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Research

Investigation of the Association of Surgical Site Infection with Socio demographic Factors and Clinical Factors

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Abstract*: A surgical site infection (SSI) is an infection of a wound from a surgery. It is a global problem in the field of surgery associated with long hospital stay, higher treatment expenditure, morbidity and mortality. The objective of this study was to determine the correlation of post-surgical wound infection with several socio-demographic factors including gender, age group and occupation as well as some clinical factors like – duration of hospital stay, surgery performed and the comorbidities of the respondents.* ***Methodology and Results:*** *This cross sectional study involved 250 patients suffering from post-surgical wound infection as respondents and the culture sensitivity tests of bacterial isolates obtained from pus samples. The study was conducted from June 2017 to May2018. Data regarding the patient's age, gender, occupation, surgery performed, duration of hospital stay and comorbidity was documented using a standard questionnaire. Male patients suffered from post-surgical wound infection more (68.2%) than female patients (31.8%). Patients aged from 51 to 60 years old were more affected (21.5%) than the patients of other age groups. According to this study, employees were at higher risk (20.5%) compared to people from other occupations. Post-surgical wound infection was more frequently observed in the patients who went for hand surgery in burn unit (17.9%). Intensive occurrence of this type of infection was found in the patients who stayed in the hospital from 11 to 20 days (35.4%). Statistically significant correlation ($p<0.05$) was observed in case of age group and duration of hospital stay.* ***Conclusion and Significance:*** *This study will help the public to become more conscious about surgical site infection and help them to maintain good health and hygienic environment everywhere. This study will also assist the clinicians to select appropriate therapeutic measures for particular patients.*

Keywords*: Association, Surgical Site Infection, Socio-demographic Factors, Clinical Factors*

Introduction

Surgical Site Infection (SSI) can be referred as the infection that occurs within about 30 days after a surgical operation and affects incision or deep tissues at the surgical site. This type of infection may be superficial or deep incisional infection or infection that includes organ or even body space (Mangram*et al*., 1999). SSI is one of the most common complications for the patients who undergo surgical procedures and the third most frequently occurring nosocomial infection in the hospital population. Postoperative surgical site infections are often correlated with increased morbidity, mortality, long duration of hospital stay and increased expenses for the health care of the patients (Weigelt*et al*., 2010).

There are several advancements to control SSI which include improved operation theatre, proper ventilation, appropriate sterilization methods, use of different barriers, modern surgical technique and the availability of antimicrobial prophylaxis. But these SSIs exist as common causes of morbidity and mortality due to emergence of antimicrobial resistance of pathogenic bacteria (Mangram*et al*., 1999). This is partly contributed by random utilization of surgical antimicrobial prophylaxis (Al-Momany*et al*., 2009).

Tanzania accounted for 19.4% of patients who developed SSI post-surgery (Eriksen*et al*., 2003). Uganda showed the 10% prevalence of SSI and among the patients suffering from SSI, 9.4% were women who had caeserian section (Hodges and Agaba, 1997). In Ethiopia, the prevalence of SSI was found 21% according to clinical features and 38.7% depending on bacteriological features in patients who had undergone surgery in their abdomen (Kotisso and Aseffa, 1998). It was demonstrated that, in Kenya the prevalence of wound infection among female who had undergone caeserian section was 19% (Koigi-Kamau*et al*., 2005). In our homeland, Bangladesh, the prevalence of post-surgical wound infection has been found 6-18% (Hadi, 1991).

Lots of preoperative, perioperative and postoperative predisposing factors were investigated and their association with the risk for development of SSIs was observed. Prospective inspection of the risk factors for SSIs among the sufferers in surgical wards in Iran revealed significant association of more than 60 years of age, diabetes mellitus, smoking and obesity with risk of SSIs (Arabshahi and Koohpayezade, 2006). Kaya and her colleagues displayed similar findings in addition to malnutrition, prolonged preoperative hospital stay and coexisting infections at the other site of the body being risk factors but smoking was not associated with risk of SSIs (Kaya *et al*., 2006).Kalmeijer and his group showed*S. aureus*,found in the nasal carriage,as one of the most important and significant independent risk factors for development of SSI with *S. aureus*(Kalmeijer*et al*., 2000).

