Egyptian Journal of Medical Microbiology Volume 27 / No.1 / January 2018 159-166 Online ISSN: 2537-0979

ORIGINAL ARTICLE

Surveillance of Surgical Site Infection in General Surgery Department at Sohag University Hospital

[1]Mamdouh M. Esmat, [1]Asmaa M. Goda*, [1]Hala Abdelal A. Abdallah, [2]Alaa A. Redwan
[1]Department of Medical Microbiology and Immunology, Faculty of Medicine, Sohag University, Upper Egypt
[2]Department of General Surgery, Faculty of Medicine, Sohag University, Upper Egypt

Key words:
SSI, ESBL, MRSA, VRSA

Corresponding Author:
Asmaa M. Goda
Department of Medical Microbiology and Immunology
Sohag Faculty of Medicine
asmaa_gouda@med.sohag.edu.eg
Tel.: 20-01010078036

ABSTRACT

***Background**: Surgical site infections (SSI) are the most common nosocomial infections in surgical patients and lead to prolonged hospital stay, readmission to the hospital, and increased morbidity and mortality. **Objectives**: This study aimed to detect the incidence of SSI and the risk factors, the causative organisms and their antimicrobial susceptibility pattern in general surgery department at Sohag university hospital. **Methodology**: A prospective SSI surveillance at Sohag University hospital from (January 2017 to June 2017) using the criteria of the Centers for Disease Control. Basic demographic, surgical data and data of possible risk factors were collected from all patients. Patients were followed up for 30 days after surgery. Swabs were collected from cases with signs and symptoms of SSI and cultured on basic microbiological culture media. Isolated colonies were identified microscopically and biochemically. Full identification of the causative organisms and their antibiotic sensitivity were done by Vitek 2 compact automated system. **Results:** The study included 482 patients and the incidence of SSI infections was (11.2%). Escherichia coli was the most common organism causing SSI and was responsible for (40%) of SSIs followed by Pseudomonas aeruginosa (20%), Staphylococcus aureus (20%), Enterobacter cloacae (10 %) and Klebsiella pneumoniae (10 %). Most of isolated E. coli and Klebsiella were ESBL producers (73.3%). Pseudomonas aeruginosa shows emergence of resistance to tigecycline (25%). All isolated staph. aureus were (MRSA) and (10%) of them were (VRSA). Univariate regression analysis show that older age, urgent operation type, bad patient general condition, contaminated wound type, hypertension, obesity, intake of antibiotic prophylaxis and increased length of hospital stay (days) were risk factors for SSI. The multivariable regression analysis revealed that urgent operations type, bad patient condition, obesity increasing length of hospital stay (days) and intake of antibiotic prophylaxis independent risk factors for the development of a SSI. **Conclusion**: The study provides a valuable data about SSI in General Surgery Department and highlights risk factors associated with SSI, the causative pathogens and their antibiotic sensitivity in our hospital that can help in updating the antimicrobial prophylaxis policy and reducing the incidence of SSI.*

INTRODUCTION

The prevalence of healthcare-associated infections in low-income and middle-income countries (LMICs) was 2 to 20 times higher than in high-income countries. Surgical site infection (SSI) was the most frequent healthcare-associated infection in low-income and middle-income countries (LMICs), affecting up to a third of patients who had surgery[1].

Surgical site infection (SSI) is a serious complication, associated with prolonged hospital stay and increased mortality and morbidity. Moreover, SSIs increase hospital costs, creating a serious economic burden[2]. Surveillance is an essential method for understanding the incidence and distribution of healthcare associated infections [3]. The study is the first study aimed to detect the incidence and risk factors of surgical site infection, the causative organisms and their antibiotic resistance in General Surgery Department in Sohag University hospital.

METHODOLOGY

Study design and patients:

A Prospective study was conducted at Sohag University Hospital at General Surgery and Medical Microbiology and Immunology Departments from January 2017 to June 2017. All patients admitted for surgery during the period of the study were included.

