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Original article

Antibiotic prophylaxis in surgery for closed fracture of the hand

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ABSTRACT

Purpose: Preoperative antibiotic prophylaxis is associated to internal fixation for closed phalangeal and metacarpal fracture, but its effectiveness is not known.
Methods: In a consecutive series of 119 adult patients undergoing Kirschner-wire fixation for phalangeal or metacarpal fracture, 56.3% (n = 67) received antibiotic prophylaxis and 43.7% (n = 52) did not.
Results: The rate of deep surgical site infection was 1.5% (n = 1) in the group with antibiotic prophylaxis and 1.9% (n = 1) in the group without. Minor skin irritation or infection of the pin tract occurred in 13.4% of cases (n = 9) in the group with antibiotic prophylaxis and 9.6% (n = 5) in the group without.
Conclusion: Our findings suggest that use of antibiotic prophylaxis could be reduced in the treatment of closed fractures of the hand treated with removable pins.
Type of study/level of evidence: Therapeutic IV (retrospective review).

Introduction

Surgical site infection (SSI) is one of the most serious complications of surgery, significantly increasing hospitalization costs and often requiring antibiotic treatment or even irrigation and debridement [1]. One common method to prevent SSI is preoperative antibiotic prophylaxis [2]. Efficacy is well proven in open fracture and joint replacement surgery [3,4]. In hand surgery, the need is less well established. Recent studies reported that antibiotic prophylaxis did not significantly reduce the incidence of SSI in elective hand surgery [5,6]. There are also multiple reports indicating that it does not reduce infection rates in closed hand injury [7,8]. Unfortunately, little research has focused on the effects of antibiotic prophylaxis in hand fracture requiring fixation.

There are a numerous reasons why excessive use of antibiotics should be avoided. Overuse is the leading cause of antibiotic resistance, which is widely recognized as a major global threat causing prolonged hospital stay and increased mortality [9]. Antibiotics can also cause allergic reactions. The most commonly used prophylactic antibiotics, cephalosporins, are also the most common cause of perioperative anaphylaxis [10,11]. While most antibiotics are relatively inexpensive, reducing unnecessary use also improves the cost-effectiveness of treatment.

The aim of the present study was to investigate the effectiveness of antibiotic prophylaxis in hand trauma requiring K-wire fixation. This was a retrospective cohort study, comparing two groups. The first group did not receive antibiotic prophylaxis and the second group received routine antibiotic prophylaxis for their operation. We compared superficial and deep infection rates per group. The study hypothesis was that antibiotic prophylaxis does not reduce risk of surgical site infection.

Methods

In June 2019 our surgery unit began implementing a recommendation that intraoperative antibiotics should not be given in the treatment of closed phalangeal or metacarpal fracture. Institutional review board approval was obtained for a retrospective chart review of adult patients undergoing K-wire fixation for closed hand fracture between January 1, 2019 and December 31, 2021. Medical records were searched using the code NDJ64 (internal fixation of hand fracture). Data for 200 patients were retrieved. Exclusion criteria comprised 1) open fracture, 2) diabetes or immunosuppressive medication, 3) pinning for reduction of joint dislocation without fracture, and 4) loss to follow-up. Inclusion process is presented in Fig. 1. Two groups of

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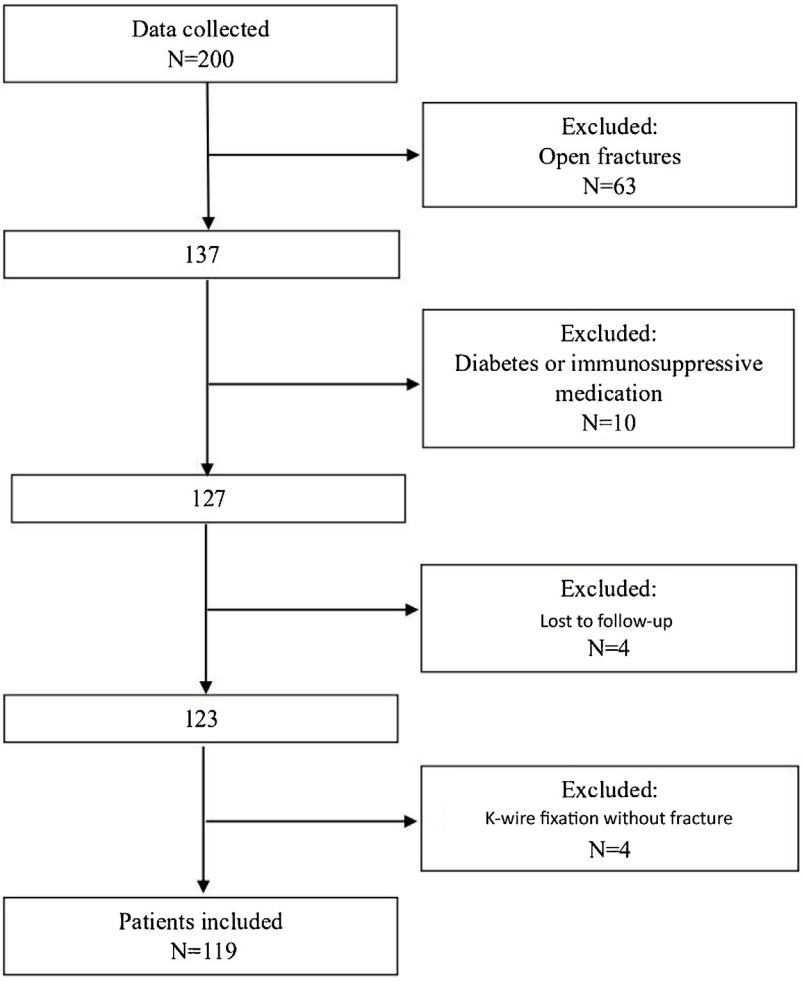

