



THE ROLE OF SUBCUTANEOUS NEGATIVE SUCTION DRAINS IN EXPLORATORY LAPAROTOMY FOR PERITONITIS

General Surgery

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ABSTRACT

Surgical site infection (SSI) is a major problem and one of the most common complications associated with open abdominal surgery. SSI attributes to increased morbidity, mortality, healthcare costs and overall patient discomfort. The most common form of postoperative complication in emergency abdominal surgical procedure is a superficial wound infection, which occurs in the first week of surgery. The role of a subcutaneous negative pressure drain is to reduce the dead space in the subcutaneous tissue plane and there by prevent accumulation of fluid and seroma formation. In this study we observed the role of a subcutaneous negative pressure for preventing SSI following exploratory laparotomy surgeries for peritonitis.

Methods: A total of 56 patients who underwent exploratory abdominal surgical procedure, in the period between April to September 2019, were observed. The patients are divided into two groups – those treated with subcutaneous drain and those for whom subcutaneous drain was not used. The choice of using a subcutaneous drain is taken by the operating surgeon on call. Antibiotic prophylaxis was applied to each patient and the diagnosis of superficial SSI was made and was graded according to Southampton Grading System.

Results: 3 patients in drain group (27) and 14 patients in no drain group (29) had incisional SSI with statistical difference ($p < 0.05$). The average post operative duration of hospital stay with drain is 5-15 days and amongst those who were managed without drain the average hospital stay is 7-20 days. No statistical difference between the two groups was observed for age and gender of patients ($p > 0.05$).

Conclusions: Subcutaneous negative pressure drain prevents postoperative surgical site infection significantly. Subcutaneous negative pressure drainage reduces hospital stay and thereby healthcare cost in a patient undergoing exploratory laparotomy surgery.

KEYWORDS

Abdominal surgery, subcutaneous negative pressure drain, surgical site infection

INTRODUCTION

The surgical wound complications are, an important causes of early and late postoperative morbidity following laparotomy. In normal, healthy individuals, the surgical wound heals by an orderly sequence of physiologic events that include inflammation, epithelialization, fibroplasia, and maturation. Any failure of wound healing at the surgical site can lead to disruption of the closure leading to seroma, hematoma, wound dehiscence, or surgical site infection. Surgical site infection (SSI) is one of the most common complications of surgery, occurring in at least 5% of all surgeries and up to 30-40% in major abdominal surgeries, depending on the level of contamination. The prevalence of surgical site infections is partially due to the emergence of antibiotic – resistant strains of microorganisms and also due to the nutrition, immune status and associated co-morbidities of the patients.

Exploratory laparotomy surgeries for peritonitis are indicated in cases of Abdominal trauma, ruptured appendix, ischemic colitis, ischemic small bowel injuries colonic diverticula, perforated duodenal ulcer, acute necrotizing pancreatitis, small/large bowel perforation, necrotizing cholecystitis, Splenic or hepatic abscess and other iatrogenic causes as well. The level of contamination of the surgery, method of skin preparation and surgical techniques used by the operating surgeons all contribute to the overall outcome of surgery and whether the patient develops SSI or not. The incidence of surgical site infection was found to almost 30-40% in major abdominal emergency surgeries worldwide. However, the incidence of surgical site infection appears to be slightly lower in developed countries.

Surgical site infection attributes to increased morbidity, mortality and overall patient discomfort. SSI is responsible for a significant increase in expenditure for health care, due to increased hospital stay and additional cost for drug treatment, investigations, procedures etc.

In our study, we are reporting the effect on SSI rates by placing a negative suction drain in the sub-cutaneous plane in all major laparotomy surgeries done for varied causes of peritonitis done by a single surgical unit over a period of 6 months (April 2019 – September 2019) in a suburban hospital setup in Tamil Nadu, India.

OBJECTIVES OF THE STUDY

To assess the SSI rates in major laparotomies done in a rural hospital setup in Tamil Nadu, by placing a negative suction drain in the subcutaneous plane.

MATERIALS AND METHODS

Our study is an observational study, conducted in a Saveetha Medical College, Kanchipuram, over a period of 6 months. Patients observed under the study are decided on the basis of the following inclusion and exclusion criteria.

