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Incidence and factors associated with surgical site infections at the surgical ward, National Referral Hospital, Bhutan

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ABSTRACT

Introduction: The burden related to surgical site infection (SSI) and antibiotic sensitivity of the organisms causing SSI is a cause of concern. This is the first study to assess SSI at Bhutan's largest surgical centre. **Methods:** This was an observational descriptive study conducted involving patients undergoing incisional surgeries at the Department of Surgery, JDWNRH from July – December 2017 using convenient sampling. Data was collected using a pro forma. The health care workers conducted the first two wound examinations and the information on the third examination was done though phone call. Southampton Wound Score (SWS) was used to assess the postoperative wound. The Research Ethics Board of Health, Bhutan, gave ethical approval. **Results:** The incidence of surgical site infection was 30.7% and the most common organism was Escherichia coli. SSI occurred in Southampton Wound Grade I and IV. Contaminated (46.2%) and dirty (33.3%) wounds had higher incidence of SSI. Patients age >60 years (p= 0.049) and those with contaminated wound (p= 0.005) were significant risk factors for SSI. Hypertension, diabetes, smoking, alcohol intake and obesity, elective or emergency case, and the seniority of surgeon were not risk factors for SSI. **Conclusions:** The incidence of SSI is high and antibiotic sensitivity patterns a cause of concern. Strict infection control and patient safety measures need to be implemented.

Keywords: Southampton wound score; Surgical site infection; Surgical ward.

INTRODUCTION

Surgical Site Infections (SSI) are the single most common adverse event following surgical procedures[1] and the second most common Hospital Associated Infection (HAI)[2]. It can occur up to 30 days after the operation and 1 year if any implants are used[3].

The global estimates of SSI varies from 0.5-15%, 2.8% in the USA, 23.5% in Tanzania' indicating that risk scores developed in industrialized countries may require adjustments for non industrialized countries. The National Nosocomial Infections Surveillance system score required adjustments to reliably predict SSI, probably to account for improper hygiene and the lack of adjustment for the duration of surgery (defined as the 75th percentile of the duration for each type of operative procedure and 23-28% in a rural hospital in India[6,7]. SSIs are associated with increased patient morbidity, mortality, length of hospital stay, hospital cost and a major health economic burden due to treatment cost. Therefore, many healthcare regulators advise the importance of periodic audits of post-operative nosocomial infection rates and raising awareness around SSI[8]. However, no such assessment was done in Bhutan. We studied the incidence and risk factors associated with surgical site infections at the Department of Surgery, Jigme Dorji Wangchuck National Referral Hospital (JDWNRH), Thimphu.

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METHODS

Research design

This was an observational descriptive study conducted at the Department of Surgery, JDWNRH.

Study population

This study was conducted among all the patients who underwent incisional surgeries at the Department of Surgery, JDWNRH between 1st July and 31st December 2017.

Sample size and sampling method

All consecutive patients who underwent incisional surgery and those who planned to come for review of their wound at the JDWNRH were recruited. No formal sample size was calculated.

Those patients who underwent wound debridement or additional procedures for past-complicated surgeries were excluded.

Data collection method

The peri-operative details were collected when the patient was admitted for surgery in the Ward while post-operative details were collected at suture removal (seven to ten days after surgery) at the dressing chamber and via telephone interview at thirty days after surgery. Physical assessment of the wound happened at two contacts: before the discharge of the patient from the hospital, and at suture removal. A trained junior doctor or a nurse did the wound assessment. In those with SSI, wound swabs were cultured for organisms and tested for sensitivity. The thirty-day assessment was done through telephone call.

Study tool

A structured pro forma was designed to collect the socio demographic details of the patient and the potential risk factors for SSI. The wound assessment was scored using the Southampton Wound Scoring System (SWS)[9]. In those with SSI, the data on the organism cultured and antibiotic sensitivity were also collected.

Data entry and analysis

Data were entered into EpiData 3.1 and analyzed EpiData Analysis 2.2.2.182 (EpiData Association, Odense, Denmark). Categorical variables are presented using frequencies and percentages. The SWS is scored into five categories: 0 for normal wound healing, I for erythema, II for inflammation, III for serous discharge, IV for pus discharge and V for deep infection. SSI was defined as a SWS score other than 0. The risk factors for SSI (yes/no) were tested using multivariable logistic regression in STATA 13.1 (Stata Corp. 2016 Stata Statistical software: Collage station, TX: StataCorp LP USA, Serial number 501306208483). Those factors with *p*-values <0.05 were considered significant.

