Preventing Postoperative Surgical Site Infection

Elijah Dixon, MD, William G Cheadle, MD, Rachael G Khadaroo, MD, PhD, for the Members of the Evidence-Based Reviews in Surgery Group

The term *evidence-based medicine* was first coined by Sackett and colleagues[1] as "the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients." The key to practicing evidence-based medicine is applying the best current knowledge to decisions in individual patients. Medical knowledge is continually and rapidly expanding and it is impossible for an individual clinician to read all the medical literature. For clinicians to practice evidence-based medicine, they must have the skills to read and interpret the medical literature so that they can determine the validity, reliability, credibility, and utility of individual articles. These skills are known as critical appraisal skills. Generally, critical appraisal requires that the clinician have some knowledge of biostatistics, clinical epidemiology, decision analysis, and economics as well as clinical knowledge.

The Canadian Association of General Surgeons and the American College of Surgeons jointly sponsor a program entitled, "Evidence-Based Reviews in Surgery (EBRS)," supported by an educational grant from Ethicon Inc and Ethicon Endo-Surgery Inc. The primary objective of this initiative is to help practicing surgeons improve their critical appraisal skills. During the academic year, 8 clinical articles are chosen for review and discussion. They are selected not only for their clinical relevance to general surgeons, but also because they cover a spectrum of issues important to surgeons; for example, causation or risk factors for disease, natural history or prognosis of disease, how to quantify disease (measurement issues), diagnostic tests and the diagnosis of disease, and the effectiveness of treatment. Both methodologic and clinical reviews of the article are performed by experts in the relevant areas and posted on the EBRS website. A listserve discussion is held, where participants can discuss the monthly article. Fellows and candidates of the College can access Evidence-Based Reviews in Surgery through the American College of Surgeons Web site (www.facs.org). All journal articles and reviews are available electronically through the Web site. Currently we have a library of 50 articles and reviews that can be accessed at any time. Each October, a new set of articles will be available each month until May. Surgeons who participate in the current (modules) packages can receive CME credits by completing a series of multiple choice questions. Additional information about EBRS is on the ACS Web site or by email to the administrator, Marg McKenzie at mmckenzie@mtsinai.on.ca.

In addition to making the reviews available through the ACS and CAGS Web sites, 4 of the reviews are published in condensed versions in the *Canadian Journal of Surgery* and the other 4 will be published in the *Journal of the American College of Surgeons* each year.

REFERENCE

1. Evidence-Based Medicine Working Group. Evidence-based medicine. JAMA 1992;268:2420–2425.

SELECTED ARTICLE

Chlorhexidine-Alcohol Versus Povidone-Iodine for Surgical Site Antisepsis

Darouiche RO, Wall MJ, Itani KMF et al. N Engl J Med 2010;362:18–26

Question:
Is chlorhexidine-alcohol more effective than povidone-iodine for preoperative skin cleansing?

Design:
Multicenter, randomized controlled trial

Setting:
Six university-affiliated hospitals in the United States

Patients: Eight hundred forty-nine patients who underwent clean-contaminated surgery (colorectal, small intestinal, gastroesophageal, biliary, thoracic, gynecologic, or urologic operations performed under controlled conditions without substantial spillage or unusual contamination) were enrolled.

Intervention: Patients were randomly assigned to have the skin at the surgical site preoperatively scrubbed with 2% chlorhexidine gluconate and 70% isopropyl alcohol

ISSN 1072-7515/11/$36.00
doi:10.1016/j.jamcollsurg.2010.12.007

or scrubbed and painted with an aqueous solution of 10% povidone-iodine from April 2004 to May 2008.

Main Outcomes Measure: Surgical site infection within 30 days after surgery

Results: The overall rate of surgical site infection was significantly lower in the chorhexidine-alcohol group than in the povidone-iodine group (9.5% vs 16.1%; $p = 0.004$; relative risk, 0.59; 95% CI, 0.41 to 0.85). Chlorhexidine-alcohol was significantly more protective than povidone-iodine against both superficial incisional infections (4.2% vs 8.6%, $p = 0.008$) and deep incisional infections (1% vs 3%, $p = 0.005$), but not against organ-space infections (4.4% vs 4.5%).

Conclusions: Preoperative cleansing of the patient's skin with chlorhexidine-alcohol is superior to cleansing with povidone-iodine for preventing surgical site infection after clean-contaminated surgery.

Commentary: The study by Darouiche and colleagues[1] is a multicenter, randomized clinical trial comparing the effectiveness of chlorhexidine-alcohol and povidone-iodine in preventing postoperative surgical site infections (SSI) in patients undergoing surgery with wounds classified as clean-contaminated. Surgical site infection is increasingly being appreciated as an important outcome that has implications with regard to short- and long-term patient morbidity and mortality, the costs of care, and length of stay. The rates of SSI in relation to the degree of contamination are reproducible.[2] Consequently, the rates of SSI per the degree of wound contamination are being used as a quality indicator to measure and benchmark the quality of surgical care delivered. Despite the importance of SSI, there have been few high quality studies that critically assess the various surgical site preparation solutions. This trial is therefore both timely and relevant. The authors demonstrated that overall rates of SSI were 9.5% in the chlorhexidine-alcohol group, and 16.1% in the povidone-iodine group ($p = 0.004$).