INCLUSION CRITERIA

Inclusion criteria were all the adult patients who underwent exploratory laparotomy for peritonitis in the Department of General Surgery at Saveetha Medical College and age group between 16 years to 75 years patients.

EXCLUSION CRITERIA

Exclusion criteria were patients with age < 16 years and > 75 years patients and those in whom accidental removal of drain was reported.

During the study period, all the exploratory laparotomy surgeries (56 Consecutive case) done by a single surgical unit were observed, 27 were given a 16Fr negative suction drain, in the subcutaneous plane and 29 were treated without drain. The choice of using a subcutaneous drain is taken by the operating surgeon on call. The cases varied in levels of contamination from clean contaminated to dirty.

A detailed history was taken for all patients; all routine lab investigations were done also done. X-ray Erect abdomen was done to look for free air under the domes of the diaphragm or multiple air fluid levels. Nasogastric suction, correction of fluid and electrolytes is done and appropriate antibiotics started. Demographic and clinical variables are recorded at the time of admission. Variables for each patient included: age, gender, diagnosis, total leucocyte counts, intra operative contamination, surgical site infection (SSI), duration of subcutaneous drain and postoperative stay.

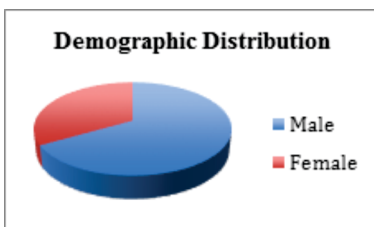
Patients diagnosed to have acute abdomen clinically and/or

radiologically are planned for exploratory laparotomy. One dose of antibiotic – third generation cephalosporin along with anti anaerobic coverage is given at the time of admission or intraoperative and efforts are taken so that cases can be taken up for surgery within 24 hrs. Abdominal cavity was irrigated and drained prior to closure of the abdomen. The Rectus layer was closed using a no: 1 loop ethilon. After placing the drain tube in the sub-cutaneous plane and brought out at a point caudal to the incision line. The Subcutaneous plane was closed using 3-0 Vicryl, absorbable sutures in an inverted fashion. The skin was closed using 2-0 ethilon sutures.

The drained contents were assessed quantitatively and qualitatively on each postoperative day. When the drained quantity was less than 10 ml over a period of 24 hours, the drain was removed. The wound infection was graded according to Southampton wound grading system. If the wound showed signs of infection, the sutures were released and pus let out. Culture swab was taken to assess the nature of growth and antimicrobial sensitivity.

RESULTS

3 patients in drain group (27) and 14 patients in no drain group (29) had incisional SSI with statistical difference (p<0.05). Out of 56 consecutive patients who underwent emergency laparotomies, ranging in contamination levels from clean contaminated to contaminated and varying from 20 years of age to 55 years. 38 patients (67.85%) were male and 18 patients (32.15%) were female. The average post operative duration of hospital stay with drain is 5-15 days and amongst those who were managed without drain the average hospital stay is 7-20 days. The surgical site was assessed according to Southampton grading system and 88.89% patients with subcutaneous drain have no infection, this is in contrast with the group managed without drain in which the SSI is much higher. In those managed with drain 7.4% have grade I, 3.70% have grade II, None of the patients we observed in this study had grade III, IV or V SSI. In the group managed without drain only 51.7% patients have no infections, 3.4% have grade I, 3.4% have grade II and 27.5% have grade III surgical site infection, 13.7% have grade IV and none of the patients had V SSI.



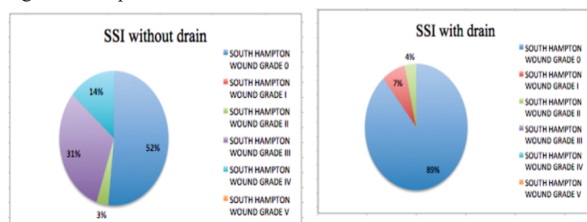
Out of the 56 cases, 5 were cases of abdominal trauma, 16 were cases of acute intestinal obstruction, 14 were cases of hollow viscus perforation including gastric ulcer perforation, duodenal ulcer perforation and colonic perforation, the remaining 21 were cases of appendicular perforation with either abscess formation or mass formation.