Ethics consideration

Informed written consent was taken from each participant to allow us to interview them and to extract some of the data from the patient's file. For children less than 18 years, the information was obtained from the parents for consistency. Patient identifiers were collected to match their wound swab culture report but were later deleted from the data set. All analyses were done on anonymised data set. Ethics approval was given from the Research Ethics Board of Health, Ministry of Health (REBH/Approval/2016/052 dated 19 June 2017). Patient autonomy and confidentiality of information was respected. Only de-identified data were analysed.

RESULTS

There were 258 valid cases after excluding 40 cases that were lost to follow up. There were 140 (54.3%) males and the median age was 33.0 years (IQR 22.0, 56.0). The basic characteristics of the patients are shown in Table 1.

Table 1. Characteristics of the participants and factors associated with surgical site infections; study on incidence and factors associated with surgical site infections at JDWNRH in Thimphu Bhutan, 2017

Characteristics	Participants	Participants with SSI. n (%)	Unadjusted RR (95%CI)	*p*-value
Age (Years)				
1-19	56	11 (19.64)	REF	REF
20-39	96	34 (35.42)	1.80 (1.00-3.27)	0.052
40-59	55	15 (27.27)	1.39 (0.70-2.75)	0.347
60 and above	51	19 (37.25)	1.90 (1.01-3.59)	0.049*
Sex				
Male	140	38 (27.14)	REF	REF
Female	118	41 (34.75)	1.28 (0.89-1.85)	0.187
Body Mass Index				
Underweight	29	7 (24.14)	REF	REF
Normal Weight	139	44 (31.65)	1.31 (0.66-2.61)	0.441
Overweight	69	20 (28.99)	1.20 (0.57-2.53)	0.629
Obese	21	8 (38.10)	1.58 (0.68-3.67)	0.290
Known Hypertensive				
No	217	65 (29.95)	REF	REF
Yes	41	14 (34.15)	1.31 (0.71-1.83)	0.586
Known Diabetic				
No	249	75 (30.12)	REF	REF
Yes	9	4 (44.44)	1.48 (0.69-3.14)	0.312
Tobacco user				
No	218	69 (31.65)	REF	REF
Yes	40	10 (25.00)	0.79 (0.45-1.40)	0.418
Alcohol consumption				
No	197	58 (29.44)	REF	REF
Yes	61	21 (34.43)	1.17 (0.78-1.76)	0.453
Surgery Type				
Elective	197	57 (28.93)	REF	REF
Emergency	61	22 (36.07)	1.25 (0.84-1.86)	0.280
Seniority of Surgeon				
Senior Surgeon	187	58 (31.02)	REF	REF
Junior Surgeon	71	21 (29.58)	0.95 (0.63-1.45)	0.824
ASA score				
Normal Healthy Patient	176	56 (31.82)	REF	REF
Mild System Disease	79	23 (29.11)	0.91 (0.61-1.37)	0.668
Severe System Disease	3	0 (0.00)	-	-
WHO wound type				
Clean wound	84	18 (21.43)	REF	REF
Clean-contaminated wound	126	40 (31.75)	1.48 (0.91-2.40)	0.111
Contaminated wound	39	18 (46.15)	2.15 (1.27-3.67)	0.005*
Dirty wound	9	3 (33.33)	1.56 (0.57-4.27)	0.392

ASA = American society of Anesthesiologist; WHO = World Health Organization.

Surgical site infections

The rate of SSI in our sample was 30.7%. Incidence related to clean, clean contaminated, contaminated and dirty were 21.4%, 31.7%, 46.2% and 33.3% respectively. Majority of score are Southampton Grade I (47%) followed by Grade IV (30%) as shown in Table 3. The types of surgeries with the incidence of SSI are given in Table 2.

All the patients were given prophylactic antibiotics as per the departmental protocol. The most common was Cephazolin (66.7%) given in elective cases.

Organisms cultured

There were 26 cases, which were cultured for bacterial growth. The lists of organisms isolated are shown in Table 4.

