Pogostnost pojavljanja okužb kirurške rane v terciarni bolnišnici v Sloveniji

Incidence of surgical site infections in a tertiary hospital in Slovenia

Avtor / Author

Ustanova / Institute

Dragana Taskovska[1], Vojko Flis[2,3]

[1]Univerza v Mariboru, Medicinska fakulteta, Maribor, Slovenija; [2]Univerza v Mariboru, Medicinska fakulteta, Katedra za kirurgijo, Maribor, Slovenija; [3]Univerzitetni klinični center Maribor, Klinika za kirurgijo, Maribor;

[1]University of Maribor, Faculty of Medicine, Maribor, Slovenia; [2]University of Maribor, Faculty of Medicine, Department of Surgery, Maribor, Slovenia; [3]University Medical Centre, Divison of Surgery, Maribor, Slovenia

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Prof. dr. Vojko Flis, dr. med.
Univerzitetni klinični center Maribor
Klinika za kirurgijo, Ljubljanska 5,
SI-2000 Maribor, Slovenija
E–pošta: vojko.flis@ukc-mb.si

Izvleček

Namen: *Bolnišnične okužbe so pereč problem sodobne medicine. Nadzor in spremljanje okužb kirurške rane sta temelj za njihovo preprečevanje. Doslej v Sloveniji ni bilo raziskav, ki bi natančneje analizirale pojavljanje omenjenih okužb. Namen pričujoče raziskave je bil ugotoviti pogostnost pojavljanja okužb kirurške rane in dejavnike tveganja za njihov nastanek v terciarni bolnišnici.*

Metode: *Šlo je za prospektivno kohortno observacijsko raziskavo, ki je potekala pol leta (2012–2013) na Kliniki za kirurgijo Univerzitetnega kliničnega centra v Mariboru. Beležili smo demografske podatke vseh operiranih bolnikov ter dejavnike tveganja za nastanek okužbe kirurške rane. Bolnike smo spremljali prvih trideset dni po operaciji. Beležili smo tudi ponovne hospitalizacije v obdobju enega leta po operaciji. Podatke smo glede na njihovo naravo analizirali z ustrezno statistično metodo.*

Abstract

Purpose: *Surveillance is an essential element of surgical site infection (SSI) prevention. Few studies have evaluated the long-term effect of these programs in Slovenia. SSIs are among the most commonly reported health care-associated infections, yet there is a paucity of data on SSI from Slovenia. We aimed to determine the incidence of SSI and explore its associated factors at a tertiary hospital in Slovenia.*

Methods: *Direct and indirect surveillance methods, based on European Centre for Disease Control and Prevention guidelines, were used to define SSI. Patients were followed at 30 days and 1 year postoperatively. Demographic and medical data were collected and risk factors were assessed. Risk factors for SSI and the effect of surveillance time on SSI rates were statistically analyzed.*

Results: *Of 8074 patients analyzed, the SSI rate was found to be 0.28%.*

Rezultati: *Med 8074 bolniki, ki so bili v obravnavanem obdobju operirani na kirurški kliniki, jih je le 0,28 % imelo okužbo kirurške rane. Statistično pomemben dejavnik tveganja je bila starost (povprečna starost je bila 66 let, standardna deviacija je bila 11,63 let: p = 0,0206, t = 2,315, statistično pomembno na ravni p < 0,005). Vsi ostali dejavniki tveganja v pričujoči raziskavi niso vplivali na pogostost pojavljanja.*

Zaključek: *Prva natančnejša epidemiološka raziskava o pojavljanju okužb kirurške rane v Sloveniji je pokazala, da je odstotek njihovega pojavljanja v slovenski terciarni bolnišnici sorazmerno izjemno nizek. Deloma je ta podatek lahko posledica uporabljene metodologije, deloma pa je kljub vsemu lahko posledica uspešnega programa obvladovanja bolnišničnih okužb. Ne glede na vzrok pa je raziskava postavila temelj za bodoče primerjave in morebitne izboljšave na tem področju v slovenskih bolnišnicah.*

One of the statistically significant risk factors for SSI included age (average age 66 years vs. 58 years: p=0.0206, t=2.315, p<0.005). Other known risk factors, such as disease severity, presence of drains, history of previous hospitalization, preoperative stay, wound classification, and surgery duration did not influence the outcome in this study.