Statistical analysis:

First descriptive statistics, including count and percentage were used to describe the demographic characteristics of the patients observed in this study. Analysis for association between use of subcutaneous drain and their potential to reduce SSI was performed using Chi Square test. P value <0.05 is considered statistically significant.

	SSI present	No SSI	Marginal Row Totals
With drain	3 (8.2) [3.29]	24 (18.8) [1.44]	27
Without drain	14 (8.8) [3.07]	15 (20.2) [1.34]	29
Marginal Column Totals	17	39	56 (Grand Total)

The chi-square statistic is 9.1348. The p-value is .002508. This result is significant at p<.05.



Southampton Wound Grading	WITH DRAIN	WITHOUT DRAIN
0	24 (88.89%)	15 (51.72%)
I	2 (7.40%)	1 (3.45%)
II	1 (3.70%)	1 (3.45%)
III	-	8 (27.58%)
IV	-	4 (13.79%)
V	-	-

DISCUSSION

The surgical wound complications are, an important causes of early and late postoperative morbidity following laparotomies. In normal, healthy individuals, the surgical wound heals by an orderly sequence of physiologic events that include inflammation, epithelialization, fibroplasia, and maturation. Any failure of wound healing at the surgical site can lead to disruption of the closure leading to seroma, hematoma, wound dehiscence, or surgical site infection.

Grade	Appearance
0	Normal healing
I	Normal healing with mild bruising or erythema
	Ia Some bruising
	Ib Considerable bruising
Ic Mild erythema	
II	Erythema plus other signs of inflammation
	Iia At one point
	Iib Around sutures
	Iic Along wound (>2 cm)
Iid Around wound	
III	Clear or haemorrhous discharge
	IIia At one point only (≤ 2cm)
	IIib Along wound (>2 cm)
	IIic Large volume
IIid Prolonged (> 3 days)	
IV	Pus
	Iva At one point only (≤ 2cm)
	Ivb Along wound (>2 cm)
V	Deep or severe wound infection with or without tissue breakdown; hematoma requiring aspiration

The cases varied in contamination level from clean contaminated to contaminated. Exploratory laparotomy surgeries for peritonitis are indicated in cases of Abdominal trauma, ruptured appendix, ischemic colitis, ischemic small bowel injuries colonic diverticula, perforated duodenal ulcer, acute necrotizing pancreatitis, small/large bowel perforation, necrotizing cholecystitis, Splenic or hepatic abscess and other iatrogenic causes as well. Perforation of the colon or rectum is categorized as Class IV (dirty-infected) based on the CDC definitions and is considered to be an extremely high-risk condition⁹.

Several methods to prevent SSI such as perioperative high inspired oxygen therapy, wound protectors, timing of antimicrobial prophylaxis, and subcutaneous drains have been reported.¹⁰⁻¹⁵ The mechanism by which a negative suction drain works is by reducing the amount of bacterial load around the wound and by removing the residual effusion and blood, which act as a medium for bacterial growth. A closed drain is an active drain and unlike open drains that must be placed on the most dependent part, it uses the power of suction. Luminal obstruction of such drains increases with time and drainage becomes poor 48hrs post insertion.³⁰ this is prevented by routinely de clogging the drain during post op care of the patient.

Some studies found that subcutaneous drains do not reduce the incidence of SSI, however, subjects of these studies were not limited to high-risk patients.¹⁶ The incisional SSI rate in patients with thick subcutaneous fat tissue was significantly reduced in high risk cases, which is a result similar to that reported previously for obese women undergoing cesarean delivery.^{11, 12} In the case of dirty wounds, the study of the utility of a subcutaneous drain has been demonstrated by Fuji et al.¹² and Kagita et al.²⁸ These studies have assessed the efficacy of the Negative suction drainage system as a subcutaneous closed suction drain system in patients undergoing surgery for colorectal perforation. Using the J-VAC drainage system was shown to be significantly more effective than not using such a system in preventing incisional SSI in high-risk patients undergoing emergency operations for colorectal perforation. Furthermore, in patients with factors such as history of laparotomy, history of diabetes, preoperative use of steroid, and a smoking habit, which were considered as risk factors of incisional SSI in previous reports, the use of the J-VAC Drainage System was more effective.¹⁶⁻¹⁹ In our present study, total of 27 cases were included with particular criteria fixed during the study period. 81.48% patients with Subcutaneous drain have no infection and this is similar to results seen in other related studies which compare incidence

of SSI in patients with drain and without drain.²⁸

The ideal time of removing the suction drain is widely varied and it is removed in our study when quantitatively the volume is less than 10ml. In elective surgery, early removal of a drain tube is done, but the optimal removal time in patients with dirty wounds has not been studied.²⁹

