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Original Research Article

# Application of double – far – near – near -far suturing for the closure of linea alba in midline laparotomy wounds for the patients of acute abdomen with perforation peritonitis admitted to Dr. Susheela Tiwari hospital, Haldwani: A Prospective Observational study.

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**Conflict of interest: Nil**

**Abstract:**

**Objectives:** The present study was undertaken to evaluate the outcomes using the technique of double-far-near-near-far sutures for the closure of linea alba in midline laparotomy wounds for the patients of perforation peritonitis.

**Methods:** A total of 50 patients of generalized peritonitis were enrolled in this study. After the completion of surgery, linea alba was closed using interrupted loop nylon no.1 sutures by the technique of double, far-near-near-far suturing which comprised of taking a far bite starting at 1 cm from the edge of linea alba from outside to inside and then taking a near bite of 0.5 cm on the other side from inside to outside, a near bite on the previous side from outside to inside and finally a far bite on the other side from inside to outside. The suture was then converted to a horizontal mattress by taking a far bite 1 cm above or below the previous bite and repeating the suturing in the similar fashion. The two ends of the suture were tied to approximate the edges of linea alba.

**Results:** Majorities of patients 21(42%) were in age group of 21-40 years. Patients were grouped as those presenting within 48 hours and those after 48 hours of onset of symptoms. Rate of surgical site infections(SSI) and duration of symptoms was greatly reduced but it was not statistically significant (p=0.178). The relation of SSI and site of perforation was also not statistically significant. The relation between low albumin and SSI was also statistically not significant (p=0.424). The association between active tuberculosis and SSI was not statistically significant (p=0.169). The rate of SSI and malignancy was also not statistically significant (p=0.395). The relation between serum creatinine values and SSI was not statistically significant (p=1). The relation of INR and SSI was not statistically significant (p=1). The relation of smoking and SSI was also not statistically significant (p=0.533). But, the rate of SSI was greatly reduced according to lower age, sex, duration of symptoms, site of perforation, lower albumin levels and lower creatinine levels. The surgical site infection (SSI) was seen in only 22% patients. There was no wound dehiscence encountered in any of the enrolled patients of the study.

**Conclusions:** The present study concluded that the double – far – near – near-far method of suturing for the closure of linea alba in midline laparotomy wounds for acute perforation peritonitis is a good method of suturing with comparatively lesser rates of surgical site infections and no wound dehiscence.

**Keywords:** Linea alba, Laparotomy wounds, double – Far – Near – far Suturing, SSI.



## Introduction

Abdominal wound dehiscence is defined as the postoperative separation of all the layers of a laparotomy wound, with or without evisceration. Despite major advances in the preoperative care of surgical patients, including the introduction of broad spectrum antibiotics and an improved understanding of the effects of systemic illness on wound healing, the incidence of abdominal wound dehiscence has remained constant at 0.4 to 3.0% [1, 2].In dirty wounds, figures ranging from 2.45% to as high as 36% have been recorded [3]. In a previous study done in LNJP Hospital, Delhi, India, the incidence of surgical site infection (SSI) was found to be 31.25% and the incidence of wound dehiscence was 13.75% [3].The causes of acute wound failure are a break of suture, a slipped knot or the suture tearing

through the fascia. The cut through of the suture is accepted as the most common cause of wound dehiscence [4]. In an experimental study Poole et al[5] ruptured 1 week-old midline incisions in 116 rats by insufflating the abdomen and found that the suture tore through the fascia in 106 wounds. No wound burst secondary to a slipped knot or a broken stitch [5]. With an endeavour to prevent the cut-through, Srivastava et al from the All India Institute of Medical Sciences used an 'X-suture' and found a very low wound dehiscence rate in dirty abdominal wounds [6]. Professor Hughes from Cardiff [7] applied a double, far-near-near-far horizontal mattress suture. His principle was that the horizontal mattress component runs at right angles to the aponeurotic fibres which would prevent the cut through. In the present study, we have used professor Hughes' technique. The objective of our study was to evaluate the outcomes using the technique of double-far-near-near-far sutures for the closure of linea alba in midline laparotomy wounds for the patients of perforation peritonitis.

## Material & Methods

A total of 50 patients of acute abdomen with perforation peritonitis, who underwent exploratory laparotomy in the emergency department of Dr. Susheela Tiwari Hospital, Haldwani were enrolled in this study.

