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Prevalence of Surgical Site Infection in Orthopedic Surgery: A 5-year Analysis

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Surgical site infection (SSI) is disastrous in orthopedic practice as it is difficult to rid the bone and joint of the infection. This study was aimed to assess the prevalence of SSI in orthopedic practice and to identify risk factors associated with surgical site infections. All patients admitted to the orthopedic male and female wards between January 2006 and December 2011 were included in the study group. The data, which were collected from the medical charts and from the QuadraMed patient filing system, included age, sex, date of admission, type of admission (elective versus emergency), and classification of fractures. Analyses were made to find out the association between infection and risk factors, the χ^2 test was used. The strength of association of the single event with the variables was estimated using Relative Risk, with a 95% confidence interval and $P < 0.05$. A total of 79 of 3096 patients (2.55%) were included: 60 males and 19 females with the average age of 38.13 $\pm$ 19.1 years. Fifty-three patients were admitted directly to the orthopedic wards, 14 were transferred from the surgical intensive care unit, and 12 from other surgical wards. The most common infective organism was *Staphylococcus* species including Methicillin Resistant *Staphylococcus aureus* (MRSA), 23 patients (29.11%); *Acinetobacter* species, 17 patients (21.5%); *Pseudomonas* species, 15 patients (18.9%); and *Enterococcus* species, 14 patients (17.7%). Fifty-two (65.8%) had emergency procedures, and in 57 patients trauma surgery was performed. Three (3.78%) patients died as a result of uncontrolled septicemia. SSI was found to be common in our practice. Emergency surgical procedures carried the greatest risk with *Staphylococcus* species and *Acinetobacter* species being the most common infecting organisms. Proper measures need to be

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undertaken to control infection rates by every available method; antibiotics alone may not be sufficient to win this war.

Key Words: Surgical Site Infection – Orthopedic Surgery – Trauma

Surgical site infection (SSI) is defined as microbial contamination of the surgical wound within 30 days of an operation or within 1 year after surgery if an implant is placed in a patient.[1] It is estimated that annual incidence of SSI in the United States is 1.07%; with 8000 deaths directly related to SSI[2] and a financial cost of treatment to $10 billion. The problem of SSI is universal; in the United Kingdom, the extra cost for each SSI is approximately €2500 (US $3394),[3] and the length of the hospital stay increases between 5.8 and 17 extra days.[4] Surgical-site infections cause increased morbidity, mortality, extended hospital in-patient stays, and economic burden to the hospital resources.[5–8]

Many preventable causes of SSI have been identified, and if proper measures are implemented, the incidence could be reduced. Patients, surgeons, and nurses, as well as operative room atmosphere and instrumentation are prime areas of concern. Various methods have been established to reduce infections in implant surgery, but infection does occur.

The washing of hands and maintaining basic hygiene,[9] prophylactic antibiotics given at the proper time and at the correct strength,[10] surgical clothing,[11] and reducing the flow of staff in the operating room[12–14] all contribute to lowering the incidence of infection.

This study was aimed to assess the prevalence of SSI in orthopedic practice at King Fahd Hospital of the University, Al Khobar, and also to identify risk factors associated with surgical site infections.

Patients and Methods

The data gathered arose from a retrospective chart review of 3096 patients who underwent orthopedic surgical procedure during January 2007 and December 2011 at King Fahd Hospital of the University, a 500-bed tertiary care center in Al Khobar, Saudi Arabia. Our main aim was to detect the occurrence of SSI within 30 days of the surgical procedure. The data, which were collected from the medical charts and from the QuadraMed patient filing system (QuadraMed Corporation, Reston, Virginia, USA), included age, sex, date of admission, type of admission (elective versus emergency) and classification of fractures. The components of the National Nosocomial Infections Surveillance (NNIS) system surgical-patient risk index used in this study were as follows:

1. A preoperative anesthesia risk scoring system as per Anesthesia Society of America (ASA);
2. Gustillo wound classification (GWC); and
3. "T time," defined as the 75th percentile of the duration for each operative procedure.

As a standard practice prophylactic, intravenous antibiotics were given on call to the operating room. The infection was assessed by the infective organism, sensitivity of the antibiotics, and recovery. Any additional days the patient stayed in the hospital were calculated on the basis of standard discharge after each such procedure. The incidence rate of SSI, according to the different categories of the individual components of the index (ASA, GWC, and T time), was calculated. The strength of the association between each of these factors and the incidence rate of SSI were estimated using the Goodman-Kruskal *G* coefficient. A measure of association between 2 variables established on an ordinal level. Analyses were made to find out the association between infection and risk factors, the χ^2 test was used. The strength of association of the single event with the variables was estimated using Relative Risk, with a 95% confidence interval and $P < 0.05$.

Results

A total of 79 of 3096 patients who had orthopedic or trauma operations contracted an SSI. The incidence of SSI was 2.55%. There were 60 males and 19 females with an average age of 38.13 ± 19.1 years. The demographic data are given in Table 1. Fifty-three patients were admitted directly to the orthopedic wards, 14 were transferred from the surgical intensive care unit and 12 from the surgical wards. Infection was significantly higher in patients who underwent an emergency procedure $P < 0.001$.

