INTRODUCTION

Surgical site infections (SSIs) represent the second major cause of increased hospital stay and mortality.¹⁻³ SSI increases the risk of mortality by 2-11 times.⁴ Patients with surgical site infections stay in hospital on average about twice as long as uninfected patients, and the cost of total care is more than double.⁵ Potential sources of infection are the patient (especially contamination by alimentary tract bacteria), hospital environment, food, other patients, staff, infected surgical instruments, dressings, and even injections.⁶,⁷

A standardized definition of SSIs requires the presence of purulent drainage; spontaneous drainage of fluid from the wound, regardless of whether it is culture positive for bacteria; localized 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.⁸ SSIs are categorized into superficial, deep, and organ/space infections.⁸,⁹ 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.¹⁰

The National Research Council, USA developed a system for categorizing incisions based on the degree of contamination of the incision.¹¹ The original classification was based on 4 categories: clean, clean-contaminated, contaminated, and dirty; but the contaminated and dirty categories were later amalgamated.¹² American Society of Anaesthesiologists (ASA) scores are categorized 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.¹³

ABSTRACT

Objective: To compare the frequencies of surgical site infections (SSI) in ASA class-I (American Society of Anaesthesiologists-I) with ASA class II-III and CCI-0 (Charlson Co-morbidty Index-0) with CCI 1-6 in clean (C) and clean contaminated (CC) surgeries.

Study Design: Analytical study.

Place and Duration of Study: This study was conducted in a General Surgical Unit of Khyber Teaching Hospital, Peshawar, from December 2008 to April 2009.

Methodology: A total of 310 clean and clean contaminated general surgical interventions with pre-operative ASA score of I-III, were included in the study, excluding anal and cystoscopic procedures. On the basis of past medical record, patients were grouped into ASA-I (patients without any co-morbidity) and ASA II-III (patients with co-morbidities) on the basis of their ASA score pre-operatively. In the same way patients were divided into CCI-0 (patients without co-morbidities) and CC 1-6 (patients with co-morbidities) according to CCI score. All the patients were operated in the same environment by the same set of surgeons. Postoperatively the surgical wounds were observed for SSI by using ASEPSIS daily scoring system for one month prospectively. SSI rates in ASA-I was compared with SSI rates in ASA II-III. Similar comparison of SSI rates was performed in CCI-0 and CCI 1-6. Data was tested by using the Fisher's exact test with confidence interval of 95%.

Results: The overall SSI rate was 6.1% (n=19) with 4.23% (n=5) in clean cases (C) and 7.29% (n=14) in clean contaminated cases (CC). There were significantly higher surgical site infection rates among patients in ASA II-III than those with ASA-I in clean contaminated surgeries (p=0.003). There were also significantly higher surgical site infection rates among patients with CCI score 1-6 than those with CCI-0 in clean (p=0.024) and clean contaminated (p=0.002).

Conclusion: American Society of Anaesthesiologists (ASA) score and Charlson comorbidity index (CCI) has strong influence on SSI rates in clean and clean contaminated cases. Patients’ with co-morbidities undergoing clean and clean contaminated general surgical procedures have greater SSI rates than those without any co-morbidity.

Key words: ASA score. Charlson comorbidity index. Surgical site infection. Clean surgery.
According to Feinstein, comorbidity is defined as any distinct clinical entity that has existed or may occur during the clinical course of a patient who has a condition under study. There are several scoring systems to evaluate comorbidity. The Charlson comorbidity index (CCI), which considers the one-year mortality of internal medicine inpatients and proved its relevance for patients with solid cancer, developed by Charlson and colleagues in 1987 (Table I). It is a weighted scoring system based on 19 items which in general can easily be assessed retrospectively from the patients’ charts. There is an optional extension of the CCI including the patient’s age adding one point for each decade beyond 50 years of age. The Charlson index was originally proposed for longitudinal mortality studies, but there is evidence of its validity in a large number of clinical situations. The CCI does not capture frequent co-morbidities like obesity, infections, and psychiatric disorders.