Many studies have reported a number of surgical procedure related factors as contributory risk factors for the development of SSIs. Kaya reported abdominal incision, whole blood transfusion, early preoperative hair removal, inappropriate antimicrobial prophylaxis, famotidine treatment and repair with mesh as independent risk factors for SSI (Kaya *et al*., 2006). Eriksenshowed prolonged duration of operation, sepsis of the wound, type of operation, type of incision, inappropriate antimicrobial prophylaxis and increased time lapse between shaving and operation as significantly associated with increased risk of SSI among patients who had undergone abdominal surgery (Eriksen*et al*., 2003).

Length of preoperative hospital stay, early preoperative hair removal and compromised nutrition status were significant risk factors for SSIs in Uganda (Tiberi*et al*., 2010). A prospective incidence study at a district hospital in Tanzania reported American Society of Anesthesiologist (ASA) score of 2-4 and long duration of operation as risk factors significantly associated with SSI (Fehr *et al*., 2006). Inadequacy and inappropriate use of preoperative antimicrobials is known to be a major risk factor associated with increased incidence of SSI. However, when applied properly it can significantly prevent the occurrence of SSI. For example, a study at a rural hospital in Tanzania showed dramatically decreased rate of SSI from 21.6% to 4% after implementation of appropriate use of preoperative antimicrobial prophylaxis (Saxer*et al*., 2009). Hence, the present study has been conducted to find out the association of post-surgical with gender, age group, occupation, duration of hospital stay, surgery performed and comorbidities of the respondents.

Methodology

This cross sectional study was conducted in Khulna Medical College Hospital, Khulna, Bangladesh from June 2017 to May 2018. The data about the patient's age, gender, occupation, surgery performed, duration of hospital stay and comorbidity was recorded with the help of standard questionnaire. The questionnaires were provided to250 patients and were requested to fill up. All these data preserved accurately and confidentially. Then the wound swabs were collected form those patients under all aseptic precaution and were kept in a sterile test tube and then were sent to the microbiology laboratory immediately. In the laboratory, the pus samples were cultured on McConkey Agar medium and Blood Agar medium. These two media were used for confirmation of the bacteria. The colony morphology of the bacteria were observed. After that, the Gram Staining was carried out which is followed by several biochemical tests including – catalase test, coagulase test, motility test and oxidase test. Data were collected and analyzed statistically using the Statistical Package for Social Sciences (SPSS) database, version 16.0, submitting the data to a

simple one factor Analysis of Variance (ANOVA). ANOVA was performed and mean separation was done by SPSS database ($p<0.05$).

Results

250 patients of Khulna Medical College Hospital were considered as the respondents of this study and 195 patients showed post-surgical wound infection containing different microorganisms (**Figure 1**). The data the gender, age, occupation, surgery performed, duration of hospital stay and comorbidity were collected and analyzed. The results have been displayed below.