**Study Design:** Prospective Observational study.

**Period of study**: February 2023 to May 2023.

**Inclusion criteria:** All patients of perforation peritonitis undergoing Emergency laparotomy.

**Exclusion criteria:**

- Patients refusing consent for inclusion in the study.
- Patients who develop leak or underwent a re-laparotomy.
- Pregnant ladies.
- Patients on steroid therapy or cytotoxic drugs.

**Procedure:** Fifty consecutive patients of generalized peritonitis admitted to the department of surgery of Dr. Susheela Tiwari hospital, Haldwani and operated upon were taken up for this study. Blood was taken for analysis of haemoglobin, blood sugar, serum albumin, serum creatinine and prothrombin time. Piperacillin-Tazobactum in the dose of 20 mg/Kg along with intravenous Metronidazole 500mg were given empirically after taking the blood samples for all the investigations. The patients were then optimized for surgery. Intravenous fluids were started. Ryle's tube and foley's catheter were put and one-hourly urine output was monitored. In patients who presented with severe sepsis a bolus intravenous fluid challenge was given. Patients with septic shock had a central line inserted to measure the central venous pressures and when needed inotropes were added. Oxygen by mask was given, blood gas analysis done and when needed, ventilatory support was given.

In all patients the abdomen was opened by a midline incision. The incision was extended depending on the findings at surgery. The amount of contamination found on opening the abdomen was quantified from the amount of fluid sucked in the suction bottle. The intra-abdominal fluid was taken for culture and sensitivity. The details of findings at surgery and the procedures performed were noted.

After the completion of surgery, linea-alba was closed using loop nylon no.1 suture by the technique of double, far-near-near-far suturing which comprised of a far bite starting at 1 cm from the edge of linea alba from outside in and then taking a near bite of 0.5 cm on the other side from inside out, a near bite on the previous side from outside in and then a far bite on the other side from inside out. The suture was then converted to a horizontal mattress by taking a far bite 1 cm above or below the previous bite and repeating the suturing in a similar manner. The two ends of the suture were tied to approximate the edges of linea alba.

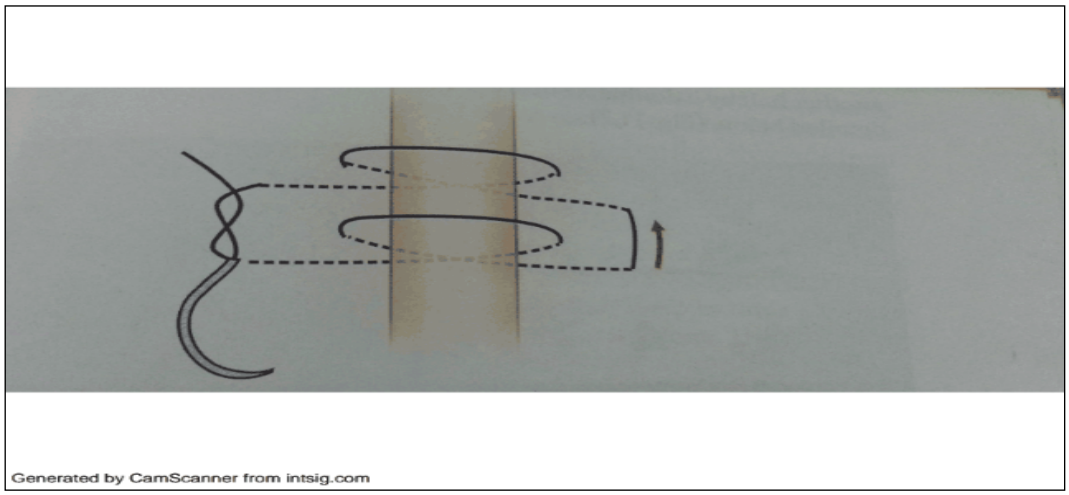


**Figure 1: double-far-near-near-far suturing technique**

In case the bowel edema did not allow abdominal wound closure, a decision to leave a laparostomy was taken by the surgeon and the case was excluded from the analysis. A 16 F romovac suction drain was left in the subcutaneous space above the closed linea alba and brought out through a separate small stab wound and sealed separately from the skin dressing. The skin was closed by interrupted nylon 2-0 sutures.

Intravenous Piperacillin-tazobactam and Metronidazole was continued postoperatively till the results of culture sensitivity were available. A de-escalation of antibiotics to simpler antibiotics was planned depending on the sensitivity report of the culture. Records were kept for the duration of intravenous fluid usage, removal of nasogastric tube and starting of oral feeds. A record of the vitals was kept including the need for inotropic support and ventilatory support. A 6 hourly record of the temperature was done.

