SHORT COMMUNICATION

Microbiology of surgical site infection in closed upper limb fractures: Data from a prospective trauma registry

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Abstract

The current study aims to determine the rate of surgical site infection, causal microorganism, and antibiotic sensitivity pattern in operated upper limb closed fractures at the Aga Khan University Hospital, Karachi. Cases presenting between June 2015 to October 2019, were selected from a single-centre, longitudinal, prospective orthopaedic trauma registry. Infection rate, causal microorganism, and antibiotic sensitivity pattern were determined up to six months after surgery. From among a total of 376 closed fractures, 12 encountered surgical site infection with some having late onset, giving an infection rate of 3% which is 1% higher than the international benchmark. Microorganism culture was performed on 5 (42%) patients out of which 2 (40%) were positive. Frequently used prophylactic antibiotics were first generation Cephalosporin and Co-amoxiclav in 9 (75%) patients, but all other patients required other antibiotic categories. Five patients required implant removal with antibiotic coverage. K-wire insertion required prolonged antibiotic treatment. Most of the cultures were negative in spite of the presence of infection.

Keywords: Trauma registry, upper limb, closed fractures, wound infection.

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Introduction

Surgical incision always carries the risk of developing surgical site infection (SSI). Closed fractures treated surgically has an infection rate of 1% to 2%.[1,2] Centre for Disease Control (CDC) defined superficial wound infection as erythema, swelling, pain, purulent discharge or heat involving only skin or subcutaneous tissue surrounding the wound, while deep wound infection as persistent wound discharge, abscess, dehiscence, wound gangrene, involvement of deep soft tissues, muscles or fascia, requiring wound debridement and/or implant removal.[3] In general, several factors are associated with SSI, such as the patient's comorbid condition, surgical procedure, and implant, etc. According to literature, SSI leads to delay in wound healing and patient recovery, risk for developing sepsis, and delayed bone union.[4-7]

Despite all the protective measures, infection rate is increasing, thus requiring selection of stringent antibiotics to control the infection.[8,9] To reduce the SSI rate, active safety measures are highly recommended by the World Health Organisation standard guidelines.[10] In order to meet the 2% SSI as international benchmark of closed fracture operation site,[2] exploration of current treatment practice with post-surgical infection rate is of utmost importance. The aim of the current study was to assess the SSI rate in patients with upper limb closed fractures, treated surgically at a tertiary care hospital, as well as to assess the antibiotic sensitivity of causal microorganism with current prophylactic antibiotic regime.

Patients/Methods and Results

After Institutional and ERC approvals, an ongoing single-centre, prospective, longitudinal orthopaedic upper limb trauma registry was initiated in June 2015 at a tertiary care hospital. The registry included all patients who had trauma-related upper limb fracture, irrespective of age and gender. Patients with amputation and pathological fracture were excluded. Patients who voluntarily participated in the registry were enrolled in the study. Written informed consent was obtained from the patients before data collection, and outcome assessment was done at two- week, six-weeks, and three-, six- and 12-month follow-ups. Data on SSI for the current study was obtained from the upper limb trauma registry, from June 2015 to October 2019, which demonstrated 12 (3%) SSI cases among 376 closed upper limb fractures. Wound infection was classified as superficial and deep infection. The treatment strategy followed by the individual treating surgeon with resultant patient outcome was assessed.

The Statistical Package for Social Sciences (SPSS) version 19.0 was used for data analysis. Continuous variables were expressed as mean ± standard deviation and categorical variables as percentages. The p-value of less than 0.05 was considered statistically significant with a confidence interval of 95%. Multiple regression analysis was performed between contributing influential variables

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such as age, comorbid condition, and delay in surgery on patient recovery.

A total of 376 closed fractures were identified from trauma registry out of which 256 (68%) were males and 120 (32%) were females, with median age of 40 years (IQR 28, range 1-84 years) (data not shown). Twelve patients encountered post-procedure SSI with an infection rate of 3% which is 1% higher than international benchmark.[1,2]

Nine (75%) out of the 12 infected patients were males and 3(25%) were females with median age of 36 (IQR 31, range 10-74 years) (Table-1). Out of these 12 patients, 8 (67%) were managed with internal plate fixation, 3(25%) with K-wire fixation and one (8%) with internal plate fixation combined with an external fixator (data not shown).

Of the 12, 7(58%) patients developed superficial wound infection, while 5(42%) developed deep infection. Culture and sensitivity was performed on 5(42%) out of the 12 infected patients, of which 2(40%) were culture positive (Figure-1).

