Rethinking How We Use Surgical Antibiotics

Andrew R. Hsu, MD

We stand on the precipice of change in how antibiotics can be effectively used during surgery. Surgical site infections (SSIs) are a major burden to the US health care system, accounting for roughly 20% of all health care infections and significantly increasing cost, length of hospital stay, readmission and reoperation rates, morbidity, and mortality.[1] SSIs are multifactorial and involve pharmacologic, operating-room environment, and patient-specific factors. Data from the Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS) showed that SSIs can extend hospital stays by up to 10 days while increasing expense by more than $20,000 per inpatient admission. Recent moves from a volume-based health care model to a value-driven model demand, now more than ever, that we find low-cost, evidence-based, innovative solutions to reduce SSIs in order to improve clinical outcomes and health care use. Cost-effectiveness is a relatively new yet powerful influence on how we must evaluate medical research and clinical care.

It has been well established that preoperative intravenous (IV) antibiotic prophylaxis is effective in reducing SSIs,[2] and the Surgical Care Improvement Project (SCIP) recommends IV cephalosporin as standard prophylaxis for patients without associated allergy. Methicillin-susceptible *Staphylococcus aureus* (MSSA) and methicillin-resistant *S aureus* (MRSA) are the main culprits behind SSIs, causing roughly 51% of infections after neurosurgical procedures, 49% after orthopedic procedures, and 33% after cardiac procedures.[3] Over the past decade, MRSA rates have increased dramatically in hospitals all over the United States, creating an unprecedented need to rethink antibiotic prophylaxis in surgical care. Although IV vancomycin is effective against MRSA, particularly in immunocompromised patients at high risk for infection, it should not be used in all patients. Routine systemic prophylaxis with vancomycin is costly and carries the risk of developing antibiotic-resistant organisms in body areas unrelated to the surgical procedure.

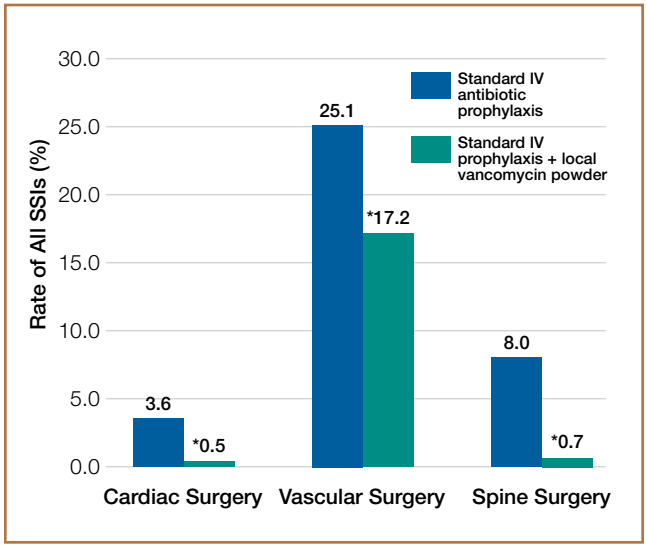

Figure. Pooled literature results of all surgical site infections (SSIs) in cardiac, vascular, and spine procedures using standard intravenous (IV) systemic antibiotic prophylaxis compared with standard IV prophylaxis with the addition of local vancomycin powder into surgical wounds.

*Indicates significantly decreased rate of all SSIs.

Local administration of antibiotics into surgical wounds for both infection prophylaxis and treatment can create high and sustained concentrations at infection sites that systemic antibiotics may not effectively reach owing to local physiologic changes or trauma. There is limited systemic absorption and toxicity with local antibiotics, and decreased theoretical potential for development of drug-resistant organisms. Findings from a previous literature review were inconclusive, and the analysis lacked specific efficacy criteria, producing mixed results across different types of local antibiotics and delivery methods.[4] With not enough studies showing a benefit, physicians had little need to revise local antibiotic use guidelines. New studies on local administration of vancomycin powder may now force us to rethink our stance on antibiotic use.