Based on comparative studies it is known that postoperative stay in patients with drain is less compared to patients without drain due to lesser incidence of SSI and our observation is that with negative suction drain mean postoperative stay in patients with drain is 5 to 15 days. Incisional SSI has some of the following causes: bacterial load, hematoma formation, subcutaneous dead space, and local ischemia of the skin or subcutaneous tissue. The use of the subcutaneous negative pressure drain is effective in reducing the incidence of incisional SSI due to the continuous suction of the subcutaneous effusion, hematoma, and bacteria and also due to the reduction in the subcutaneous wound area dead space.

CONCLUSION

Subcutaneous negative pressure significantly reduces the post-operative surgical site infection. Subcutaneous negative pressure drainage also reduces duration of postoperative stay following emergency

laparotomy. Aggressive wound management is often involving a multidisciplinary approach. Leading to reduced incidence of wound sepsis and its associated morbidity and costs. This study method has no impact on mortality, shows improved rate of recovery, less SSI and finally decreased morbidity in terms of hospital stay.

REFERENCES

- Kenneth L. Mattox. Saunders Elsevier. Sabiston Text Book of Surgery. 19th Edition. 2012;2:1141.
- Swanes C, Soreide JA, Soreide O, Bakke P, Vollset SE, Skarstein A. Smoking and ulcer perforation. *Gut*. 1997;41:177-805.
- Leaper DJ. Surgical infection. Bailey & Love's short practice of surgery, 25th edition; 2004.
- Richard T. Wound healing. Sabiston Text book of Surgery, 19th edition, 2012: 151-177.
- Corman ML, Veidenheimer MC, Collier JA. Controlled clinical trial of three suture materials for abdominal wall closure after bowel operations. *Am J Surg*. 1981;141:510-3.
- López-Quintero L, Evaristo-Méndez G, Fuentes-Flores F, Ventura-González F, Sepúlveda-Castro R. Treatment of open abdomen in patients with abdominal sepsis using the vacuum pack system. *Cir Cir*. 2010;78(4):322-6.
- Farnell MB, Worthington-Self S, Mucha P Jr, Ilstrup DM, McIlrath DC. Closure of abdominal incisions with subcutaneous catheters. *Arch Surg*. 1986;121:641-8.
- Williams N, O'Connell PR, McCaskie A. Bailey and Love's Short practice of surgery, 27th Edition. 2018: 48.
- Mangram AJ, Horan TC, Pearson ML, Silver LC, Jarvis WR. Guideline for Prevention of Surgical Site Infection. *Infection Control Hospital Epidemiol*. 1999;20:247-78.
- Iseron KV. The man behind the 'French' gauge. *J Emerg Med*. 1987;5(6):545-8.
- Chowdri NA, Qadri SA, Parray FQ, Gaglao MA. Role of Subcutaneous Drains in Obese Patients Undergoing Elective Cholecystectomy: A Cohort Study. *Int J Surg*. 2007;5:404-7.
- Fujii T, Tabe Y, Yajima R, Yamaguchi S, Tsutsumi S, Asao T, Kuwano H. Effects of Subcutaneous Drain for the Prevention of Incisional SSI in High-Risk Patients Undergoing Colorectal Surgery. *Int J Colorectal Dis*. 2011;26:1151-5.
- Smith RL, Bohl JK, McElearney ST, Friel CM, Barclay MM, Sawyer RG, et al. Wound Infection after Elective Colorectal Resection. *Ann Surg*. 2004;239:599-607.
- Murray BW, Huerta S, Dineen S, Anthony T. Surgical Site Infection in Colorectal Surgery: A Review of the Nonpharmacologic Tools of Prevention. *J Am Coll Surgeons*. 2010;211:812-22.