### Table I: Charlson Comorbidity Index (CCI) scale and prevalence of co-morbidity conditions in 310 patients.

<table>
<thead>
<tr>
<th>Score</th>
<th>Condition</th>
<th>No. of patients (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Coronary artery diseasea</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Congestive heart failure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chronic pulmonary disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Peripheral vascular disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mild liver disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mild liver disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Connective tissue disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diabetes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dementia</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Hemiplegia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate to severe renal disease</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Diabetes with end organ damage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Any prior tumour (within 5 years of diagnosis)b</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Leukemia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lymphoma</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Moderate to severe liver disease</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Metastatic solid tumour</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AIDS (not only HIV positive)</td>
<td></td>
</tr>
</tbody>
</table>

(a) including myocardial infarction, coronary artery bypass graft, percutaneous transluminal coronary angioplasty and angina pectoris.

(b) Except basal cell skin carcinoma.

Information compiled from reference 15

The ASEPSIS scoring system (additional treatment, the presence of serous discharge, erythema, purulent exudate, and separation of deep tissues, the isolation of bacteria, and the duration of inpatient stay can be used to assess SSI. It is a quantitative scoring method that provides a numerical score related to the severity of wound infection using objective criteria based on wound appearance and the clinical consequences of the infection. We classified ASEPSIS scores > 20 as infected. ASEPSIS scores of 10-20 (“disturbance of healing”) are known to describe some infections, but most reflect wound breakdown due to other causes. Patients' co-morbidities are considered to increase the rates of surgical site infection. To help anticipate precautionary measures for the prevention, different scoring systems are used for the risk stratification of SSI in patients with co-morbidities.

The aim of this study was to compare the SSI rates in different ASA (ASA-I with ASA II-III) and CCI (CCI-0 with CCI 1-6) scores for clean and clean contaminated general surgical procedures, in order to determine the role of ASA and Charlson co-morbidity index scoring systems.

### METHODOLOGY

This study was conducted on patients admitted for surgery in a general surgical ward of Khyber Teaching Hospital, Peshawar. All patients with pre-operative ASA score of I-III, who underwent any clean or clean contaminated surgery involving a skin incision were included in the study.

Anorectal procedures and surgeries not involving an incision such as cystoscopic procedures, patients with ASA score more than III and those not willing for the study were excluded.

A total of 310 clean and clean contaminated surgeries from December 2008 to April 2009 were studied. After verbal consent, each patient's registration number, date of admission, date of surgery, date of discharge, address, co-morbidities, ASA score, CCI score, surgical wound type, surgical condition, and surgery were recorded. Patients were grouped into “ASA class I” and “ASA class II-III” on the bases of ASA score and into CCI “score 0” and CCI “scores 1-6” on the basis of Charlson co-morbidity index in both clean and clean contaminated surgeries. ASA scores II-III and the CCI scale 1-6 were combined in order to eliminate falsely elevated p-values. The surgical wounds were observed for SSI on the basis of daily ASEPSIS score for 30 days postoperatively.

Data were analysed using SPSS for Windows (release 11.0.0; SPSS Inc.) and 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 clean and clean contaminated surgeries were compared using the Fisher's exact test with the confidence interval of 95%. Infection rates between patients with Comorbidity Scale “0” (no co-morbidity) and those with combined Comorbidity Scale 1–6 in clean and clean contaminated surgeries were also compared using the Fisher's exact test with the level of significance of p < 0.05.

### RESULTS

The overall SSI rate was 6.1% (n=19). SSI rate in clean cases was 4.23% (n=5) and in clean-contaminated cases was 7.29% (n=14). Out of a total 68 cases of hepatobiliary surgeries, SSI was observed in 6 cases with SSI rate of 8.82%. The genitourinary and gastro-
intestinal surgeries had SSI rates of 6.8% (4 cases of SSI out of 59) and 3.37% (3 cases of SSI out of 89) respectively. The rate of infection was found to be directly related to increasing ASA scores and CCI score in each contamination category (Tables II and III).