The wound was inspected for development of surgical site infection(SSI) on daily basis. The subcutaneous suction drain, which was brought out through a separate stab wound and held in place by a suture, was rolled a bit every day to dislodge debris and effectively drain out any collections. It was removed on day 5. In case of discharge of pus suggesting SSI one or more of the skin sutures were to be removed to let out the pus and the pus was sent for culture and sensitivity.

A note was made in case there was copious discharge from the wound suggesting dehiscence. Patients developing a leak of bowel contents were recorded. The need for re-laparotomy was decided by the condition of the patient. Any patient developing a leak, whether re-operated or not was removed from the analysis (exclusion criterion). All other morbidities including chest infections, urinary tract infections and organ failures were recorded. The time of discharge was noted. Mortality was recorded. All the patients were followed up in the follow-up-clinic at the designated time and place on day 7 after the discharge and day 30 after the surgery. In case SSI or wound dehiscence developed, the patients were kept in the ward and dressed on a daily basis till the discharge from the wounds was minimal and the wound showed healthy granulations.

**Outcomes were recorded as:**

1. Healing of the wounds by primary intention.
2. Surgical site infection (SSI), any time till day 30 after surgery. The definition used was discharge of pus with or without organisms being cultured.
3. Wound dehiscence any time till day 30 after surgery. The definition used was separation of all the layers of the abdomen with evisceration.
4. Morbidities- Chest infection, urinary tract infection, organ dysfunction.
5. Mortality.

**Statistical Analysis**

Data was analysed with the help of SPSS software. Fisher's exact test was used. p-value was taken less than or equal to 0.05 ($p \leq 0.05$) for significant differences.

**Observations**

In the present study, out of 50 patients, majorities of patients 21(42%) were in age group of 21-40 years. When Fisher's exact test was applied for data analysis, all the three-age group patients (0-20, 21-40 and >40 years with SSI were not statistically significant ($p > 0.05$).

**Table 1: showing the relation of SSI with Age**

| Age( in years) | SSI | | Total | |
|---|---|---|---|---|
| | Absent (%) | Present (%) | | |
| 0-20 | 6 (66.67%) | 3 (333.33%) | 9(18%) | (Fisher's exact test) Association between Age and SSI is not statistically significant As p-value >0.05 |
| 21-40 | 17 (80.95%) | 4 (20.05%) | 21(42%) | |
| >40 | 16 (80%) | 4 (20%) | 20(40%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

A statistical correlation with sex of the patients and SSI was done. No statistically significant difference was found on using the Fisher's exact test (p= 0.688).

**Table 2: Showing the relation of SSI and sex**

| Sex | SSI | | Total | p-value=0.688 (Fisher's exact test) Association between Sex and SSI is not statistically significantAs p-value >0.05 |
|---|---|---|---|---|
| | Absent (%) | Present (%) | | |
| Male | 31(79.48%) | 8(20.51)% | 39(78%) | |
| Female | 8(63.63%) | 3(30%) | 11(22%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

In the present study, patients were grouped as those presenting within 48 hours and those after 48 hours of onset of symptoms. SSI and duration of symptoms was not statistically significant on performing a Fisher's exact test.

**Table 3: Showing the relation of SSI with duration of symptoms**

| -Duration of symptoms | SSI | | Total | p-value=0.178 (Fisher's exact test) Association between duration of symptoms and SSI is not statistically significant as p-value >0.05 |
|---|---|---|---|---|
| | Absent (%) | Present (%) | | |
| < 48 hours | 24(85.72%) | 4(14.28%) | 28(56%) | |
| >48 hours | 15(68.18%) | 7(31.81%) | 22(44%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

The relation of SSI and site of perforation was not statistically significant, p-value=0.114. (>0.05).
The relation between low albumin and SSI was not statistically significant on subjecting to Fisher's exact test.

**Table 4: Showing the relation of SSI and comorbidities.**

| Albumin <3.5 gm/dL | SSI | | Total | p-value=0.424 (Fisher's exact test)Association between Albumin <3.5 gm/dL and SSI is not statistically significant as p-value >0.05 |
|---|---|---|---|---|
| | Absent (%) | Present (%) | | |
| Absent | 31(81.58%) | 7(18.42%) | 38(76%) | |
| Present | 8(75%) | 4(25%) | 12(24%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

The association between active tuberculosis and SSI on using the Fisher's exact test was not found to be statistically significant (p=0.169).