Data were collected from non-infected and infected cases detected after surgery and they were followed up 30 days after operation to detect any infection in the wound. Exclusion criteria were wounds other than surgical wound and stitch abscess, burns and dirty wounds

Surgical site infection (SSI) was defined according to the criteria established by the Center for Disease Control and Prevention (CDC, 2017) which classified SSI to Superficial Incisional SSI, Deep Incisional SSI, Organ/Space SSI and use signs and symptoms of surgical site infection with the isolation of the organism by culture for diagnosis and following the patient for 30 days after surgery.

Data collection:

Basic demographic and clinical informations were recorded including age, sex and admission data as date of admission, date of surgery, date of discharge, intake of presurgical antibiotic prophylaxis. information about potential risk factors as diabetes mellitus, hypertension, chronic illness, malignancy, hepatitis C virus infection and obesity. Surgical intervention data included the type of surgical interventions, use of pre-operative antibiotics, and duration of surgery, type of operation classified as clean, clean-contaminated, contaminated and dirty. Informed written consent was taken from all participants or their parents in the case of children. The study was approved by the Research Ethics Committee of Sohag Faculty of Medicine.

Bacterial isolation, identification and antibiotic sensitivity testing:

The samples collected aseptically form patients with symptoms and signs of wound infection were pus aspirates and wound swabs. The area around the surgical wound was cleaned with 70% ethyl alcohol and the exudates was collected from the depth of the wound using sterile cotton swabs, care was taken not to touch the surrounding tissues to prevent contamination of the swab from endogenous resident flora then the sample was collected, labelled and sent to the laboratory immediately.

Swabs were plated out on primary culture, blood agar, nutrient agar, media mannitol salt agar and MacConkey agar. Morphologically suspected *Staph* colonies were gram stained and biochemically tested for catalase and coagulase test, to confirm *Staph aureus* identification. Gram negative bacilli were sub cultured on Eosin Methylene Blue agar (EMB) for lactose fermenter colonies, Cetrimide Agar for non-lactose fermenter colonies, Triple Sugar Iron (TSI) agar, oxidase and catalase test were done. Confirmation of identification and antibiotic sensitivity testing was done by Vitek 2 compact system (bio Mérieux, France) for both gram positive and gram negative organisms.

Statistical analysis:

Data was analyzed using SPSS computer program version 24.0. Quantitative data was expressed as mean ± standard deviation, median and range. Qualitative data was expressed as number and percentage. The data were tested for normality using Shapiro-Wilk test. The nonparametric Mann–Whitney test was used for data which wasn't normally distributed. Chi-square ($\chi 2$) test and Fisher's Exact Test were used for comparison regarding qualitative variables as appropriate. Univariate and multiple cox regression analysis were used to determine factors associated with surgical site infection among the studied patients. A 5% level was chosen as a level of significance in all statistical tests used in the study.

RESULTS

During the period of study 482 patients were recruited, 54 (11.2%) patient of them had surgical site infection. In 51 case the infection was superficial and deep in 3 cases. Mean age of the patients was 29.5 years old. The majority of them were males (53.3%). Mean duration of operation were 2.2 hours. More than forty percent (46.7%) of operations were urgent and 36.9% of them were contaminated. Mean duration of hospital stay were 6.7 days with mean duration of post - operative stay 4.3 days. Comparing the 2 groups of patients (with and without SSI), there was statistically significant difference between the patients as regard age (P-value=0.006), urgency of operation (P-value <0.001), patient general condition (P-value <0.001), wound type (P-value <0.001), intake of Antibiotic prophylaxis (P-value <0.001), hypertension (P-value=0 .018), obesity (P-value= 0.001), length of hospital stay (days) (P-value <0.001) and number of post-operative days (P-value <0.001). the data is shown in table 1.