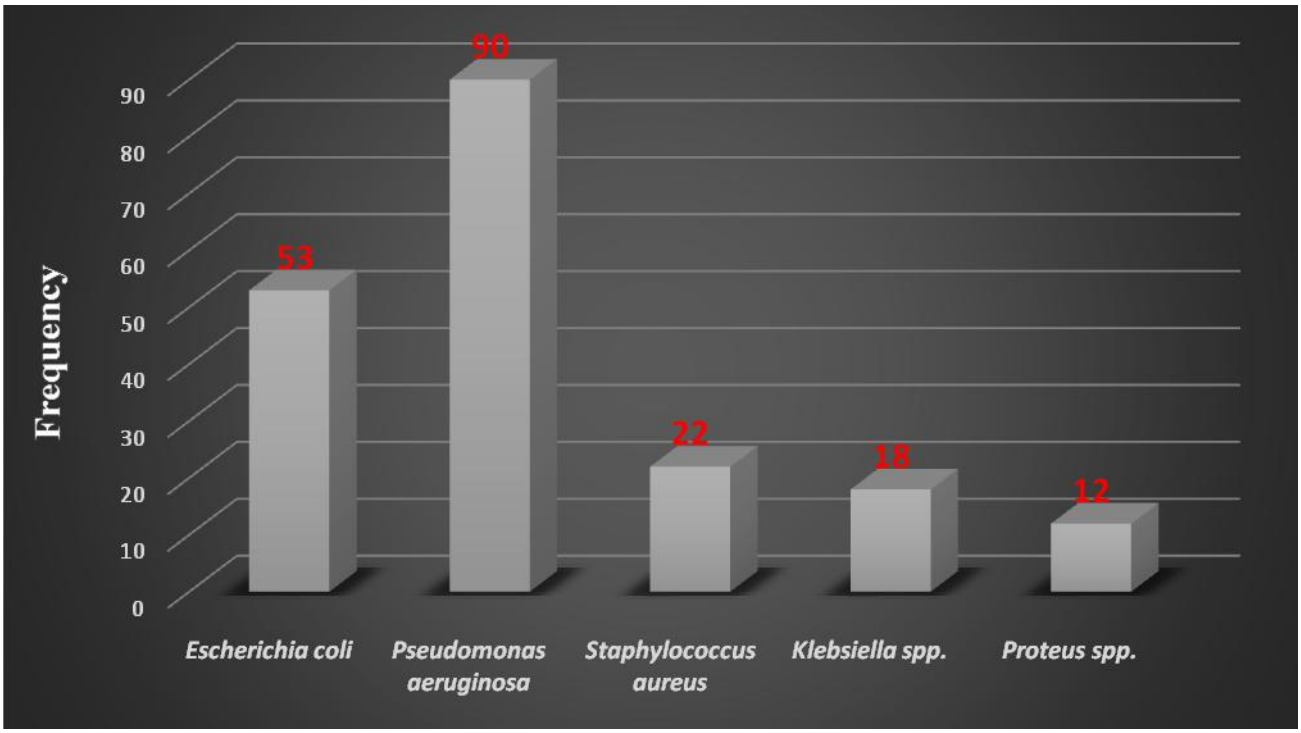

Figure1: Frequency of the bacteria responsible for post-surgical wound infection.

Among the microorganisms responsible for post-surgical wound infection 53 are *Escherichia coli* (27.18%), 90 are *Pseudomonas aeruginosa*(46.16%), 22 are *Staphylococcus aureus*(11.28%), 18 are *Klebsiella spp*. (9.23%) and 12 are *Proteus spp*. (6.15%) (**Figure 1).**