- Hagihara M, Suwa M, Ito Y, Muramatsu Y, Kato Y, Yamagishi Y, Mikamo H. Preventing Surgical Site Infections after Colorectal Surgery. *J Infection Chemotherp*. 2012;18:83-9.
- Sehgal R, Berg A, Figueroa R, Poritz LS, McKenna KJ, Stewart DB, et al. Risk Factors for Surgical Site Infections after Colorectal Resection in Diabetic Patients. *J Am Coll Surgeons*. 2011;212:29-34.
- Malone DL, Genuit T, Tracy JK, Gannon C, Napolitano LM. Surgical Site Infections: Reanalysis of Risk Factors. *J Surgical Res*. 2002;103:89-95.
- Blumetti J, Luu M, Sarosi G, Hartless K, McFarlin J, Parker B, et al. Surgical Site Infections after Colorectal Surgery: Do Risk Factors Vary Depending on the Type of Infection Considered? *Surgery*. 2007;142:704-11.
- Sørensen LT, Hemmingsen U, Kallehave F, Jørgensen PW, Kjærgaard J, Møller LN, et al. Risk Factors for Tissue and Wound Complications in Gastrointestinal Surgery. *Ann Surg*. 2005;241:654-8.
- Shaffer D, Benotti PN, Bothe A Jr, Jenkins RL, Blackburn GL. A prospective, randomized trial of abdominal wound drainage in gastric bypass surgery. *Ann Surg*. 1987;206(2):134-7.
- Imada S, Noura S, Ohue M, Shingai T, Sueda T, Kishi K, et al. Efficacy of subcutaneous penrose drains for surgical site infections in colorectal surgery. *World J Gastrointest Surg*. 2013;5(4):110-4.
- Tochika N, Namikawa T, Kamiji I, Kitamura M, Okamoto K, Hanazaki K. Subcutaneous continuous suction drainage for prevention of surgical site infection. *J Hosp Infect*. 2011;78(1):67-8.
- Cardosi RJ, Drake J, Holmes S, Tebes SJ, Hoffman MS, Fiorica JV, et al. Subcutaneous management of vertical incisions with 3 or more centimeters of subcutaneous fat. *Am J Obstet Gynecol*. 2006;195(2):607-14.
- Baier PK, Glück NC, Baumgartner U, Adam U, Fischer A, Hopt UT. Hopt. Subcutaneous Redon drains do not reduce the incidence of surgical site infections after laparotomy. A randomized controlled trial on 200 patients. *Int J Colorectal Dis*. 2010;25(5):639-43.
- Tsujita E, Yamashita Y, Takeishi K, Matsuyama A, Tsutsui S, Matsuda H, et al.

- Subcuticular absorbable suture with subcutaneous drainage system prevents incisional SSI after hepatectomy for hepatocellular carcinoma. *World J Surg*. 2012;36(7):1651-6.
- Kozol RA, Fromm D, Ackerman NB, Chung R. Wound closure in obese patients. *Surg Gynecol Obstetr*. 1986;162(5):442-4.
- Farnell MB, Worthington-Self S, Mucha P Jr, Ilstrup DM, McIlrath DC. Closure of abdominal incisions with subcutaneous catheters. A prospective randomized trial. *Arch Surg*. 1986;121(6):641-8.
- Kagita R, Mulla SA, Pai BS, Desai M. Subcutaneous negative pressure versus simple closure of skin incision following an emergency laparotomy: a randomized control study. *Int Surg J* 2019;6:1230-7.
- Sumi Y, Yamashita K, Kanemitsu K, Kanaji S, Yamamoto M, Imanishi T, Nakamura T, Suzuki S, Tanaka K, Kakeji Y. (2014) Effects of Subcutaneous Closed Suction Drain for the Prevention of Incisional SSI in Patients with Colorectal Perforation. *Surgical Science*, 5, 122-127. doi: 10.4236/ss.2014.53022.
- Gupta P, Kumar R. Role of subcutaneous drain in reducing surgical site infections after emergency laparotomy. *Int Surg J* 2017;4:2717-20