Table 1 : Patient Demographics and Possible Surgical Site Infection Risk Factors

Factors	Total	Surgical site infection		P-value
		Yes NO. = 54 (11.2%)	No NO. = 428 (88.8%)	
Age Mean± S.D. Median (Range)	29.5 ± 19.8 28 (1 - 90)	35.8 ± 16.6 35.5 (1 – 70)	28.8 ± 20.1 27 (1 – 90)	**0.006***
Gender Male (%) Female (%)	257 (53.3%) 225 (46.7%)	25 (46.3%) 29 (53.7%)	232 (54.2%) 196 (45.8%)	0.272
Duration of operation (hours) Mean± S.D. Median (Range)	2.2 ± 1.03 2 (0.5 - 9)	2.2 ± 1.2 2 (1 – 8)	2.2 ± 1.01 2 (0.5 – 9)	0.893
Urgency of operation Yes (%) No (%)	225 (46.7%) 257 (53.3%)	40 (74.1%) 14 (25.9%)	185 (43.2%) 243 (56.8%)	**< 0.001***
Patient general condition Bad (%) Good (%)	21 (4.4%) 461 (95.6%)	10 (18.5%) 44 (81.5%)	11 (2.6%) 417 (97.4%)	**< 0.001***
Wound type Clean (%) Clean contaminated (%) Contaminated (%)	129 (26.8%) 175 (36.3%) 178 (36.9%)	0 (0.0%) 25 (46.3%) 29 (53.7%)	129 (30.1%) 150 (35%) 149 (34.9%)	**< 0.001***
Antibiotic prophylaxis No (%) Yes (%)	141 (29.3%) 341 (70.7%)	2 (3.7%) 52 (96.3%)	139 (32.5%) 289 (67.5%)	**< 0.001***
Diabetes No (%) Yes (%)	473 (98.1%) 9 (1.9%)	2 (3.7%) 52 (96.3%)	139 (32.5%) 289 (67.5%)	0.069
Hypertension No (%) Yes (%)	467 (96.9%) 15 (3.1%)	51 (94.4%) 3 (5.6%)	422 (98.6%) 6 (1.4%)	**0 .018***
Obesity No (%) Yes (%)	474 (98.3%) 8 (1.7%)	49 (90.7%) 5 (9.3%)	418 (97.7%) 10 (2.3%)	**0 .001***
Cancer No (%) Yes (%)	463 (96.1%) 19 (3.9%)	49 (90.7%) 5 (9.3%)	425 (99.3%) 3 (0.7%)	0.252
HCV infection No (%) Yes (%)	479 (99.4%) 3 (0.6%)	50 (92.6%) 4 (7.4%)	413 (96.5%) 15 (3.5%)	0.3
Length of hospital stay (days) Mean± S.D. Median (Range)	6.7 ± 5.4 5 (2 - 45)	10.4 ± 7.6 7 (3 – 38)	6.2 ± 4.8 5 (2 – 45)	**< 0.001***
Number of post-operative days Mean± S.D. Median (Range)	4.3 ± 3.5 4 (1 - 43)	7.3 ± 5.9 5.5 (1 – 30)	4.4 ± 3.6 4 (1 – 43)	**< 0.001***

**Statistically significant P -value: < 0.05*
Highly significant P- value :< 0.01

Risk factors may predispose to SSI, a univariate analysis of the preoperative risk factors revealed that; older age OR=1.02 (95%CI= 1.003– 1.03, p=0.019), Urgent operation type OR=3.4 (95%CI= 1.9 – 6.3,p= < 0.001), bad patient general condition OR =4.3 (95%CI= 2.1 – 8.6, p=< 0.001), contaminated wound type OR=2.2 (95%CI= 1.4– 3.2, p=< 0.001), hypertension OR=2.9 (95%CI=1.2 – 7.5, p=0.02) ,obesity OR=6.1(95% CI= 2.4 – 15.3, p= < 0.001) , intake of antibiotic prophylaxis OR=11.7(95% CI=2.8 – 47.9, p< 0.001) and increased length of hospital stay (days) OR=1.05(95% CI=1.02– 1.08, p=< 0.001) were risk factors for SSI (table 2). the final model of multivariable regression analysis revealed that urgent operations type OR=2.1 (95%CI= 1.1 – 4.03, p=0 .019), bad patient condition OR=2.4 (95% CI=1.08 – 5.1, 0 .031), obesity OR=3.4 (95%CI= 1.2 – 9.5, p=0 .019) increasing length of hospital stay (days) OR= 1.03(95% CI= 1.004– 1.06, p=0.028) and intake of antibiotic prophylaxis OR=5.6 (95%CI= 1.3 – 25.3, p= 0.024) to be an independent risk factor for the development of a SSI. table 3

Table 2 : Univariate regression analysis of factors predicting surgical site infection