E coli was the organism that caused the maximum cases (10; 38.6%) of SSI followed by *Staphylococcus aureus* (4; 15.4%), *Klebsiellaoxytoca* (4; 15.4%), *Haemophilus influenza* (1; 3.8%), *Pseudomonasaeruginosa*(1; 3.8%) and *Citrobacter* species. There were five cases of mixed bacterial growth. The antibiotic sensitivity and resistance pattern are given in Figure 1 and Figure 2.

Table 2. The types of surgeries where SSI were reported amongst surgeries performed at the Department of Surgery, JDWNRH, Bhutan, 2017

Procedure	Total number *n*	SSI developed *n* (%)
Abdominal surgery		
De-roofing and drainage of liver cyst	6	3 (50)
Appendectomy	40	16 (40)
Percutaneous nephrolithotomy	10	4 (40)
Ureterolithotomy	5	2 (40)
Laparotomy	16	5 (31)
Duodenal ulcer perforation repair	8	2 (25)
Laproscopic cholecystectomy	46	10 (21)
Herniotomy	32	6 (19)
Hernioplasty	14	2 (18)
Non-abdominal surgery		
Varicose surgery	17	3 (14)

Table 3. Southampton Wound Score (SWS) of post-operative wound examination among patients who underwent surgery at the Department of Surgery, Jigme Dorji Wangchuck National Referral Hospital, Thimphu, 2017

Wound exam	Normal Healing (SWS-0)	Erythema (SWS-I)	Inflammation (SWS-II)	Serous discharge (SWS-III)	Pus discharge (SWS-IV)	Deep infection (SWS-V)	Total
First wound exam	218	21	5	8	6	0	258
Second wound exam	233	7	8	2	5	0	255a
Third wound exam	207	19	3	2	19	0	250b

a = 3 cases were diagnosed as SSI in the first reading, so no subsequent follow up
b = 8 cases were diagnosed as SSI in the second reading, so no subsequent follow up

Table 4. Bacterial growth cultured from the surgical site infections at the Department of Surgery, JDWNRH, Thimphu in 2017 (*n* = 26)

Bacterial growth	*n*	(%)
Escherichia coli	10	(38.5)
Staphylococcus aureus	4	(15.4)
Klebsiella oxytoca	4	(15.4)
Haemophilus influenza	1	(3.8)
Citrobacter species	1	(3.8)
Pseudomonas aeruginosa	1	(3.8)
Mixed bacterial species	5	(19.3)

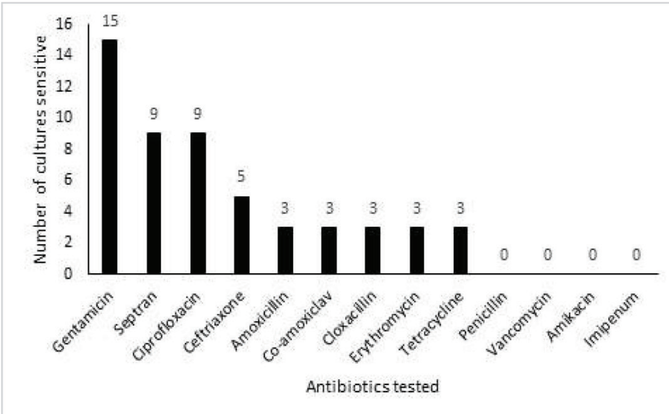

Figure 1. Antibiotic sensitivity pattern of the organisms cultured from the surgical site infections at the Department of Surgery, JDWNRH, Thimphu in 2017 (*n*=26)

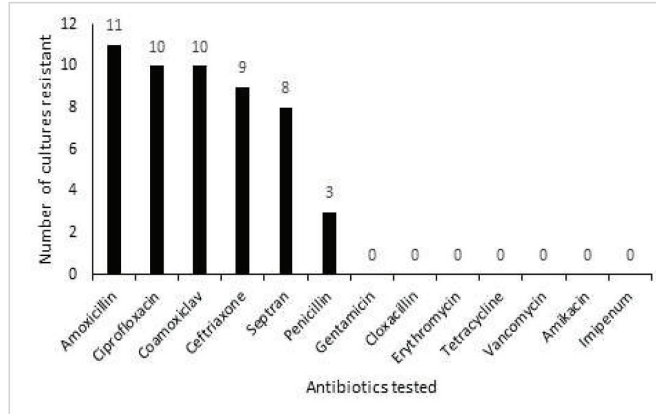

Figure 2. Antibiotic resistance pattern of the organisms cultured from the surgical site infections at the Department of Surgery, JDWNRH, Thimphu in 2017 (*n* = 26)