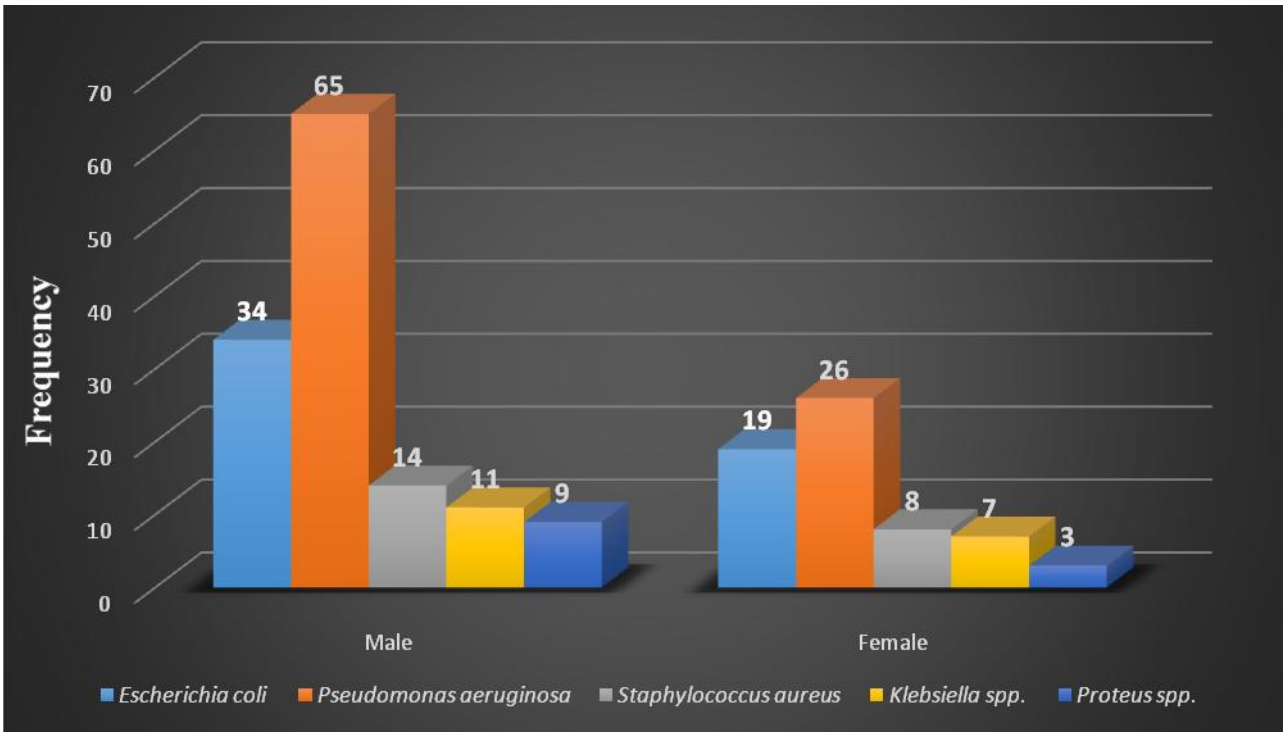

Figure 2: Distribution of bacteria responsible for post-surgical wound infection based of the gender of the respondents.

*Pseudomonas aeruginosa*has shown the highest frequency in both male and female. *Proteus spp.* has shown the lowest frequency in both male and female. However, the microorganisms responsible for post-surgical wound infection do not have any correlation with the gender of the respondents (**Figure 2**).

Table1: Percentage of post-surgical wound infection based on the age groups of the respondents

Age group (years)	Frequency (Total number of patients in each group)	Post-surgical Wound Infection (%)
0-9	5	2.6[a]
10-19	23	11.8[b]
20-29	34	17.4[c]
30-39	34	17.4[c]
40-49	36	18.5[d]
50-59	**42**	**21.5[e]**
60-69	17	8.7[f]
70-79	4	2.1[g]

The age group ranging from 50 years to 59 years showed the highest percentage of post-surgical wound infection (21.5%). On the other hand the age group ranging from 70 years to

79 years had the lowest percentage of post-surgical wound infection (2.0%). In this study, post-surgical wound infection showed statistically significant correlation with the age groupat P<0.05 level. Different letters reveal the significant difference at P<0.05 level while same letters reveal the non-significant difference at P<0.05 level**(Table 1)**.

Table 2: Percentage of post-surgical wound infection based on the occupations of the respondents

Occupation of the respondents	Frequency	Post-surgical wound infection (%)
Businessman	22	11.3[a]
Employee	**40**	**20.5[b]**
Driver	21	10.8[c]
Farmer	13	6.7[d]
Student	31	15.8[e]
Teacher	13	6.7[d]
Housewife	27	13.8[f]
Labor	21	10.8[c]
Social Worker	7	3.6[g]

The highest percentage of post-surgical wound infection (20.5%) was observed in case of the respondents who work as employees, whereas, the social workers presented the lowest percentage of post-surgical wound infection (3.6%).Different letters reveal the significant difference at P<0.05 level while same letters reveal the non-significant difference at P<0.05 level**(Table 2).**

Table 3: Percentage of post-surgical wound infection based on the duration of hospital stay of the respondents

Duration of Hospital Stay (days)	Frequency	Post-surgical wound infection (%)
0-10	51	26.2[a]
11-20	**69**	**35.3[b]**
21-30	51	26.2[a]
31-40	18	9.2[c]
41-50	6	3.1[d]

Patients who spent 11-20 days in hospital, had the highest percentage of post-surgical wound infection (35.3%). Patients who stayed in the hospital 41-50 days displayed the lowest percentage of post-surgical wound infection (3.1%). Statistically significant correlation was found between post-surgical wound infection and the duration of hospital stay at P<0.05 level.Different letters reveal the significant difference at P<0.05 level while same letters reveal the non-significant difference at P<0.05 level**(Table 3).**

