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Evaluation of Outcomes of Subcutaneous Negative Suction Drain in Emergency Laparotomy in Children with Peritonitis

Dr. Md. Asif Iqbal[1*], Dr. Mohammed Shadrul Alam[2], Dr. Md. Asaduzzaman[3], Dr. A.K.M. Khairul Basher[4], Dr. Md. Hasanuzzaman[5], Dr. Amitava Biswas[6], Dr. Khandokar Moynul Hasan[7], Dr. Mithun Kumar Sarker[8], Dr. Md. Masud Rana[9]

[1]Resident Surgeon, Pediatric Surgery, Institute of Child and Mother Health (ICMH), Matuail, Dhaka, Bangladesh
[2]Professor and Head, Department of Pediatric Surgery, Mugda Medical College and Hospital, Dhaka, Bangladesh
[3]Assistant Professor, Department of Pediatric Surgery, Mugda Medical College and Hospital, Dhaka, Bangladesh
[4]Assistant Professor, Department of Pediatric Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
[5]Assistant Professor, Department of Pediatric Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
[6]Junior Consultant, Department of Pediatric Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh
[7]Assistant Professor, Department of Pediatric Surgery, Shaheed Suhrawardy Medical College Hospital, Dhaka, Bangladesh
[8]Medical Officer, Sadar Upazila Health Complex, Mymensingh, Bangladesh
[9]Upazila Health and Family Planning Officer, Patharghata, Barguna, Bangladesh

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***Corresponding author:** Dr. Md. Asif Iqbal
Resident Surgeon, Pediatric Surgery, Institute of Child and Mother Health (ICMH), Matuail, Dhaka, Bangladesh
Email: asifiqbaldmch@gmail.com

Abstract **Original Research Article**

Background: Emergency laparotomy for peritonitis is associated with the highest rates of infective complication, especially surgical site infection (SSI) and it's linked to higher morbidity, mortality, and healthcare costs. ***Aim of the Study:*** The aim of this study was to evaluate the outcome of subcutaneous negative suction drain in emergency laparotomy in children with peritonitis. ***Methodology:*** This prospective interventional study was conducted in the Department of Pediatric Surgery, Dhaka Medical College Hospital, Dhaka from January, 2020 to December 2021 over a period of two years. A total of 64 patients who underwent emergency laparotomy with features of peritonitis were enrolled in this study as per selection criteria. They were divided into two groups equally. Subcutaneous negative suction drain was used in Group A patients, and in Group B patient's standard of care was provided. Patients were followed up to 30thpostoperative day. Outcome was evaluated by superficial surgical site infection (s-SSI), wound dehiscence, secondary suturing and duration of hospital stay. Superficial surgical site infection(s-SSI) assessed by CDC criteria of surgical site infection on 3rd, 5th, 7th, 14th& 30thpostoperative day. Microsoft Excel was used for data analysis. ***Results:*** Mean age of the study populations in Group A was 8.41 ± 2.27 years and Group B was 8.95 ± 2.27 years. Male were predominant than female in both the two groups. s-SSI was observed significantly(p=0.016) lower in Group A (9.4%) than Group B (34.4%). Culture & sensitivity growth was observed significantly(p=0.020) lower in Group A (6.3%) than Group B (28.1%). Wound dehiscence was (9.4%) in Group A and (28.1%) in Group B. Secondary suturing was (3.1%) and (15.6%) in Group A and Group B respectively. Duration of hospital stay was found significantly (p=0.011) lesser in Group A than Group B (6.68 ± 2.14 vs 8.50 ± 3.29) days. ***Conclusion:*** Subcutaneous negative suction drain reduces the post-operative superficial surgical site infection(s-SSI), wound dehiscence, secondary suturing and duration of hospital stay.

Keyword: Laparotomy, Surgical site infection (SSI), Superficial surgical site infection (s-SSI), CDC.

