# Risk factors associated with surgical site infection post-appendectomy

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**ABSTRACT**

**Objective:** To find out the possible risks factors associated with surgical site infection post-appendectomy. SSI is multifactorial and there is the threat of serious surgical site infection in complicated ruptured appendicitis.

**Methods:** Observational cross-sectional study conducted at the general surgical ward of Hayatabad medical complex (HMC). Total 40 patients having appendectomy procedure taken into study. Data collected through Proper Research Questionnaire. Different variables of risk factors like age, gender, comorbidities, surgery duration, type of procedure, postoperative antibiotics, and surgeon experience, collected and analyzed.

**Results:** It was revealed that among 40 patients 11(27.5%) developed surgical site infection (SSI). The overall rate of SSI is 27.5%. The age of 40 patients ranged from 10-69 years and it was highest 60% in the age group of 40-49 years. Among 40 patients, 57.5% are male and 42.5% are female. SSI in males is 26.08% and in females, it was 29.41% slightly higher than males. SSI developed in patients those procedures performed by TMOs is 46.66% and those by assistant professors is 25% and by the professor is 7.69%.

**Conclusions:** It can be concluded from the study that surgical site infection is multifactorial. Patient-related risk factors, surgery-related risk factors, can cause surgical site infection. Host factors like obesity, diabetes, can cause surgical site infection. Duration of surgery, type of surgery, elective and emergency surgery, gangrenous and ruptured appendicitis, and experience of operating surgeon greatly contribute to the occurrence of SSI. Therefore, quality of surgical care including immediate patient assessment, preparation of an aseptic environment can reduce surgical site infection.

**Keywords:** SSI, Surgical site infection, CDC Center for Disease Control and Prevention, BMI Body Mass Index

## INTRODUCTION

Surgical site infection occurs within the part of the body wherever the surgery occurred.(1) SSI typically occurs within 30 days after surgery.(2) CDC brought out definitions for each category (CDC, 2013) Superficial SSIs restricted to the skin and subcutaneous tissue; Deep Incisional SSIs involving the fascia and muscle layers; and Organ or space.(3) Surgical wound infection was modified to Surgical site Infection by the Surgical Wound Infection Task Force in 1992 (4)

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SSI is the most common reported hospital acquired infection.(5) Most common emergency surgical operation within the world is appendectomy. Superficial SSI is the most typical postoperative complication after appendectomy.(6) SSI is common when appendectomy particularly in difficult appendicitis (i.e., gangrenous and ruptured) with incidence of 9 to 53%(7). SSI after appendectomy are health care associated infections affecting the incision site, deep tissues and organs.(8) (9). Mostly appendectomy is done by laparoscopic procedure(10)Surgical site infection is leading causes of morbidity and mortality in each developed and developing countries.(11) SSI increase overall hospital stay length, delay wound healing.(12) SSI is the sixth leading cause of death in USA.(5)(13). The patient having positive SSI having 2-11 times greater risk of death as compared to patient having no SSI(13). (14) Risk factors of SSI may related to patient conditions such as; BMI, Age, and co-morbidities. Type of surgery such as endoscopic or open, elective or emergency, also some risk factor of SSI(1) Type of wound is main factor of SSI and clean contaminated and dirty wound have highest risk of SSI having 6.77% and 14.58% respectively(13). World Health Organization report shows that

66% of developing countries have no published data about surgical site infection.(12)

Research work needed to find out SSI rate and risk factors but unfortunately, there is no such data collection from Pakistan. Therefore, the motive of this study is to find out frequency of SSI and their associated risk factor in-patient admitted to general surgery ward of HMC Peshawar having appendectomy.