Factors	Hazard ratio (CI $_{95\%}$)	P – value
Age	1.02 (1.003– 1.03)	0.019*
Gender	1.3 (0.77 – 2.3)	0.306
Duration of operation (hours)	1.06 (0.8 – 1.4)	0.699
Urgency of operation	3.4 (1.9 – 6.3)	< 0.001*
Patient condition	4.3 (2.1 – 8.6)	< 0.001*
Wound class	2.2 (1.4– 3.2)	< 0.001*
Antibiotic prophylaxis	11.7 (2.8 – 47.9)	0.001*
Diabetes	3.05 (0.9–9.8)	0.062
Hypertension	2.9 (1.2 – 7.5)	0.02*
Obesity	6.1 (2.4 – 15.3)	< 0.001*
Cancer	1.6 (0.6 – 4.4)	0.393
HCV infection	4.03 (0.6– 29.3)	0.168
Length of hospital stay (days)	1.05 (1.02– 1.08)	0.001*
Number of post-operative days	1.02 (0.98– 1.06)	0.444

**Statistically significant*

Table 3: Final model of multivariable regression analysis of indicators of surgical site infection among the studied patients

Factors	Adjusted hazard ratio (CI $_{95\%}$)	P – value
Urgency of operation	2.1 (1.1 – 4.03)	0 .019*
Patient condition	2.4 (1.08 – 5.1)	0 .031*
Obesity	3.4 (1.2 – 9.5)	0 .019*
Antibiotic prophylaxis	5.6 (1.3 – 25.3)	0.024*
Length of hospital stay (days)	1.03 (1.004– 1.06)	0.028*

**Statistically significant*

Sixty microorganisms were isolated from diagnosed cases, their number and distribution are shown in table 4. The infection was polymicrobial in six cases (more than one organism was isolated). The polymicrobial samples included *Pseudomonas aeruginosa* and *Escherichia coli* in three cases, *Staphylococcus aureus* and *Escherichia coli* in one case and *Staphylococcus aureus* and *Klebsiella pneumoniae* in another case and *Pseudomonas* and *Enterobacter cloacae* in the last case.

In our study (79.2%) of isolated *E. coli* were ESBL producer, (100%) of them were resistance to ampicillin and (95.8%) ampicillin/sulbactam and (95.8%) resistant to cefazolin and. All the *E. coli* isolates were sensitive to tigecycline (100%). And (87.5%) were sensitive to imipenem, ertapenem, meropenem. For *Enterobacter cloacae* isolates, all isolate (6) (100%) were sensitive to piperacillin /tazobactam, aztreonam, ertapenem, imipenem and meropenem, amikacin, ciprofloxacin, levofloxacin, moxifloxacin, tigecycline, nitrofurantoin but resistant to cefoxitin (100%) and cefazolin, ceftazidime and ceftriaxone (83.3%).

Fifty percent (3) of *Klebsiella pneumoniae* are ESBL producer, but all of them were sensitive to amikacin, gentamycin, tigecycline. All *Pseudomonas aeruginosa* isolates were resistant to ampicillin, ampicillin/sulbactam, cefazolin, cefoxitin, ceftriaxone but 9 (75%) of them were sensitive to aztreonam, ertapenem, imipenem, meropenem and tigecycline. Details of antibiotic resistance of gram negative isolates were shown in table 4. All *Staph. Aureus* isolates were methicillin resistant (MRSA), with one organism (8.3%) was vancomycin resistant (VRSA). All the isolates were sensitive to linezolid. table 5

Table 4: List of organisms isolated from SSI

Organism	**N. (%)**
Total	60 (100%)
Gram positive	
Staphylococcus aureus	12 (20%)
Gram negative	
E. coli	24 (40%)
Enterobacter cloacae	6 (10%)
Klebsiella pneumonia	6 (10%)
Pseudomonas aeruginosa	12 (20%)