Fig. 1. Inclusion flowchart.

included patients were distinguished: group A (n = 52) had not received antibiotic prophylaxis and group B (n = 67) had. Demographic data are shown in Table 1. We also performed a subgroup analysis, removing cases of carpal bone or distal phalanx fracture; in both groups A and B, 8 patients were excluded, but the resulting demographics was very similar to the main groups. The recommended routine prophylactic antibiotic for non-allergic patients during the study period was intravenous cefuroxime 1.5 g (patients <80 kg) or 3 g (patients >80 kg). Clindamycin was primarily used for patients with allergy to cephalosporins. Five consultant hand surgeons and two residents operated on the patients. The use of antibiotic prophylaxis was based on the decision of the treating physician rather than on institutional guidelines. Pins were unburied and K-wires were long enough to be removed during the postoperative outpatient consultation. All patients were given written instructions for pin-site care.

Surgery was followed by at least one routine check-up by a hand surgeon or hand surgery resident, at 3–6 weeks postopera-

Table 1
Patient characteristics.

Patients included in the study N = 119	Antibiotic prophylaxis	No antibiotic prophylaxis
	N = 67	N = 52
Mean age (SD)	38.9 (13.80)	38.7 (14.57)
Gender		
Male	44 (65.67%)	31 (59.62%)
Female	23 (34.33%)	21 (40.38%)
Mean days between injury and surgery (SD)	5.94 (3.64)	6.00 (2.82)
Mean weeks between surgery and check-up (SD)	4.4 (0.6)	4.5 (0.7)
Mean surgery time (minutes) (SD)	54.0 (23.5)	45.1 (17.0)
Location of fracture		
Distal phalanx	4 (5.97%)	8 (15.38%)
Middle phalanx	5 (7.46%)	7 (13.46%)
Proximal phalanx	12 (17.91%)	18 (34.62%)
Metacarpal	49 (73.13%)	25 (48.08%)
Carpal bones	5 (7.46%)	0
Multiple fracture	8 (11.94%)	6 (11.54%)

SD – standard deviation.

tively. Additionally, we screened medical records for any late surgical site infections. The charts were inspected from the operation until the time of study data collection. For analysis, infections were categorized as superficial or deep, in line with the SSI guidelines of the Centers for Disease Control and Prevention [12]. Superficial SSI comprised skin infections and minor pin-tract infections, and deep SSI comprised osteomyelitis and deep subcutaneous infections. The surgical site was considered infected in case of clinical symptoms of infection such as erythema, swelling, pain and pus formation in the pin tract. Diagnoses were made by the attending emergency department physician or by the hand surgeon or resident at the routine check-up. SSIs were treated by oral antibiotics, leaving the internal fixation to provide stability for the fracture. One patient needed surgical irrigation and debridement for deep surgical site infection.

We compared superficial and deep infection rates per group on chi^2 test. The null hypothesis was that there is no difference in infection rates between groups. The significance threshold was set at $p < 0.05$, with confidence intervals for proportions per group and for intergroup differences.

Results

119 patients were included: 75 male, 44 female; 67 with antibiotic prophylaxis (56.3%) and 52 (43.7%) without (Table 1). The most common fractures were metacarpal (62.2%, n = 74) and proximal phalangeal (25.2%, n = 30). Mean time from injury to surgery was 6 days. The first routine check-up at a mean 4.5 weeks. Mean surgery time was 54 min with antibiotic prophylaxis and 45 min without. In the group with antibiotic prophylaxis, the infection rate was 13.4% (9/67) and in the group without antibiotic prophylaxis 9.6% (5/52) (p = 0.52; 95% confidence interval for difference, −0.0076 to −0.15). Superficial SSI rates were 11.9% (8/67) and 7.7% (4/52) respectively and deep SSI rates 1.5% (1/67) and 1.9% (1/52). Comparisons between patients with and without antibiotic prophylaxis are shown in Table 1.

On chi^2 test, the p-value was 0.52 and the 95% proportions confidence interval was 0.063−0.24 for the group with antibiotic prophylaxis and 0.032−0.21 for the group without. The confidence interval for difference in proportions was −0.0076 to −0.15. Results are shown in Table 2.