## LITERATURE REVIEW

The knowledge about causes of infection documented in 19th century. Koch describe first definition of infective disease. If appropriate number of microorganisms in host is extracted from the host and inoculate in another host will cause infection(15)Smoking increase risk of surgical site infection by reducing inflammatory cytokines and destroy neutrophils activation and decreased inflammatory process that increased risk of infection.(16)

According to WHO preoperative anemia is when hemoglobin level is less than 13.0 g/dl in men and 12.0 g/dl in female is one of risk factor for postoperative SSI.(17) Anemia decrease immune system process and increase risk of infection. (18)Obesity increased risk of SSI. In obesity adipose tissue, vascularization is below par and their effect on oxygenation of tissue and immune response increased chance for SSI.(19)

Diabetes mellitus is one of the risk factor that cause SSI.(20) Pre-operative stress cause hyperglycemia condition in those patients who have no diabetic history and lead to SSI.(21)Operative time is one of the independent variable and modifiable risk factor, which cause SSI. When operative time increases open, wounds are, expose to environment for longer time drying of tissue occur and increase chance of infection. (22)

Infection is common due to use of different suturing material. Suture material like monofilament absorbable suture have subsequent risk of infection.(23) Antibacterial suture material is used to minimize possible risk of SSI.(24)With increasing age patient is prone to postoperative infections. Some investigators revealed that factors indirectly related to age like comorbid condition, acute illness and decreased host response to bacterial invasion is real reason of older patient have increased risk of SSI. However, age is not an independent risk factor for SSI reveals that with increase in age the risk of SSI decreases(25)

## MATERIALS AND METHODS

### Study Design:

Observational cross-sectional study design will be follow. Patient will follow up for one month through telephone interview or during hospital visit.

### Study Approval:

Prior to commencement of this study, Ethical Committee of RMI and HMC Peshawar had approved the Synopsis proposal.

### Study Setting:

Data collected from patients who admitted in General Surgery ward of Hayatabad Medical Complex (HMC) Peshawar who undergoing appendectomy procedure.

### Duration of Study:

Expected duration of our research study will be 3 months.

### Sample Size:

According to Literature review, sample size for our research study will be up to forty

### Sampling Technique:

Convenient Non-Probability Sampling Technique.

### Inclusion Criteria:

i. Those patients who willingly involve in this study
ii. All patient who undergoing appendectomy procedure
iii. Patients >10 year of age.

### Exclusion Criteria:

i. Those patients who refuse to involve in this study.
ii. Those patients who have immune compromised disease.

## RESULTS:

Observational, cross-sectional study design carried out to determine factors aggravated surgical site infection after appendectomy that helpful in reducing rate of SSI. Forty patients have appendectomy procedure selected from

Hayatabad medical complex Peshawar during period of 1 June 2021 to 31 August 2021. Data collected through Proper Research Questionnaire from patients who admitted in General Surgery ward of Hayatabad Medical Complex (HMC) Peshawar who undergoing appendectomy procedure.

**Table 1: Surgical Site Infection (SSI) distribution by different age groups**

| Age Groups | Surgical site infection | | Total |
|---|---|---|---|
| | yes | No | |
| 10-19 | 3 | 10 | 13 |
| 20-29 | 5 | 12 | 17 |
| 30-39 | 0 | 3 | 3 |
| 40-49 | 3 | 2 | 5 |
| 50-59 | 0 | 1 | 1 |
| 60-69 | 0 | 1 | 1 |
| Total | 11 | 29 | 40 |

SSI were found in three participants having age group of 10-19 years, five participants having age group of 20 - 29 years and three participants having age group of 40- 49 years. SSI not found in remaining participants of research study.

**Table 2: distribution of the patients by gender**

| Gender | Surgical site infection | | Total |
|---|---|---|---|
| | yes | No | |
| male | 6 | 17 | 23 |
| female | 5 | 12 | 17 |
| Total | 11 | 29 | 40 |

Regarding sex distribution, it was observed that among 23 male patients 6 (26.08%) developed SSI, whereas among 17 female patients 5(29.41 %) developed SSI. Rate of SSI was slightly higher in females. Sex difference in SSI was not statistically significant (P > 0.05)

**Table 3: Distribution of the patients by nutritional status**

| Nutritional status | Surgical site infection | | Total |
|---|---|---|---|
| | yes | No | |
| obese | 1 | 0 | 1 |
| overweight | 5 | 9 | 14 |
| normal | 5 | 20 | 25 |
| Total | 11 | 29 | 40 |

Regarding nutritional status distribution, It was observed that 1 out 1 obese patient developed SSI and 5(35.71%) overweight patients developed SSI and 5(25%) normal patient developed SSI. Rate of SSI were higher in obese and overweight patients. However, these differences were not statistically significant.