Table 5: Antibiotic resistance of isolated organisms

Antibiotics	**Gram negative isolates**					**Gram positive isolates**
	E. coli (24)	**Enterobacter cloacae (6)**	**Klebsiella pneumoniae (6)**	**pseudomonas aeruginosa (12)**	**Total gram negative (48)**	**Staphylococcus aureus (12)**
ESBL	19 (79.2%)	-	3 (50%)	-	73.3%*	-
Benzyl penicillin	-	-	-	-	-	12 (100%)
Oxacillin	-	-	-	-	-	12 (100%)
Ampicillin	24 (100%)	-	6 (100%)	12 (100%)	100%*	-
Ampicillin-sulbactam	23 (95.8%)	-	5 (83.3%)	12 (100%)	95%*	-
Piperacillin-tazobactam	11 (45.8%)	0 (0.0%)	6 (100%)	7 (58.3%)	50%	-
Cefazolin	23 (95.8%)	5 (83.3%)	5 (83.3%)	12 (100%)	93.8%	-
Cefoxitin	10 (41.7%)	6 (100%)	6 (100%)	12 (100%)	70.8%	12 (100%)
Ceftriaxone	22 (91.7%)	5 (83.3%)	5 (83.3%)	12 (100%)	91.6%	-
Ceftazidime	22 (91.7%)	5 (83.3%)	5 (83.3%)	11 (91.7%)	89.5%	-
Cefepime	22 (91.7%)	2 (33.3%)	5 (83.3%)	8 (66.7%)	77%	-
Aztreonam	19 (79.2%)	0 (0.0%)	4 (66.7%)	3 (25%)	54.1%	-
Ertapenem	3 (12.5%)	0 (0.0%)	4 (66.7%)	3 (25%)	20.8%	-
Imipenem	3 (12.5%)	0 (0.0%)	4 (66.7%)	3 (25%)	20.8%	-
Meropenem	3 (12.5%)	0 (0.0%)	4 (66.7%)	3 (25%)	20.8%	-
Amikacin	1 (4.2%)	0 (0.0%)	0 (0.0%)	4 (33.3%)	10.4%	-
Gentamicin	10 (41.7%)	2 (33.3%)	0 (0.0%)	5 (41.7%)	35.4%	6 (50%)
Tobramycin	10 (41.7%)	3 (50%)	4 (66.7%)	6 (50%)	47.9%	-
Ciprofloxacin	15 (62.5%)	0 (0.0%)	2 (33.3%)	4 (33.3%)	43.7%	3 (25%)
Levofloxacin	13 (54.2%)	0 (0.0%)	2 (33.3%)	4 (33.3%)	39.5%	3 (25%)
Moxifloxacin	14 (58.3%)	0 (0.0%)	2 (33.3%)	4 (33.3%)	41.6%	3 (25%)
Tigecycline	0 (0.0%)	0 (0.0%)	0 (0.0%)	3 (25%)	6.52%	0 (0.0%)
Nitrofurantoin	1 (4.2%)	0 (0.0%)	2 (33.3%)	8 (66.7%)	22.9%	1 (8.3%)
trimethoprim sulfamethoxazole	14 (58.3%)	5 (83.3%)	1 (16.7%)	12 (100%)	66.6%	2 (16.6%)
Erythromycin	-	-	-	-	-	6 (50%)
Clindamycin	-	-	-	-	-	3(25%)
Inducible clindamycin resistance	-	-	-	-	-	2 (16.6%)
Quinupristin/ Dalfopristin	-	-	-	-	-	1 (8.3%)
Vancomycin	-	-	-	-	-	1 (8.3%)
Linezolid	-	-	-	-	-	0 (0.0%)
Rifampicin	-	-	-	-	-	4(33.3%)

**percent were calculated for tested organisms only*

DISCUSSION

SSIs remain a significant problem despite improvements in their prevention, as they are associated with substantial mortality and morbidity. This surveillance study at Sohag University Hospitals at General Surgery Department describes the incidence of SSIs using standardized Center for Disease Control and Prevention definitions.

We found an overall rate of SSIs (11.2%), which was lower than rate reported in 11 Egyptian hospitals, they identified 510 SSIs following 4,246 surgeries with an overall SSI rate of 12% [4], and lower than that reported in an Indian study (12.5%) [5], the rate almost similar to that reported in Saudi Arabia 11.4% (183 SSI cases) [6] and higher than a rate reported in a study conducted at Tanta University Hospital in Egypt detecting an overall SSI incidence rate of 8 %[7]. The rate was much higher than a rate reported in Mainland China (3.1%) [3]and higher than that reported in USA (5.9%) [8].It was also higher than that reported in a General Surgery Department of a hospital in Mali (7.9 %)[9].