On subgroup analysis, the infection rate for the group with antibiotic prophylaxis was 7/59 (11.86%), and 5/44 (11.36%) for the group without. On chi^2 test, the p-value was 0.27 and the 95% proportion confidence interval was 0.049−0.23 for the group with antibiotic prophylaxis and 0.038−0.25 for the group without. The confidence interval for difference in proportions was -0.12−0.13. Results are shown in Table 3.

Discussion

The main finding of this retrospective study was that there was no significant difference in rates of superficial and deep surgical site infection according to antibiotic prophylaxis in closed hand fractures requiring K-wire fixation. The antibiotic prophylaxis group had an overall infection rate of 13.4% and the group without antibiotic prophylaxis had a rate of 9.6%. The infections were mostly pin-tract and skin infections. There was one case of osteitis and 1 of osteomyelitis, which required irrigation and debridement. The chi^2 p-value was 0.52: i.e., the difference between groups was non-significant; this does not prove that there was no difference but, based on the 95% confidence intervals and the difference in proportions confidence interval, the groups seemed to be clinically comparable.

It is widely accepted that fractures in the distal phalanxes need no antibiotic prophylaxis, as has been shown in many studies of open fracture [13,14]. On subgroup analysis without patients with distal phalanx or carpal bone fractures, infection rates were similar in the groups with and without antibiotic prophylaxis: 11.86% and 11.36% respectively.

The present findings are consistent with previous research. A recent study by Feldman et al. reported that antibiotic prophylaxis had no significant effect on closed hand fractures requiring internal fixation [15]. Similar results were found in a large prospective study with 1042 patients by Gillis et al. [16]. Another study in 2010 also reported that antibiotic prophylaxis was not effective in both elective and trauma hand surgeries [17]. The hand is thought to be less prone to infection than other parts of the body, perhaps

Table 2
Infection rate per group and statistical analysis.

	Antibiotic prophylaxis N = 9	No antibiotic prophylaxis N = 5
Total SSI rate	13.43%	9.62%
Superficial SSI rate	8 (11.94%)	4 (7.69%)
Deep SSI rate	1 (1.49%)	1 (1.92%)
95% confidence interval for proportions	0.063–0.24	0.032–0.21
95% confidence interval for difference in proportions	−0.076 to 0.15	
Chi^2 test p-value	p = 0.52	

SSI: surgical site infection.
Confidence intervals and Chi-Squared test were calculated for combined superficial and deep infection rate.

Table 3
Infection rate per group and statistical analysis excluding distal phalanx and carpal fractures.

	Antibiotic prophylaxis N = 7	No antibiotic prophylaxis N = 5
Total SSI rate	7/59 (11.86%)	5/44 (11.36%)
Superficial SSI rate	6 (10.17%)	4 (9.09%)
Deep SSI rate	1 (1.69%)	1 (2.27%)
95% confidence interval for proportions	0.049–0.23	0.038–0.25
95% confidence interval for difference in proportions	−0.12 to 0.13	
Ch^2 test p-value	p = 0.27	

Confidence intervals and chi^2 test were calculated for combined superficial and deep infection rate.

due to the anatomy and vascular supply of the bones and soft tissue [18]. There are also studies reporting no significant effect of antibiotic prophylaxis on infection rates in open hand fracture [13,19], although there is some evidence supporting the use of antibiotics in complex open hand trauma and open fractures with contaminated wounds [20].

The present study showed similar deep SSI rates as in previous research reporting rates of 0–2% [21–23]. The rate of minor infection of the pin tract or surrounding skin was rather high, at 8–12%. This might be explained by the low threshold we applied to define superficial SSI. For example, Shewring et al. reported a low superficial SSI rate of 1.7% but included only infections which were confirmed on culture [24]. Distinguishing superficial SSI from pin-tract irritation is difficult, and we opted to include all suspected cases. Many of the present postoperative SSIs were diagnosed and treated in the hospital's emergency department.

Our study had certain limitations. The design was retrospective. A larger sample could provide more accurate results and more reliable statistical analysis. Surgeries were performed by different surgeons, whose individual preferences affected their decision to use antibiotic prophylaxis or not. It should be noted that antibiotics were used in some cases where they would not be not recommended by the protocol, which may have caused some undetected discrepancies between groups. All patients with carpal bone fractures received antibiotic prophylaxis. Also, due to the retrospective design, there may be unknown variables out of control of the researchers.

In conclusion, our results suggest that not using antibiotic prophylaxis in closed finger fractures with removable K-wires is feasible and safe. The results are in line with previous research. However, further prospective studies are needed to establish trustworthy clinical guidelines.

Ethical considerations

Institutional review board approval was obtained for this retrospective chart review from Turku University Hospital: n° T01/008/22.

Disclosure of interest

The authors have no potential conflicts of interest to disclose with respect to the research, authorship, and/or publication of this article.

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Author contributions

KL collected data, wrote the manuscript and carried out the statistical analysis IH wrote parts of the manuscript and provided substantial improvements to the manuscript MP designed the study, wrote parts of the manuscript and provided supervision.

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