Table 4: Percentage of post-surgical wound infection based on the surgeries performed to the respondents

Surgery Performed	Frequency	Post-surgical Wound Infection (%)
Abdominal Surgery	29	14.9[a]
Leg Surgery	30	15.4[b]
Hand Surgery	**35**	**17.9[c]**
Hip Surgery	15	7.8[d]
Scalp Cut Injury	29	14.9[a]
Vascular Surgery	19	9.7[e]
Back Surgery	19	9.7[e]
Skin Surgery	19	9.7[e]

Patients who have gone thorough hand surgery showed the highest percentage of post-surgical wound infection (17.9%) but patients with the hip surgeryshowed the lowest percentage of post-surgical wound infection(9.7%). Different letters reveal the significant difference at P<0.05 level while same letters reveal the non-significant difference at P<0.05 level **(Table 4).**

Table 5: Percentage of post-surgical wound infection based on the comorbidities of the respondents

Comorbidities	Frequency	Post-surgical wound infection (%)
Diabetes	**8**	**4.1[a]**
Asthma	6	3.1[b]
Arthritis	3	1.5[c]
Stroke	2	1.0[d]
Ulcer	3	1.5[c]

The diabetic patients had the highest percentage of post-surgical wound infection (4.1%). The patients with previous stroke showed the lowest percentage of post-surgical wound infection (1.0%).Different letters reveal the significant difference at P<0.05 level while same letters reveal the non-significant difference at P<0.05 level**(Table 5).**

Discussion

In the present study, 250 patients having post-surgical wound infection were considered as the respondents. Five types of microorganisms including *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *Klebsiella*species and *Proteus* species were recognized. Similar study was carried out by Mengeshaand his colleagues during 2012 in Ethiopia. In that study, those five types of microorganisms have been found as well but among the microorganisms 6 were *Escherichia coli* (5.1%), 11 were *Pseudomonas aeruginosa*(9.4%), 40 were *Staphylococcus aureus*(34.8%), 29 were *Klebsiella*(24.8%) and 15 were *Proteus* (12.8%) (Mengesha*et al*., 2014).

In the present study, male and female showed different frequencies of the microorganisms. The study of Agwunglefah and his colleagues revealed that, in case of male respondents 16 were *Pseudomonas aeruginosa*, 21 were *Staphylococcus aureus*, 10 were *Klebsiella*and 4 were *Proteus* and in case of male respondents of Federal Christiana Hospital 15 were *Pseudomonas aeruginosa*, 19 were *Staphylococcus aureus*, 9 were *Klebsiella*and 2 were *Proteus*(Agwunglefah*et al*., 2014).

Under present investigation, the microorganisms responsible for post-surgical wound infection were distributed according to the age of the respondents after dividing them into several age groups. In the age group of 0-9 years, the total number of microbial isolates was 5. In the age group of 10-19 years, the total number of microbial isolates was 23. In the age group of 20-29 years, the total number of microbial isolates was 34. In the age group of 30-39 years, the total number of microbial isolates was also 34. In the age group of 40-49 years, the

total number of microbial isolates was 36. In the age group of 50-59 years, the total number of microbial isolates was 42. In the age group of 60-69 years, the total number of microbial isolates was 17. In the age group of 70-79 years, the total number of microbial isolates was 4.In the study of Agwunglefah and his colleagues, the age group of 0-9 years had the total isolates of 8, the age group of 10-19 years had the total isolates 6, the age group of 20-29 years had the total isolates 7, the age group of 30-39 years had the isolates 12, the age group of 40-49 years had the total isolates 5, the age group of 50-59 years had the total isolates 6 and the age group of 60-69 years had the total isolates 6 also (Agwunglefah*et al*., 2014). In the present study, there was a statistically significant correlation between age and the bacteria that caused post-surgical infection. Mengeshaand his colleagues have not found such statistically significant correlation (Mengesha*et al*., 2014).

