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A Case Study – Surgical Site Infection of Open Fracture Grade II Caused by *Pseudomonas aeruginosa*

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Abstract | **Case Report**

Introduction: Surgical Site Infections (SSI) are the third most commonly reported nosocomial infections which has an adverse impact on the hospital as well as on the patient. SSI a hospital acquired infection among surgery patients, which in turn delays normal recovery process and increases hospital length of stay and health care costs. ***Case study:*** A 34-years-old woman underwent ORIF surgical procedure on 22/3/2023 and developed symptoms like oozing of pus from surgical site on fifth day of post-surgery, fever spikes on same day, increase of pain at surgical site. She was treated with linezolid-600mg-BD a day intravenously and Meropenem-1gm-BD a day intravenously. After 10 days she made eventful recovery and got discharged. ***Microbiology Examination and Diagnosis:*** Pus sample collected from surgical site gave rise to growth of Pseudomonas aeruginosa on mac cockney agar medium. Pseudomonas aeruginosa of this particular sample showed resistance to most of the antibiotics that were tested. ***Discussion:*** Patient's conditions like duration of operative procedure (>2 hours), immune-compromised condition like type II Diabetes, obesity, antibiotic prophylaxis and class of wound all these factors becomes risk factors for developing SSI. ***Conclusion:*** These infections are more common in elderly patients, patients undergoing emergency surgeries, longer surgical duration (>2 hours), and patients with a high ASA index. In order to decrease incidence of SSI we would have to: a) decrease the duration of the surgeries performed b) focus on regular and intensive drain care c) if a patient has any conditions that can complicate the surgical procedure rule out them first with proper management d) conduct periodic surveillance to keep a check on SSI.

Keywords: Surgical site infections (SSI), American Society of Anesthesiologists index (ASA index), nosocomial infections, Pseudomonas aeruginosa.

INTRODUCTION

Any infection occurring at the site of a surgical incision superficially or deep within the fascia, within 30 days of a surgical procedure is termed as a surgical site infection (SSI). If an SSI involves only the skin and underlying subcutaneous tissue, it is termed as a superficial SSI and if it penetrates into the deep fascia and the muscle it is called a deep SSI. As there are both open fractures and closed fractures, among both open fractures surgeries are complicated compared to closed one [1].

As Open fractures are complex injuries involving the bones and surrounding tissue [2]. According to the 2017 American Academy of Orthopedic Surgeons (AAOS), open fractures are broken bones with open wounds and skin damage caused by bone fragments that penetrate the skin at the time of injury [3]. Here in our case we going to discuss about grade II open fracture surgery. Some open fracture cases need an operative fixation. The operative fixation of skeletal fractures can be highly complex due to the unpredictable nature of bone damage. One of the most challenging complications in this management is Infection after fracture fixation (IAFF) [4]. By breaking the skin, open fractures eliminate one of the major barriers to infection. Bacterial contamination has shown to occur in up to 70% of open fracture wounds [2].

Instead of that, loss of skin integrity and exposure of the subcutaneous tissue provides a warm, conducive environment for the colonization and growth of microorganisms unless it treated with prophylactic

antibiotics and surgical debridement. The goals of open fractures management include the prevention of infection, achievement of bone union, and restoration of function [5]. Important factors increasing the risk of an SSI include pre-existing infection, malnutrition, obesity, low serum albumin, elderly, smoking, and immunosuppression (diabetes mellitus, irradiation). Contaminated surgeries, emergency surgeries, prolonged procedures, substandard sterilization, inadequate handling of instruments, and inadequate antiseptic surgical site preparation. Conditions that contribute for increased incidence of SSI include multi-trauma, hemodynamic instability, shock, massive blood transfusions during the procedure, and postoperative hypothermia, hypoxia, and hyperglycemia. Other independent predictors of SSI include abdominal surgeries, contaminated or dirty procedures [6].

PRESENTATION OF A CASE

A 34-year-old woman presented to emergency ward on 22 March 2023 with grade II open fracture of her right lower extremity, especially right leg. Patient admitted with complaints of grade II open fracture, pain at knee, difficulty in movement, right arm pain.

Patient demographics

Patient weight was 105kgs, height of 155cms. BMI of 46.6kg/m^2, known diabetic since 2 years and with no past surgical history. On 22nd March 2023 an open reduction and internal fixation (ORIF) surgical procedure was planned. Before operative procedure, patient's laboratory tests done to ensure general condition of a patient. The results of the blood examination shown below in table 1.