Conclusion: *The incidence of SSI at our hospital was lower than reported in many comparable studies. We establish baseline data for targeted implementation strategies to further improve the quality and safety of health care in this and similar hospitals in Slovenia.*

INTRODUCTION

Surgical site infection (SSI) is an infection that occurs in wounds created by an invasive surgical procedure (1). SSIs represent a significant portion of healthcare-associated infections (HAIs). In 2006, British studies reported an incidence of HAIs of approximately 8% (1, 2). Among all HAIs, 14% were SSIs. In general, it is expected that 2% of all surgical patients will develop SSIs (3). Research about the incidence of SSI is underestimated because most SSIs clinically manifest a few weeks postoperatively, after the patient is discharged (4, 5).

SSIs are associated with a higher morbidity and mortality rate and contribute to one-third of all postoperative deaths (1, 2). Superficial SSI manifests with skin erythema, which disappears in a few days and has the lowest morbidity and mortality rate (1). Morbidity and mortality increase with the depth of the wound infection.

SSIs present an economic burden, prolonging hospital stay and adding a cost burden related to reoperation, intensive care, and medications (1). They are also indirectly associated with a decreased quality of life, loss of productivity, disability, and litigation. In Great Britain, the average additional costs are approximately 800 £ for simple superficial SSI, up to 9000 £ for healed deep SSI, and a few ten thousand Euros for deep space infections (6).

However, there is still no precise epidemiologic information about the incidence and prevalence of SSIs in Slovenia (7). We aimed to determine the incidence of SSIs in different departments within our institution in Slovenia and describe their clinical characteristics.

METHODS

The prospective cohort study included all surgical departments in the Surgery Clinics of University Clinical Centre Maribor between December 2012 and May 2013. This study was approved by our institutional research committee and was based on actively treated SSI patients,. All patients and surgeons provided informed consent prior to study enrollment.

The following departments were included: thoracic surgery, urology, orthopedics, abdominal and general surgery, traumatology, cardiac surgery, plastic surgery, and vascular surgery. All patients who underwent surgery during this period of data collection were followed and enrolled in the study if they met the following inclusion criterion: infection as consequence of surgery. Patients with other infections, such as drain or urinary catheter associated infection, were excluded, as well as those who declined study participation.

Data collection was anonymous. The following data points were collected: gender, age, height and weight, American Society of Anesthesiologists (ASA) score, length of hospital stay, body mass index (BMI), presence of diabetes, smoking history, use of deep vein thrombosis prophylaxis, surgery type and duration, presence of a central venous catheter, peripheral intravenous catheter, or urinary catheter, type of anesthesia, antibiotic use on survey day, surgeon qualifications, anatomic location of the wound, and SSI level were noted.

Surgical wounds were classified into clean, clean-contaminated, contaminated, and dirty or infected, as defined by the Center for disease control (CDC) and the National Institute for Health and Care Excellence (NICE) (1). A surgical wound was defined as infected if it occurred within 30 days of surgery and manifested with erythema, pain, warmth, and swelling at the incision, or with signs and symptoms of a more extensive infection (8). Patients with implants were followed for 1 year postoperatively. Wound cultures were obtained from all infected surgical wounds.

Surgical procedures were classified as minor, moderate, major, and complex major; the surgical method was distinguished as minimally invasive and open (1). Degree of surgery was classified as emergency or elective; emergency surgeries were defined as surgeries performed within 24 h of hospitalization (9).

Data collection was performed a few times daily on randomly chosen days, in questionnaire format. On the day of data collection, the total number of hospitalized patients in each surgery department and number of patients with SSI were noted. If wound assessment was impossible, a surgeon classified the wound. The remaining data were collected from patients medical history and clinical examination or medical documentation.

Statistical analysis

Patients' clinical data were noted as categorical variables where appropriate. The chi-squared test and the bilateral t-test were used. Statistical analysis was performed with GraphPad Prism 6 (2014 GraphPad Software, Inc., San Diego, California, USA). Data were analyzed within a 95% confidence interval. A p-value of less than 0.05 was considered to be statistically significant.

