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Incidence and Risk Factors of Surgical Site Infections in Kathmandu University Hospital, Kavre, Nepal

Shrestha S,[1] Wenju P,[1] Shrestha R,[2] Karmacharya RM[3]

[1]Department of Nursing

[2]Department of Orthopedic and Traumatology

[3]Department of Surgery

Dhulikhel Hospital, Kathmandu University Hospital,

Dhulikhel, Kavre, Nepal.

Corresponding Author

Sulekha Shrestha

Department of Nursing

Dhulikhel Hospital, Kathmandu University Hospital,

Dhulikhel, Kavre, Nepal.

E-mail: sulekhastha@gmail.com

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ABSTRACT

Background

Surgical site infections (SSI) are the common nosocomial infection in surgical patients, and are a significant source of postoperative morbidity resulting in increased hospital stay, morbidity and cost.

Objective

The objective of this study was to obtain the incidence of SSI and determine various risks factors influencing the SSI rate with special reference to the National Nosocomial Infections Surveillance System risk index in Kathmandu University Hospital, Kavre, Nepal.

Method

Six hundred and thirty eight patients who underwent various surgeries in Dhulikhel Hospital, Kathmandu University Hospital during a three-month period were included. Using a pre designed questionnaire with follow up to 30 days and in orthopedic cases, where metal implants were used as internal fixation devices, with follow up to 90 days data were collected. Infected cases were identified using Centre for Disease Control and Prevention definition for surgical site infections. Swabs were obtained from wounds and were processed without delay using standard microbiological methods.

Result

Overall SSI rate was 2.6%. The most common pathogen isolated was *Escherichia coli* (5 isolates, 29.4 %). The SSI rate was 0.0% for clean wounds, 2.9%, 15.3% and 18.7% for clean-contaminated, contaminated and dirty wounds respectively. Increased incidence of surgical site infections were associated with higher grades of wound, emergency surgeries, American Society of Anesthesiologists score >2 and increased in National Nosocomial Infections Surveillance System risk index.

Conclusion

The incidence of SSI in this study meets the standard of center for disease prevention and control. Increases in surgical wound class, National Nosocomial Infections Surveillance System risk index, American Society of Anesthesiologist score >2 and emergency surgeries were associated with increased SSI rates.

KEY WORDS

National Nosocomial Infections Surveillance System (NNIS) risk index, Surgical site infection, wound class

INTRODUCTION

Infection is defined as 'invasion and multiplication of microorganisms in body tissues, which may be clinically unapparent or result in local cellular injury because of competitive metabolism, toxins, intracellular replication or antigen-antibody response.[1] Surgical site infection (SSI) appear in the postoperative period that occurs within 30 or 90 days of post- operative procedure in the case of metallic implant insertion.[2,3]

Infection has always been a feature of human life and sepsis in modern surgery continues to be a significant problem for health care practitioners across the globe.[4] It is not only an important cause of morbidity and mortality but also cause severe economic burden throughout the world by causing pain, increasing the risk of hospital readmission and making repeated procedures more likely.[5]

The incidence of SSI differs from one country to another according to the different systems employed for the epidemiological control of hospital infections.[6,7] While the global estimates of SSI have varied from 0.5-15%, in the United States, every year SSI develops in 2-5% of patients, resulting in at least 500,000 infections, 3.7 million excess hospital days and $1.6 billion in extra hospital charges.[8,9] Studies in India have consistently shown higher rates of SSI ranging from 16-38.8%.[10,11] In Nepal, some retrospective studies have suggested the prevalence rate of SSI to be 4-7% for all kinds of operation.[12-14]

The objective of this study was to obtain the incidence of SSI and determine various risks factors influencing the SSI rate. A better understanding of the risk factors associated with SSI could help reduce their occurrence by promoting effective strategies for infection prevention. So there is a great need of the studies for better understanding of the incidence and risk factors of SSI in the developing countries like Nepal.[12] Baseline information regarding SSI with feedback of appropriate data to surgeons has shown to be an important component of strategies to reduce SSI risk.[15]

METHODS

After approval of Institutional Review Committee, Kathmandu University School of Medical Sciences, a prospective descriptive study was conducted on all patients undergoing elective and emergency surgery on departments of General surgery, Gynecology and Obstetrics, Orthopedics and Trauma and Otorhinolaryngology and Head & Neck Surgery of Dhulikhel Hospital, Kathmandu University Hospital in between 1st February to 30th April, 2014. Informed consent was obtained from the patients or the parents of the patients in cases of children (less than 16 years of age).

