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Review article

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## Incidence of infected open fracture wounds in level I trauma center in Saudi Arabia

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### ABSTRACT

#### Objectives

The aim of the study is to report the incidence of positive cultures among open fractures presented to King Abdulaziz Medical City (KAMC) level I trauma center.

#### Methods

This is a prospective cross sectional study, we are reporting the incidence of positive deep swabs by taking two swab cultures from inside open fracture wounds in emergency department and operation room, then sending the swabs to our microbiology lab for cultures.

#### Results

We were able to study 36 open fractures presented to (KAMC) in a 6-month period, complete swabs were taken from 19 wounds. Negative cultures were found in 18 open fracture wounds, only one wound had a positive culture for Methicillin- resistant Staphylococcus aureus (MRSA). We were able to follow the patients for short period; none of the 18 wounds got infected. The incidence rate of contaminated wounds was 5%. The internal fixation frequency was 17 cases out of 19. One case ended up with amputation, and we treated one case conservatively with cast after irrigation and debridement.

#### Conclusion

Open fracture wounds have high risk of infection. Among our subjects, the risk was reduced by following the standard protocols in managing open fractures promptly.

**Keywords:** Open fractures, Wound cultures, Infected wounds, MRSA

## INTRODUCTION

Open fracture is usually defined as a fractured bone with a disrupted skin over the fracture site. It usually results from a high and low energy trauma ranging from motor vehicle collision to small finger trauma. This kind of fractures is well known to cause a deep tissue infection with a wide range of causative pathogens [1–16]; especially in type III fractures according to The Gustilo open fracture classification system. It is a fact that the risk of the infection increases, as the severity of fracture increases. [14–17]

A lot of studies tried to recognize the most frequent organism in open fracture. These studies varied between retrospective and prospective; they were depending on pre-operative, intra-operative, or post-operative cultures. Each study represents its environment and region. In one study done in Mexico by Salcedo-Dueñas JA, a sample for culture was taken upon admission from 75 patients; the most frequent organisms found in the positive cultures were *Staphylococcus aureus* and *Candida albicans*. [13] Another study done by Burns TC, cultures were taken from 192 Operation Iraqi Freedom/Operation Enduring Freedom military personnel; it was a retrospective study but focused on Gustilo and Anderson (G/A) type III diaphyseal tibia fractures. It revealed that the most common isolated organism in surveillance cultures was *Acinetobacter baumannii* and the most common isolated organism in infection cultures was *Staph. aureus*. [4]

Johnson EN conducted a retrospective study from 40 patients by taking intraoperative cultures; the patients were US military service members wounded in Iraq or Afghanistan. The most common organism was *Acinetobacter calcoaceticus-baumannii* complex. This study focused on Gustilo and Anderson type III tibia fractures, which limits the efficacy of the study. (10) In Malaysia, Faisham WI did a prospective study on 33 patients with open tibial fractures; they concluded that 13 (39.3%) out of 33 pre-debridement swabs grew bacteria, five of those swabs grew *Staphylococcus aureus*, and 4 swabs grew *Staphylococcus epidermidis*. None of the organisms, which grew in the pre-debridement culture, caused later infection. (6) In Nigeria, Ako-Nai AK and Ojo OD prospectively compared the initial wound swabs with the occurrence of deep bacterial infections. No

patient with an initial negative culture developed a wound infection; the most common organism was *Staphylococcus aureus*. [2, 11]

Incidence rate of infection in open fractures is mostly described in relation to Gustilo classification. Gustilo in his paper collected 303 patients with open fractures to get the Incidence rate of infection. He found that type I & II range from 0 – 7% and the rate of infection reached up to 25% in type III and overall sepsis rate among open fractures was 4.4%. However, when he went more specifically into subtypes of type III, he found that rate of infection in type IIIC reached up to 50%. [8]

In Saudi Arabia, we have no data revealing the most common organism in open fractures, or incidence of positive cultures, although we have a high rate of motor vehicle accidents and thus a large number of open fracture patients. Also, comparing our geographic area to the other countries, we have different climate which can affect the types of organisms detected. Our aim is to report the incidence of positive cultures and the common organism in open fractures presented to the Emergency Department of King Abdulaziz Medical City in Riyadh – Saudi Arabia. Also, we report the method of fixation and the standard management protocol done at King Abdulaziz Medical City to treat open fracture cases.

## METHOD

This is a prospective cross sectional study, we are reporting the incidence of positive deep swabs by taking two swab cultures from inside open fracture wounds in the emergency room and the operation room, then sending the swabs to our microbiology lab for gram stain and culture. All cases are presented to Emergency Department of King Abdulaziz Medical City in Riyadh – Saudi Arabia. The swabs are taken by orthopedic staff who responds first to trauma cases in ER. Our inclusion criteria was fresh presentation to our hospital and not referred from another hospital, also we included open fractures in upper and lower limbs only. All cases were presented in a 6 month period between 2015 and 2016.

All data was recorded on a standard forms that include (site of fractures, pre and post irrigation swabs, and method of fixation). Most of our swabs were taken twice, one swab was taken before irrigating the wound and bone, and one swab was

taken after doing full surgical irrigation and debridement. All patients presented to our ED were treated promptly with antibiotics, tetanus toxoid, and bedside irrigation and sterile dressing. Then they are booked for surgical irrigation and debridement within 48h. The number of surgeries is dependant on severity of trauma, the current condition and stability of the patient, and surgeon judgment pre and intraoperation.