This study has some important methodologic strengths. It is multicenter (6 participating centers) and included a broad variety of intracavitary surgical procedures that cross surgical disciplines, which increases the external validity of the findings. The use of randomization to control for both known and unknown confounders appears to have worked, as shown in Table 1 of that study. There was equal distribution of known potential confounders between the 2 arms of the trial. The trial had a clearly defined primary outcome that was measured by observers who were blinded to group assignment, reducing the possibility of measurement bias. In addition, the study had adequate sample size to detect a clinically and statistically significant difference in outcomes.

There are, however, some limitations and interesting unanswered questions. First, the use of chlorhexidine-alcohol and povidone-iodine raises some questions about what might be the compound that is active. Is it the chlorhexidine, the alcohol, or the combination of the two? Is it possible that many of the other commercially available preparatory solutions might result in similar rates of SSI if they contained 70% alcohol? The only other high quality study that has looked at skin preparation solutions was performed by Swenson and associates.[3] In this study, 3 solutions were compared: povidone-iodine (Betadine [Purdue-Pharma]) with isopropyl alcohol; iodine povacrylex in isopropyl alcohol (DuraPrep [3M]); and 2% chlorhexidine and 70% alcohol (ChloraPrep [CareFusion]). They showed that in patients with clean-contaminated wounds, the rates of SSI were 8.1%, 6.5%, and 10.1%, respectively. These results led the authors to conclude that alcohol in combination with iodophor-based compounds are superior to chlorhexidine-based solutions. This study used a sequential inclusion protocol, which is not as strong methodologically. It, however, leaves the question unanswered—which compound is most effective in decreasing the rates of SSI, and it confirms the need for a randomized controlled trial comparing alcohol in combination with an iodine-based solution with a chlorhexidine-based solution.

Other potential issues include the sponsorship of the trial and the affiliation of the investigators. Although Cardinal Health was involved in the funding and design of this trial, they had no role in the data collection and analysis; both solutions are Cardinal Health products, making it highly unlikely that the validity of the results is impaired. Third, are the results of the trial generalizable beyond clean-contaminated cases? The rates of SSI in clean cases may be so low that a preparation solution of higher cost cannot be justified. This raises the fourth issue: in addition to assessing differences in the rates of SSI, one of the outcomes should be a cost-effectiveness analysis that takes into consideration all the costs associated with the care and management of an SSI. The fifth issue is the risk of fire and burns with alcohol-based solutions. The true incidence is unknown, and the costs of even one patient injury are hard to calculate. The issue of whether waiting a certain amount of time can truly avoid this complication is unknown. At a minimum, the alcohol-based preparations should not be used in emergent situations, when time is critical. The use of the alcohol-based preparation solutions will also increase the procedural time.

Finally, the trial raises some interesting questions around the relative importance of a strongly positive single trial. Is

1 trial such as this enough to change practice, and if so, in what population? Or, are further confirmatory trials required? And if so, who will fund such a trial? Will surgeons and investigators be willing to enroll their patients knowing the results of this trial? What is considered adequate equipoise? Some believe that a single trial is not enough upon which to base change. However, if this is the case, is it possible to get a confirmatory trial funded and approved by institutional review boards, and to convince colleagues to enroll their patients? In relation to the current question regarding the ideal skin preparation solution to reduce SSI, possibly the ideal trial is one with 3 arms: povidone-iodine, chlorhexidine-alcohol, and povidone-iodine with alcohol. This trial could potentially be confirmatory and may help answer which alcohol-based solution is best.

In summary, although there are still some issues surrounding whether or not this trial alone is enough to change practice, it is clear the authors have produced a study of high methodologic quality that shows that SSI rates in clean-contaminated operative cases are lower in patients who underwent surgical site skin preparation using chlorhexidine-alcohol in comparison to povidone-iodine. When using alcohol-based solutions, care must be taken to avoid fire and burns at the site of skin preparation and areas where the solution may have pooled. These preparations should probably not be used in emergency operations, where time is of critical importance.

REFERENCES

1. Darouiche RO, Wall MJ, Itani KMF, et al. chlorhexidine-alcohol versus povidone-iodine for surgical site antisepsis. N Engl J Med 2010;36:18–26.
2. Mangram AJ, Horan TC, Pearson ML, et al. 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.
3. Swenson BR, Hedrick TL, Metzgar R, et al. Effects of preoperative skin preparation on postoperative wound infection rates: a prospective study of 3 skin preparation protocols. Infect Control Hosp Epidemiol 2009;30:964–971.

The Evidence Based Reviews in Surgery Group Comprises: