Investigation of risk factors for surgical wound infection among teaching hospitals in Tehran

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ABSTRACT

This prospective study was carried out to investigate the risk factors and incidence of surgical site infection (SSI) among patients in surgical wards of five hospitals affiliated to Iran University of Medical Sciences. Data was collected in a register card filled by specially trained staff. Nine-hundred and eighteen patients admitted in surgical wards were followed 30 days postoperatively for SSI during 1 April 2003 to 30 September 2003. A total of 77 patients were identified among 918 cases included in the study, with a resulting overall SSI rate of 8·4%. The risk of SSI was increased by age older than 60 years (OR = 3·9; $P < 0·0001$), diabetes mellitus (OR = 4·9; $P < 0·0001$), smoking (OR = 3·1; $P < 0·0001$), obesity (OR = 4·1; $P < 0·0001$) and wound drain (OR = 2·2; $P < 0·0001$). There were significant statistical difference in duration of anaesthesia (131·6 vs. 177 min, $P < 0·001$) and duration of surgery (99 vs. 140·5) between patients without SSI and patients with SSI. In conclusion, identification of the risk factors for SSI will help physicians to improve patient care and may decrease mortality and morbidity and hospital care costs of surgery patients.

Key words: Epidemiology ● Incidence rate ● Risk factors ● Surgical site infection

INTRODUCTION

Surgical site infections (SSIs) also referred to as infections of the surgical wound are one of the most common healthcare-associated infections (HAIs). SSI in the general surgical population is an important public health issue (1), and it can result in a delay in patient recovery and an increase in the duration of hospital stay and costs associated with treatment of the infection (2). Estimating the cost of SSIs has proved to be difficult, but many studies agree that additional bed occupancy is the most significant factor. A review of the incidence and economic burden of SSIs in Europe estimated that the mean length of extended stay attributable to SSIs was 9·8 days, at an average cost per day of €325 (3). SSI is therefore an important outcome measure for surgical procedures and a priority for surveillance. Multiple studies have demonstrated that the risk of SSI is affected by many variables such as old age, underlying disease, length of anaesthesia and surgery, smoking, malnutrition, diabetes, immune deficiency and malignancy (4). A better understanding of these independent factors associated with SSI could help us to improve our efforts to reduce their occurrence by promoting effective preventive strategies. According to our knowledge, there is little known about the SSIs in Iran; therefore, we conducted a prospective study to identify risk factors for SSIs.

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Key Points

- surgical site infections (SSIs), also referred to as infections of the surgical wound are one of the most common healthcare-associated infections (HAIs)
- multiple studies have demonstrated that the risk of SSI is affected by many variables such as old age, underlying disease, length of anaesthesia and surgery, smoking, malnutrition, diabetes, immune deficiency and malignancy
- a better understanding of these independent factors could help to reduce their occurrence

Key Points

- a prospective study was conducted in 4 hospitals affiliated to Iran University of Medical Sciences in Teheran
- during hospital stay, information on diagnostic and therapeutic procedures was recorded
- patients with hospital infections were identified
- surveillance was extended to 30 days after hospital discharge, to detect hospital infections that developed at home
- of 910 patients, 77 (8.4%) developed SSIs
- the risk factors found to be independently associated with SSI are summarised in Table 2
- the risk of SSI has repeatedly been shown to be proportional to the duration of the operative procedure

METHODS AND METHODS

A prospective study was conducted in four general hospitals affiliated to Iran University of Medical Sciences, in Tehran. From 1 April to 30 September 2003, detailed information was collected and recorded by five especially trained staff for each patient who was admitted for general surgery, neuro-surgery, obstetrics and gynecology, orthopedic surgery and ear, nose and throat surgery, was collected every day by five specially trained staffs in this field. Patients were interviewed in the outpatient office or within the first 24 hours after admission. During hospital stay, information on diagnostic and therapeutic procedures was recorded including starting and ending dates; admission to the ICU and the use of peripheral catheters, central catheters, mechanical ventilation, parental nutrition, antibiotics or other medications. Information on variables associated with surgery (e.g. type of surgical wound or duration of operation) was also gathered. Those patients admitted to the hospital for short observation and transferred or discharged in less than 1 day were excluded. Informed consent was obtained from every study subject enrolled. Patients with hospital infections were prospectively identified. Data were recorded on a standardised data collection form. Hospital infections were diagnosed according to Centers for Disease Control and Prevention criteria (5). Surveillance was extended to 30 days after hospital discharge, to detect hospital infections that developed at home. A total of 918 patients were enrolled.

RESULTS

Of 910 patients, 77 (8·4%) developed SSIs. Table 1 summarises the mean length of hospital stay, ICU stay before operation, the duration of operation and anaesthesia in both groups with SSI and without SSI. There were statistically significant differences between duration of anaesthesia and operation in patients with SSIs and without developing SSIs ($P = 0{\cdot}002$ and $P < 0{\cdot}0001$, respectively). Patient characteristics found to be significantly associated with the development of SSI included age, diabetes mellitus, obesity, type of operation (elective or emergency) and use of a drain. The risk factors found to be independently associated with SSI are summarised in Table 2.

