The Effects of Early Antibiotic Administration on Bacterial Culture Growth From Hand Abscesses

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Abstract

Background: Traditional management of hand abscesses consists of withholding antibiotics prior to drainage to optimize bacterial culture growth and outcome. The purpose of this study was to determine the effect of preoperative empiric antibiotics on the rate of culture growth and rate of adverse events in patients with acute hand abscesses. **Methods:** We performed a retrospective review of prospectively collected data on 88 consecutive hand abscesses that received empiric antibiotics prior to incision and drainage from 2012 to 2013 at an urban academic institution. We analyzed patient demographics, bacteriology, culture growth results, time to surgery, and frequency of adverse events. **Results:** The overall rate of positive culture growth was 90% (n = 79) despite running the antibiotics for a mean of 31 hours prior to debridement. Furthermore, 96% of the isolates were given a susceptible antibiotic during that time. The mean number of debridements was 1.5 per patient, but 4 re-operations were necessary for wound complications. No patients required an amputation or were upgraded to intensive care. **Conclusions:** Preoperative empiric antibiotic administration does not appear to greatly reduce bacterial culture growth from hand abscesses. The adverse events are relatively few for simple abscesses treated with pre-surgical antibiotics and decompression within 24 hours.

Keywords: abscess, antibiotics, culture, hand

Introduction

Infections of the hand may result in contracture, stiffness, pain, and potential amputation. To avoid debilitating sequelae, treatment for hand abscesses involves prompt surgical decompression and appropriate antibiotic administration.^{4,5,14} However, the timing of antibiotic administration is variable among surgeons. A few recent studies argue that appropriate antibiotic coverage administered before surgery can reduce length of stay and prevent sepsis.^{6,8} However, traditional protocols contend that preoperative administration of antibiotics may preclude a significant yield of bacterial growth on culture and thus affect the outcome.^{11,12} We present a retrospective review of prospectively collected data to determine the proportion of hand abscesses that grow bacteria on culture if antibiotics are given prior to surgical drainage and to determine the frequency and type of adverse events associated with this protocol.

Materials and Methods

We performed a retrospective review of prospectively collected data at an urban hospital for all surgically treated hand

abscesses from April 2012 to September 2013. The original prospective study compared the number of operations needed to treat hand abscesses between two groups randomized to receive postoperative soaks versus dry dressing changes, which excluded patients with infections proximal to the wrist, chronic wound infections, outpatient-managed infections, critically ill patients, and those who were non-compliant with the study protocol.¹⁵ For the present study, we further excluded patients who did not receive antibiotics prior to surgery and patients who did not have a record of a wound culture result.

We treated abscesses caused by bite wounds with ampicillin-sulbactam. All other patients with hand abscesses were given weight-based vancomycin, which was chosen in response to the regional prevalence of methicillin-resistant *Staphylococcus aureus* (MRSA).^{16,17} A second antibiotic

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was added to cover gram-negative bacteria if the infection was considered severe or if a history of fecal, water, or soil contamination was evident. We debrided most abscesses in this cohort in the operating room; the wounds were irrigated with normal saline and partially closed with suture over a penrose drain. The orthopedic resident performed a bedside drainage initially for paronychias and felons. Dorsal finger and hand abscesses received bedside drainage if the patient was febrile (temperature $>38^{\circ}\text{C}$). Wounds from bedside debridements were left open and packed with an iodinated gauze wick. We placed all patients in a bulky dressing, which was removed on postoperative day 1. A fellowship-trained hand surgeon determined the need for repeat debridements on daily rounds. Patients were observed in the hospital until clinical improvement was achieved and culture and sensitivity data were final. At the time of discharge, we prescribed a 10-day course of oral antibiotics unless they had a positive blood culture or osteomyelitis. In such cases, the patients received a longer course of antibiotics and were concurrently observed by an infectious disease consultant. Patients without a positive culture received amoxicillin-clavulanic acid for bite wounds, whereas all other patients received oral doxycycline or trimethoprim-sulfamethoxazole to empirically treat local resistant organisms. Patients were asked to follow up 1, 3, and 6 weeks after discharge. Finally, we reviewed this cohort for the proportion of cases with positive growth on culture, the time that elapsed between administration of antibiotic and surgery, length of stay, and the number of complications defined as wound healing failure, re-admission, re-operation, amputation, and upgrade to intensive care. We obtained institutional review board approval.

Results

Twelve patients were excluded from the final analysis because no cultures were obtained during their hospitalization ($n = 3$) or they did not receive antibiotics prior to drainage ($n = 9$). A total of 88 hand infections that received empiric antibiotics prior to incision and drainage met inclusion criteria. Most patients were males in the fifth decade of life, and many admitted to current intravenous drug use (Table 1). Dorsal hand abscess and dorsal finger abscess were the most common diagnoses, although abscesses were discovered in a variety of anatomic spaces. Abscesses resulting from intravenous drug use and trauma were the most common etiologies (Table 2).