Table 1: Results of the blood examination

Laboratory parameters	Pre-operative	Post-operative
Hemoglobin	11.5	9.4
White blood cells	11340	9360
Platelets	3.32,000	2,65,000
Serum creatinine	0.5	0.5
Blood glucose	106	-

Table 2: Results of urine examination

Lab parameters	Pre-operative	Post-operative
Pus cells	2 – 3	5 – 6
Epithelial cells	2 – 3	15 – 20
Red blood cells	0 – 1	Absent

On 22nd March 2023, ORIF operative procedure was done and the antibiotic administered as surgical prophylaxis is Cefoperazone/sulbactam-3gm in 100ml NS as drip intravenously, this antibiotic was continued until 28 of March with a frequency of twice a day and added Amikacin-500mg, BD intravenously from 26th of March for stabilizing her condition. The time gap between prophylaxis antibiotic administration and time of incision is > 1hour. On 25th of March 2023, developed 3 fever spikes i.e., 99.5 F, 99.7 F, 100.4 F respectively and patient's C-reactive protein value reported as 238 mg/dL. On 27th of March 2023 there was pus oozing out from the surgical site and it continued for 3 days. There were fever spikes of 100 F, 100.5 F and 100 F, 100.2 F on 28th and 29th of March respectively. Infected surgical site after surgery shown in a figure 1.

Figure 1: Post-operative condition

MICROBIOLOGY EXAMINATION AND DIAGNOSIS

On 27th of March, pus sample collected with a sterile transport media and sealed inside an icebox to maintain mutual condition of the bacteria. Bacteria inoculation on Mac-Conkey agar plate done immediately. The results of the pus culture were identified biochemically and microscopically. The

bacterial colony was bacilli and gram negative, identified as Pseudomonas aeruginosa. The growth of bacteria showed in figure 2.

Figure 2: growth of Pseudomonas aeruginosa on Mac-Conkey agar plate that is collected from pus sample of surgical site

VITEK compact system used for determining microbial susceptibility to antibiotics. The organism was found to be MDR, that developed resistance against many antibiotics include beta- lactam's, beta-lactam/beta- lactam inhibitors (BL/BLI's), Cephalosporins, Tetracyclines. So based on report and patient condition, surgeons advised for re-surgery on 30th of March.

OUTCOMES AND FOLLOW UP

On 30th March patient underwent for re-surgery, this time antibiotic used as prophylaxis is Meropenem-1gm in 100 ml NS as drip intravenously, this was continued for 7 days-TID and also added Linezolid-600mg-BD from 29th march and continued till 6th of April 2023. Patient got eventful recovery and discharged on 7th of April with Meropenem-1gm-TID and Linezolid-600mg-BD for further 5 days and further follow up after 5 days.

DISCUSSION

Risk factors for SSI

a. Patient related/Endogenous factors: As age increases the immune system response decreases and the occurrence of chronic diseases increases which act as synergistic factor for SSI [1]. Pre-existing infections, malnutrition, obesity, immunosuppression (diabetes mellitus, anemia, hypertension.)
b. Surgery/Procedure related factors: contaminated surgeries, emergency surgeries, prolonged procedures, substandard sterilization, inadequate antiseptic surgical site preparation.
c. Physiological conditions: the conditions that contribute to an increased incidence of SSI include multi-trauma, hemodynamically instability, sepsis, shock, blood transfusions during operative procedure, hyperglycemia, hypoxia.
d. Miscellaneous factors: conditions like abdominal surgeries, contaminated or dirty procedures, more diagnoses upon hospital discharge.
e. American Society of Anesthesiologists (ASA) index: incidence of SSI was higher among patients with ASA index II and III when compared with ASA index I in clean, clean-contaminated procedures [6].

Co-relating above mentioned risk factors with current case:

a. In a current case, patient weight is 105kgs, BMI of 46.6 kg/m^2. Patient was a known diabetic since 2 years.
b. It is a contaminated surgical site and emergency surgery, degree of surgery influences the probability of SSI. And the surgery was carried out for 6 hours 30 min, there was no chlorhexidine bath done at surgical site,
c. It is a traumatic surgery.
d. This is contaminated and grade II open surgery.
e. As per ASA index she comes under a category of ASA 2.

Also above all,

The time difference between time of incision and time of prophylactic antibiotic is >1 hour, also one more co-relating factor is that, organism that was found in pus sample and water that is used in OT theatre was same. That can be seen in the below figure 3 and figure 4.

