ORIGINAL ARTICLE

Subcutaneous Fat Thickness and Superficial Surgical Site Infection in Patients Undergoing Open Appendectomy: An Observational Study

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Abstract

Introduction: Surgical site infection is a common complication following appendectomy and contributes to patient morbidity and prolonged hospital stay. Body mass index is often used to identify obesity, but it does not reflect localized fat distribution at the incision site. Subcutaneous fat thickness measured intraoperatively provides a simple method to describe local adiposity. The study was aimed to find out the prevalence of superficial surgical site infection and describe subcutaneous fat thickness among patients undergoing open appendectomy.

Methods: This descriptive cross-sectional study was conducted in the Department of Surgery of a tertiary care hospital from 1st July 2023 to 31st July 2024. Ethical approval was obtained from the Institutional Review Board (Ref: 534/2080/81). A total of 118 patients with uncomplicated appendicitis undergoing open appendectomy were included using convenience sampling. Subcutaneous fat thickness at the incision site was measured intraoperatively with a sterile scale and categorized into <1.5 cm, 1.6–2.5 cm, and >2.5 cm. Data were entered in Microsoft Excel and analyzed using Statistical Package for the Social Sciences version 26. frequency and percentages for categorical variables.

Results: Among 118 patients, 11 (9.30%; CI: 4.76–15.92) developed superficial surgical site infection. Infection was observed in 6 (12%) female patients and 5 (7.40%) male patients. The median age of the study population was 30 years. Subcutaneous fat thickness at the incision site ranged from 0.8 to 4.2 cm. Categorization of thickness showed 33 (28%) patients with <1.5 cm, 42 (35.59%) with 1.6–2.5 cm, and 43 (36.40%) with >2.5 cm. Among patients with thickness >2.5 cm, 7 (16.28%) developed infection, compared to 4 (5.88%) among those with thickness ≤2.5 cm. Most infections occurred in patients aged 21–40 years.

Conclusions: Superficial surgical site infection occurred in approximately one-tenth of patients following open appendectomy. Higher subcutaneous fat thickness at the incision site was observed among patients with infection.

Keywords: *appendectomy; surgical site infection; subcutaneous fat; abdominal surgery; Nepal.*

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Introduction

Surgical site infection is a common postoperative complication that increases patient morbidity, healthcare costs, and duration of hospital stay worldwide.[1-3] The reported incidence of surgical site infection following appendectomy ranges from 7% to 8%, contributing substantially to postoperative discomfort and wound-related complications.[4-7]

Obesity has been identified as an important contributor to surgical site infection and is commonly measured using body mass index.[8-10] However, body mass index does not reflect local fat distribution at the surgical site.[8–10] Subcutaneous fat thickness has been proposed as a localized indicator of adiposity that may influence wound healing.[11,12] Radiological methods such as computed tomography and ultrasonography have been used to measure subcutaneous fat thickness, but these techniques involve radiation exposure or operator dependency.[4,12–14] Direct intraoperative measurement provides a simple and practical alternative.[15]

The objective of this study was to determine the prevalence of superficial surgical site infection among patients undergoing open appendectomy and to describe subcutaneous fat thickness in this population.

Methods

A descriptive observational study was conducted at the Department of General Surgery, Bir Hospital, Kathmandu, Nepal after ethical clearance from the Institutional Review Board of the National Academy of Medical Sciences. (Reference number: 534/2080/81). The study was conducted from July 2023 to July 2024. Written informed consent was obtained from all participants prior to enrollment. Patients with a clinical or radiological diagnosis of uncomplicated appendicitis undergoing open appendectomy with incision at McBurney's point between the ages of 18 and 80 years were included. Patients with complicated appendicitis, known diabetes, steroid use, immune-compromised status with other known abdominal pathologies like abdominal tuberculosis, Crohn's disease, ulcerative colitis, sub-acute intestinal obstruction, and abdominal malignancy were excluded.

Sample size was calculated using the formula,

$n = (Z^2 \times p \times q) / e^2$

$n = 1.96^2 \times 0.0750 (1 - 0.0750) / (0.05)^2$

$=106.60$

$=107$

Where,

n = sample size

p = 0.0750 (Prevalence of SSI in appendectomy is 7-8 %[5–7,16,17], mean value of 7.5% taken)

e = margin of error of 5%

z = 1.96 at 95% confidence interval

Therefore, the minimum sample size was 107. A total of 118 cases were included adding 10% attrition rate. Convenience sampling was used.