**Table 5: Showing the relation of SSI and tuberculosis.**

| Active Tuberculosis | SSI | | Total | p-value=0.169 (Fisher's exact test) Association between Active Tuberculosis and SSI is not statistically significant as p-value >0.05 |
|---|---|---|---|---|
| | Absent(%) | Present (%) | | |
| Absent | 35(81.39%) | 8(18.60%) | 43(86%) | |
| Present | 4(57.14%) | 3(42.85%) | 7(14%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

The rate of SSI and malignancy was also not statistically significant (p=0.395).

**Table 6: Showing the relation of malignancy and SSI.**

| Malignancy | SSI | | Total | p-value=0.395 (Fisher's exact test) Association between Malignancy and SSI is not statistically significant as p-value> 0.05 |
|---|---|---|---|---|
| | Absent (%) | Present (%) | | |
| Absent | 38(79.16%) | 10(20.83%) | 48(96%) | |
| Present | 1(50%) | 1(50%) | 2(4%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

The relation between serum creatinine values and SSI was statistically not significant on subjecting to Fisher's exact test.

**Table 7: Showing the relation of serum creatinine and SSI.**

| Serum Creatinine >1 gm/dL | SSI | | Total | p-value=1.000 (Fisher's exact test)Association between Serum Creatinine >1 gm/dL and SSI is not statistically significant as p-value >0.05 |
|---|---|---|---|---|
| | Absent (%) | Present (%) | | |
| Absent | 36(76.59%) | 11(23.40%) | 47(94%) | |
| Present | 3(100%) | 0 (0) | 3(6%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

The relation of INR and SSI was not statistically significant (p=1).

**Table 8: Showing the relation of INR and SSI**

| INR >1.5 | SSI | | Total | p-value=1 (Fisher's exact test)Association between INR >1.5 and SSI is not statistically significant as p-value >0.05 |
|---|---|---|---|---|
| | Absent (%) | Present (%) | | |
| Absent | 36(78.26%) | 10(21.73%) | 46(92%) | |
| Present | 3(75%) | 1(25%) | 4(8%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

The relation of smoking and SSI was also not statistically significant (p=0.533).

**Table 9: Showing the relation of SSI and smoking.**

| Smoking >20 pack years | SSI | | Total | p-value=0.533 (Fisher's exact test) Association between Smoking >20 pack years and SSI is not statistically significant as p-value >0.05 |
|---|---|---|---|---|
| | Absent (%) | Present (%) | | |
| Absent | 37(78.72%) | 10(21.28%) | 47(94%) | |
| Present | 2(66.67%) | 1(33.33%) | 3(6%) | |
| Total | 39(78%) | 11(22%) | 50(100%) | |

## Discussion

A total of 50 patients of perforation peritonitis were enrolled in the present study.

### Demographic characteristics of patients

### Age

The mean age of the patients who presented with peritonitis was found to be 36.9 years in this study. This is in accordance with other studies where the mean age of presentation of patients of perforation peritonitis in India was found to be around 40 years of age. It was 36.8 years in study by Jhobta et al in the department of surgery, Government Medical College and Hospital (GMCH), Chandigarh, who reported on a series of 504 consecutive cases of perforation peritonitis [8]. Another study conducted by Bali et al in which the study population included 400 patients of perforation peritonitis (diffuse or localized) presenting to the surgical emergency of Lok Nayak Hospital, Delhi from May 2010 to June 2013, the mean age was found to be 37.8 years [3].

### Sex

39(67.8%) of the patients in our study were males. This observation is also similar to other studies. There were 84% males in study by Jhobta et al [8], 68.5% males in the study by Bali et al [3], 83.1% males in the study done by Yadav et al [9] and 68.3% in the study which was conducted by Afridi et al [10].

### Co-morbidities

About one-fourth of the patients were found to have a low albumin and about 14% were on treatment for active tuberculosis. Patients presenting with perforation peritonitis often had other co-morbidities too [3,8,9,10].

### Site of perforation and surgery performed.

Peptic ulcer perforation was found in half of our patients followed by Ileal perforations in 32.7 % of the patients. Perforation of the proximal part of the gastrointestinal tract (GIT) is more common in the Indian subcontinent, [3,8,9,10] which is in contrast to the studies from western countries where perforations are common in the distal parts of the GIT(106-108).

In a study conducted by Doklestic et al in Serbia from January 2009 to Jan 2010, a frequency of 29.41% peptic ulcer perforations, 12.26% ileal perforations, 20.59 of colonic perforations and 22.06 of appendicular perforations were noted [11].