Difference in the rate of SSI may be explained by the differences in the characteristics of the hospital populations, the underlying diseases, differences in clinical procedures, the extent of the infection control measures, and in addition the hospital environment[10], added that sample sizes, and surveillance methodology including the methods used to detect SSI that develop after discharge are another factor [11].

As regard risk factors for SSI which were analyzed using a univariate regression showed that increasing age is associated with increased risk of SSI OR=1.02 (95%CI =1.003– 1.03). The result was in agreement with other studies confirming that as age increases the risk of occurrence of SSIs increases [12]. Different authors revealed that, as the age increases, the immunity will decrease and increases the occurrence of chronic disease that decrease the immunity of the patient, both of which synergistically predispose the patient to have SSIs. However, SSI was not associated with sex. the same result in a study done in Alexandria University Hospital[13] and China [14].

Operative settings (elective or emergency) also play a significant role in determining infection rates, emergency cases are more likely to get infected due to inadequate preparation, pre-existing infection and reduced immunological status of patient. In our study urgent operation were independent risk factor for SSI, OR=3.4 (95%CI = 1.9 – 6.3). A study in Pakistan showed four times higher infection rate in emergency cases[15], also another study in Egypt reported a significantly higher rate of SSI in emergency operations compared to routine elective surgeries [16].

The length of hospital stay was associated with the risk of SSI; long hospital stay could increase the probability of exposure to pathogens [17]. In our study the multivariate regression analysis shows the length of hospital stay (days) OR= 1.03 (95%CI= 1.004– 1.06) to be an independent risk factor for the development of a SSI. The same results were reported in Egypt [13], Saudi Arabia [6].

In our study risk of SSI was highest in contaminated wound OR=2.2 (95%CI= 1.4– 3.2), as numerous bacteria thrive in contaminated wounds which are the source of the infection [14], the same was reported by many studies in India [5], Egypt [13] and China [14]. the relation between duration of operation and SSI revealed non-significant relation, but in China the incidence of SSI increases where surgery had been prolonged for ≥ 2 hours[3,14].

As regard co-morbid condition associated with SSI, obesity OR=6.1(95%CI = 2.4 – 15.3), bad patient condition OR =4.3 (95%CI = 2.1 – 8.6), Hypertension OR=2.9 (95%CI= 1.2 – 7.5) were a risk factors for SSI. In obese patients, the increased risk of SSI is thought to be due to diminished blood flow, increased wound area, and the added technical difficulty of handling adipose tissue. In addition to lower perfusion of the subcutaneous tissue, obesity is associated with longer operations and larger dead space in wounds that are primarily closed. the same result was in study in Athena [18].

Hypertension was reported by 2 Indian studies[19,20] as risk factor for SSI. Patients with bad general conditions (anemic, underweight, malnourished, with chronic debilitating diseases) are known to have a weaker immune defenses making them more susceptible to infections [21,22].

On the other hand, diabetes, cancer and HCV infection were not a risk factors for our patient included in the study. This agree with a study in Egypt [13]. although other studies in Saudi Arabia and Athena, reported that SSIs increased in diabetics as compared to non-diabetics [6,18]. Malignancy may affect the immune response to infection per se or by the associated treatment as chronic administration of glucocorticoids and cytotoxic agents[23].

In our study antibiotic prophylaxis was independent risk factor of infection by univariate OR=11.7 (95%CI = 2.8 – 47.9) and multivariate regression analysis OR=5.6 (95%CI =1.3 – 25.3), It was reported by many studies that Inappropriate prophylaxis by using broad spectrum antibiotics for long duration was associated with more SSI rate and increased rate of resistance [11,19]. In addition preoperative antibiotic was introduced in our setting to urgent surgeries and patients with contaminated operations and that most of the isolated organisms were resistant to the used prophylactic antibiotics

The most common isolated microorganism was *Escherichia coli* representing (40%) and *Staphylococcus aureus* was the most common gram positive organisms. Our finding was similar to that reported in India[24] and Saudi Arabia [16]. The predominance of gram negative organisms may be due to intra-abdominal procedures. Comparing our results with other Egyptian studies, *Klebsiella pneumonia* was isolated in (35%) and *Escherichia coli* (33%) of cases[4], India isolated gram negative bacteria in (73.1%) more than gram positive (28.9%)[25]. In Japan the main organisms isolated from SSI were *Enterococcus faecalis* (14.3%) and *Staphylococcus aureus* (14.2%) [26].