RESULTS

In the period between December 2012 and May 2013, 5016 male patients (average age 52.6 years, standard deviation (SD)=22.8 years) and 3058 female patients (average age 51.8 years, SD=23.4 years) were hospitalized (total 8074, average age 56.1 years, SD=20.5 years). Twenty-three cases of SSI (0.28%) were found; two patients declined participation in this study and were therefore not included. Of the 21 SSI patients, 12 were male and the average age was 66 years (SD 11.63 years). The age difference between all surgical patients and those with SSI was significantly different (p=0.0206, t=2.315).

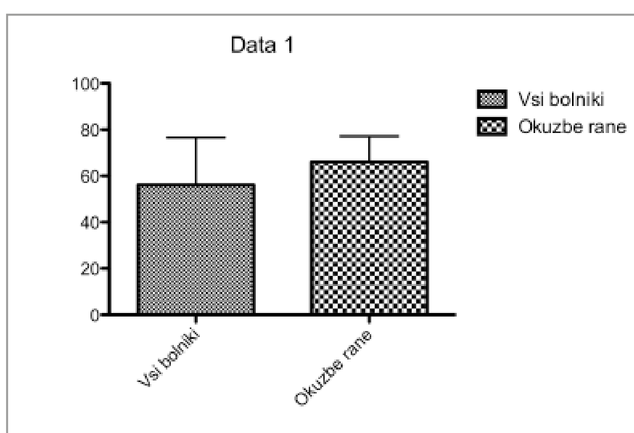

Figure 1. *Graphic presentation of average age difference between groups.*

One patient had a sternal SSI after a cardiac surgery procedure (5%), eight patients had an SSI associated with abdominal surgery (38%), five of 21 patients had a vascular surgery-related SSI (24%), four patients had an injury-related SSI (19%), and one patient in each of the following groups had an SSI: neurosurgery, orthopedics and plastic surgery (5% each).

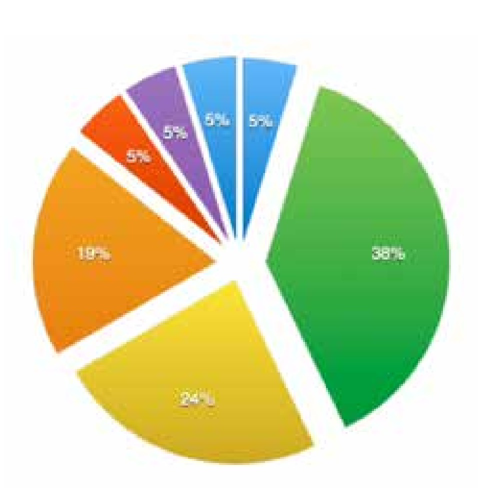

Figure 2. *Distribution of infections among departments. There was one case each (5%) in the departments of cardiac surgery, neurosurgery, orthopedics, and plastic surgery. There were eight cases in the department of abdominal surgery (38%), five cases in the department of vascular surgery (24%) and 4 cases in traumatology (19%).*

Among all patients with SSI, 14 were hospitalized for 6 or more days, five patients were hospitalized for 2 or fewer days, and two patients were hospitalized for between 2 and 6 days. Five patients with an SSI had a BMI of greater than 30 kg/m^2. Only four patients with SSI had diabetes and six patients were smokers. Among hospitalized patients, only 7.3% had diabetes (588 of 8074 patients). By Fisher's test, a statistical difference was not found between patients with SSI and all hospitalized patients (p=0.0626).

Six SSI patients had an ASA score of 3 or more and 24 had an ASA score of 2; a statistically significant correlation between ASA score and severity of infection was not found (chi-square=5047.2, alpha<0.05). In the group of all hospitalized patients (n=8074), 22% had an ASA score of 3 or greater; of those with an SSI, 28% had an ASA score of 3 or greater (ns, Fisher's test, p=1.0).