The criteria developed by the Centre for Disease Control and Prevention (CDC) and National Nosocomial Infections Surveillance System (NNIS) was used for the diagnosis of SSI. Superficial incisional SSI was set as any infection that occurs within 30 days of procedure or within 90 days of metallic implant insertion and has at least one of the following conditions present: a) purulent discharge, with or without laboratory confirmation, from the superficial incision b) pain and tenderness, c) localized swelling and d) redness, malodor and fever. Deep incisional SSI occurs within 30 days of procedure or within 90 days of metallic implant insertion and has at least one of the following conditions present: a) Purulent drainage from the deep incision but not from the organ/space component of the surgical site b) a deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38^{0}C), localized pain, or tenderness, unless site is culture-negative.[2]

Data was collected on a predesigned questionnaire form regarding demographic details, surgery related details and postoperative status of the wound on third, seventh, thirtieth and ninetieth days post operatively. Wound swabs were studied from those positive cases on the basis of clinical suspicion. Data were entered into Microsoft Access and analyzed by Statistical Package for the Social Sciences (SPSS) version 14; using Chi squared test for non parametric categorical data and t- test for parametric data. P value less than 0.05 was considered significant.

RESULTS

Out of 638 patients who got enrolled in the study, 258 (40.43%) were male and 380 (59.57%) were female. The mean age was 33.5+16.7 years, range 2-85 years. Seventeen patients (2.66%) (5 male and 12 female) developed SSI. Infection rate was found to be highest in age group of 20 to 30 years (Table 1). Fifteen (88%) of them had superficial incisional SSI, one (6%) had deep incisional SSI and one (6%) had organ space SSI.

Table 1. SSI distribution according to age and sex (N=638)

Age (Years)	No of patients with SSI		
	Male	Female	Total (%)
0-10	0	0	0
11-20	1	3	23.5
21-30	1	7	47.0
31-40	1	2	17.6
41-50	1	0	5.8
51-60	1	0	5.8
61-70	0	0	0
71-80	0	0	0
> 80	0	0	0
Total	**5**	**12**	**2.7**

The mean duration of operation was 94.2 ± 67.6 minutes. The mean body mass index (BMI) of the patients was 23.81

± 6.69 and there was no statistically significant association between BMI and infection rate. Thirteen (76.4%) infected cases were culture positive, while four (23.5%) infected cases were negative. The pathogens isolated were *Escherichia coli* (38.47%), *Enterococcous species* (30.77%), *Coagulase negative Staphylococci species* (15.38%) and *Staphylococcous aureus* (15.38%).

Elective cases had significantly lower SSI compared to emergency cases. (p=0.00)

Prophylactic antibiotics were administered in 99.8% of all operations. Preoperative (single dose) and postoperative (multiple dose) antibiotic prophylaxis were administered in 67 (10.6%) and 570 (89.4%) operations respectively. Three most common prophylactic antibiotics used were ceftriaxone (35.9%), cefuroxime (22.2%), and cefotaxime (15.3%). Increased infection rates were significantly associated with wound class, ASA grading, NNIS and use of drains (Table 2).

Table 2. Surgical site infection rates (infections/100 operations)

Characteristics	Total Number	Infection	Rate	P value
Wound Class				
Clean	204	0	0.0	<0.01
Clean-contaminated	405	12	2.9	
Contaminated	13	2	15.3	
Dirty/infected	16	3	18.7	
ASA Grading				
Class I	528	12	2.2	0.051
Class II	88	4	4.5	
Class III	5	1	20.0	
NNIS risk-index category				
0	450	9	2.0	<0.01
1	172	4	2.3	
2	13	3	23.0	
3	2	1	50.0	
Drain in situ				
Yes	122	6	4.9	0.086
No	516	11	2.1	
Type of operation				
Elective	395	3	0.7	<0.01
Emergency	243	14	5.7	
Total	**638**	**17**	**2.6**	

SSI was highest in Obstetrics cases (6.5%) particularly for Lower Segment Caesarean Section (LSCS), followed by urology (4.1%). (Table 3)

The infection rate was the highest (3.3%) in the patient with pre-operative hospital stay up to one week (Table 4).

