ORIGINAL ARTICLE

RATE AND RISK FACTORS FOR SURGICAL SITE INFECTION AT A TERTIARY CARE FACILITY IN PESHAWAR, PAKISTAN

Mansoor Khan, Jawad Khalil, Rooh-ul-Muqim, Mohammad Zarin, Touseef Ul Hassan, Nisar Ahmed, Muhammad Salman, Ghulam Muhammad

Department of Surgery, Khyber Teaching Hospital, Peshawar, Pakistan

Background: Surgical site infections (SSI) are among the most common complications in surgical patients and have serious consequences for outcomes and costs. This study aimed to determine the rates and risk factors affecting surgical site infections and their incidence at Surgical 'C' Unit, Khyber Teaching Hospital, Peshawar, Pakistan. The study was conducted to compare with rates obtained by large international multi-centre studies. **Methods:** A review of all general surgical interventions involving an incision, excluding anal procedures, performed between December 2008 and March 2009 (n=269) was undertaken. Various clinical parameters were recorded. Infection rates were calculated. Data were analysed using the Fisher's exact test. **Results:** The overall SSI rate was 9.294%, 4.88% in clean cases (C), 8.39% in clean contaminated cases (CC), and 20.45% in contaminated or dirty cases (D). There were significantly higher surgical site infection rates among patients with combined American Society of Anaesthesiologists scores II and III than those with ASA score I in clean contaminated (p=0.0007), and dirty cases (p=0.0212). There were also significantly higher surgical site infection rates among patients with combined Co-morbidity Scale score 1–6 than those with no co-morbid factors in clean contaminated (p=0.0002). Surgical site infection rate was highest in gastrointestinal system surgeries. **Conclusion:** The Surgical site infections can be minimised by adopting international protocols for surveillance.

Keywords: Charlson Co-morbidity Index, Surgical Site Infection, Clean, clean-contaminated and dirty surgeries; Risk factors

INTRODUCTION

Postoperative nosocomial infections (NIs) are the single most common class of complication that can reach excessive levels while attracting very little attention.[1] Many health care providers and organizations such as the US Centres for Disease Control and Prevention (CDC), the Joint Commission on Accreditation of Healthcare Organizations and the Surgical Infection Society, consider that periodic audits of postoperative NIs should be mandatory because surveys of this nature decrease infection rates by raising awareness of the issue.[2]

A standardised definition of SSIs was published by the Surgical Wound Infection Task Force USA in 1992. According to which: the presence of purulent drainage; spontaneous drainage of fluid from the wound, regardless of whether it is culture positive for bacteria; localised signs of infection for superficial sites or radiological evidence of infection for deep sites; an abscess or other type of infection on direct surgical exploration; or a diagnosis of an infection by a surgeon.[3] Furthermore, SSIs have been categorised by the CDC into 3 categories: superficial, deep, and organ/space infections.[3] Superficial infections involve the skin or subcutaneous tissue; deep infections involve the muscle or fascia; and organ/space infections involve the body cavity such as the pleural cavity or liver bed.[4]

The National Research Council, USA developed a system for categorising incisions based on the degree of contamination of the incision.[5,6] The original classification was based on 4 categories: clean, clean-contaminated, contaminated, and dirty; but the contaminated and dirty categories were later amalgamated and are referred to as 'dirty' (Table-1).[7,8]

SSIs are the second most common type of NIs, accounting for 20%–25% of the total. Surgical site infection (SSI) develops in 2%–5% of patients undergoing surgical procedures every year in the United States, resulting in at least 500,000 infections, 3.7 million excess hospital days, and US$ 1.6 billion in extra hospital charges.[9]

ASA scores are categorised into 4 classes: Class-I normal healthy person; Class-II patient with mild systemic disease; Class-III patient with severe systemic disease that limits activity but is not incapacitating; Class-IV patient with an incapacitating systemic disease that is a constant threat to life; and Class-V moribund patient who is not expected to survive 24 hours with or without surgery.[10]

In this article, we compare postoperative surgical site infection (SSI) rates at Surgical 'C' ward of KTH, Peshawar, a tertiary care facility to international postoperative SSI rates obtained from large tertiary care centres. We also examine various factors associated with increased risk of infection.

The Charlson Co-morbidity Index (CCI), developed by Charlson and colleagues.[11] (Table-2).