Hospital acquired infection are commonly associated with high antibiotic resistance and multidrug resistant (MDR) organism (those resistant to 3 or more classes of antibiotics)[7]. Our study showed that *E. coli*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Klebsiella pneumoniae* were MDR organisms. There was a high rate of resistance of *Escherichia coli* and *Klebsiella pneumonia* to pencillin drugs; Ampicillin (100%), ampicillin/sulbactam (93%) and third generation cephalosporins, ceftriaxone (90%) as seen in table 5. This make Tigecycline (100% sensitivity) the last hope for treating these multidrug resistant organisms.

Isolated Pseudomonas aeruginosa (n=12) were MDR multiple drug resistance (table 5). The resistance rate is higher than that reported in studies from Ethiopia[27], India[16] and Egypt[7]. All *Staphylococcus aureus* 12 (100%) were (MRSA). The same was reported in an Indian study[28]. In our study 1(8.3%) were VRSA which is the first time to report VRSA in our setting. all isolates of *Staphylococcus aureus* show sensitivity to linezolid (100%).

The resistance pattern of isolated organisms explains the inefficacy of antibiotic prophylaxis regimen given in our setting which is (Amoxicillin/ clavulanic, cefotaxime). Almost all isolates were resistant to these drugs. Measures as active surveillance, strict antibiotic policy to control spread of MDROs and reduce drug resistance should be applied. selection of appropriate surgical chemoprophylaxis should depend on susceptibility patterns of the isolated organisms.

CONCLUSION

Our study is the first surveillance study for SSI in Sohag district which provides a valuable data about the magnitude of surgical site infection at general surgery wards. prolonged hospital stay and inappropriate prophylactic antibiotic intake were important risk factors for SSI which could be modified or taken in consideration when managing patients. *E. coli* was the most common isolated organism. Resistance rate is high. Highly resistant strains as MRSA, VRSA, and ESBL were isolated. Strict infection control measures should be taken to reduce their spread and reduce SSIs.

REFERENCES

1. Allegranzi B, Nejad SB, Combescure C, et al. Burden of endemic health-care-associated infection in developing countries: Systematic review and meta-analysis. Lancet. 2011;377(9761):228-241.
2. Ban KA, Minei JP, Laronga C, et al. American College of Surgeons and Surgical Infection Society: Surgical Site Infection Guidelines, 2016 Update. J Am Coll Surg. 2016;224(1):59-74.
3. Fan Y, Wei Z, Wang W, et al. The incidence and distribution of surgical site infection in mainland China: A meta-analysis of 84 prospective observational studies. Sci Rep. 2014;4:1-8.
4. Abduo EM, El-Kholy J, Abdou S, Hafez S, Omar N, Talaat M. Incidence and Microbial Etiology of Surgical Site Infections at Select Hospitals in Egypt. Am J Infect Control. 2016;44(6):S52-S53.
5. Kumar A, Rai A. Prevalence of surgical site infection in general surgery in a tertiary care centre in India. Int Surg J. 2017;4(9):3101-3106.
6. Ahmad A, Rawabdeh A, Rahman A, Al S, Khan ZU. Surgical Site Infections Incidence, their Predictors and Causative Organisms in a Teaching Hospital. Int J Community Fam Med. 2016;1(104):1-6.
7. Afifi IK, Labah EA, Ayad KM. Surgical site infections after elective general surgery in Tanta University Hospital: rate, risk factors and microbiological profile. Egypt J Med Microbiol. 2009;18(2):61-72.
8. Wick EC, Vogel JD, Church JM, Remzi F, Fazio VW. Surgical Site Infections in a “High Outlier” Institution: Are Colorectal Surgeons to Blame? Dis Colon Rectum. 2009;52(3):374-379.
9. Dembélé BT, Traoré A, Kanté L. Operating Site Infections at General Surgery Department of Gabriel Toure Training Hospital. Surg Sci. 2015;(6):59-64.
10. Kamat US, Fereirra AMA, Kulkarni MS, Motghare DD. A prospective study of surgical site infections in a teaching hospital in Goa. Indian J Surg. 2008;70(3):120-124.
11. Roumbelaki M, Kritsotakis EI, Tsioutis C, Tzilepi P, Gikas A. Surveillance of surgical site infections at a tertiary care hospital in Greece: Incidence, risk factors, microbiology, and impact. Am J Infect Control. 2008;36(10):732-738.