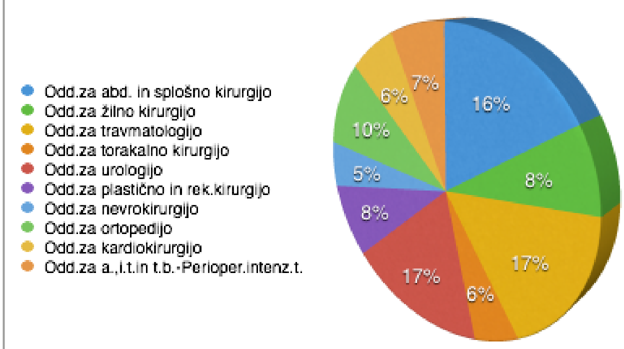

Figure 3. *All operations distributed by surgery departments.*

Eleven SSI patients had a clean-contaminated wound, eight had a contaminated wound, one had an infected or dirty wound, and one had a clean

Table 1. *Isolated bacteria in surgical site infections in our hospital.*

Bacterium	Patients
Staphylococcus hominis	1
Streptococcus agalactiae	1
Klebsiella pneumoniae (ESBL)	3
Pseudomonas aeroginosa	3
Enterococcus faecalis	1
Enterococcus faecalis (2)	2
Staphylococcus caprae	1
Staphylococcus aureus	2
Staphylococcus aureus (2)	1
Escherichia coli	3
Enterobacter aerogenes	1
Enterobacter aerogenes (2)	1
Streptococcus pneumoniae	1
Enterobacter cloacae (ESBL)	1

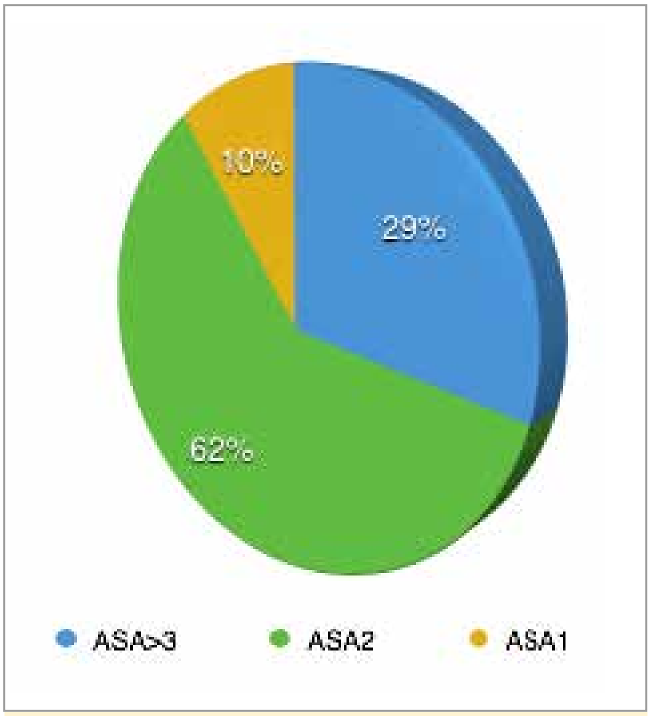

Figure 4. *Classification of patients by ASA score (patients with SSI, n=21)*

wound. Eleven patients underwent major surgery, one underwent a major complex operation, seven underwent a moderate operation, and two underwent a minor operation. Forty-three percent of SSI patients had undergone emergency surgery, while the remainder had elective operations. There was no statistically significant correlation between urgency severity and a higher incidence of SSI (chi-square=3786.20, alpha 0.05, p=1).

All surgical procedures were performed by board-certified surgeons. The average length of surgery in the group of hospitalized patients (n=8074) was 93.8 minutes (SD 48.78 min). The duration of surgery in the SSI patient group was shorter than the average length of surgery. In 12 cases, the wound was assessed as a SSI 0, in five cases as an SSI 1, and in only four cases as an SSI 2.

Regarding anatomic location, seven SSIs were abdominal, five SSIs were femoral region, three SSIs were crural, and the remainder were in other regions.