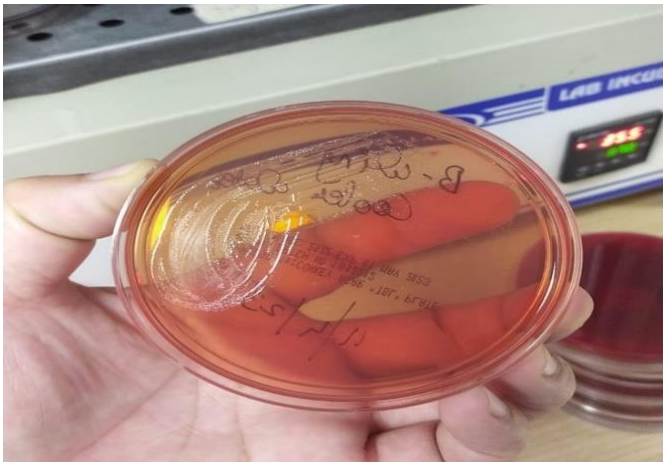

Figure 3: Indicates bacterial growth of water sample collected from OT

Measures to prevent the occurrence of SSI

Administration of antibiotics prior to skin incision will reduce the risk of postoperative infection when compared to prophylactic antibiotics given after skin incision. Prophylactic antibiotics recommended for all operations involving hollow organs. Administration of prophylactic antibiotics known to be the most significant protective factor in reducing the incidence of SSI after surgical procedure. Antibiotics given preoperatively, ideally within 30 minutes of induction of anesthesia. Adequate antibiotic concentrations in serum and tissue will reduce the risk of bacterial development during the postoperative period [7]. Guidelines published in the Surgical Infection Prevention Guideline recommend prophylactic antibiotics given 60 minutes before incision and discontinued within 24 hours of surgery [8]. Re-disinfection of the skin around the incision site prior to skin closure been reported to reduce the incidence of postoperative SSI. It also been reported that irrigation with an antibiotic solution at the incision site is safe, does not show any side effects, and is an effective method in reducing infectious morbidity and SSI after surgical procedure.

The rate of surgical wound infections strongly influenced by operating theatre quality, too [9]. A safe and salubrious operating theatre is an environment in which all sources of pollution and any micro-environmental alterations kept strictly under control. Can achieved only through careful planning, maintenance and periodic checks, as well as proper ongoing training for staff [10]. There several features like ventilation, floor of an OT, water, procedural and behavioural factors of staff in OT. The environmental factor related to our case study is water. The water distribution system in hospitals may constitute a source of healthcare-associated infections caused by opportunistic pathogens such as, Pseudomonas aeruginosa, Stenotrophomonas maltophilia, Burkholderia cepacia, Acinetobacter spp, fungi, etc. Taps are common sources of Pseudomonas aeruginosa and other Gram-negative bacteria and linked to infections in multiple hospital settings [11]. Immunocompromised patients are particularly susceptible to infection by waterborne microorganisms, which can cause bacteraemia, pneumopathy, meningitis, urinary tract infections and surgical site infections [12-14]. However, infections clearly linked to contaminated hands of surgeons after surgical hand scrub with contaminated water have not yet documented. In countries lacking continuous monitoring of drinking water and improper tap maintenance, recontamination may be a real risk even after correct surgical hand scrub.

CONCLUSION

This case of SSI in a postoperative open fracture used to evaluate the importance of administrating prophylactic antibiotic within one hour of incision time. Re-administration of second dose of prophylactic antibiotic if any surgical procedure goes beyond 3 to 4 hours. Following proper aseptic procedure like using chlorhexidine bath before initiating surgical procedure for surgical site especially in a case of contaminated and dirty wounds will add worth and helps in reducing SSI rate. Following sterile dressing procedure, regular and intensive drain care. In conclusion, surgical site infection rates improved by acting upon various factors, from the surgical environment itself to procedural aspects and staff behaviour. Moreover, surveillance of SSIs be well established, well documented to lower the incidence of SSIs. Many hospitals still do not follow this recommendation despite its effectiveness. The Centers for Disease Control and Prevention guidelines for the prevention of SSIs emphasize the importance of good patient preparation, aseptic practice, and attention to surgical technique; antibiotic prophylaxis indicated in specific circumstances. Therefore, the prevention of SSI requires a multidisciplinary approach and the commitment, including that of those who are responsible for the design, layout and functioning of operating theatres.

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