Out of the 7 superficial infections, culture and sensitivity was sent for 3 (43%) patients and the remaining 4 (57%) were treated by empiric antibiotics and/or antiseptic dressing only, depending on the surgeon's choice. One (33%) out of three superficial wound cultures was positive and grew Staphylococcus aureus that was resistant to Penicillin, Clindamycin, Trimethoprim, and Erythromycin. The patient was treated according to culture sensitivity. CRP was performed on one (14%) out of the 7 superficial infection patients and it was noted to be raised. Superficial SSI resolved in one (14%) out of 7 patients by antiseptic dressing only, 3(43%) by antibiotics combined with antiseptic dressing, and three patients required removal of K-wires in 2(29%) and external fixator in one (14%) (Figure-1, Table-2).

Among the five patients presenting with signs and symptoms of deep infection, only 2(40%) were investigated for microorganism by culture; of these, one patient showed growth of Enterobacter species, that was

Table-1: Demographics of the cases and the subset with surgical site infection.

	All cases	Surgical site infection
N	376	12 (3%)
Age (Median IQR)	40 (28)	36 (31)
Male	256 (68%)	9 (75%)
Female	120 (32%)	3 (25%)

Table-2: Treatment strategy for surgical site wound infection of individual closed upper limb fracture.

Wound Infection	Fracture	Antibiotic			Surgical Wound Infection Treatment
		Prophylactic	Empiric	Therapeutic (culture positive)	
Superficial infection	Humerus shaft	Cefazolin			Antiseptic dressing
	Distal humerus		Clindamycin Cefixime		
	Radius shaft	Ciprofloxacin Clindamycin	Polymixin		
	Fifth metacarpal	Cefazolin Polymixin Gentamycin	Cephalexin Polymixin Levofloxacin		Infected K-wire removal
	Distal radius	Cefazolin		Levofloxacin Clindamycin Vancomycin Ceftriaxone	Infected K-wire removal
	Distal radius	Cefazolin Co-amoxiclav			Antiseptic dressing External fixator removal
	Proximal humerus	Co-amoxiclav Cefazolin	Cephalexin		
Deep infection	Phalanx, 3rd digit		Cefazolin		Infected K-wire removal
	Distal humerus	Cefazolin Ciprofloxacin	Pip/Tazo		
	Proximal humerus	Cefazolin	Cephalexin	Ciprofloxacin Clindamycin	
	Clavicle	Cefazolin	Cefazolin		Infected Implant removal
	Elbow	Cefazolin	Clindamycin Ciprofloxacin		