## RESULTS

Out of 36 open fractures presented to (KAMC) in a 6-month period between 2015 and 2016, we were able to take complete swabs from 19 wounds. 18 open fracture wounds showed negative cultures, and one wound had a positive culture for Methicillin-resistant *Staphylococcus aureus* (MRSA). Over a period of 1 month follow up; none of the 18 wounds got infected. The incidence rate of contaminated wounds was 5%. Out of 19 cases, 17 cases were treated with internal fixation, one ended up with amputation (the decision of amputation was made since the limb was non-salvageable), and one case was treated conservatively with cast after irrigation and debridement.

When we looked at the site of fractures, we found that 11 case involved tibia, 3 in patella, 3 in femur, and 1 case in humerus, and ulnar. In regard to the age of patients, we classified the age of the participants into 3 groups: less than 18 years old, between 18 and 40 years old, and more than 40 years old. We found 13 patients with age between 18-40 years old, and five patient whose age was more than 40 years old, and only one patient with age of 4 years old. The mean age among our population was 35 years.

The mechanism of injury among our subjects was mostly due to motor vehicle accidents, we encountered this kind of high energy trauma in 15 out of 19 patients. The rest had either a fall or a hit that caused an open fracture (2 out of 19 for each). Timing of the first surgery which included irrigation and debridement of the open fracture wound was within 24 hours in 17 out of 19 patients. However, one patient due to his unstable condition was taken for surgery after 9 days and another patient was taken within the first 48 hours.

We looked at the number of surgeries needed to make sure of a good debridement with possibility of

fixing the fracture, we had 9 patients needed one surgery only that included debridement with fixation. 8 patients who underwent two surgery, starting with irrigation and debridement in the first one and in the second surgery we repeated irrigation and debridement and did a final internal fixation. We encountered two patients out of 19 who needed 3 surgeries due to extensive tissue loss and the general condition of the wounds and patients who had a septic look.

The antibiotics that were used were chosen by our physicians based on patient condition and hospital regulations, we looked at the type, dose and duration of antibiotics. 14 out of 19 patients used only one antibiotics, which was Cefazolin in 13 patients and Vancomycin in one patient who had Methicillin-resistant *Staphylococcus aureus* (MRSA) positive culture. 12 out of 13 patients who were treated with Cefazolin, received treatment for 5 to 7 days only, two of them were discharged on cefuroxime for one additional week.

Dual antibiotics were used in 5 patients; all combinations included Cefazolin in addition to Gentamicin, Ceftazidime, or Piperacillin/Tazobactam (Tazocin). This dual use of antibiotics did not correlate with multiple surgeries or discharging the patient on oral antibiotics.

## DISCUSSION

Comparing our results to other studies, we had a 5% incidence rate of infected wound while in USA, Antonia(5) described a 10% rate of infection in open fracture wounds. We think that the difference in the results can be due to many factors, most importantly is the sample size, however, these patients were collected from two trauma centers. Also, the different environment can lead to such variable results.

We have many limitations in our study. Major limitation is small sample size, this was caused by our desire to conduct a prospective study. However, if we were able to conduct a larger sample size, we will be able to describe our population in more depth and with higher statistical precision and accuracy. Also, number of normal saline liters used during irrigation in many cases was uncontrollable due to surgeon preferences and we had no standard protocol to use specific number of liters in specific cases.

We were faced also with standard protocol in our institute to give first generation cephalosporins to any patients presenting in Emergency Department with open wounds, regardless if it is a fracture or not. The previous limitation can be the main reason for primary negative cultures among our population. Also, we could not follow up patients for more than 3 months, we think this is due to the nature of our population after bone healing is reached. However, this short follow up periods did not allow us to describe the union rate which is out of the scope of this study.

Although the incidence of Methicillin-resistant *Staphylococcus aureus* (MRSA) was not a primary object in our study, we found that the only positive culture among our population is an MRSA positive. This can be interpreted as a low MRSA rate in open fracture patients among a sample of Saudi population. MRSA rate in open fracture wounds was described through literature to be between 4% and 25%.(5–10) The MRSA rate is considered to be high and trending up if we correlate the results from North American papers from 2007 to 2013, however, we do not have studies that mentioned the MRSA rate among Saudi population to compare our results.

Age group among our subjects showed that young adults were at higher risk to have open fractures, however, this can be explained as that most of our Saudi population who usually drive by themselves are young adults. Our mean age (35 years) was different from what Faisham WI had among Malaysian population, which was 25.5 years.(6)

Yusuf Et al. described stabilising the fractures upon admission among all of his population, using external fixator in most cases (70%).(15) In comparison with our subjects, half of them (52%) underwent revisions for more irrigation and

debridement with different method of temporary fixation, either by an external fixator or splinting, as it fits the circumstances for each patient.

According to our results, using proper prophylactic antibiotics as soon as possible once receiving the patient in Emergency department, can decrease the rate of infected wounds in open fractures significantly. We do not think that the timing of surgery or the fixation methods were associated with decreasing infection rate; the reason is that all of our cultures which were taken before surgery, appeared to be negative. However, early timing for surgery can be the reason for maintaining negative results in subsequent cultures or follow ups.

## CONCLUSION

By following the standard protocols in managing open fractures promptly, we were able to almost eliminate the risk of infection in open fracture wounds which are well known to have a high risk of contamination. We recommend and think it is necessary to conduct regional epidemiological studies to accurately evaluate this problem across different countries and to monitor the Methicillin-resistant *Staphylococcus aureus* (MRSA) rate among our population.

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