12. Laloto TL, Gemeda DH, Abdella SH. Incidence and predictors of surgical site infection in Ethiopia: prospective cohort. BMC Infect Dis. 2017;17(119):1-9.
13. Hafez S, Saied T, Hasan E, et al. Incidence and modifiable risk factors of surveillance of surgical site infections in Egypt: A prospective study. Am J Infect Control. 2012;40(5):426-430.
14. Fan Y, Wei Z, Wang W, et al. The Incidence and Distribution of Surgical Site Infection in Mainland China: A Meta-Analysis of 84 Prospective Observational Studies. Sci Rep. 2015;4(1):6783.
15. Malik ZI, Nawaz T, Abdullah MT, Waqar SH, Zahid MA. Surgical Site Infections in General Surgical Wards at a Tertiary Care Hospital. Pak J Med Res. 2013;5(4):5-5.
16. Khairy GA, Kambal AM, Al-Dohayan AA, et al. Surgical site infection in a teaching hospital: A prospective study. J Taibah Univ Med Sci. 2011;6(2):114-120.
17. Leong G, Wilson J, Charlett A. Duration of operation as a risk factor for surgical site infection: comparison of English and US data. J Hosp Infect. 2017;63(3):255-262.
18. Aikaterini M, George N, Dionysia K, et al. Risk factors analysis concerning infections in general surgery. Aristotle Univ Med J. 2015;42(2):12-17.
19. Rana DA, Malhotra SD, Patel VJ. Inappropriate surgical chemoprophylaxis and surgical site infection rate at a tertiary care teaching hospital. Brazilian J Infect Dis. 2013;17(1):48-53.
20. Setty N, Nagaraja M. A study on Surgical Site Infections (SSI) and associated factors in a government tertiary care teaching hospital in Mysore, Karnataka. Int J Med Public Heath. 2014;4(2):171-175.
21. Shinkawa H, Takemura S, Uenishi T, et al. Nutritional risk index as an independent predictive factor for the development of surgical site infection after pancreaticoduodenectomy. Surg Today. 2013;43(3):276-283.
22. Alp E, Altun D, Ulu-Kilic A, Elmali F. What really affects surgical site infection rates in general surgery in a developing country? J Infect Public Health. 2014;7(5):445-449.
23. Poultsides LA, Ma Y, Della Valle AG, Chiu Y-L, Sculco TP, Memtsoudis SG. In-hospital surgical site infections after primary hip and knee arthroplasty--incidence and risk factors. J Arthroplasty. 2013 Mar;28(3):385-9.
24. Khan HA, Baig FK, Mehboob R. Nosocomial infections: Epidemiology, prevention, control and surveillance. Asian Pac J Trop Biomed. 2017;7(5):478-482.
25. Dessie W, Mulugeta G, Fentaw S, Mihret A, Hassen M, Abebe E. Pattern of bacterial pathogens and their susceptibility isolated from surgical site infections at selected referral hospitals, Addis Ababa, Ethiopia. Int J Microbiol. 2016;2016.
26. Takesue Y, Watanabe A, Hanaki H, et al. Nationwide surveillance of antimicrobial susceptibility patterns of pathogens isolated from surgical site infections (SSI) in Japan. J Infect Chemother. 2012;18(6):816-826.
27. Mama M, Abdissa A, Sewunet T. Antimicrobial susceptibility pattern of bacterial isolates from wound infection and their sensitivity to alternative topical agents at Jimma University Specialized Hospital, South-West Ethiopia. Ann Clin Microbiol Antimicrob. 2014;13(1):14.
28. Fadnis M, Desai S, AK, RB. Surgical Site Infections: Incidence and Risk Factors in a Tertiary Care Hospital, Western. Int J Healthc Biomed Res. 2014;2(3):152-161.