DISCUSSION

The results of the present study were consistent with those of other studies measuring the incidence of SSIs. The proportion of SSIs in patients who underwent surgery in our study was 8·4%. This rate appears to be comparable with previous studies, although comparison is difficult as the patient populations and method of collection data may vary. In United States of America, the SSI rate is estimated to be 2·8% (6), while reported rates from African countries range from 16·4 to 38·7% (7). Surveillance of SSI in English hospitals reported an incidence of SSI of 4·2% (8). Leaper and colleagues (9) reviewed several studies; according to their work, the average rate of SSI lies in the range of 2–5% in European countries; however, they also suggest that more realistic range of the rate SSI lies between 15 and 20% depending mainly on the type of surgical procedure and the wound classification. The rate of SSIs in Japan and Vietnam are estimated to be 7·6 and 10·7%, respectively, (10,11). In another study which was carried out in Shiraz (southern part of Iran), the rate of SSI was found 9·9% (12). Although the rate of 8·4% which we found in our study is slightly higher compared with results from developed countries, it is similar to other studies from less-developed countries.

The risk of SSI has repeatedly been shown to be proportional to the duration of the operative procedure (13). This is in agreement with our finding. As it can be seen from

Table 1 The comparison of selected variables between patients with SSI and without SSI

Variable	SSI	No SSI	*P* value
Stay prior to surgery (Mean stay, days)	6·7	3·1	0·12
Duration of operation (Mean duration, minutes)	140·5	99	<0·0001
Duration of anaesthesia (Mean duration, minutes)	177	131·6	0·002
ICU stay prior to procedure (Mean stay, days)	6·2	4·4	0·55
ICU stay after operation (Mean stay, days)	8·7	3·2	0·07

ICU, intensive care unit; SSI, surgical site infection.

Table 2 Unadjusted association of selected variables and SSIs

Variable	SSI (Number)	No SSI (Number)	OR	CI (95%)	*P* value
Age					
<60 yeas	20	68	1	–	<0·0001
≥60 years	57	773	3·9	3·3–4·6	
Diabetes					
No	61	799	1	–	
Yes	16	42	4·9	4·0–6·1	<0·0001
Smoking					
No	61	776	1	–	
Yes	16	65	3·1	2·5–3·7	<0·0001
Obesity					
No	64	801	1	–	
Yes	13	40	4·1	3·2–5·1	<0·0001
Type of operation					
Elective	44	433	1	–	
Emergency	39	402	1·1	0·9–1·1	0·23
Wound drain					
No	41	567	1	–	
Yes	43	267	2·2	2·0–2·4	<0·0001

CI, confidence interval; OR, odds ratio; SSI, surgical site infection.

Key Points

- our study demonstrated that age significantly increases the risk of SSI
- patients with diabetes were approximately 1–5 times more likely to develop SSI
- the risk of SSI multiplied by 3–1 when smoking was present
- obese patients are at a higher risk for SSI
- patients with drain were 2–2 times more likely to develop SSI

Table 1, the rate of SSI was higher in the patients who had longer time of operation and as well as anaesthesia. The present study did not demonstrate a statistically significant independent association between length of stay at ICU prior to procedure and SSI.

Our study demonstrated that age significantly increases the risk of SSI. Patients older than 60 years are more than 3·9 times likely to develop SSI.

Previous studies have documented diabetes mellitus associated with increased risk for SSI (14,15). Debra and colleagues (16) in their study showed that patients with diabetes were approximately 1·5 times more likely to develop SSI. The analysis of our results demonstrated that patients with diabetes mellitus were at a 4·9-fold increased risk for SSI indicating that diabetes mellitus was a significant independent risk factor for SSI. With strong evidence supporting the role of diabetes to develop SSI, measures to decrease should be considered. Preoperative control of blood glucose levels may eliminate the increased risk of infection associated with diabetes.

Many studies have demonstrated that smoking delays primary wound healing by increasing tissue hypoxia and causing local and systemic vasoconstriction (17). The results of this study showed that the risk of SSI multiplied by 3·1 when this risk factor (smoking) was present.

Obese patients are at higher risk for SSI. In the operating room, an obese patient presents technical challenges that often result in increased procedure time and resultant complications. Because adipose tissue is poorly vascularised, it is susceptible to tissue hypoxia and ischemia that affects wound healing. In a study of 2964 patients, the incidence of infection after abdominal and gynaecological procedures was evaluated. The authors determined that 11% of patients with a BMI greater than 30 had a course complicated by infection, compared with a 5% infection rate in patients with low or normal (20 and 21–29) BMI (18). The findings of our study demonstrated that the risk of SSI in obese people is approximately 4·1 times more than non obese. Therefore, the obesity is an independent risk factor of SSI, and obese patients should be educated regarding the increased risk of infection after surgery, particularly abdominal surgery.

The findings of this study revealed that the type of operation either emergency or elective was not statistically significant ($P = 0·23$).

The use of a surgical drain was shown to be a risk factor in developing SSI in our study. Patients with a drain were 2·2 times more likely to develop an SSI. This is supported by Soleto and colleagues. They showed in their study that patients who had wound drain

Key Points

- in conclusion, these data suggest that controlling these modifiable factors perioperatively can lead to potential improvements in patient outcome

were 1·9 times more likely to develop SSI than patients who did not have a wound drain (19).

CONCLUSION

These data suggest a need to control for these modifiable factors perioperatively if at all possible, and attempts at reducing the duration of surgery can lead to potential improvements in patient outcome.

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