Superficial surgical site infection was defined according to the Centers for Disease Control and Prevention guidelines, which include infection occurring within 30 days postoperatively involving skin and subcutaneous tissue with signs such as purulent discharge, localized pain, swelling, redness, or positive culture.[1]

Data were collected prospectively using a structured proforma. All patients received preoperative antibiotic prophylaxis with ceftriaxone 1 gram intravenously approximately 30 minutes before skin incision. Skin preparation was done using 10% povidone-iodine solution followed by sterile draping.

Subcutaneous fat thickness was measured intraoperatively at the incision site from the dermis to the external oblique aponeurosis using a sterile surgical measuring scale immediately after incision at McBurney's point and recorded in millimeters. Subcutaneous fat thickness measurements were categorized into three groups: less than 1.5 cm, 1.6–2.5 cm, and greater than 2.5 cm.[18]

The abdominal wall was closed using polyglactin 910 suture (Ethicon Inc., Somerville, New Jersey, USA), and skin closure was performed using skin staplers. No abdominal drain was placed. Postoperatively, a single dose of ceftriaxone 1 gram was administered, and patients were discharged on oral cefixime 200 milligrams twice daily for five days. Wound dressing was performed on alternate days using 10% povidone-iodine solution. Staplers were removed on the seventh postoperative day.

Patients were followed up on the second, seventh, and thirtieth postoperative days for signs of superficial surgical site infection. If infection was suspected, wound swab culture was obtained, and management included dressing, antibiotics according to culture sensitivity, and secondary suturing when required.

Data were entered into Microsoft Excel 2016 and analyzed using Statistical Package for the Social Sciences version 26. Descriptive statistical methods were used to summarize the data. Categorical variables were presented as frequency and percentage, while continuous variables were

expressed as mean ± standard deviation or median based on data distribution. Data analysis was performed using Statistical Package for the Social Sciences version 26.

Results

A total of 118 patients satisfying the inclusion criteria were included in the final analysis. Among them, 68 (58%) were male and 50 (42%) were female. Superficial surgical site infection developed in 11 (9.30%) patients following open appendectomy (Table 1).

Table 1: Gender distribution of appendicitis with SSI

	No Superficial SSI n(%)	Superficial SSI n(%)	Total n(%)
Female	44 (88)	6 (12)	50 (100)
Male	63 (92.60)	5 (7.40)	68 (100)
Total	107 (90.70)	11 (9.30)	118 (100)

The age of patients ranged from 18 to 74 years with a median age of 30 years. Distribution of patients across age groups and occurrence of superficial surgical site infection is shown in Table 2.

Table 2: Age distribution in years in each age group with SSI incidence

Age distribution (Years)	n(%)	SSI (n) in each age group
18-20	24 (20.34)	1
21-30	37 (31.36)	3
31-40	27 (22.88)	2
41-50	16 (13.56)	1
51-60	8 (6.78)	2
61-70	4 (3.39)	1
71-80	2 (1.69)	1
Total	118 (100)	11

The subcutaneous fat thickness was categorized based on three thickness groups as similar to Mahaseth et al, i) below 1.5 cm ii) 1.6 cm-2.5 cm and iii) above 2.5 cm.[18] The incidence of SSI was higher in patients whose subcutaneous fat thickness was above 2.5 cm with 7 (63.64%) of total SSI observed in this group (Table 3).