Risk factors for SSI

Although there was no relationship observed between gender and development of SSI it was seen that older people (>60years) have the significant risk of SSI compared to younger age groups. It was also been noticed that young age group of 20-39 years also have the higher risk of SSI with *p*-value 0.052. Contaminated wound had the higher risk of SSI compared to other wound types. 18 participants out of 39 (46.2%) developed SSI.

Hypertension, diabetes, smoking, alcohol intake and obesity did not predispose to increase risk of SSI in this study. Emergency, elective cases and those operated by junior surgeons or postgraduate residents did not have difference in risk of developing SSI.

DISCUSSION

Establishing the incidence of SSI is the first step in preventing the clinical and economic burden they cause. SSI is a global health problem in both economic and human terms, and most of SSI is avoidable. In the USA every year, SSI develops in 2-5% of patients, resulting in at least 5,00,000 patients infected, 3.7 million excess hospital days and 1.6 billion dollars in extra hospital charges[10].

The incidence of SSI in our study is 30.7%much higher than the 2-5% reported in the USA and Europe10 3.9% in Canada[11], 2.6% in Nepal[12].

Among different wound types, clean, clean contaminated, contaminated and dirty case, our SSI rate are 21.4%, 46.15%, 31.7% and 33.3% respectively which varies greatly from other studies but the most common pattern seen is, SSI increases with more contaminated wounds[10,12].

The majority of SSI (62%) of SSI were detected after discharge similar to 80.9% found in a study in Brazill3. This reaffirms that post-discharge surveillances is important in diagnosing cases of SSI.

The type of surgery with highest SSI in our study is de roofing and drainage of liver cyst and appendectomy (Table 2) whereas in other studies hernia surgeries reported higher rates of SSI[14]

Although emergency surgeries are done with minimal preparation most studies have shown them to have higher rates of infection among emergency surgeries as compared to elective surgery[12,15]. Our study showed 25% of emergency surgeries infected compared to 57% of elective cases infected, which could be due to less participation of emergency cases.

Obesity was not observed to be a significant risk factor for developing SSI in our study. However it was noted to be associated with SSI in other studies[16].

Although diabetic patients are at 4 times higher risk of SSI, it was not a risk factor in our study[16].

This study did not show any relation of SSI with BMI, history of hypertension or diabetes, alcohol intake or smoking and surgeon although other studies have noted a significant correlation. This could be greatly due to low number of the participants with above risk factors.

The common organisms isolated in our SSI cases are similar to those in the region, E coli in Nepal[17], Staphylococcus aureus in India[18]. The antibiotic sensitivity pattern in our setting raises an alarm flag and calls for strict rational use of antibiotics.

High SSI in our study could be due to inadequate infection control practice by health workers and poor patient follow up after discharge.

LIMITATIONS

This study did not include other departments that conduct surgery and share the same operation theatre at the JDWNRH. The number of participant was less. The numbers of swabs sent for analysis were not adequate, as this study did not sponsor the laboratory tests.

CONCLUSIONS

The incidence of SSI in our study was high and postoperative follows up of patients for SSI is important. Antibiotic sensitivity of the organisms causing SSI is a cause of concern.

RECOMMENDATIONS

A strong system of infection control and surveillance for SSI is needed at the JDWNRH. The rational use of antibiotics needs to be emphasized keeping in view of the large burden of SSI.

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AUTHORS CONTRIBUTION

Following authors have made substantial contributions to the manuscript as under:

SJ: Concept, design, data collection and analysis, manuscript writing and review.

TDW: Design, data collection and analysis, manuscript writing and review

PW: Design, data collection, manuscript writing and review

PW: Design, data collection, manuscript writing and review

Author agree to be accountable for all respects of the work in ensuring that questions related to the accuracy and integrity of any part of the work are appropriately investigated and resolved.

CONFLICT OF INTEREST

None

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