Cultures identified a total of 14 different bacterial species. MRSA grew on culture in 43% of cases. The second most common pathogen was methicillin-sensitive *Staphylococcus aureus* (MSSA), followed by *Streptococcus* species. Gram-negative bacteria and anaerobic bacteria grew on culture in 3% and 6% of cases, respectively. More than 1 species grew on culture in 7% of cases (Table 3).

Table 1. Basic Demographics and Laboratory Values.

Demographics	
Male	73% ($n = 64$)
Female	27% ($n = 24$)
Mean age, y	41.6 (range, 27-96)
Diabetes mellitus, %	8
Human immunodeficiency virus, %	4
Hepatitis C virus, %	20
Intravenous drug user, %	40
Chemotherapy, %	1
Smoker, %	39
Mean laboratory values	
White blood cell $\times 10^3 \mu\text{L}$	11.1
Erythrocyte sedimentation rate, mm/h	37
C-reactive protein, mg/L	47

Table 2. Etiology and Diagnosis.

Etiology	
Intravenous drug user, %	32
Trauma, %	26
Idiopathic, %	17
Human bite, %	15
Foreign body, %	3
Insect bite, %	2
Other, %	5
Diagnosis	
Dorsal hand abscess, %	44
Dorsal finger abscess, %	22
Septic arthritis, %	
Metacarpal joint, %	8
Proximal interphalangeal joint, %	2
Distal interphalangeal joint, %	1
Paronychia, %	5
Flexor tenosynovitis, %	9
Felon, %	3
Extensor tenosynovitis, %	2
Volar finger abscess, %	2
Web space abscess, %	1
Midpalmar space abscess, %	1

An organism was identified on culture in 79 cases (90%), and the initial antibiotic covered the organism(s) in 96% of cases (Table 4). The mean time from antibiotic administration to surgical drainage was 31 hours. Surgery was most commonly performed in the afternoons. Wound complications necessitated 5 re-admissions and 4 re-operations. All 4 of these patients had dorsal hand wounds that failed to heal by secondary intention at 6 weeks from surgery. Two patients presented with smaller, non-erythematous, partially granulated wounds

Table 3. Culture Results.

Frequency of cultured organisms	
MRSA, n	38
MSSA, n	16
Coagulase-negative <i>Staphylococcus</i> , n	4
<i>Streptococcus</i> species, n	18
Gram negatives, ^a n	3
Anaerobes, ^b n	5
No growth, n	9

Note. MRSA, methicillin-resistant *Staphylococcus aureus*; MSSA, methicillin-sensitive *Staphylococcus aureus*.

^a*Acinetobacter* (1), *Enterobacter* (1), *Haemophilus parainfluenzae* (1).

^b*Eikenella corrodens* (3), *Pasteurella multocida* (1), *Proteus mirabilis* (1).

Table 4. Outcome Measures.

Outcome measures	
Positive culture (%)—Overall	90
Positive culture (%)—With initial bedside debridement	96
Positive culture (%)—With initial operative debridement	87
Time from antibiotics to I + D (hh:mm)—Median	19:58
Time from antibiotics to I + D (hh:mm, mean)—Overall	31:18 (range, 00:50-135:49)
Time from antibiotics to I + D (hh:mm, mean)—In culture positive cases	31:26 (range, 00:50-135:49)
Time from antibiotics to I + D (hh:mm, mean)—In culture negative cases	30:10 (range, 09:52-61:22)
Time from antibiotics to I + D (hh:mm, mean)—With initial bedside debridement	31:30 (range, 01:45-135:49)
Time from antibiotics to I + D (hh:mm, mean)—With initial operative debridement	31:13 (range, 00:50-97:16)
Time of day first I + D (hh:mm, mean)	12:17 (range, 00:47-23:51)
Empiric antibiotic covered organism, %	96
Number of surgeries, mean	1.5 (range, 1-4)
Length of stay, days	4.4 (range, 1-16)
Re-admissions, n	5
Re-operations, n	4
Upgrade of care to ICU, n	0

Note. I, incision; D, drainage; ICU, intensive care unit.

and were amenable to debridement and primary closure. Two patients had exposed tendons and poor granulation: 1 patient was treated with a local rotational flap, and the other had a

Z-plasty, which dehisced after a fall and was treated with a synthetic dermal regeneration graft.

None of the wound complications occurred in the 10% of patients whose abscess did not yield bacteria on culture. Of those patients with no growth on culture, 4 were bite wounds, 2 were traumatic, and 3 were from intravenous drug use; by anatomic site, 4 cases were dorsal hand abscesses, 2 were flexor tenosynovitis, and 3 were interphalangeal joint septic arthritis. No patients in this series required an amputation or upgrade to intensive care.

