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The Use of Preoperative Antibiotics in Elective Soft-Tissue Procedures in the Hand

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Abstract

» The use of preoperative antibiotic prophylaxis is not supported for elective cases of patients undergoing soft-tissue hand procedures that are ≤2 hours in length.

» The use of preoperative antibiotic prophylaxis is not supported for patients with diabetes undergoing elective, soft-tissue hand surgical procedures.

» There is a paucity of literature evaluating the use of preoperative antibiotic prophylaxis in patients with rheumatoid arthritis, those with cardiac valves, and those taking corticosteroids; because of this, there is no evidence to vary from our general recommendations.

Surgical site infections are a major source of morbidity and impose a large economic burden in orthopaedic surgery[1–3]. Preoperative antibiotic prophylaxis is commonly used to prevent surgical site infection. Although there is evidentiary support for the use of preoperative antibiotic prophylaxis for many orthopaedic procedures (e.g., open fractures[4–6], lower-extremity fractures[7–9], and total joint replacement[10–12]), the use of preoperative antibiotic prophylaxis for elective soft-tissue hand surgical procedures is controversial[13,14]. For example, current recommendations from the American Association of Plastic Surgeons are to not utilize preoperative antibiotic prophylaxis for clean hand surgical procedures, and current recommendations from the American Academy of Orthopaedic Surgeons are to not utilize preoperative antibiotic prophylaxis for carpal tunnel release[15,16]. Despite these recommendations, 2 surveys of hand surgeons reported rates of antibiotic use for carpal tunnel syndrome between 31% and 49%[17,18].

Although millions of soft-tissue hand procedures are performed each year[19,20], the rate of infection is reported to be low, with studies showing infection rates between 0.3% and 1.5%[13,21–25] for elective cases (e.g., carpal tunnel release and trigger finger release). Although the rate of infection for urgent soft-tissue cases is reported to be higher (e.g., 1.1% to 9.8% for lacerations, open fractures, or bite injuries[26–28]), this review will focus on elective soft-tissue surgical procedures (e.g., carpal tunnel release, trigger finger release, Dupuytren contracture release). Despite the low rate of infections, complications can be devastating, leading to soft-tissue loss, stiffness, scarring, and amputation[29]. Preoperative antibiotic prophylaxis, given to prevent infection, is associated with its own complications,

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including *Clostridium difficile* colitis, allergic reactions, and potential contribution to antibiotic resistance[30–32].

Given the low overall infection rate, detecting the effect of prophylactic antibiotics on surgical site infections necessitates a large sample size. Because of the scarcity of large randomized controlled trials, controversy exists with regard to the use of preoperative antibiotic prophylaxis in elective soft-tissue procedures. However, several large, well-conducted investigations on the topic have been recently published. With this critical analysis, we aim to review the evidence in support of and against the use of preoperative antibiotic prophylaxis and to provide recommendations with regard to the use of preoperative antibiotic prophylaxis in elective soft-tissue surgical procedures in the hand.

Evidence Supporting Routine Prophylaxis

The importance of preoperative prophylactic antibiotics has been established for several orthopaedic procedures[7–13,33]. In a double-blinded, placebo-controlled randomized trial, Pavel et al. found that prophylactic antibiotics reduced the postoperative infection rate in clean orthopaedic procedures; the study included orthopaedic procedures throughout the body (e.g., hand, wrist, forearm, spine, and knee) but did not perform a subgroup analysis to identify the differences ininfection rates between groups on the basis of the surgical site[34]. However, the study did demonstrate an increase in infection rate in both groups for those cases that were >2 hours. Although not reaching significance, in reviewing cases >2 hours in length, the infection rate in those patients receiving preoperative prophylactic antibiotics was lower than that in patients who did not receive preoperative prophylactic antibiotics. The study was criticized in a review by Norden for its unequal cohort sizes, suggesting a possible breakdown in randomization[35]. Another prospective, randomized, double-blinded study by Henley et al. found that preoperative antibiotic prophylaxis reduced the rate of surgical site infections for elective orthopaedic procedures, including those of the hand, but only for procedures that were .˃2 hours[36]. Again, a subgroup analysis was not performed and only 35 hand procedures were included. Given the low infection rate, these studies were not adequately powered to detect the potentially small treatment effect of preoperative antibiotic prophylaxis for patients undergoing an elective, soft-tissue hand surgical procedure.

