparation for lower extremity total joint arthroplasty. J Arthroplasty. 2016;31:2856–2861. doi:10.1016/j.arth.2016.05.043.