### Wound dehiscence and techniques of wound closure-

The rate of wound dehiscence has been noted in various studies in dirty abdominal wounds around the world and it ranges from 2.45% to as high as 36% observed in a previous study [12].

### Western studies

Usang et al conducted a retrospective study of 32 patients with dirty abdominal wounds who had surgery for typhoid perforations in a teaching hospital in south western Nigeria, Africa over a period of ten years between May 1994 to April 2004. Laparotomy was done with a sub-umbilical transverse incision and after repair, the anterior rectus sheath was approximated using a simple continuous suture technique. Of the 32 patients, 5 patients (15%) had developed wound dehiscence [13].

Penninckx et al of the department of Surgical and Anesthesiological Sciences, Academic Hospital, Sint-Rafael, University of Leuven, Leuven, Belgium in 1979 conducted a study on 4538 patients comprising emergency and elective procedures. Wound dehiscence occurred in 65 of the 973 emergency patients (6.7%) after emergency laparotomy which was significantly higher than the 1.5% frequency of wound dehiscence after elective surgeries. Overall 117 patients (2.58%) developed wound dehiscence [14].

### Indian subcontinent studies

In a study of non-traumatic duodenal ulcer perforations done earlier, Saran et al reported an incidence of wound dehiscence of 36% of the patients. They used continuous nylon sutures for closure of the midline wounds [12].

In the study conducted by Afridi et al from Karachi, Pakistan which included three hundred consecutive patients of perforation peritonitis, the abdomen was closed with number 1 polypropylene.

In the study conducted by Bali et al, the study population included 400 patients of perforation peritonitis (diffuse or localized) presenting to the surgical emergency of Lok Nayak Hospital from May 2010 to June 2013, Delhi, who underwent exploratory laparotomy, 13.7% patients developed wound dehiscence [3]. Singh et al, in a study conducted in Department of Surgery, GMC, and Patiala in 1980-81 where 60 patients with dirty abdominal wounds were taken and abdominal cavity opened with a paramedian rectus displacing incision. Before closure, they divided the patients into 2 groups. In one group rectus sheath closure was done with an interrupted cotton and in the second group, rectus sheath closure was done by an interrupted nylon suture. A frequency of 3 patients (5%) of abdominal wound dehiscence was observed [15].

### Wound dehiscence in this study

We found no wound dehiscence in all the 50 patients that were analysed. We have used a technique of double far-near-near-far sutures where a vertical limb was added to prevent the cut-through of sutures.

This technique uses the same principle of adding a vertical limb to the abdominal closure, preventing a cut-through as has been reported by Srivastava et al from the All India Institute of Medical Sciences where they used an 'X-suture' and found a very low wound dehiscence rate in dirty abdominal wounds [6].

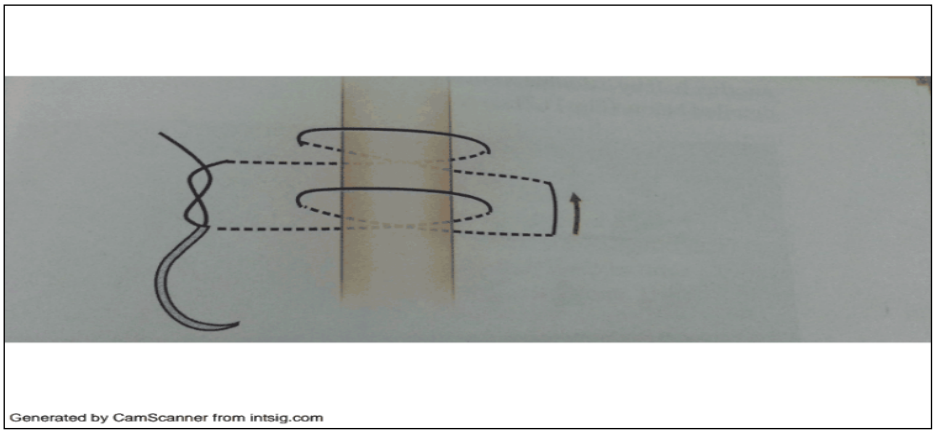


**Figure 2:**

**Surgical site infection (SSI)**

Rate of SSI in this study was found to be 22% whereas it was 84% in a study conducted in the other institutions previously [12].

**Incidence of SSI in dirty abdominal wounds**

In the study conducted by Cohn et al in Florida, USA, in 1999, 51 patients with dirty abdominal wounds related to perforated appendicitis and other perforated viscera were enrolled [16]. Forty percent of the patients developed SSI. Duttaroy et al conducted a study in 2009 where a total of 81 consecutive patients with dirty abdominal incisions were enrolled. The incidence of SSI was 23%[17].