Evidence Against Routine Prophylaxis

Several nonrandomized and retrospective studies have questioned the routine use of antibiotic prophylaxis for various clean, soft-tissue hand procedures. A single-center, retrospective analysis by Bykowski et al. consisting of 8,850 elective hand surgery cases (of which 43% were carpal tunnel release and 23% were trigger finger release) did not find a difference in the rate of surgical site infection between patients who received antibiotic prophylaxis and those who did not[37]. In a separate retrospective analysis of 600 elective soft-tissue hand surgical procedures, Tosti et al. similarly found no difference in the rate of surgical site infection between patients who received antibiotic prophylaxis and those who did not[38]. However, the low rate of surgical site infection following a soft-tissue hand surgical procedure introduces a potential limitation to these studies. Along with the potentially small treatment effect of antibiotic prophylaxis, the limited number of infection

events in a given study requires a very large sample size to ensure adequate statistical power and therefore reduce the likelihood that a true effect was not detected.

To address this challenge, Li et al. recently published a population-based analysis of 516,986 patients who underwent soft-tissue hand surgical procedures to assess the effect of antibiotic prophylaxis on the surgical site infection rate; the study used propensity score matching, controlled for potential confounding variables (e.g., patient demographic characteristics, procedure type, medication use, and comorbidities), and was appropriately powered for negative results. This analysis, similar to prior findings in the literature, did not find a significant treatment effect of preoperative antibiotic prophylaxis (odds radio, 1.03; $p = 0.585$)[13]. Although not a randomized controlled trial and limited by the nature of database investigations, the study provides a robust and adequately powered analysis of the use of antibiotic prophylaxis in soft-tissue hand surgical procedures.

Important to note is the growing body of literature with regard to the risks of antibiotic use. In 2015, the World Health Organization released a Global Action Plan with objectives including the improvement of awareness and understanding of antimicrobial resistance and the optimization of antimicrobial use in humans[39]. Antibiotic use may put patients at an increased risk of certain types of infections (e.g., *C. difficile* and *Candida*), may cause allergic reactions, and may lead to antibiotic resistance[30,31,40]. In the United States, *C. difficile* was found to be responsible for almost half a million infections and >27,000 deaths in 2011 alone[32]. Few data are available on the association of *C. difficile* and antibiotic prophylaxis in orthopaedic surgery; however, it is known that the rate of *C. difficile* infection is lower in orthopaedic patients than in patients from other specialties. Importantly, even a single dose of antibiotic has been implicated in the development of *C. difficile* colonization and disease and life-threatening allergic reactions[41–44]. Antibiotic resistance is an emerging threat to individuals and health-care systems, causing >23,000 deaths annually in the United States and resulting in an excess economic cost as high as $55 billion and loss of productivity[45–47].

Special Scenarios

Host Factors

Diabetes mellitus is a demonstrated risk factor for surgical site infections in lower-extremity procedures, spine procedures, and total joint arthroplasties[48–51]. In patients with orthopaedic trauma, stress hyperglycemia (e.g., an elevation of blood glucose levels during periods of illness[52,53]) is associated with a higher rate of surgical site infection[54]. In a retrospective evaluation of 187 patients without diabetes admitted to the intensive care unit after sustaining critical orthopaedic injuries, Richards et al. identified a strong association between hyperglycemia and surgical site infection[55,56]. Hyperglycemia was identified as an independent risk factor for surgical site infection within 30 days in a separate evaluation of 790 patients without a diagnosis of diabetes mellitus who were not in the intensive care unit and had sustained isolated orthopaedic injuries requiring acute surgical intervention[57]. However, the impact of diabetes mellitus on surgical site infection in hand surgical procedures and the indications for antibiotic prophylaxis in patients with diabetes mellitus after upper-extremity surgical procedures are not well characterized.

In a subgroup analysis of their large, retrospective review of 8,850 elective hand surgery cases, Bykowski et al. found that, although diabetes mellitus was a risk factor for surgical site infection, the rate of surgical site infections in this group did not change with antibiotic prophylaxis[37]. In another large, retrospective review of patients undergoing carpal tunnel release, Harness et al. found that preoperative antibiotic prophylaxis did not reduce surgical site infections in a cohort that included patients with diabetes, although no subgroup analysis was performed[23]. A recent study evaluated the association between diabetes mellitus and surgical site infections in 346 patients undergoing clean, elective hand surgical procedures lasting <30 minutes. In this cohort, only 4 patients developed a surgical site infection and only 1 of those patients who developed a surgical site infection had diabetes mellitus, leading the authors to conclude that diabetes did not affect the rate of surgical site infection[58]. Ko et al. attempted to address whether preoperative antibiotic prophylaxis reduces surgical site infections in patients with diabetes mellitus undergoing carpal tunnel release. The authors performed a retrospective review of 469 carpal tunnel release procedures using a propensity scorematched model, comparing patients with diabetes and patients without diabetes, and found that preoperative antibiotic prophylaxis did not reduce the odds of surgical site infection in patients with diabetes compared with those without diabetes[59]. However, these studies were all limited by their small sample size and therefore were not adequately powered to evaluate the efficacy of preoperative antibiotic prophylaxis in patients with diabetes who were undergoing an elective, soft-tissue hand surgical procedure. At present, there is a lack of substantial data to support the use of preoperative prophylactic antibiotics in patients with diabetes or hyperglycemia undergoing a clean hand surgical procedure.

