Current Evidence Regarding Routine Antibiotic Prophylaxis in Hand Surgery

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Abstract

Background: Although routine antibiotic prophylaxis immediately preceding an orthopedic surgery has become the standard of care in most cases, this practice is poorly defined in hand surgery. The purpose of this analysis is to review the most current literature of antibiotic use in hand surgery. **Methods:** A careful review of the literature regarding routine antibiotic prophylaxis in hand surgery was made. Current relevant resources were used in the construction of this review. **Results:** There is a mixed consensus on the role for prophylactic antibiotics in hand surgery with some resources and data showing support and others opposed. **Conclusions:** Based on the current literature, the authors recommend the following patient characteristics not receive antibiotics: clean hygienic patients, without autoimmune disease, and those not taking steroid medication. Surgical characteristics that would render prophylaxis unnecessary include those without hardware, those without reasonable risk of hematoma formation, or those performed at an ambulatory surgery center as opposed to a large hospital. However, the decision should be made on a case-by-case basis weighing the evidence presented.

Keywords: hand surgery, infection, prophylaxis, orthopedics, antibiotic

Introduction

Routine preoperative antibiotic prophylaxis immediately before surgery is generally considered the standard of care in orthopedic procedures, particularly routine trauma, open fractures, total knee arthroplasty, and total hip arthroplasty.^{7,11,23,31,44,53} The findings of studies in large open cases of longer duration have precipitated the Surgical Care Improvement Project (SCIP) guidelines. The first infection-related SCIP guideline recommends prophylactic antibiotic administration within 1 hour of surgical incision.¹⁸ Although this is routinely applied to most orthopedic cases, the guidelines are not as readily followed in hand surgery. In fact, the majority of hand surgeons do not use antibiotics for clean elective hand cases. In a recent international survey of hand surgeons revealed that only 49% of American surgeons gave prophylactic antibiotics for carpal tunnel release (CTR) and only 13% of international surgeons did so.⁴¹ A 2008 literature review provided some clarity regarding prophylaxis in hand surgery; however, there have been several large studies published in the preceding years.⁴⁶ The following review will outline the detrimental effects of routine unnecessary prophylaxis, and the evidence in support of, and against, antibiotic prophylaxis in hand surgery.

Evidence in Support of Prophylaxis

There is a general consensus in support of antibiotic use in hand surgery for dog bites, human bites, elbow arthroplasty, and for leech use.^{12,20,30,34} There is also evidence to support antibiotic prophylaxis in the upper extremity to treat pin track infections from external fixators or in cases using Kirschner wires (K-wires).^{6,22} Conversely, it is worth noting in a series of 1243 pediatric orthopedic cases without antibiotic prophylaxis, including those requiring K-wires, Steinmann pins, and screws, there was only 1 (0.0008%) infection requiring a return trip to the operating room.¹⁷

The emergency setting is also an indication for antibiotic prophylaxis in hand surgery. In a 236-patient British review, emergency cases as compared with elective ones had an 8.5-fold reduction in the infection rate when antibiotics

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Table 1. Recent Comparative Analyses Regarding Surgical Site Infection in Hand Surgery.

Study	Design (level of evidence)	Cases	Procedure	Infection rate	Surgical site infection associations
Harness et al ²⁸	Retrospective, multicenter (III)	2336	CTR	Antibiotic prophylaxis vs control: SSI: 0.4% vs 0.7% ($P = .354$) DI: 0.1% vs 0.2% ($P = 1$)	No association with sex, age, or DM
Bykowski et al ⁸	Retrospective, single-center (III)	6095	CTR	Antibiotic prophylaxis vs control: 0.54% vs 0.26% ($P > .05$)	Infection associated with tobacco, DM, and longer operative time Prophylactic antibiotic did not prevent SSI in males, tobacco users, or for those with longer operative times
Tosti et al ⁵¹	Retrospective, multicenter (III)	600	CTR, DQR, TFR, and ME	Antibiotic prophylaxis vs control: 0.47% vs 0.77% ($P = 1$)	No association with DM and tobacco

Note. CTR = carpal tunnel release; SSI = surgical site infection; DI = deep infection; DM = diabetes mellitus; DQR = De Quervain release; TFR = trigger finger release; ME = mass excision.

were used.⁴³ However, there was no overall difference in the infection rate when antibiotics were used or not when considering all cases together. In addition, it should be noted that not all emergency cases are the same. Some emergent cases can be clean and may not benefit from routine prophylaxis. On the contrary, dirty wounds such as open hand fractures or crush injuries caused a 13.4-fold increase in the postoperative wound infection rate and should undergo antibiotic prophylaxis.⁴³ There exists no clear indication to prophylactically use antibiotics in routine, elective, clean hand cases.