Table 3. SSI among various surgical departments

Department	Total Number	Infection	%
Obstetrics (LSCS)	138	9	6.5
GI surgery and Abdominal surgery	172	5	2.9
Gynecology	54	1	1.8
Urology	24	1	4.1
Orthopedics and traumatology	142	1	0.7

Table 4. Correlation of infection rate with preoperative hospital stay

Preop. hospital stay	Total Number	Infection	%
One day or less	525	14	2.6
Up to 1 week	90	3	3.3
More than 1 week	6	0	0

DISCUSSION

An overall infection rate observed in our study was 2.66%, which is lower than that reported in other studies.[4,9,10,12-14,16-19] (Table 5) Similar rates of infection were observed in European countries (2.5%), and CDC (NNIS) report (2.6%).[20] Hospitals within the country have reported higher rates.[12,13]

Table 5. Comparison of SSI in different studies

Authors	Year of study	Country/ Institution	SSI rate (%)
Present study	2014	Dhulikhel Hospital, Nepal	2.66
Arabashahi KS et. al	2003	Iran	8.4
Bibi S et. al	2008-2009	Pakistan	7.32
Walraven V et. al	2010	Australia	3.9
Amenu D et. al	2009-2010	Ethiopia	11.4
Hafez S et. al	2009-2010	Egypt	17.0
Ganguly PS et. al	1998	India	38.8
Nwankwo EO et. al	2008-2010	Nigeria	20.3
CDC NNIS System	1986-1996	CDC	2.6
Giri S et. al	2011	Nepal, Tribhuvan University Teaching hospital (TUTH), Kathmandu	23
Giri BR et. al	2004	Nepal, Manipal Teaching hospital, Pokhara	7.3

NNIS system reports *Staphylococcus aureus, Coagulase-negative staphylococci, Enterococcus spp.*, and *Escherichia coli* to be the most frequently isolated pathogens, which is similar to our report.[19,21]

The higher infection rate in the patients undergoing emergency surgery than in elective surgery seen in our study has been also reported by several other studies.[6,13,14,17] However in our study there was no significant association between ASA grading and infection rate, which in contrast to the study found ASA score is highly predictive for development of SSI.[6,13,14,17] Culver et al. also reported ASA score more than two associated with higher rate of SSI.[22] ASA score is associated with other risk factors like diabetes mellitus, obesity, malnutrition, other infection, smoking and these factors are indicators of general health and immunity.[13] The lower ASA grades have better general health and reduced SSI is thus obvious and understandable.

Despite every effort to maintain asepsis, almost all surgical sites are contaminated with bacteria, but the degree of contamination and the risk of subsequent infection vary among patients.[17] Based on the degree of contamination, wounds are classified as clean, clean-contaminated, contaminated, dirty or infected. As in this study other studies have also revealed that the risk of infection increase significantly with degree of contamination.[5,6,13,18,23]

The NNIS risk index is a significantly better predictor of SSI risk than the traditional wound classification system as explained by the authors in CDC NNIS system.[19] The rate of SSI increased with increase in the risk index from 0 to 3. Culver et al. and Flavia et al. in their studies have also observed similar findings.[19,22,24,25]

Studies have described that the risk of post-operative surgical site infection increases when drain is placed at the wound site. Drain can act as a portal of entry for pathogenic organisms.[9,11,17,24] The present study also shows higher infection rate in patients with drain than the patients without drain. On the contrary, some authors have found that use of drain has reduced SSI as they argue, drain reduces the possibility of collection and hence the chances of infection. Ho et al. argued that failure to use a postoperative drain might be a factor that increased risk of SSI.[26] Similarly Gunne et al. suggested that SSI may be controlled by the use of a separate drain in the layer between fascia and the skin stitches that prevent the development of dead space in obese patients.[27]