INTRODUCTION

Peritonitis is defined as an inflammation of the serosal membrane that lines the abdominal cavity and the organs contained therein. The peritoneum, which is an otherwise sterile environment, reacts to various pathologic stimuli with a fairly uniform inflammatory response [1]. The resulting peritonitis might be infectious or sterile, depending on the underlying disease (ie,chemical or mechanical). The second most prevalent site of sepsis and subsequent peritonitis is the abdomen [2]. Intra-abdominal sepsis is a peritoneal inflammation produced by pathogenic bacteria and their compounds. Intra-abdominal sepsis is an inflammation of the peritoneum caused by pathogenic microorganisms and their products. The inflammatory process may be localized (abscess) or diffuse in nature. Generalized peritonitis as a result of gastrointestinal perforation is a common surgical emergency. In majority, cases present late to the hospital with purulent or fecal contamination and septicemia of varying degree. Thus surgical management of perforation peritonitis becomes highly demanding and more complex. Abdominal closure is sometimes challenging to the surgeon where bowel become oedematous in severe peritonitis. There will be outpouring of fluid or pus from peritoneal cavity to the surgical wound-subcutaneous tissues that can lead to surgical-site infection and wound dehiscence [3]. The incidence of surgical-site infection increases with the degree of contamination; therefore, surgical-site infection occurs at much higher rates after operations for peritonitis (i.e. 5-15%, compared with <5% for elective abdominal operations for non-infectious etiologies) [4]. Emergency laparotomy is a challenging surgical procedure in pediatric practice and data are scarce for this age group [5]. Wounds and their management are fundamental to the practice of surgery. Wound seromas, infections and wound dehiscence are the commonest complications of the wounds. Wound seromas are collections of serum and lymph that becomes symptomatic or clinically apparent after operations in which subcutaneous lymphatic channels are disrupted. Abdominal wound dehiscence is one of the complications after abdominal surgery; wound dehiscence is the parting of the layers of a surgical wound. Either the surface layers separate (wound gap) or the whole wound splits open. Primary cause of wound dehiscence is infection and seroma formation. Wound infection referred to as Surgical Site Infection (SSI) by the Centers for Disease Control and Prevention is the most common nosocomial infection in surgical patients. Postoperative wound infections are the major source of infectious morbidity in surgical patients. Development of a surgical site infection has a large impact on mortality and morbidity as well as healthcare costs, patient inconvenience and dissatisfaction [6]. In any elective surgery or in the surgery of trauma, the surgeons' task is to minimize the adverse effects of the wound, remove or repair damaged structures and enhance the process of wound healing to restore function. Because of unavoidable contamination of wounds that occurs at the time of surgery, surgeons have used a number of methods of wound management. Placement of subcutaneous drains at the site of surgery is one of them. Surgical site infection (SSI)-defined by the Centers for Disease Control and Prevention (CDC) as infection related to an operative procedure that occurs at or near the surgical incision within 30 days of the procedure, or within one year if prosthetic material is implanted at surgery. Surgical site infection and delayed wound failure are more common in peritonitis-related abdominal surgeries than in other gastrointestinal surgeries [7]. Surgical site infections are not only associated with increased morbidity, but also with increased mortality and care costs, as they are caused by a breach of mechanical or anatomic defense mechanisms. The most common infectious complications following surgery are superficial wound infections that occur within the first week of surgery [8]. Superficial surgical site infections (s-SSI) are a difficult problem for surgeons and patients worldwide, especially in areas with high contamination. It has been reported that the incidence ranges from 2% to 30%, or even higher, depending on the type of surgery and patient characteristics, specifically for clean (class I), <2.0 %; clean- contaminated (class II), 5.0 % to 15.0 %; contaminated (class III), 15.0 % to 30.0 %; and dirty infected wounds (class IV), >30% [9-11]. Emergency laparotomy, which is commonly contaminated surgery, has a higher risk of s-SSI when compared to other GI interventions [12]. Because s-SSI may lengthen postoperative hospital stays and thus pose an additional financial burden, they deserve our full attention in order to reduce the incidence and manage for stable postoperative recovery [13,14]. Superficial surgical site infection (s-SSI) has some of the following causes: subcutaneous effusion, bacterial load, hematoma formation, subcutaneous dead space, and local ischemia of the skin or subcutaneous tissue. Hand washing, skin preparation, prophylactic antibiotics are just a few of the approaches and methods that have been proposed to reduce the incidence of post-operative infections, and they have all been universally adopted [15]. Though pre-operative antibiotic prophylaxis and post-operative thorough peritoneal lavage are important in preventing SSI, an effective method of wound closure is also essential. Complete wound dehiscence in SSI is a major concern for surgeons because it can compromise respiratory functions if reclosed, whereas nosocomial infection can occur if the wound is left open [7,16]. Subcutaneous drains are classified into two types: open drains and closed suction drains. An open drain is a passive drain that relies on capillary action. A closed suction drainage system is a type of active drain that uses continuous suction. Closed- suction drains, as opposed to passive (open) drains, create a negative pressure gradient between the wound and the external environment and empty into a sealed reservoir, reducing the risk of retrograde microbial contamination [17]. The placement of a negative suction drain in the subcutaneous plane during an emergency laparotomy has been shown to significantly reduce infection through a variety of mechanisms such as seroma evacuation, evacuation of infected content, and decreased bacterial load, resulting in improved healing, better wound management, and decreased morbidity and hospital stay [18].