**Table II: Comparison of SSI rates in patients with ASA Class I and ASA Class II–III.**

<table>
<thead>
<tr>
<th>Wound category</th>
<th>ASA Class I Patients with infection</th>
<th>ASA Class I Patients without infection</th>
<th>ASA Class II–III Patients with infection</th>
<th>ASA Class II–III Patients without infection</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>3</td>
<td>98</td>
<td>2</td>
<td>15</td>
<td>118</td>
<td>0.1506</td>
</tr>
<tr>
<td>Clean contaminated</td>
<td>6</td>
<td>144</td>
<td>8</td>
<td>34</td>
<td>192</td>
<td>0.0030</td>
</tr>
</tbody>
</table>

*p values calculated by Fisher’s exact test; *< 0.05 = significant.

ASA-I group had a total of 251 with 9 (3.58%) cases of SSI while ASA II–III group had 59 cases with 10 cases (16.95%) of SSI. There were significantly higher SSI rates in clean contaminated surgeries with combined American Society of Anaesthesiologists (ASA) scores II and III than those with ASA score I in CC (p=0.003) with odd ratio 1.707 (using the approximation of woolf). While in clean cases the difference of SSI rates for ASA-I and ASA II–III was not significant statistically (p=0.150).

Total number in patients in CCI-0 group was 251 in which SSI rate was 3.19 percent (n=8). The number of patients in CCI 1-6 group was 59 with SSI rate of 18.64% (n=11). Significantly higher SSI rates were observed among patients with combined CCI score 1–6 than those CCI score-0 in both C (p=0.024) and CC (p=0.002) surgeries.

**Table III: Comparison of SSI rates in patients with CCI score “0” and CCI score 1–6.**

<table>
<thead>
<tr>
<th>Wound category</th>
<th>Co-morbidity Scale score 0 Patients with infection</th>
<th>Co-morbidity Scale score 0 Patients without infection</th>
<th>Co-morbidity Scale score 1–6 Patients with infection</th>
<th>Co-morbidity Scale score 1–6 Patients without infection</th>
<th>Total</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean</td>
<td>2</td>
<td>98</td>
<td>3</td>
<td>15</td>
<td>118</td>
<td>0.0249</td>
</tr>
<tr>
<td>Clean contaminated</td>
<td>6</td>
<td>145</td>
<td>8</td>
<td>33</td>
<td>192</td>
<td>0.0025</td>
</tr>
</tbody>
</table>

*p values calculated by Fisher’s exact test; *< 0.05 = significant.

**DISCUSSION**

Active SSI surveillance requires substantial resources. In the current study some of the infections may have been missed due to short hospital stay. Risk factors for infections such as duration of surgery, antibiotic prophylaxis and skin preparation which are difficult to quantify retrospectively, were also omitted.

Hospitals often cannot meaningfully compare their results with those from other hospitals because surveillance methods are not standardized. ASA score, CCI and ASEPSIS daily scoring system can help facilitate SSI surveillance performed over time in different institutions.

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.

The SSI rates differ from institute to institute and region to region. The overall infection rate in the current study was 6.1% which is lower than rates reported in an Indian study, 8.95%. The SSI rates in clean and clean contaminated surgeries were 4.23% and 7.29%, favourably comparable with rates of 1%–5%, 5%–10% respectively. In another study Sangrasi et al. from Hyderabad, Pakistan, observed SSI rate of 5.3% and 12.4% in clean and clean contaminated cases respectively. In contrary to Pishori et al. who reported highest rates post-mastectomy patient, SSI rates were the highest in hepatobiliary surgeries because this group had 31% patients with co-morbid conditions and 30% patients with ASA score more than I which were higher than other groups.

The CCI has been found to be useful in some reports. Birim et al. used CCI in patients with operated primary non-small cell lung cancer and found it to be a useful tool. Fried et al. also found that the CCI was a strong predictor of mortality in peritoneal dialysis patients. Singh and colleagues reported in a multi-institutional study of patients with head and neck cancer that the CCI was a valid prognostic indicator. In the current study it was found that the CCI has a significant influence on SSI in both clean and clean contaminated interventions while ASA score is important in only clean contaminated cases.

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

**CONCLUSION**

The ASA score and Charlson comorbidity index (CCI) are easy to use and have widespread applicability. These scoring systems have definite influence on the frequencies of surgical site infection (SSI) in different surgical categories and the SSI rates increase with the increasing ASA and CCI scores.
REFERENCES