Table-1: USA National Research Council categorization of incisions[7,8]

Category	Definition	Examples	Accepted Infection Rates
Clean	Wounds that are non-traumatic and/or do not enter the digestive, respiratory or genital urinary tract. These cases involve only the skin and sterile body spaces without breaks in sterile technique.	Breast surgery, Inguinal hernia repair, Carpal tunnel release	1–5%
Clean contaminated	Wounds in which the digestive, respiratory or genitourinary system is entered, without visible contamination and without obvious infection. These cases involve non-sterile viscera, which have a relatively low level of bacterial colonization.	Biliary surgery, Bowel surgery with prepared bowel, Hysterectomy, Tonsillectomy	5–10%
Dirty	Wounds in which there is visible contamination from a hollow viscous or are clinically infected. These cases involve exposure to high levels of bacteria.	Excision of perforated appendix/ bowel, Drainage of abscess	10–40%

Table-2: Charlson Co-morbidity Index (CCI) scale

Score	Condition			
1	Coronary artery disease[a] Mild liver disease	Congestive heart failure Mild liver disease	Chronic pulmonary disease Connective tissue disease	Peripheral vascular disease Diabetes Dementia
2	Hemiplegia Any prior tumour (within 5 years of diagnosis)[b]	Moderate to severe renal disease	Diabetes with end organ damage	Leukemia Lymphoma
3	Moderate to severe liver disease			
6	Metastatic solid tumour	AIDS (not only HIV positive)		

[a]Including myocardial infarction, coronary artery bypass graft, percutaneous transluminal coronary angioplasty and angina pectoris.
[b]Except basal cell skin carcinoma. Information[11]

MATERIAL AND METHODS

The Surgical 'C' ward of KTH, Peshawar is a tertiary care facility. It receives approximately 100 admissions monthly, and has 46 acute-care beds.

A systematic chart review was carried out of all surgical interventions performed in the operating room between December 2008 and March 2009 at Surgical 'C' ward KTH, Peshawar as recorded in the operating room logbook, ward record book and patients' papers. A total of 269 cases were studied. Anorectal procedures were excluded from the study due to difficulties in follow up. Surgeries not involving an incision such as cystoscopic procedures were also excluded.

For each case in-patient and out-patient charts were reviewed to record the study variables. The type of procedure and the degree of contamination of each case was determined from the operative report. The ASA score and the co-morbidity factors were collected from admission histories, anaesthesia records and discharge summaries. The occurrences of postoperative infections, as recorded in the patient charts, were noted. The minimum postoperative follow up for any case was 1 months.

Data was calculated Graph Pad InStat® v. 3.06 by Graph Pad Software Inc. Infection rates between patients with ASA Class-I and patients with combined ASA Class-II and III in each contamination category were compared using the Fisher's exact test. Infection rates between patients with Co-morbidity Scale 0 and those with combined Co-morbidity Scale 1–6 in each contamination category were compared using the Fisher's exact test. ASA scores II–III and the Co-morbidity Scales 1–6 were combined in order to eliminate falsely elevated *p*-values.

RESULTS

The overall SSI rate was 9.294% (Table-3). SSI rate in clean cases was 4.88%; in clean-contaminated cases was 8.39%; and in dirty cases was 20.45%. SSI rates were found to be highest in gastrointestinal surgeries (13.51%). Hepatobiliary surgeries had an SSI rate of 12.28% while in genitourinary surgeries it was 9.30% (Table-4, 5). The rate of infection was found to be directly related to increasing ASA scores and CCI score in each contamination category (Table-6, 7). There were significantly higher SSI rates among patients with combined American Society of Anaesthesiologists (ASA) scores II and III than those with ASA score I in CC (p=0.0007), and D (p=0.0212). There were also significantly higher SSI rates among patients with combined Co-morbidity Scale score 1–6 than those with no co-morbid factors in CC (p=0.0002).

Table-3: Surgical site infection rates, by wound Classification category

Type of wound	Category		
	Clean (n=82)	Clean Contaminated (n=143)	Dirty/Contaminated (n=44)
Surgical Site Infection (and rate)	4 (4.88)	12 (8.39)	9 (20.45)

Table-4: Description of the 269 cases of surgical intervention chosen for the study

Category	Gastrointestinal	Hepatobiliary	Genitourinary	Others	Total
Clean	0	2	17	63	82
Clean Contaminated	63	53	25	2	143
Dirty/contaminated	11	2	1	30	44
Total	74	57	43	95	269

Table-5: Rates of surgical site infections based on type of surgery

Type of infection	Type of Surgery				
	Gastrointestinal (n=74)	Hepatobiliary (n=57)	Genitourinary (n=43)	Others (n=95)	Total (n=269)
Surgical site infection (and rate)	10 (13.51)	7 (12.28)	4 (9.30)	4 (4.21)	25 (9.29)