Table 3: Subcutaneous fat thickness and SSI in each group

Subcutaneous fat thickness (cm)	Frequency	SSI n(%)
<1.5	33 (28)	1 (3)
1.6-2.5	42 (35.60)	3 (7.10)
>2.5	43 (36.40)	7 (16.30)
Total	118 (100)	11(9.30)

Discussion

Acute abdomen accounts for 7%-10% of hospital admissions, among which acute appendicitis is the most common cause of lower abdominal pain needing surgery.19 Most of the patients of this study of uncomplicated appendicitis were below 40 years, which was similar to data where the incidence of appendicitis was higher in the age group between 5-45 years.[20]

Most studies use radiological tools such as ultrasonography (USG) or CT scans due to their high sensitivity, subcutaneous fat thickness can also be measured manually using a simple sterile scale. This manual method, as demonstrated by Teppa et al. and in the present study, is cost-effective in resource-limited settings, avoids exposing patients to harmful radiation (unlike CT scans), and eliminates operator dependency like in USG, which often requires a radiologist and specialized equipment.[15]

Of the 118 cases, superficial SSI occurred in 11(9.70 %) patients following open appendectomy, comparable with the data from a meta-analysis.[16] This study from the year 2020 analyzed the global incidence of superficial SSI following appendectomy.[16] Eleven per 100 open appendectomies developed superficial SSI, which was higher than the incidence following laparoscopic appendectomy with 4.60%.[16]

In this study, patients with a skin thickness > 2.5 cm had a higher incidence of SSI (63.64%) compared to those with a thickness <2.5 cm (36.36%), indicating that the risk of SSI increases with subcutaneous fat thickness. In most studies, more than 2 cm thickness below the umbilicus is a risk factor for SSI, which further supports study the finding.[13–15,22] In other studies conducted on other surgeries, related to abdominal surgery, the subcutaneous thickness is taken into consideration for the incidence of superficial SSI. Patients with increased subcutaneous thickness have a higher incidence of superficial SSI than those with decreased subcutaneous thickness.[4,12,15,23]

There are also studies in which BMI is taken as a predictor for SSI, and high BMI was found to increase

the risk of SSI; however, it also has its limitations because it does not quantify fat distribution in the body correctly.[8,9,24–27] In studies wherein BMI and subcutaneous fat thickness are compared as predictors of SSI, it was found that subcutaneous fat thickness was found to be better predictor of SSI than BMI, although in our study, BMI was not used as a predictor.[13,14,18,28] BMI fails to differentiate between lean body mass and body fat mass.[29] Individuals like athletes with higher muscle mass could be classified as overweight or obese, even though they have excellent health. On the other hand, people with normal BMI may have increased subcutaneous fat thickness at the abdomen with increased risk factors for metabolic syndrome, showing the fallacy of BMI.[29] As fat distribution in the body is not symmetric, and subcutaneous fat thickness at the site of incision could give a better idea about the distribution of fat at the site of incision in comparison to BMI, which sometimes is not accurate.[24,27] Adiposity at the site of incision can be a better predictor for SSI rather than BMI as a surrogate for overall fat distribution.[24,29] Surgical sites with high adiposity have poor vascularity, leading to a decrease in the supply of nutrient, which impairs wound healing, and an increase in dead space due to increased subcutaneous thickness, leading to the accumulation of fluid, providing media for bacterial growth, and poor penetration of prophylactic antibiotics at the incision site may be a reason for SSI.[30] This highlights subcutaneous fat thickness as a better predictor of SSI compared to BMI.

The study has some limitations. While subcutaneous fat thickness was assessed, body mass index was neither calculated nor utilized as a predictor of surgical site infection. Inclusion of both parameters could have allowed better comparison between localized adiposity and overall obesity, thereby strengthening validation of the findings. Second, only patients undergoing emergency open appendectomy for uncomplicated appendicitis were included, excluding laparoscopic procedures and complicated cases such as perforated or gangrenous appendicitis, where the risk of surgical site infection may differ. The study was conducted at a single center with a limited sample size, which may restrict generalizability of the results to broader populations. A multicenter study with a larger cohort would have provided more comprehensive and representative data. Additionally, the intraoperative manual measurement of subcutaneous fat thickness may be subject to observer variability despite standardization efforts. Longer follow-up periods could also help capture late-onset surgical site infections. Future studies incorporating multiple centers, larger samples, body mass index comparison, and extended follow-up are recommended to further substantiate these findings.

Conclusions

Superficial surgical site infection occurred in a proportion of patients undergoing open appendectomy. Higher subcutaneous fat thickness was associated with the presence of infection. Intraoperative measurement is simple, practical, and may help guide preventive surgical measures. This approach allows early identification of high-risk patients without the need for specialized equipment. Considering subcutaneous fat assessment into routine surgical practice may contribute to reducing postoperative infectious complications.

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