OBJECTIVES

General Objective

The general objective of the study was to evaluate the outcome of subcutaneous negative suction drain in emergency laparotomy in children with peritonitis.

Specific Objective

- To compare the rate of superficial surgical site infection (s-SSI).
- To compare the rate of wound dehiscence.

- To compare the rate of secondary suturing.
- To compare the duration of overall hospital stay.

METHODOLOGY

This study was designed as prospective interventional study. The study was carried out at the Department of Pediatric Surgery in Dhaka Medical College Hospital, Dhaka. The study was conducted from January, 2020 to December, 2021 for a period of two years. All the patients underwent emergency laparotomy with features of peritonitis at the Department of Pediatric Surgery, Dhaka Medical College Hospital, Dhaka were selected as study population. A total number of 64 patients 32 patients with subcutaneous negative suction drain and 32 with standard of care underwent emergency laparotomy with features of peritonitis were enrolled for this study after fulfilling the selection criteria. These samples were selected consecutively by purposive sampling techniques and allocated into two groups. First patient was assigned in group A and subsequently in to group B. In this manner odd number bearing patients were in group A and even number bearing patients were in Group B. The analysis of different variable was done according to standard statistical analysis. Qualitative data were expressed as frequency with percentage and quantitative data were expressed as mean with standard deviation. Quantitative data were analyzed by student t-test and qualitative data by Chi-square test. For all analysis level of significance was set at 0.05 and p-value <0.05 was considered as significant. Microsoft Excel was used for data analysis.

Group A (Study group): Negative suction drain was placed in subcutaneous space (bellow fascia scarpa) in whole length of the wound at the time of closure of abdomen in laparotomy surgery and was taken out from separate incision.

Group B (Control group): Standard of care (SOC) was provided at the time of closure of abdomen in laparotomy surgery.

Inclusion Criteria:

- Children between the ages of 1 year and 14 years (Institutional criteria) undergoing emergency laparotomy for peritonitis.
- Patient's parents or legal guardian willing to participate in the study.

Exclusion Criteria:

- All immune compromised patient.
- Re-exploratory surgery.
- Patient in whom stoma was constructed as the part of procedure.

Ethical Consideration

Prior to the commencement of this study, the research protocol was approved by Ethical Review Committee (ERC) of Dhaka Medical College Hospital. The aims and objectives of the study along with its procedure, methods, risks and benefits of this study were explained to the parents or legal guardian of the patients. and informed written consent was taken from the parents or legal guardian of each patient. It was assured that all information and records would be kept confidential and the procedure was helpful for both the physicians and the patients in making rational approach of the case management.