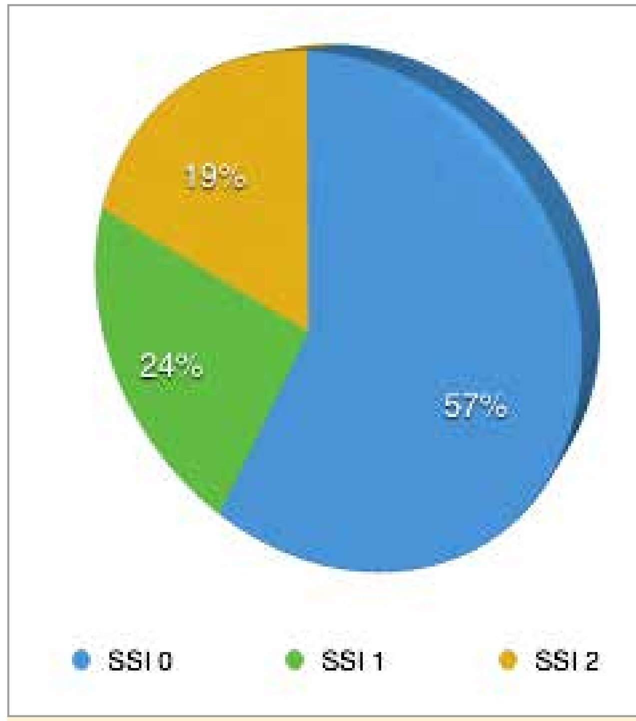

Figure 5. *The highest portion of patients with SSI had superficial SSI (SSI 0=57%). Deep SSI (SSI 1) was present in 24% and only 19% had organ or space SSI (SSI 2).*

DISCUSSION

Healthcare-associated infections are issues in European hospitals (2). SSI is defined as an infection that develops within 30 days of surgery or within 1 year of surgery if a prosthetic implant is used. According to wound depth and extension, SSI is classified as superficial, deep, or organ/space SSI. The other classification of SSI is based on severity of contamination and predicted risk of infection. Risk factors for SSI are related to the operative procedure and patient (1, 2).

The European Center for Disease Prevention and Control (ECDC) has contributed in the following and surveillance of HAIs, especially SSI (3). Some studies report an approximately 8% incidence of HAIs; 14% of these are SSIs. At least 2% of surgical patients develop SSI (3) and most studies report this percentage as underestimated. Many SSIs occur a few weeks after surgery, after patients have already been discharged (4, 5). SSI is associated with a higher morbidity and mortality rate; up to one-third of postoperative deaths are directly or indirectly correlated with SSI (1,2).

SSI is also related to poor clinical outcomes, such as hypertrophic scar, restriction of movement, chronic pain, and impairment of mental health and quality of life; they also pose a serious economic burden as they prolong hospital stay and are associated with costs related to reoperation, intensive care, and medications (1). They are also indirectly related with decreased quality of life, loss of productivity, disability, and litigation. The average additional costs in Great Britain are about 800 £ (for simple superficial SSI) to 9000 £ (for healed deep SSI). The costs of additional medical care could be a few times higher from the highest average, which depends from the severity of infection, length of stay in intensive care unit and from type of additional surgeries. Treatment of the infections in single body cavity could cost a few ten thousand Euros (6).

Slovenia has minimal epidemiologic data relating to the incidence and prevalence of SSIs in hospitals (7). Our country did not participate in a large study performed by the ECDC in 2008 and 2009 (4). There is also a lack of epidemiologic data about implementation strategies for improving safety of patients and medical staff. Our study, which was performed in a tertiary hospital, has contributed the first set of epidemiological data on SSI incidence in Slovenia.

The incidence of SSI in our study was lower than reported in many comparable studies. Only 0.28% of our patients had an SSI, as compared to 2% in a European study from 2009 (3). However, the incidence depends on methodology and varies between 1% to 20% in different hospitals (10, 11, 12). An incidence lower than 1% is rare and poorly explained (13). While a recent study at the Mayo Clinic aimed to reduce the incidence of SSI after colectomy, the authors were unable to define all the factors that influenced the incidence of SSI in their institution (13).

Many factors may be attributed to a deviation of the incidence from the average. It is less likely that a high number of SSIs were not recognized; greater than 150 SSIs of 8074 postoperative patients would have been missed. It is more likely that a portion of SSIs in the period after discharge were not recognized. For example, SSI can occur up to 1 year postoperatively in orthopedic patients; these results are a consequence of the methodology used. Patients were not followed 1 year postoperatively for SSI (4, 5). Some authors advocate that patients should be followed up regularly in the long-term by telephone because a considerable portion of SSI occurs late (4, 5).