Table 2 lists the procedures carried out, showing that the majority were trauma. The average operating time was 151.7 ± 44.5 minutes (range, 40–370

Table 1 Demographic data

Number of operations	3096
Number of patients with SSI	79
Average age, y	38.13 ± 19.1
Site of hospital admission	
Orthopedic wards	53 (67%)
Intensive care units	14 (17.7%)
Surgical wards	12 (15.3%)
ASA score	
ASA1	49 (62%)
ASA2	21 (26.6)
ASA3	9 (11.4%)
Type of surgery	
Emergency	52 (65.8%)
Elective	27 (34.2%)

minutes). Patients overstayed in the hospital owing to infection for an average of 24.75 days (range, 3–150 days). Sixty-two patients (78.4%) had various complications, and 3 patients (3.79%) died directly as a result of uncontrolled septicemia. Table 3 gives the different organisms and the percentages.

The most common infective organism was *Staphylococcus* species including Methicillin Resistant *Staphylococcus aureus* (MRSA) in 23 patients (29.11%), *Acinetobacter* species in 17 (21.5%), *Pseudomonas* species in 15 (18.9%), and *Enterococcus* species in 14 (17.7%).

Sixty-one patients (77.21%) cultured a single organism, 15 had 2 infecting organisms, and 3 patients cultured more than 2 organisms. In all patients who had 2 or more organisms, *Acinetobacter* species was the common organism.

Discussion

The incidence of SSI in the present study was 2.55%, which is below the reported worldwide incidence of 2.6% to 41.9%.[15] Second, our study differs from the literature in that SSI was more common in younger patients, whereas studies reported SSI to be high in

Table 2 Type of surgery

Intramedullary nailing	43
Plate and screws	14
Spinal trauma	5
Scoliosis	1
Spondylolisthesis	1
THR	2
TKR	4
Implant removal	1
Others	8

THR, Total hip replacement; TKR, Total knee replacement.

Table 3 Infective organisms

Staphylococcus aureus + MRSA	23
Acinetobacter sp	17
Pseudomonas sp	15
Enterococcus sp	14
Escherichia coli	3
Klebsiella sp	3
Serratia sp	2
Providencia stuartii	1
Stenotrophomonas	1
Proteus mirabilis	1
Burkhalderia	1
Peptospirosis sp	1

patients of over 55 years of age. This could be because the majority of our patients were operated on due to trauma, and it has been reported that preoperative soft-tissue damage is a major risk factor for developing SSI.[16] The other independent risk factors for patients developing SSI were having an emergency operation and having prolonged surgery. The majority of patients with infection had an ASA score of 1, but other studies have suggested that the higher the ASA score, the higher the risk of infection.[16–18]

The movement and number of staff in the operating room is long known to influence the incidence of SSI. In our patients, we have practiced to reduce the staff in the operating room to essential staff only, and this has shown that there was no serious deep-seated infection post arthroplasty, whereas during other types of surgery the entry and exit of the staff was not controlled. The incidence of SSI was significantly higher in trauma surgery versus total joint arthroplasty ($P < 0.001$). There are apparent unintended differences in the quality of care that exist between patients undergoing joint arthroplasty or spinal surgery and those undergoing trauma surgery. There could be a couple of reasons for these differences. During total joint replacement, scoliosis and other spine surgery senior staff are available, while routine trauma surgery is performed by junior staff. Last, because of the gravity of infection in a patient with arthroplasty, surgeons tend to extend extra care while operating, and arthroplasty surgeons go the extra mile to limit SSI on the basis of research,[19–20] and monitoring the quality of care.[21] Barring the level of the surgeon, the other preventable differences cannot be justified.

There are limited data available to review with regard to SSI in Saudi Arabian patients. Abdel-Fattah[22] reported after a 12-month study of nosocomial infection from a military hospital, the incidence of SSI was 12.9%, whereas Khairy *et al*[23] reported an incidence of 6.8% after a prospective study. In both studies, the incidence appears higher than in our study. Even though the authors did not specify the different specialties these patients were taken. In the recent past, the outbreaks of *Acinetobacter* infections, which occur in intensive care units, have caused much concern to health care providers, hospital administrators, and patients at large. Trauma patients who are admitted to the ICU initially always carry a risk of infection, which they carry from the ICU to the wards. In this series, the majority of the patients who contracted an SSI and cultured *Acinetobacter* species apparently had been admitted to the ICU, which is the primary breeding ground for such organisms. Our study shows that *Acinetobacter* organisms are increasing their presence in the orthopedic wards, and this needs to be controlled. At present it appears that the morbidity and mortality that they cause are enormous and sometimes beyond the control of the treating physicians.

Results

This study has some limitations as well as strengths. It is limited in that we studied only the patients who developed infection postoperatively. The study would have had more strength if we gathered the data of all 3096 patients who were operated on and compared them with the infected group.