Table-6: Comparison of surgical site infection rates between patients whose charts indicated an American Society of Anaesthesiologists (ASA) Class I or an ASA Class II–III score

SSI, and category	ASA Class I score		ASA Class II–III score		*p value
	Patients with infection	Patients without infection	Patients with infection	Patients without infection	
Clean	3	68	1	9	0.4160
Clean contaminated	4	109	8	24	0.0007
Dirty	1	20	8	14	0.0212

**p* values calculated by Fisher's exact test

Table-7: Comparison of surgical site and infection rates between patients whose charts indicated a Co-morbidity Scale (CS) score of 0 or a CS score of 1–6

Surgical site infection, and category	Co-morbidity Scale score 0		Co-morbidity Scale score 1–6		
	Patients with infection	Patients without infection	Patients with infection	Patients without infection	*p value
Clean	2	67	2	10	0.1025
Clean contaminated	4	114	8	19	0.0002
Dirty	3	24	6	10	0.0576

**p* values calculated by Fisher's exact test

DISCUSSION

The SSI incidence varies with the definition of wound infection, the intensity of surveillance, and the prevalence of risk factors for SSI in the patient group. The US Centres for Disease Control definitions of infection have been developed and validated over several years, and they are the most commonly used definitions for SSI diagnosis in research worldwide. All surgical wounds are contaminated by bacteria, but only a minority demonstrate clinical infection. SSIs are a consequence of a summation of several factors: the inoculum of bacteria introduced into the wound during the procedure, the virulence of the contaminants, the microenvironment of each wound, and the integrity of the patient's host defence mechanisms. Factors intrinsic to the patient, as well as those related to the type and circumstances of surgery, affect the incidence of infection. Work undertaken by the National Nosocomial Infections Surveillance (NNIS) program, run by the CDC, has indicated that three factors: surgical risk, as measured by the ASA, duration of surgery, and level of bacterial contamination of the wound, provide a satisfactory risk-adjusted infection rate across a wide range of surgical procedures.[12]

The overall SSI rate (9.294%) was found to be higher than the rates obtained by large international multicentre studies. SSI rate of 3%–5% are reported in the United States.[6] Lower SSI rates are also reported: a national Belgian study[13] reported an SSI rate of 1.47% and a multi-centre Italian study[14] found an SSI rate of 2.7%. However, Weiss and colleagues[2] showed that 70% of NNIS hospitals did not perform post-discharge SSI surveillance and that 13%–61% of infections only become apparent after discharge. Indeed, the Belgium and the Italian studies did not analyze post-discharge SSI infection rates. It is important to note that the omission of post-discharge infections will falsely decrease SSI rates.[15] In our study, all post-discharge infections were included in the calculation of SSI rates.

SSI rates were 4.88% in clean cases, 8.39% clean-contaminated cases, and 20.45% dirty cases compared with rates of 1%–5%, 5%–10%, and 10%–40%, respectively.[6] SSI rates were highest in gastrointestinal surgeries because 80% of these infected cases were mostly dirty cases. The Composite Risk Score shows that an ASA score of III increases the risk of infection.[16]

Our study is based on small study population. When analysis of some subpopulations are made (i.e., infection rates according to type of surgery) the study numbers are small. Thus, conclusions drawn from these rates may be limited.

The loss of patients to follow up in our setting is quite low. In our institution, postoperative patients are seen by their surgeon weekly for 4 weeks after surgery in follow up out-patient services and the occurrence of infection during this time was recorded. In addition, telephonic follow up was done in those patients who did not come for follow up. If patients required postoperative medical or surgical care at other wards, they would be referred to their surgeons and this would be documented.

Non-quantifiable risk factors for infections such as duration of surgery, antibiotic prophylaxis and skin preparation[4] have been determined to be important in other studies, but are difficult to quantify retrospectively and are thus not included in various scoring or classification systems and were not analyzed in this study.

CONCLUSION

SSI rates in Surgical 'C' ward of KTH, Peshawar were higher than International SSI rates. This study validates various factors that contribute to increased infection rates such as type of procedure, degree of contamination, ASA score and Charlson Co-morbidity Index. In order to raise awareness and limit infection rates, we suggest that all hospitals should adapt protocols to survey their postoperative infection rates.

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Address for Correspondence:

Dr. Mansoor Khan, Village & PO Maini, District and Tehsil Swabi, Pakistan, **Cell:** +92 333 5037988
Email: Mainwi_k@yahoo.com