In this present study, the correlation between the occupation of the respondents and the microorganisms responsible for post-surgical wound infection was investigated by distributing the microorganisms according to the occupation of the respondents. In case of businessmen the total number of microbial isolates has been found 22, in case of employees it has been found 40, in case of drivers 21, in case of farmers 13, in case of students 32, in case of teachers 13, in case of housewives 27, in case of 21 and in case of social workers 7. In the study of Agwunglefah and his colleagues the microorganisms was distributed according to the occupation of the respondents as well. It that study the total number of microbial isolates form the students was 9, form the petty traders was 6, form the drivers was 14, form the infants was 4, form the housewives was 2, form the civil servants was 2, form the educationists was 5, form the businessmen was 4 and form the respondents involved in several forces was 4 (Agwunglefah*et al*., 2014).

The prevalence rate of post-surgical wound infection among various surgical procedures was observed in the present study. In case of abdominal surgery the frequency of post-surgical wound infection is 29, in case of leg surgery 31, in case of hand surgery 35. In case of herniorrhaphy 15, in case of Craniotomy 29, in case of vascular surgery 19, in case of joint prosthesis and skin surgery 19.In the study of Humaun Kabir Sickder and his colleagues, laparotomy showed the highest frequency (24) of post-surgical wound infection. In case of Hernioplasty the frequency was 23, in case of Appendisectomy 13, in case of Mastectomy 10, in case of Cholecystectomy 9, in case of Prostatectomy 6, in case of Choledecholithotomy 5, in case of Nephrolithotomy 2 and in case of other operations the frequency was found 4 (Humaun*et al*., 2017).

In the present study the microorganisms responsible for post-surgical wound infection was distributed according the duration of the hospital stay of the respondents. The respondents who spent 0-10 days in hospital the number of total bacterial isolates was 51, in case of the respondents spending 11-20 days in hospital it was 69, in case of the respondents who spent 21-30 days 52, in case the respondents who spent 31-40 days 6. In the study of Mengesha and his colleagues the respondents who spent 1 day or less in hospital, the total number of bacterial isolates was 39, more than 1 day in hospital 57, less than 14 days hospital 33 and more than 14 days in hospital 63 (Mengesha*et al*., 2014). In the present study, the p value of the correlation between age and the bacteria that caused post-surgical infection has been found 0.04. Reiye and his colleagues have showed the p value of the correlation between age and the bacteria that caused post-surgical infection and it is 0.014 (Mengesha*et al*., 2014).

The frequency of post-surgical wound infection was distributed according to the comorbidities of the respondents. In case of diabetes, the frequency of wound infection is 8. In case of asthma the frequency of wound infection is 6. In case of respondents suffering from arthritis, the frequency is 3. In case of stroke, the frequency is 2. The frequency is 4 in case of heart block. In case of ulcer, the frequency has been found 3. In case of the respondents suffering from jaundice, the frequency is 2.In the study conducted by Nur-e-elahi, the respondents suffering from diabetes showed the frequency of post-surgical wound infection 38, the respondents suffering from jaundice showed 30, the respondents suffering from malnutrition 44, the respondents suffering from hypertension showed 4 and the respondents suffering from renal failure showed 6 (Nur-e-elahi*et al*., 2011).

The probable reasons of such variations in the results of this study and the results found in other similar studies may be difference in sample size, difference in the proportions of male and female respondents, differences in grouping based on occupation, different pattern of grouping based on the duration of hospital stay, the difference in the prevalence of the microbes, the difference in the time frames of the studies and different attack rates or modes of infection of microorganisms.

Conclusion

Men suffered from post-surgical wound infection more often than women. Patients aged from 51 to 60 years old were more adversely affected than the patients of other age groups. Employees were found to have higher risk for developing SSI than the people from other occupations. Post-surgical wound infection was vigorously observed in the patients who have undergone hand surgery. Intensive occurrence of SSI was found in the patients who stayed in the hospital from 11 to 20 days. This study will help the general people and the hospital

management committee to have a clear understanding about the severity of post-surgical wound infection in Bangladesh as well as the importance of clean and hygienic environment for the prevention of such infection.

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