The incidence of SSI would have been higher if patients from the departments of otorhinolaryngology, gynecology and obstetrics, and pediatric surgery were included (14, 15). A higher incidence of SSI could be expected in children after oral cavity and head procedures, as well as caesarean section, which is also recognized as a risk factor for SSI (14, 15). The incidence of SSI after caesarean section ranges from 5% to 9% and may even be as high as 12% (16). However, the low incidence of SSI may be due to good surveillance and prevention of HAIs, appropriate preoperative antimicrobial prophylaxis, suitable surgical technique, and good postoperative wound care (7).

Other epidemiologic data from our study are similar and comparable with that of European hospitals (4, 17). Deviations in preoperative ASA score, reported to be a significant risk factor for SSI, was not found. However, the average age of our patients was significantly higher (Figure 1).

The most common SSI in our patients was superficial SSI, while deep SSI and organ or space SSI were rare; this is comparable with patients from other countries. The percentage of SSI patients with diabetes was also comparable to results of foreign studies. About 7.3% of hospitalized patients had diabetes; only 19% of patients with SSI had diabetes and this comparison was not found to be significantly different. This finding may be the result of a small group of patients with SSI (21 of 8074 hospitalized patients).

Most of our patients with SSI had vascular and abdominal surgery. A portion of the patients with SSI who underwent surgery for atherosclerosis are proportionally high. Approximately 0.6%–0.9% of postoperative deaths are due to SSI (4). Meanwhile, vascular surgery increases the risk for postoperative death (18); about 30% of patients die from a vascular aortic graft infection. Approximately 20% of patients require major (above or below knee) amputation; mortality and limb loss can increase up to 75% (19). None of our patients had vascular graft infections; of our patients with SSI after vascular surgery, most had SSIs in the femoral region or after a below knee amputation.

The third most common SSI occurred after a traumatology operation. According to the literature, the general incidence of SSI after fracture surgery is between 0.1% and 4% and the prevalence of HAIs is between 3% and 21%; among these, 5%–34% are SSIs (20, 21). In our study, the relative portion of SSI after injury is similar to that of other studies but the absolute portion is relatively low (17).

Causes of SSI and other infections in surgery differ greatly due to the unique microbiological flora present anatomically, based upon the operative location. Infection with staphylococcus is a potential for any operative procedure. The most common causes of infection in cardiac surgery and neurosurgery are Staphylococcus aureus (S. aureus) and coagulase negative staphylococcus (CoNS); in orthopedic surgery, S. aureus, CoNS, Streptococcus, and gram-negative bacteria; and in thoracic surgery, S. aureus, CoNS, gram-negative bacteria, and Streptococcus pneumoniae. The most common causes of SSI in vascular surgery are S. aureus and CoNS, while appendectomies, biliary tract surgery, and colorectal surgery are associated with SSIs caused by gram-negative bacteria and anaerobic bacteria. Gastroduodenal operations are associated with SSIs caused by Streptococcus, gram-negative bacteria, and anaerobic bacteria of the oropharyngeal region. Operative procedures of the head and neck are associated with SSIs caused by S. aureus, Streptococcus, and oropharyngeal anaerobic bacteria. Urologic operations are associated with SSIs caused by gram-negative bacteria (20,21,22). The isolated bacterial cultures in our study did not differ from those reported in other studies. Methicillin-resistant Staphylococcus aureus (MRSA) was not isolated in our patients. However, extended-spectrum beta-lactamases (ESBL) were isolated in four cases.

CONCLUSION

In one of the first epidemiological studies of SSI in Slovenia, we demonstrated a considerably lower incidence of SSI in a Slovenian tertiary hospital, compared with other studies. This finding is partially due to methodology used and partially to a successful surveillance strategy of hospital-associated infections. We established baseline data for targeted implementation strategies to further improve the quality and safety of health care, with regards to the incidence of preventable SSI, in this and similar hospitals in Slovenia.

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