Evidence Against Prophylaxis

It is possible that factors other than antibiotic prophylaxis can have dramatic effects on infection rates in orthopedic surgery. Sir John Charnley and others were able to significantly lower infection rates in hip arthroplasty by changing the technique and operating room setup.^{10,32} It is likely that in clean, elective hand surgery, proper prepping, draping, and sterile technique are more important and have less adverse side effects than antibiotic prophylaxis. The most recent literature regarding prophylaxis in routine hand cases, including 3 retrospective, nonrandomized, large level III studies, has demonstrated that antibiotic prophylaxis is unnecessary (Table 1).

In 2010, a retrospective multicenter review of 2336 CTR patients demonstrated no difference between antibiotic prophylaxis and controls in neither surgical site infection (SSI; 0.4% vs 0.7%, $P = .354$) nor deep infection (0.1% vs 0.2%, $P = 1$).²⁸ Later, a larger, 6095-patient study retrospectively reviewing CTR at a single center demonstrated no statistical difference between those receiving antibiotics and those without treatment (0.54% vs 0.26%, $P > .05$). Of note, infection was correlated with tobacco use, diabetes mellitus

(DM), and a longer operative time but not a lack of antibiotic prophylaxis.⁸ Finally, a year later, a third multicenter review of 600 hand cases, including De Quervain tenosynovitis release, CTR, trigger finger release, and mass excision, again found no difference between prophylaxis versus controls (0.47% vs 0.77%, $P = 1$).⁵¹

Patient Factors

Secondary to wound healing risks, DM is a known risk factor for SSI in orthopedic surgery.^{36,37} Despite this, a number of older, short, retrospective series have shown no difference in infection rates between patients with and without DM.^{21,33,39} In addition, a recent analysis of 658 patients with and without DM undergoing CTR showed no difference in the infection rate. Furthermore, there was no correlation even among those with poorly controlled blood sugar levels.⁵⁴ Similarly, a review of 2336 patients undergoing CTR revealed no difference in SSI in diabetic patients.²⁸ However, only 17 patients in total were infected, so the authors are therefore unable to report that there truly exists no difference or whether the statistical finding was from a lack of power. As the general rate of infection in routine hand cases is very low, a tremendous number of cases are therefore required to demonstrate statistical difference. Recently, a larger series reviewing 8850 cases of elective hand surgery demonstrated that while there was no difference in SSI in those treated and not treated with prophylactic antibiotics, diabetics had a higher incidence of suture granuloma (relative ratio, 7.0) and SSI (odds ratio, 2.8).⁸ The authors attribute this difference to a larger sample size, differences in surveillance, and varying definitions on infection. While it is likely that a true difference does exist in the infection rate in clean, elective hand cases among diabetics, it is worth considering if this difference is clinically relevant and worth the drawbacks of antibiotic prophylaxis.

Patients with rheumatoid arthritis have a natural deficiency in the ability to heal wounds and often take medications which predispose them to infection.⁴ While rheumatoid arthritis may elevate risk factor for infection in elbow arthroplasty, there was no increase in infection in arthroplasty of the metacarpophalangeal or proximal interphalangeal joints.^{5,40,50} However, none of the aforementioned arthroplasty studies involved a cohort without antibiotic prophylaxis. There is insufficient evidence to recommend for or against antibiotic prophylaxis in routine hand cases in this cohort.

The deleterious effect of tobacco on wound healing and its association with infection are well described.^{13,16} In the previously mentioned review of 8850 cases of elective hand surgery, the authors found that tobacco use increased the SSI risk by a factor of 3, which was more powerful than either DM (2.8) or length of procedure (1.02).⁸ However, 2 other large comparative analyses including patients who received prophylaxis and a control group in elective hand surgery showed no difference in infection rates with tobacco use (Table 1).^{28,51} As with DM, tobacco use may increase the risk for SSI, but the difference may not be clinically relevant.