The highest infection rate was observed in the patients of Department of Obstetrics. One of the study suggested that operations in obstetrics involve some degree of bacterial contamination, and are classified as ‘clean-contaminated’ cases, even when the patient has no preoperative symptoms of active infection because the vagina is entered during hysterectomy and cesarean, even an uninfected one is classified as a clean-contaminated operation.[28] Pregnant women are at risk of infection during labor and delivery; most infections of the female pelvic organs occur when normal flora of the female genital or gastrointestinal tract contaminate the normally sterile amniotic fluid and uterus.[21]

The increased rate of SSI found in this study with increase in preoperative hospital stay is consistent with the findings from other studies.[4,11] The prolonged preoperative hospital stay leads to colonization with antimicrobial resistant microorganisms and itself directly affects patient’s susceptibility to infection either by lowering host resistance or by providing increased opportunity for ultimate bacterial colonization.[4,11] However, the lesser incidence of SSI in patients who were admitted for more than a week could not be explained in the present study, probably because of the smaller number of study population.

The study is limited by the small size of population, single centre, lack of uniform protocol to follow for infection prevention and treatment. A larger multicentric study is advised to further gain information about SSI in Nepal which could better prepare us for the surgical site infection and also may be common protocol to follow.

Limitations

All the cases of SSI couldn’t be directly followed up by the primary researcher (not involved in direct patient care). Patients were discharged before 30 days of surgery so complete follow up of the patients couldn’t be confirmed. Similarly, other confounders which can affect the incidence of SSI, such as the technique of hair removal at a surgical site, skin preparation for surgery, blood glucose level, hypothermia during surgery and smoking habits and/or alcohol consumption of the patient could not be studied in the present study.

CONCLUSION

The incidence of SSI in this study meets the standard given by center for disease prevention and control (CDC). The risk factors such as increase in surgical wound class, NNIS risk index, ASA >2, emergency surgeries were significantly associated with increased SSI rates.