Patients with rheumatoid arthritis are classically considered to be at higher risk for surgical site infection[60]. Not only are patients with rheumatoid arthritis vulnerable to infection given the nature of their disease, but the recent increasing use of immunomodulating agents may further contribute to this risk[61–63]. We are unaware of any studies evaluating the infection rate with or without preoperative prophylactic antibiotics in soft-tissue-only hand surgical procedures in patients with rheumatoid arthritis. In reviewing upper-extremity surgical procedures involving bone, the data are mixed as to whether this patient population is at an increased risk for surgical site infection. Studies of patients with rheumatoid arthritis undergoing total elbow arthroplasty have demonstrated an increased risk of infection[64–66], and patients undergoing metacarpophalangeal and proximal interphalangeal joint implant arthroplasties do not demonstrate an increased risk of infection compared with patients without rheumatoid arthritis[67,68]. Not only is there a paucity of clinical data on the relative risk of surgical site infection in patients with rheumatoid arthritis in the hand surgery literature, but there is also a lack of clinical data on whether the use of antibiotic prophylaxis in a soft-tissue hand surgical procedure benefits this population.

There is also debate with regard to preoperative prophylactic antibiotics in patients with cardiac valves and in patients who are prescribed corticosteroids[69–73]. We are not aware of any studies examining the use of preoperative prophylactic antibiotics in soft-tissue hand surgical procedures in patients with cardiac valves or patients taking corticosteroids.

Surgical Factors

Surgery duration and wound class (e.g., dirty or contaminated) have been established as risk factors for surgical site infections[74–76]. A retrospective database study of 58,498 patients undergoing a wide variety of procedures conducted by Haley et al. demonstrated that surgical duration of >2 hours and wounds classified as contaminated or dirty were important predictors of surgical site infection[74]. Similarly, in a study of 1,852 patients, Garibaldi et al. found that procedures lasting longer than 2 hours tripled the odds of surgical site infection[75]. Neither of these studies were isolated to hand or upper-extremity surgical procedures or had a subgroup analysis of procedure location. Henley et al. conducted a double-blinded, placebo-controlled, randomized trial to evaluate the effect of antibiotic prophylaxis on reducing surgical site infections in elective orthopaedic procedures, which included 35 hand surgical procedures[36]. Overall, the authors found that the use of preoperative prophylactic antibiotics achieved a reduction in surgical site infections only for procedures lasting >2 hours. Aydın et al. conducted a double-blinded, placebo-controlled, randomized trial in 1,340 patients undergoing elective and emergency hand surgical procedures, in which they demonstrated that prophylactic antibiotic use did not reduce surgical site infection rate in cases that were >2 hours or in cases that were classified as dirty[77]. This study excluded high-risk patients, such as those with diabetes mellitus, immunosuppression, or heart valve disease, and it was not adequately powered to evaluate elective, soft-tissue only cases. Given the lack of adequately powered studies, we cannot make recommendations for or against the use of preoperative antibiotic prophylaxis in these scenarios.

Conclusions

After a critical analysis of the literature, we recommend that otherwise healthy patients undergoing clean, elective, soft-tissue hand surgical procedures of ≤2 hours in length do not receive preoperative antibiotic prophylaxis. We also recommend against the use of preoperative antibiotic prophylaxis in patients with diabetes (Table I). We do not believe that there is ample literature to recommend for or against the use of preoperative antibiotic prophylaxis in patients with rheumatoid arthritis, those with cardiac valves, and those taking corticosteroids.

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TABLE I

Grade of Evidence for the Use of Preoperative Antibiotic Prophylaxis in Hand Surgical Procedures

Recommendation	Grade of Evidence*
Do not use antibiotics in cases that are ≤2 hours	B†
Do not use antibiotics in patients with diabetes	B†

*Grade A: Good evidence (Level-I studies with consistent findings) for or against recommending intervention. Grade B: Fair evidence (Level-II or III studies with consistent findings) for or against recommending intervention. Grade C: Poorquality evidence (Level-IV or V studies) not allowing a recommendation for or against intervention. Grade I: There is insufficient evidence to make a recommendation.

†There was consistent evidence from Level-III studies.