In the study conducted by Afridi et al which included three hundred consecutive patients of perforation peritonitis in Karachi, Pakistan, 42% patients developed SSI [10]. In the study conducted by Bali et al which included 400 patients of perforation peritonitis (diffuse or localized) presenting to the surgical emergency of Lok Nayak Hospital, Delhi, who underwent exploratory laparotomy [3], 31.25% of the patients developed SSI. In the study conducted by Yadav et al in Hindu Rao Hospital, New Delhi, India, SSI developed in 19.5% of the patients [9]. Doklestic et al conducted a retrospective study over one year period with 204 patients of generalized secondary peritonitis who had undergone laparotomy at the Clinic for Emergency Surgery between January 2009 and January 2010 [11].The incidence of SSI was 25.49%. Owens et al conducted a study on dirty abdominal wounds in 2008 in USA and observed a SSI rate of 20% in dirty abdominal wounds [18]. Nguyen et al, in a study conducted in Vietnam in 2001 observed a SSI frequency of 43.9% [19]. A SSI rate of 60% was seen by Usang et al in a study conducted in 2009 in Nigeria[13].

**SSI in the present study**

In the 50 patients in this study, SSI was seen in 22% of the patients. All the patients had dirty abdominal wounds. The lower rate of SSI observed could be attributed to two factors. We have used Piperacillin-Tazobactam and Metronidazole empirically in all the patients. The antibiotics were given intravenously within an hour of the admission after the collection of blood samples to all the patients.

The cultures taken at the time of surgery showed that the organisms cultured were mostly sensitive to Piperacillin-Tazobactam which we had used as the empirical antibiotic. The second reason could be the universal use of subcutaneous suction drains in all the patients which could have contributed as a factor leading to reduced surgical site infection rates.

**Age and SSI**

The incidence of SSI, in our study, showed an increasing trend as the age progressed. The age group of 0-20 years had three patients with SSI but all three of them were known cases of active tuberculosis and were on anti-tubercular treatment (ATT). However, the relationship of SSI with age was not found to be statistically significant. Some of other studies done on dirty abdominal wounds also found no correlation of increasing age with SSI [20,21].

**Sex and SSI**

The SSI rate was higher in the male patients in this study (16%) in comparison to that of females(6%). In a similar study by Watanabe et al, the percentage

of female patients with SSI was 39.4% and that of males was 26.7% respectively but the difference was not statistically significant either(p-value=0.23) [20].

**SSI and Co-morbidities**

The rate of SSI in this study was found to be 22% in patients who had one or more of the comorbidities and was only 20% in patients who had none of the co-morbidities however the difference was not statistically significant.

Lower albumin levels have been found to be a factor predisposing to SSI in previous studies [21]. They also found a significantly higher number of SSI in patients with lower haemoglobin levels. Smokers also have been found to have a higher frequency of SSI [22]. Alcoholism was associated with increased risk of SSI in one study [21]. Watanabe et al [20] found a greater incidence of SSI in patients with increased serum creatinine levels.

**Summary**

Fifty consecutive patients of generalized perforation peritonitis coming to the department of Surgery, Dr. Susheela Tiwari hospital, Haldwani, were admitted and operated upon. The male to female ratio of patients was 3.5:1. Nearly half of the patients presented within 48 hours of onset of symptoms. Four patients presented with features of septic shock of which two were revived and operated upon while the other two died during resuscitation. Nearly half of the patients had co-morbidities. Fourteen patients had serum albumin levels of less than 3.5 g/dL while seven patients had active tuberculosis. All the patients were operated. Twenty patients had gross intra-abdominal contamination (>1000 mL fluid). Peptic ulcer perforation (prepyloric and duodenal) was found in half of our patients and ileal perforation in nearly one-third.

The intra-abdominal pus/fluid culture was positive in 10 patients. E. coli was isolated in 8 of them. The incidence of SSI was 22%. No statistically significant co-relation of SSI could be found out with age, sex and duration of symptoms, site of perforation and the presence of other co-morbidities. We found no wound dehiscence in any of the patients.

**Conclusions**

The present study concluded that the double – far – near – near-far suturing method for the closure of linea alba in midline laparotomy wounds for acute perforation peritonitis is a good method of suturing with comparatively lesser rates of surgical site infections and no wound dehiscence.

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