Study Procedure

The study population were selected on the basis of selection criteria. Informed written consent was taken from the parents or legal guardian of each patient. Before laparotomy all the patients were assessed by detailed history, clinical examination and investigation. All patients were investigated for routine hematological and other relative imaging investigations to confirm the diagnosis. All patients were resuscitated and prepared for operation. Ceftriaxone and metronidazole was given to all patients in preoperative and postoperative period. In complicated cases Amikacin injection was additionally used. Additional second dose of antibiotic was given in cases of prolong surgery. In general antibiotic coverage was continued up to 7th POD. In cases of s-SSI antibiotic was given according to culture and sensitivity of wound swab or pus until infection subsides. During laparotomy operation primary pathology was identified and act accordingly. Thorough peritoneal toileting was given and intraperitoneal wide bore drain was kept in pelvic cavity in both groups of patients. During closure of the laparotomy wound in study group peritoneum and facial layer were closed by vicry l 4-0 (R\B). Then negative suction drain with feeding tube and disposable syringe was applied according to size of the wound and age of the patients (for 1-5 years 8Fr, for 6-10 years 10Fr and for more than 10 years 12Fr feeding tube was placed subcutaneously under fascia scarpa) along the whole length of operative wound. Then skin was closed in subcuticular continuous manner by 4-0 or 5-0 vicryl**.** After completion of skin closure negative suction was applied with 10 CC disposable syringe. In case of standard of care (SOC) abdominal wall was closed in layer by layer without subcutaneous negative suction drain. Negative suction drain was emptied and measured every day and drain tube was removed on 3rd post-operative day except copious collection.

Figure I: Peroperative placement of 8Fr feeding tube along the whole length of operative wound (under fascia scarpa)

Figure II: Peroperative negative suction given by 10 CC disposable syringe

Figure III, IV, V, VI and VII showed postoperative days follow up of a patient (Group-A). Superficial surgical site infection (s-SSI) was assessed and followed up by CDC criteria of surgical site infection and wound dehiscence was identified on 3rd, 5th, 7th, 14th and 30th Postoperative day.

Figure III: 3rd postoperative day Figure IV: 5th postoperative day Figure V: 7th postoperative day

 

Figure VI: 14th postoperative day Figure VII: 30th postoperative day

RESULTS

Table1 showed comparison of age and gender between the two groups. Mean age of the study populations in Group A was 8.41 ± 2.27 years and Group B was 8.95 ± 2.27 years. There was no significant difference between the groups. Males were predominant than female in both the two groups. In Group A, males were 23(71.9%) and females were 9 (28.1%), similarly in Group B, males were 24 (75.0%) and females were 8 (25.0%). There was no significant difference between the groups.

Table 1: Comparison of age and gender between the two groups (N=64)

Variables	**Group A n (%)**	**Group B n (%)**	**p-value**
Age (years)			
Mean ± SD	8.41 ± 2.27	8.95 ± 2.27	0.338
Range	4 - 12	4 - 12	
Gender			
Male	23(71.9)	24(75.0)	0.777
Female	9(28.1)	8(25.0)	

Table 2 showed comparison of the study populations according to superficial surgical site infection (s-SSI)**.** s-SSI was observed significantly (p=0.016) lower in Group A (9.4%) than in Group B (34.4%).

Table 2: Comparison of the study populations according to superficial surgical site infection (s-SSI) (N=64)

s-SSI	**Group A n (%)**	**Group B n (%)**	**χ^2**	**p-value**
Present	3(9.4)	11(34.4)	5.851	0.016^{S}
Absent	29(90.6)	21(65.6)		

Table 3 showed comparison of the study populations according to culture & sensitivity of wound swab or pus. Culture & sensitivity growth was observed significantly (p=0.020) lower in Group A (6.3%) than in Group B (28.1%).