**Table 4: Distribution of the patients by diabetic status**

| Diabetic status | Surgical site infection | | Total |
|---|---|---|---|
| | yes | No | |
| diabetic | 2 | 0 | 2 |
| non diabetic | 9 | 29 | 38 |
| Total | 11 | 29 | 40 |

Regarding diabetic status distribution, It is observed that 2 out of 2 diabetic patient developed SSI and 9 (23.68%) non-diabetic patient developed SSI. Rate of SSI higher in diabetic patient. However, these differences were statistically significant.

**Table 5: Distribution of the patients by Smoking**

| Smoking | Surgical site infection | | Total |
|---|---|---|---|
| | yes | No | |
| yes | 3 | 6 | 9 |
| no | 8 | 23 | 31 |
| Total | 11 | 29 | 40 |

Regarding smoking status distribution, It is observed that 3(33.33%) developed SSI in active smoker patients and 8(25.80%) developed SSI in nonsmoker patients. Rate of SSI higher in active smoking patients. However, these differences were not statistically significant.

**Table 6: SSI Distribution by Mode of surgery**

| Mode of surgery | Surgical site infection | | Total |
|---|---|---|---|
| | yes | No | |
| elective surgery | 0 | 7 | 7 |
| emergency surgery | 11 | 22 | 33 |
| Total | 11 | 29 | 40 |

Regarding mode of surgery, It can be observe that no SSI developed in elective surgery and 11(33.33%) emergency surgery patients developed SSI. Rate of SSI is higher in emergency surgery. However, these differences were not statistically significant.

**Table 7: SSI distribution based on category of surgeons**

| surgery performed by: | Surgical site infection | | Total |
|---|---|---|---|
| | yes | No | |
| professor | 1 | 12 | 13 |
| assistant professor | 3 | 9 | 12 |
| TMO | 7 | 8 | 15 |
| Total | 11 | 29 | 40 |

Surgery performed by TMO is 15(37.5%). Out of which 7 (46.66%) have developed SSI. Surgery performed by assistant professor is 12(30%) SSI developed in 3(25%) patients. In addition, SSI in professor surgery is 1(7.69%). Rate of SSI higher in those whose surgery performed by TMOs.

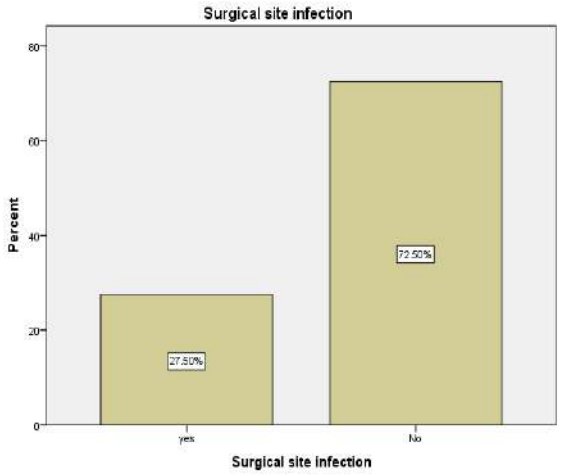


**Fig. 1: Bar diagram showung incidence of SSI.**

SSI developed in 11(27.5%) patients out of 40 patients

**DISCUSSION:**

Observational cross-sectional study conducted among 40 patients having appendectomy in surgical ward of Hayatabad medical complex, from 1 June 2021 to 31 August 2021. The study carried out to determine the factors responsible for surgical site infection (SSI) following appendectomy operation.

Age of 40 patient ranged from 10-69 years. Most of the patient 17(42.5%) were in between 20-29 years. It was observed that rate of SSI in different age group was (23.07%) in the 10-19 years, 5(29.41 %) in the 20 - 29 years, and no SSI found in the 30 - 39 years, 3 (60%) in the 40 - 49 years, no SSI in the 50 - 69 years. It was highest 60% in 40-49 years.

It was revealed that among 40 patients 11(27.5%) developed surgical site infection (SSI). Overall rate of SSI is 27.5%. This finding is consistent with the finding of Pawar OP et al. 2020 where they found 24 patients among 140 (17.14%) suffered from SSI (Pawar OP et al. 2020).