Discussion

Traditional management for hand abscesses consists of prompt surgical drainage followed by empiric antibiotic therapy, which is subsequently modified in response to the culture and sensitivity assays. Advocates of this protocol contend that bacterial growth on culture is maximized, and thus treatment is optimized, if the sample is taken before antibiotics are administered. Studies that have reviewed their experience with periprosthetic infections and other indolent musculoskeletal infections typically support this sequence of events.^{1,7} However, for the treatment of acute hand abscesses, the data are limited and consist mostly of expert opinion.^{8,12} In a retrospective review by Fowler et al, surgical drainage of 1345 hand abscesses yielded bacterial growth on culture in only 416 cases (30.9%); the authors suggested that preoperative administration of antibiotics may have contributed to the low yield.³ In contrast, Section et al reported on 869 children with a variety of musculoskeletal infections over a 5.5-year period; they noted a growth rate of 88.3% for abscesses despite 63.7% receiving antibiotics before surgery, which was not significantly different from the growth rate of abscesses from patients in whom antibiotics were withheld.¹⁰

We reviewed data collected from a prospective study of hand abscesses, during which, all patients received empiric antibiotics prior to undergoing surgical drainage. We identified bacteria on culture in 90% of cases despite running antibiotics for a mean time of 31 hours (range, 1-138 hours). Furthermore, 96% of the isolates were given a susceptible antibiotic during that time. We believe the high yield in the present study is related to the protective encapsulation of purulent fluid, pH environment, and drug deactivation by bacterial enzymes, which is consistent with the fact that antibiotics alone usually cannot cure a mature abscess.¹⁸ In the same vein, we suspect that these same protective factors contribute to the lack of antibiotic effectiveness in inhibiting bacterial growth on culture media. However, 10% of cases did not grow bacteria on culture. Many of these cases were bite wounds or infections in small joints, which proportionally had a lower yield than dorsal hand or finger abscesses. The yield in these cases may have been affected by the type of bacteria, the number of bacteria, the maturity

of the abscess, or the presence of antibiotics. The effect of antibiotics in these cases is difficult to determine from the low number of culture negative cases and the lack of a comparison group that did not receive preoperative antibiotics.

Although the mean time from antibiotics to incision was 31 hours, the median time was 20 hours. Some patients were initially diagnosed with cellulitis, which delayed their treatment. However, most patients received empiric antibiotics within an hour of presentation to the hospital and were decompressed in the operating room within 24 hours from the diagnosis of abscess, which met the goal of the protocol. This practice resulted in an average of 1.5 operations, a mean length of stay of 4.4 days, a 5.6% re-admission rate, a 4.5% re-operation rate after discharge, and no upgrades to intensive care. Outcomes in this series are similar to previous studies.^{6,8,19} We believe our protocol is resource conserving yet safe for the following reasons. Centers lacking daily availability of a hand surgeon can safely manage hand abscesses overnight as long as an appropriate empiric antibiotic is selected. In this series, the empiric, preoperative antibiotic provided appropriate coverage in 96% of cases that eventually identified an organism on culture. However, we caution that an understanding of the regional bacterial epidemiology is critical in properly selecting an empiric antibiotic.^{2,6,8,16,17,19} Centers that provide daily availability of hand surgeons do not necessarily have to expend personnel in the middle of the night for simple abscesses. Increasing evidence suggests that after-hours surgical start times are associated with potentially less desirable outcomes and that surgeon fatigue may affect performance during cases the next day.^{9,13}

The current study has several limitations. We performed this study at an urban hospital that frequently treats an indigent population with a high prevalence of MRSA. Our rates of admission to ensure compliance are likely higher than suburban or rural centers. Although the data were prospectively collected, our review was retrospective which limited the variables we were able to examine. Furthermore, the study design does not include a comparison group. We studied a variety of infections but most were dorsal hand or finger abscesses, which may bias the conclusions; some surgeons advocate more strongly for immediate decompression of suppurative flexor tenosynovitis to prevent adhesions and subsequent loss of motion. We further did not evaluate outcomes on the basis of motion or subjective functional outcomes. Most importantly, our series did not include any patients who presented “in extremis.” Therefore, our treatment protocol is not generalizable to patients with signs of systemic sepsis or physiologic instability, such as those with necrotizing fasciitis. We advocate for immediate surgical intervention in such cases.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. This article does not contain any studies with animal subjects.

Statement of Informed Consent

Additional informed consent was obtained from any patient for whom identifying information is included in this article in the form of a formal and signed media consent.

Declaration of Conflicting Interests

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