Table 3: Comparison of the study populations according to culture & sensitivity of wound swab or pus (N=64)

Variables	**Group A n (%)**	**Group B n (%)**	**χ^2**	**p-value**
Growth	2(6.3)	9(28.1)	5.379	0.020^{S}
No growth	30(93.7)	23(71.9)		

Table 4 showed wound dehiscence among the study populations in two groups. In Group A, wound dehiscence was found in 3 (9.4%) cases. In Group B, wound dehiscence was found in 9 (28.1%) cases.

Table 4: Wound dehiscence among the study populations (N=64)

	Group A n (%)	Group B n (%)	χ 2	p-value
Wound dehiscence	3(9.4)	9(28.1)	3.69	0.054NS

Table 5 showed secondary suturing among the study populations in two groups. In Group A, secondary suturing in 1 (3.1%) cases. In Group B, secondary suturing in 5 (15.6%) cases.

Table 5: Secondary suturing among the study populations (N=64)

	Group A n (%)	Group B n (%)	χ 2	p-value
Secondary suturing	1(3.1)	5(15.6)	0.107	0.301^{NS}

Table 6 showed mean duration of hospital stay in two groups. Duration of hospital stay was found significantly (p=0.011) lesser in Group A than in Group B (6.68 ± 2.14 vs 8.50 ± 3.29 days).

Table 6: Comparison of the study populations according to duration of hospital stay (N=64)

Duration of hospital stay (days)	Group A	Group B	t	p-value
Mean ± SD	6.68 ± 2.14	8.50 ± 3.29	-2.609	0.011S
Min - max	5-14	5-14		