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REFERENCES

1. Ohuvatosin OM. Surgical wound infection: a general overview. *Annals of Ibadan postgraduate medicine* 2005; 3(2): 26-31.
2. Mangram AJ, Horan TC, Pearson ML, et al. Guideline for Prevention of Surgical Site Infection, 1999. Centers for Disease Control and Prevention (CDC) Hospital Infection Control Practices Advisory Committee. *Am J Infect Control* 1999; 27:97–132.
3. CDC NHSN Patient Safety Component (PSC) Manual Updates. CDC/ NHSN Surveillance Definitions for Specific Types of Infections. Surveillance Definition. January 2014 Release. Available from http:// www.apic.org/Resource_/TinyMceFileManager/AdvocacyPDFs/ CDC_NHSN_Patient_Safety_Component_PSC_Manual_Updates_ January_2014_Release.pdf.
4. Bibi S, Channa AG, Siddiqui RT, Ahmed W. Frequency and risk factors of surgical site infections in general surgery ward of a tertiary care hospital of Karachi, Pakistan. *Int J Infect Control* 2011; 7(3).
5. Whitehouse JD, Friedman ND, Kirkland KB, Richardson WJ, Sexton DJ. The impact of surgical-site infections following orthopedic surgery at a community hospital and a university hospital: adverse quality of life, excess length of stay, and extra cost. *Infect Control Hosp Epidemiol* 2002; 23:183-9. doi: 10.1086/502033
6. Smyth ETM, EmmersonAM. Surgical site infection surveillance. *J Hosp Infect* 2000; 45:173-4.
7. Lizan-Garcia M, Garcia-Caballero J, Asensio-Vegas A; Risk factors for surgical-wound infection in general surgery: A prospective study. *Infect Control Hosp Epidemiology* 1997; 18: 310-5.
8. Lapsley HM, Vogels R. Quality and cost impacts: prevention of post-operative clean wound infections. *Int J Health Care Qual Assur* 1998; 11:222-31. http.dx.doi.org/10.1108/09526869810243935.
9. Arabashahi KS, Koohpayezade J. Investigation of risk factors for surgical wound infection among teaching hospitals in Tehran. *Int Wound J 2006*; 3:59-62. http://dx.doi.org/10.1111/j.1742-4801.2006.00176.x.
10. Ganguly PS, Khan Y, Malik A. Nosocomial infection and hospital procedures. *Indian J Common Med* 2000; 25(1):39-43.
11. Patel S, Patel M, Patel S, Soni S, Kinariwala D, Vegad M. Surgical site infections: incidence and risk factors in a tertiary care hospital, western India. *National Journal of Community Medicine* 2012; 3(2):193-6.
12. Giri S, Kandel BP, Pant S, Joshi P, Singh YP, Vaidya P. *Surgical Infections* 2013;14(3): 313-8. doi:10.1089/sur.2012.108.
13. Giri BR, Pant HP, Shankar PR, et al. Surgical site infection and antibiotics use pattern in a tertiary care hospital in Nepal. *J Pak Med Assoc* 2008; 58:148–51.
14. Tuladhar NR, Ghimire P, Bhatta DR, et al. Surgical Wound Infections in patients of Tribhuvan University Teaching Hospital. *J Nepal Health Res Council* 2003; 1:5.
15. Nwankwo EO, Ibeh IN, Enabulele OI. Incidence and risk factors of surgical site infection in a tertiary health institution in Kano, Northwestern Nigeria. *International Journal of Infection Control* 2012;8(4). doi: 10.3396/ijic.v8i4.035.12.
16. Walraven V, Musselman R. The Surgical Site Infection Risk Score (SSIRS) A Model to Predict the Risk of Surgical Site Infections. *PLoS ONE* 2013; 8(6) e67167. doi10.1371journal.pone.0067167.
17. Amenu D, Belachew T, Araya F. Surgical Site Infection Rate and Risk Factors Among Obstetric Cases of Jimma University Specialized Hospital, Southwest Ethiopia. *Ethiopian Journal of Health Sciences* 2011;21(2):91–100.
18. Hafez S, Saied T, Hasan E, Einawasany M, Ahmad E, Lloyd L, Shobary W, House B, Talaat M. Incidence and modifiable risk factors of surveillance of surgical site infections in Egypt: A prospective study. *American Journal of Infection Control* 2012; 40(5):426-30.
19. CDC NNIS System. National Nosocomial Infections Surveillance (NNIS) system report, data summary from January 1992 to June 2003. 2004; 32:470-85. doi:10.1016/j.ajic.2004.10.001.
20. Malone DL, Genuit T, Tracy JK, Gannon C, Napolitano LM. Surgical site infections: reanalysis of risk factors. *Journal of Surgical Res.* 2002; 103(1):89-95.
21. Riley MM, Suda D, Tabsh K, Flood A, Pegeus D. Reduction of surgical site infections in low transverse cesarean section at a university hospital. *American Journal of Infection Control* 2012; 40:820-5.
22. 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; 91152
23. Gaynes Robert P, Culver David H, Horan Teresa C, Edwards Jonathan R, Richards Chesley, Tolson James S, the National Nosocomial Infections Surveillance Surgical Site Infection (SSI) Rates in the United States, 1992–1998: The National Nosocomial Infections Surveillance System Basic SSI Risk Index. *Clinical Infectious Diseases.* 2001; 33:S69–S77. doi: 10.1086/321860.
24. Flavia F.E., Carlos E.F.S., Tania C.M.C., Mariangela C. Applicability of the National Nosocomial Infections Surveillance System Risk Index for the Prediction of Surgical Site Infections. A review. *The Brazilian J of Infectious Diseases* 2007; 11(1):134-41.
25. Kamat US, Fereirra AMA, Kulkarni MS, Motghare DD. A prospective study of surgical site infections in a teaching hospital in Goa. *Ind J Surg* 2008; 70:120-24.
26. Ho C, Sucato DJ, Richards BS. Risk factors for the development of delayed infections following posterior spinal fusion and instrumentation in adolescent idiopathic scoliosis patients. *Spine*. 2007;32:2272–77. doi: 10.1097/BRS.0b013e31814b1c0b.
27. Gunne AF, Larhoven CJHM, Cohen DB. Incidence of surgical site infection following adult spinal deformity surgery: an analysis of patient risk. *European Spine Journal.* 2010;9(6):982–88. doi 10.1007s00586-009-1269-1.docx.
28. Van Beneden Chris A, Hicks Lauri A, Riley Laura E, Schulkin Jay. Provider knowledge, attitude, practices regarding obstetrics and post surgical gynecologic infections. *Infect dis Obs/Gyn*. 2007; 9.