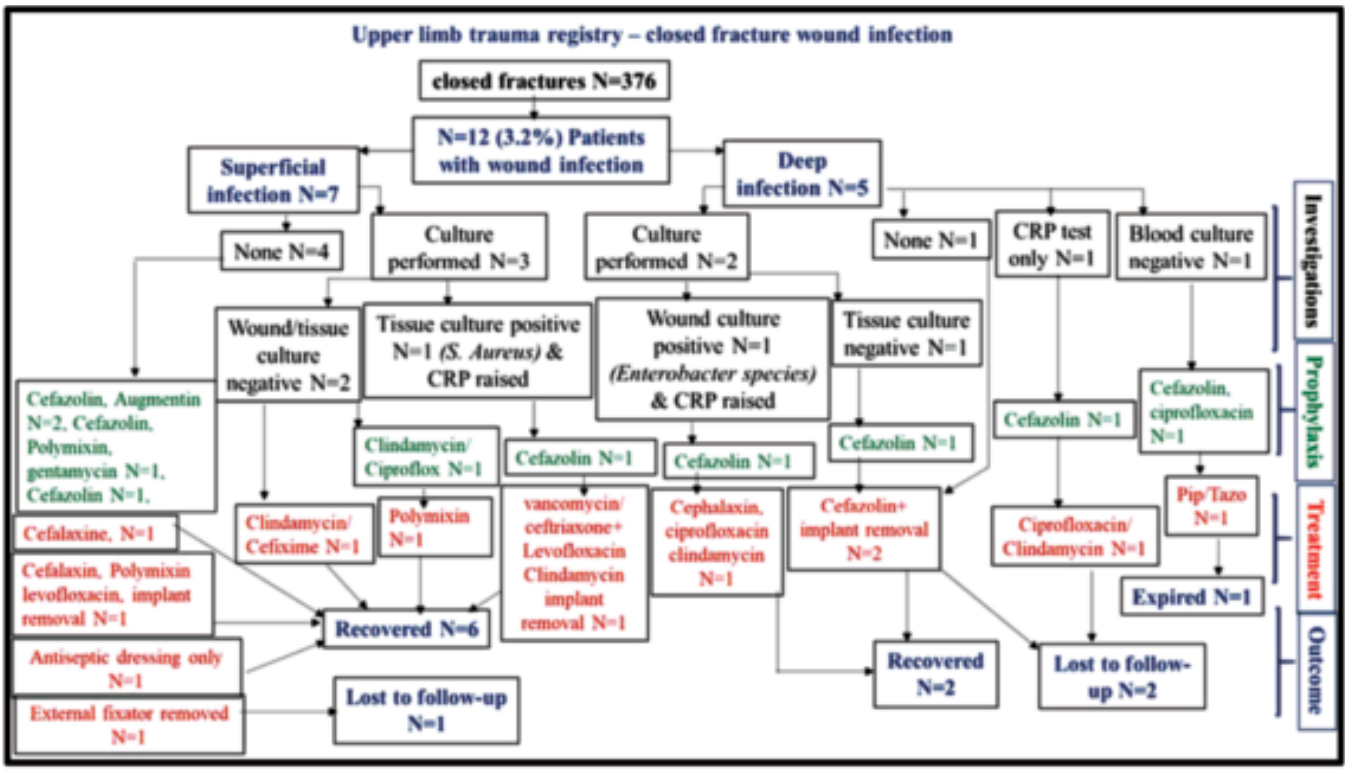

Figure-1: Upper limb closed fracture surgical wound infection and its management.

resistant to Penicillin group of antibiotics and was managed according to culture sensitivity (Figure-1, Table-2). The other patient was culture negative in whom the surgical implant was removed and he was treated with broad spectrum antibiotics. One (20%) patient was managed by antibiotics combined with antiseptic dressing, one (20%) required removal of infected K-wire, and one (20%) severely comorbid patient, with deep infection and negative blood culture, was managed by antibiotics Cefazolin and Ciprofloxacin as prophylactic and Pip/Tazo as empiric therapy but developed systemic sepsis and expired five weeks post-treatment. In 2(40%) of the five patients with deep infection CRP was performed which was raised (Figure-1).

In routine practice, the most frequently used first line antibiotics before surgery were first generation Cephalosporin in 9(75%) of the 12 patients. Seven (78%) of these 9 patients receiving prophylactic first generation Cephalosporin developed SSI within six weeks while 1 (11%) patient at 3-months and 1(11%) at 5-months follow-up after surgery (Figure-1, Table-2). According to CDC guidelines, SSI is labelled if infection develops up to 90 days after surgery.[11] In the current data, five patients developed SSI up to five months later, suggesting that SSI can even occur late depending upon the immunity and underlying comorbidity and requires a careful patient assessment.

Nine (75%) of the 12 patients were managed surgically within 24 hours of hospital admission in which 2 (22%) patients had underlying comorbid conditions, while 3 (60%) patients with comorbidity were operated after 2-4 days of admission (data not shown). Interestingly, multiple regression analysis showed that there was no significant association between surgical delay, comorbid condition, and age with resolved wound infection.

Prolonged use of antibiotics in K-wire associated infection is uncommon. In our study, three out of five patients required K-wire removal with prolonged antibiotic therapy for complete recovery. This uncommon finding is in accordance with one published study.[12]

First generation Cephalosporin was overprescribed that might lead to antibiotic resistance,[13] suggesting the need for better selection of antibiotics for effective infection coverage and avoiding emerging resistance.

Based on previous literature, bone healing problem due to infection was determined by X-ray reports.[4] At the time of infection, 3 (27%) out of these 12 patients had evidence of some bone healing. Seven (64%) had no bone healing, while two patients had no X-ray record available (data not shown). Thus, most of the patients had some delay in bone healing. No additional surgical procedure was required for any of the infected patients.

Guidelines for prevention of SSI recommend removal of implant for deep infections.[3] Current evidence showed that 5 (42%) patients required implant removal. Most of the cultures were negative despite existence of infection, similar to the findings in a study with 9% occurrence of culture negative infections.[14] As this study was conducted in a single centre, generalisability is limited.

Conclusion

The current data shows 3% infection rate in surgically treated upper limb closed fractures, which is 1% higher than international benchmark. For SSI, implant removal along with antibiotic coverage was required and most of the cultures were noted to be negative in spite of infection. Late presentation of SSI after 90 days of surgery is possible. As an uncommon research finding, K-wires with the tips outside the skin were predisposed to prolonged infections. Inconsistency in SSI treatment and investigation was observed among surgeons. Adoption of a pathway for standardisation of workup and antibiotic treatment in SSI following closed fractures implant surgery is recommended.

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Conflict of Interest: None.

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