DISCUSSION

Surgical site infection (SSI) have been reported to be one of the most common causes of nosocomial infections, accounting for 20% to 25% of all nosocomial infections worldwide [19]. Globally, surgical site infection rates have been reported to range from 2.5% to 41.9% [20]. This study included 64 children ranging in age from 1 year to 14 years. In this study, a subcutaneous negative suction drain was used in the study group (Group A) and standard of care was provided in the control group (Group B). Mean age of the study populations in Group A was 8.41 ± 2.27 years and Group B was 8.95 ± 2.27 years in this study. There was no significant (p=0.338) difference between the groups. Similar age was observed in the study of [11]. As there is not much similar study on pediatric age group, so it is very difficult to correlate the mean age of the study population. In this study, male was predominant than female in both the two groups. In group A, males were 23 (71.9%) and females were 9 (28.1%), similarly in group B, males were 24 (75.0%) and females were 8 (25.0%). There was no significant (p=0.777) difference between the groups. Similar male predominance was observed in the study of [4,11,19]. Superficial surgical site infection (s-SSI) was found to be significantly (p=0.016) lower in Group A (9.4%) than group B (34.4%). Similar significant lower rates of superficial surgical site infection (s-SSI) also observed in the drain group than the non-drain group in the study of (Chen *et al.*, 2017; Kumar *et al.*, 2017; Manoharan *et al.*, 2018; Kagita *et al.*, 2019; Gilkar *et al.*, 2019) [4,7,11,18,19]. Kaya *et al.*, (2010) [21] found overall superficial surgical site infection (s-SSI) rate of 7.7%. s-SSI rate in drain and non-drain group was found to be 5.7% and 9.9% respectively. Though there was a decrease in s-SSI rate, it was not statistically significant. Chowdri *et al.*, (2007) [22] in their study, had shown 8% s-SSI in cases without drain versus no s-SSI in cases with subcutaneous drain. Cardosi *et al.*, (2006) [23] studied the use of subcutaneous suction drain in which no significant difference in s-SSI rate was noted between the non-drain group and the drain group. Studies found that subcutaneous drains do not reduce the incidence of s-SSI however, subjects of these studies were not limited to high-risk patients [24-26]. Superficial surgical site infection (s-SSI) was 2.4 times greater in individuals without a subcutaneous closed suction drain than in patients with a subcutaneous closed suction drain following an emergency laparotomy for perforation peritonitis [3]. Individuals without subcutaneous drains had a 2.5 times greater risk of surgical site infections than patients with subcutaneous drains [27]. Infection rates were 2.1 times greater in the group without a drain than in the group with a drain [28]. Postoperative wound infection, wound seroma, and wound dehiscence were all 2.5 times, 2.6 times, and 3.0 times greater in the group without a drain than in the group with a negative suction drain [29]. Studies have shown that, placement of subcutaneous negative suction drain reduces the incidence of superficial surgical site infection (s-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. For most surgical site infections, the source of pathogens is the endogenous flora of the patient skin, mucous membranes, or hollow viscera. When the gastrointestinal tract is opened during an operation and is the source of pathogens, gram-negative bacilli, gram-positive organisms, and sometimes anaerobes are the typical s-SSI isolates. It is thought to be that exogenous sources of s-SSI pathogens include surgical personnel (especially members of the surgical team), the operating room environment (including air), and all tools, instruments, and materials brought to the sterile field during an operation. Exogenous flora are primarily aerobes, especially gram-positive organisms [19]. In this study culture & sensitivity of wound swabs or pus growth was observed significantly (p=0.020) lower in Group A (6.3%) than in Group B (28.1%). Bacteriological evidence was revealed in 2 cases in Group A and 9 cases in Group B among s-SSI patients. The most common organism isolated was E.coli followed by Klebsiella which is endogenous gram-negative bacilli. Wound dehiscence was observed 9.4% in Group A and 28.1% in Group B and secondary suturing was 3.1% and 15.6% in Group A and Group B respectively. Similar lower rates of wound dehiscence and secondary suturing also observed in the drain group than the non-drain group in the study of (Khan and Kodalkar, 2016; Chen *et al.*, 2017; Manoharan *et al.*, 2018; Patel and Koyani, 2019; Vazifdar and Gavali, 2021) [7,11,27,29,30]. Studies have shown that wound dehiscence and secondary suturing in patients with subcutaneous negative suction drain is less compared to patients without drain due to lesser incidence of superficial surgical site infection (s-SSI). Duration of hospital stay was found significantly (p=0.011) lesser in Group A than Group B (6.68 ± 2.14 vs 8.50 ± 3.29) days. A similar study of Manoharan *et al.*, (2018) [7], revealed significantly lesser period of hospital stay in drain group (9 days) than no drain group (14 days). Kim *et al.*, (1998) [31] in a study evaluated the hospital stay period in patients with and without wound drain. It was found to be 8 days in the group with drain and 11 days in the group without drain. A similar study of Zhen *et al.* (2011) [32], it was found that the closed suction group had lesser period of stay (9 days) than the group without drain (20 days). Similar lesser period of hospital stays also observed in the drain group than the non-drain group in the study of [4,5,7,11,18,27]. Duration of hospital stay in patients with subcutaneous negative suction drain is less compared to patients without drain due to lesser incidence of superficial surgical site infection (s- SSI) and wound dehiscence. Subcutaneous negative suction drains prevent postoperative superficial surgical site infection, wound dehiscence, secondary suturing and also reduces hospital stays in emergency laparotomy in children with peritonitis.

LIMITATION

This study has used feeding tube and disposable syringe to create subcutaneous negative suction drainage, these were all available within the hospital resources. It is yet to be confirmed if this combination will provide optimum suction drainage like a vacuum suction will do. This process still under evaluation.

RECOMMENDATIONS

Subcutaneous negative suction drain may be an effective method of wound closure in the case of children with peritonitis to reduce superficial surgical site infection (s-SSI) and its morbidity such as wound dehiscence, secondary suturing and prolong hospital stays. After evaluation, this has been confirmed that, subcutaneous negative suction drainage when combined with feeding tube and disposable syringe give optimum suction.

CONCLUSION

Placement of a subcutaneous negative suction drain significantly reduces the post- operative superficial surgical site infection (s-SSI). It also reduces s-SSI related morbidity such as wound dehiscence, secondary suturing and prolong hospital stays.

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