Surgical Factors

Prolonged operative time is a well-documented risk factor for complications in many orthopedic procedures.^{14,48,52} Specifically, infection has been correlated with length of operative time.^{11,25,26} Similarly, in elective hand cases, prolonged operative time has been associated with an increased risk of infection (odds ratio, 1.02) irrespective of antibiotic prophylaxis.^{8,35} Prolonged length of operative time may reflect increased tissue handling and a greater degree of bacterial contamination on instruments on the sterile field.⁴⁵

Suture material has also been shown to affect SSI after elective hand surgery. In a randomized trial comparing wound closure of CTR with nylon, steel, and polyfilament Vicryl suture, the SSI rate was 0%, 0%, and 8%, respectively ($P < .05$). There was also a higher rate of suture granuloma in the Vicryl cohort, although the authors did not describe antibiotic prophylaxis.³⁸ Finally, the type of anesthesia and location of operating room may also make a difference in hand surgery infection. In a survey of the National Surgical Quality Improvement Program, which tracks complications for 30 days, local anesthesia (vs. general) and outpatient (vs. inpatient) were associated with significantly lower risk for complication.³⁵ Although this may be due in part to a selection bias, it is worth considering the infection risk at a large hospital.¹⁹

Potential Detrimental Effects of Widespread, Universal Prophylaxis

Antibiotics confer a degree of risk to the patient. Up to 10% of the general population may experience an adverse reaction to penicillin administration.^{47,49} In addition, the most

commonly used prophylactic antibiotic at our institution, cephalexin, may include anaphylaxis in 1 in 1000 patients. Furthermore, up to 26% of patients receiving amoxicillin/clavulanic acid may report diarrhea.²⁹ Other notable complications include a potentially secondary infection with *Clostridium difficile* and a 21% risk of diarrhea in clindamycin, a slight risk of toxic epidermal necrolysis with trimethoprim/sulfamethoxazole, and a risk of arthralgia (1.5%) and phototoxicity (0.4%) with ciprofloxacin. Prior exposure to antibiotics is also a known risk factor in the development of antibiotic resistance.^{3,15,27}

Moreover, unnecessary antibiotic use in surgery may pose a risk to the community. Infection in total joint arthroplasty, potentially secondary to bacterial resistance from overexposure, is steadily rising.²⁴ It is estimated that high-volume hospitals in large cities can have susceptibilities of common organisms as high as 44% to 74%.¹⁹ Because of high antibiotic resistance, the American Academy of Orthopaedic Surgeons (AAOS) has advocated the use of vancomycin for preoperative prophylaxis in primary total joint arthroplasty, which may or may not provide the same benefit in simple hand surgery cases.² However, while vancomycin-resistant staphylococci were first noted in Japan 20 years ago, resistance is becoming a significant problem.⁹ Limiting unnecessary use of antibiotics in hand surgery may help reduce future infections in surgery.

Finally, the cost of routine antibiotic prophylaxis is not only unnecessary but also expensive. It is estimated that 200 000 CTRs are performed annually in the United States and likely half receive routine preoperative antibiotics.^{41,42} In addition, a recent cost analysis determined that 1 g of cefazolin costs \$150.00.¹ Therefore, for CTR alone, if prophylactic antibiotics were not routinely administered, a savings of \$15 to \$30 million would be conferred each year. This is believed to be an underestimate, as hospital costs rates are likely higher; many patients receive 2 g; and this analysis does not account for nursing time and other necessary equipment and supplies needed to administer the antibiotic, and associated waste costs. In an era of continuous cost-cutting and historic national debt, all cost savings measures in medicine must be considered.

Conclusion

The authors recommend the following patient characteristics not receive antibiotics: clean hygienic patients, without autoimmune disease, and those not taking steroid medication. Surgical characteristics that would render prophylaxis unnecessary include those without hardware, those without reasonable risk of hematoma formation, or those performed at an ambulatory surgery center as opposed to a large hospital. The decision should be made on a case-by-case basis weighing the evidence presented. Although if in doubt, the authors would recommend prophylaxis, the surgeon would

do well to recognize and weigh the cost-benefit ratio when considering prophylactic antibiotics in hand surgery.

Authors' Note

Some authors are employees of the US Federal Government and the United States Army. The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or reflecting the views of William Beaumont Army Medical Center, the Department of Defense, or the United States government. Data presented in this investigation are derived from the Armed Forces Medical Examiner System (AFMES). The AFMES is not responsible for any claims arising from works based on the original data.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

This study involves no human participants, so informed consent was not sought or required.

Declaration of Conflicting Interests

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