Dr. Hsu is Resident Physician, Department of Orthopaedic Surgery, Rush University Medical Center, Chicago, Illinois.

Author's Disclosure Statement: The author reports no actual or potential conflict of interest in relation to this article.

Address correspondence to: Andrew R. Hsu, MD, Department of Orthopaedic Surgery, Rush University Medical Center, 1611 W Harrison St, Suite 300, Chicago, IL 60612 (tel, 650-906-8923; fax, 312-942-2101; e-mail, andyhsu1@gmail.com).

Am J Orthop. 2014;43(5):E105-E106.

Across 10 studies encompassing cardiac, vascular, and spine procedures and 5,888 patients, intrawound application of 0.25 g to 2.0 g of vancomycin powder combined with standard systemic antibiotic prophylaxis significantly reduced (31% to 100%) the rate of all SSIs, deep incisional SSIs, and SSIs caused by *S aureus* (**Figure**).[5] No studies reported vancomycin powder complications, such as systemic toxicity, development of antimicrobial resistance (vancomycin-resistant *Enterococcus*), and adverse local wound healing. From the standpoint of health care resources, use of local vancomycin powder is cost-effective ($4/g), easy to implement, and does not increase operating room time or relative risk. This is a prime example of how simple health care improvements using existing technology can improve patient care at low cost.

Vancomycin powder is not a panacea and results are not conclusive, but it is critical to recognize that modern SSI research is changing. As with many aspects of medicine, further prospective, randomized clinical trials are needed to justify routine use of this antibiotic technique and to clarify any complications that may arise in larger cohorts of patients. Current studies have varying levels of quality and intrinsic bias, but additional clinical trials are under way along with concurrent basic science studies. Risk stratification for infection in patients must also be studied to determine who would benefit most from local application of antibiotics. On a broader scale, what vancomycin powder use represents is a reshaping of our idea of health care innovation and resource allocation. Rather than heavily relying on industry development of expensive new technologies and pharmaceuticals that are often unsustainable on a large scale, we must recognize that we have the ability to find new roles for existing medications and treatments.

Cost-effective innovation must become an integral part of health care if we are to significantly reduce cost while improving quality. Although we typically evaluate medical research for its clinical significance, innovation, methods, results, and conclusions, our social and political climate necessitates adding cost to the list. We need to know if treatments will ultimately save or lose money based on their intrinsic cost relative to the value imparted to patient care. The future of health care innovation depends on the ingenuity, resourcefulness, and collaboration of physicians and researchers to find low-cost solutions to difficult problems such as SSIs. Rethinking how we use and deliver surgical antibiotics can be a catalyst to rethinking how we can become accountable for the cost-effectiveness and value of the health care we deliver.

References

1. de Lissovoy G, Fraeman K, Hutchins V, Murphy D, Song D, Vaughn BB. Surgical site infection: incidence and impact on hospital utilization and treatment costs. *Am J Infect Control*. 2009;37(5):387-397.
2. Page CP, Bohnen JM, Fletcher JR, McManus AT, Solomkin JS, Wittmann DH. Antimicrobial prophylaxis for surgical wounds. Guidelines for clinical care. *Arch Surg*. 1993;128(1):79-88.
3. Hidron AI, Edwards JR, Patel J, et al. NHSN annual update: antimicrobial-resistant pathogens associated with healthcare-associated infections: annual summary of data reported to the National Healthcare Safety Network at the Centers for Disease Control and Prevention, 2006–2007. *Infect Control Hosp Epidemiol*. 2008;29(11):996-1011.
4. McHugh SM, Collins CJ, Corrigan MA, Hill AD, Humphreys H. The role of topical antibiotics used as prophylaxis in surgical site infection prevention. *J Antimicrob Chemother*. 2011;66(4):693-701.
5. Chiang HY, Herwaldt LA, Blevins AE, Cho E, Schweizer ML. Effectiveness of local vancomycin powder to decrease surgical site infections: a meta-analysis. *Spine J*. 2014;14(3):397-407.