Regarding gender distribution of the patient, among the total 40 cases 23 (57.5%) were male and 17 (42.5 %) were female. Therefore, it can be assume that males are more commonly affected by appendicitis require appendectomy. The rate of SSI in male is 26.08% whereas among female was 29.41%. Rate of SSI slightly higher in female, which is statistically not significant. This finding is consistent with that of (Pawar OP et al. 2020) where they could not find any significant correlation between gender status and SSI. Moreover, rate of SSI in males were 17.98 % whereas in females it was 15.69 % ($P > 0.05$). Therefore, SSI not correlated with sex (Pawar OP et al. 2020).

Regarding nutritional status distribution, 1(2.5%) were obese and 14(35%) were overweight and 25(62.5%) were normal. It was observed that 1 out 1 obese patient developed SSI and 5(35.71%) overweight patients developed SSI and 5(25%) normal patient developed SSI. Rate of SSI were higher in obese and overweight patients.

Regarding diabetic status distribution, 2 (5%) were diabetic and 38 (95%) were non-diabetic. It is observed that 2 out of 2 diabetic patient developed SSI and 9 (23.68%) non-diabetic patient developed SSI. Rate of SSI higher in diabetic patient.

Regarding smoking status distribution, 9(22.5%) were active smokers and 31(77.5%) were nonsmokers. It is observed that 3(33.33%) developed SSI in active smoker patients and 8(25.80%) developed SSI in nonsmoker patients. Rate of SSI higher in active smoking patients.

Regarding type of appendicitis patient's distribution, 39(97.5%) have gangrenous appendicitis and 1 patient have ruptured appendicitis. It was observed that 10(25.64%) have gangrenous appendicitis developed SSI and 1 out of 1 have ruptured appendicitis developed SSI.

Regarding mode of surgery 7(17.5%) have elective surgery and 33(82.5%) have emergency surgery. No SSI developed in elective surgery and 11(33.33%) emergency surgery patients developed SSI. Rate of SSI is higher in emergency surgery.

Surgery performed by TMO is 15(37.5%) 7 (46.66%) have developed SSI. Surgery performed by assistant professor is 12(30%). SSI developed in 3(25%) patients. In addition, surgery performed by professor 13(32.5%) and SSI developed in 1 (7.69%) patients. Rate of SSI higher in those whose surgery performed by TMOs. These findings are inconsistent with the findings of study carried out by Pawar OP in 2020 where rate of SSI in surgery done by junior surgeons like assistant registrars or TMOs was 19.19% whereas, rate of SSI was relatively lower when operated by experienced surgeons such as resident surgeon 2 among 15 (13.33%). No SSI occurred in 6 cases done by professor (Pawar OP et al. 2020).

**CONCLUSIONS:**

This observational cross-sectional study conducted at general surgical ward of Hayatabad medical complex Peshawar, during the period from 1 June 2021 to 31 august 2021. It can concluded from the study that surgical site infection is multifactorial. Patient related risk factors, surgery related risk factors, can cause surgical site infection. Host factors like obesity, diabetes, can cause surgical site infection. Duration of surgery, type of surgery, elective and emergency surgery, gangrenous and ruptured appendicitis, and experience of operating surgeon greatly contribute to occurrence of SSI. Therefore, quality of surgical care including immediate patient's assessment, preparation of aseptic environment can reduce surgical site infection. Modern OT facilities and

CSSD department necessary to provide aseptic environment and best surgical care.

## DECLARATIONS

We hereby declare that this thesis, entitled **"Risk factors associated with surgical site infection post-appendectomy"** is our own research effort carried out by Khayam Akbar, Farman Ullah, Hassnain.

The work in research project report has not previously submitted for examination leading to the award of a degree nor does it contain any material from the published resources.

We also declare that we are aware of the term's 'copyright' and 'plagiarism'. We will be solely responsible for the consequences of violation to these rules (if any) found in the research project report.

### Author's contributions:

The research project has been carry out as team. Every member of the group has equal contribution in this research project.

### Conflict of interest:

There are no relevant financial or non-financial competing interest to report.


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