In conclusion, this study shows that the incidence of SSI in orthopedics and trauma patients is comparable with the reported incidence in the literature. We believe that development of SSI is a complex process, which is dependent on several different factors related to the patient, the surgical environment (such as the ICU), staff involvement, and finally the surgical technique. We were able to identify the areas that need to be addressed to further reduce the incidence of SSI in our patients.

References

1. Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG. CDC definitions of nosocomial surgical site infections, 1992: a modification of CDC definitions of surgical wound infections. *Infect Control Hosp Epidemiol* 1992;**13**(10):606–608
2. Scott RD II. *The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention*. Atlanta, GA: Centers for Disease Control and Prevention, 2009
3. Plowman R, Graves N, Griffin MA, Roberts JA, Swan AV, Cookson B *et al*. The rate and cost of hospital-acquired infections occurring in patients admitted to selected specialties of a district general hospital in England and the national burden imposed. *J Hosp Infect* 2001;**47**(3):198–209
4. Geubbels EL, Mintjes–de Groot AJ, Van den Berg JM, de Boer AS. An operating surveillance system of surgical site infections in The Netherlands: results of the PREZIES national surveillance network. Preventie van Ziekenhuisinfecties door Surveillance. *Infect Control Hosp Epidemiol* 2000;**21**(5):311–318
5. Awad SS, Palacio CH, Subramanian A, Byers PA, Abraham P, Lewis D *et al*. Implementation of a methicillin resistant *Staphylococcus* aureus (MRSA) prevention bundle results in decreased MRSA surgical site infections. *Am J Surg* 2009; **198**(5):607–610
6. Weigelt JA, Lipsky BA, Tabak YP, Derby KG, Kim M, Gupta V. Surgical site infections: causative pathogens and associated outcomes. *Am J Infect Control* 2010;**38**(2):112–120
7. Fry DE. The economic costs of surgical site infection. *Surg Infect (Larchmt)* 2002;**3**(suppl 1):S37–S43
8. Urban JA. Cost analysis of surgical site infections. *Surg Infect (Larchmt)* 2006;**7**(suppl 1):S19–S22
9. Pittet D. Compliance with hand disinfection and its impact on hospital acquired infections. *J Hosp Infect* 2001;**48**(suppl A): S40–S46
10. Polk HC Jr, Christmas AB. Prophylactic antibiotics in surgery and surgical wound infections. *Am Surg* 2000;**66**(2):105–111
11. Tammelin A, Ljungqvist B, Reinmüller B. Comparison of three distinct surgical clothing systems for protection from air-borne bacteria: a prospective observational study [abstract]. *Patient Saf Surg* 2012 Oct 15;**6**(1):23
12. Ayliffe GA. Role of the environment of the operating suite in surgical wound infection. *Rev Infect Dis* 1991;**13**(suppl 10): S800–S804
13. Letts RM, Doermer E. Conversation in the operating theater as a cause of airborne bacterial contamination. *J Bone Joint Surg Am* 1983;**65**(3):357–362
14. Ritter MA. Operating room environment. *Clin Orthop Relat Res* 1999;**369**(369):103–109
15. Lilani SP, Jangale N, Chowdhary A, Daver GB. Surgical site infection in clean and clean-contaminated cases. *Indian J Med Microbiol* 2005;**23**(4):249–252
16. Bachoura A, Guitton TG, Smith RM, Vrahas MS, Zurakowski D, Ring D. Infirmity and injury complexity are risk factors for surgical-site infection after operative fracture care. *Clin Orthop Relat Res* 2011;**469**(9):2621–2630
17. Maksimović J, Marković-Denić L, Bumbaširević M, Marinković J, Vlajinac H. Surgical site infections in orthopedic patients: prospective cohort study. *Croat Med J* 2008;**49**:58–65
18. Culver DH, Horan TC, Gaynes RP, Martone WJ, Jarvis WR, Emori TG *et al*. Surgical wound infection rates by wound class, operative procedure, and patient risk index. National Nosocomial Infections Surveillance System. *Am J Med* 1991;**91**(3B): 152S–157S

19. Lidwell OM, Lowbury EJL, Whyte W. Effect of ultraclean air in operating rooms on deep sepsis in the joint after total hip or knee replacement: a randomised study. *Br Med J* 1982; **285**(6334):10–14
20. Lidwell OM, Lowbury EJL, Whyte W. Airborne contamination of wounds in joint replacement operations: the relationship to sepsis rates. *J Hosp Infect* 1983;**4**(2):111–131
21. Kärrholm J, Garellick G, Rogmark C, Herberts P. *Swedish Hip Arthroplasty Register Annual Report 2007*. Gothenburg, Sweden: Department of Orthopaedics Sahlgrenska University Hospital, 2007
22. Abdel-Fattah MM. Surveillance of nosocomial infections at a Saudi Arabian military hospital for a one-year period. *Ger Med Sci* 2005;**3**:1–10
23. Khairy GA, Kambal AM, Al-Dohayan AA, Al-Shehri MY, Zubaidi AM, Al-Naami MY *et al*. Surgical site infection in a teaching hospital: a prospective study. *Journal of Taibah University Medical Sciences* 2011;**6**(2):114–120