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Research Article

Role of Suction Drain in Subcutaneous Plane in Reducing Post Emergency Laparotomy Wound Infection

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Abstract

Introduction: Surgical site infection remains to be one of the most common cause of post-operative complications and contributes hugely towards burden over the patient as well as the healthcare system in terms of hospital stay and prolonged treatment remedies.

Objectives:

1. To compare the results of suction drain in subcutaneous plane with no suction drain in terms of SSI, hospital stay, dehiscence of the wound and other co-morbid problems.
2. To establish a conclusion that the placement of suction drain during closure of a laparotomy wound during Emergency exploratory laparotomy reduces the incidence of SSI and reduces duration of stay in hospital.

Study Design: Comparative randomized control study conducted at MMIMSR for a period of 2 years from November 2019 to October 2021.

Materials and Methods: Comparative RCT comprising of a total of 50 patients presenting to Emergency of Surgery Department at MMIMSR, Mullana and undergoing Emergency exploratory laparotomy for a period of 2 years from November 2019 to October 2021. The study was conducted after randomizing the patients into 2 groups of those with suction drain in subcutaneous plane and other group with no suction drain.

Results: The result of our study showed that surgical site infection rate was 20% in study group as compared to 60% in control group with p value 0.004 which is significant. Similarly, the rate of seroma formation in study group was 20% while that in control group was 52% with a p value of 0.018 with statistical significance. The incidence of wound dehiscence was found to be 8% in study group as compared to a very high rate of 44% in control group with p value of 0.004 which also is statistically significant. The mean duration of hospital stay in study group was 9.08 **± 2.753 while that in control group was 11.16 ± 1.02. It** depicts early discharge of patients from hospital in study group. There was a significant relationship between the rate of surgical site infection, seroma formation and type of incision wound as the p value was < 0.05 which was not in the case of wound dehiscence as the p value was found to be 0.567 i.e., greater than the level of significance 0.05.

Conclusion: We conclude from the present study that the use of negative suction drain in subcutaneous plane during Emergency laparotomy surgery significantly reduces the incidence of post-operative surgical site infection, seroma formation, wound dehiscence and hospital stay.

Keywords: *Suction Drain; SSI; Seroma; Wound Dehiscence*

Introduction

Surgical site infection (SSI) is one of the most common postoperative complications, which occurs at an average of 5% of all patients who undergo surgery overall and in patients undergoing abdominal surgery it is around 30 - 40%, depending on the contamination [1].

Surgical site infections are third most frequently described nosocomial infection which account for nearly 14% to 16% of all nosocomial infections among hospitalized patients [2].

It has been described by WHO that hospital acquired infection is one of major infection which is causing huge impact on economy [3].

Heavy healthcare costs, patient inconvenience and dissatisfaction during hospital stay due to development of surgical site infection have been brought upon a large impact on mortality and morbidity [4,5].

Any purulent discharge from a closed surgical incision within 30days of an operation, together with the signs of inflammation of surrounding tissue has been considered as wound infection, irrespective of micro-organisms being cultured [6].

Infectious complications with wound infection: the most common being superficial wound infection occurring within first week of surgical intervention remains to be the main cause of postoperative morbidity in abdominal surgery [7].

Seroma formation is one of the complications after abdominal surgery, seroma is clear fluid which develop as a result of damage to blood and lymphatic vessels that occurs during surgery. The complications of wound as a result of seroma formation include, abscess formation, seroma calcification, poorer cosmetic results, unsatisfactory appearance of the surgical scar, sepsis (a life-threatening bacterial blood infection), surgical wound dehiscence (opening of a recently opened surgical site) [8].

Wound dehiscence has been one of the complications after abdominal surgery. parting of the layers of a surgical wound is known as wound dehiscence. There is either the surface layers separating and opening up (wound gape) or whole wound splitting open, a small wound gape which small in size being treated with regular dressing and tend to heal itself, but when wound dehiscence is deep, the use of regular dressing, regular debridement of infected part and after granulation tissue formation secondary suturing is done as a part of management [9].

It has been shown that placement of suction drain in the subcutaneous plane reduces the incidence of SSI by evacuation of the infected contents, also the emptying of collected seroma(serous) in subcutaneous space. Invasion of tissues by bacteria and microorganisms which usually consume the nutrients and oxygen that would be directed towards the tissue repair which leads to impaired wound healing has been noticed in the presence of infected fluid and varying degrees of microorganisms in the subcutaneous space. The microorganisms also release enzyme which break down protein, this is an important component in wound repair mechanism. Negative suction drain improves the healing capacity of wound by reducing the bacterial load in the operative wound site [10-12].

Negative pressure drain provides a moist and protected environment, also reducing peripheral edema around wound, enhancing the circulation to the wound bed, decreases bacterial colonization, increases the rate of granulation tissue formation and epithelization of the wound [13].

The mechanics of physics have been applied in negative pressure wound therapy. The application of controlled sub-atmospheric pressure which causes mechanical stress to the tissues. Stimulation of mitosis, new vessels being formed, leading to wound margins being brought close and finally approximated [14].

The closure of abdominal wall in the presence of sepsis presents a challenge to every surgeon. These patients present usually present late after many hours or days after perforation peritonitis. Peritonitis has the gut being edematous and the presence of sepsis in the peri-

toneal cavity which then causes an outpouring of fluid, sometimes till the infection is brought under control. Closure of abdominal wall layers under pressure after liberal peritoneal lavage leads to compartment syndrome or wound dehiscence or burst abdomen in significant number of patients. Placement of negative suction in the subcutaneous space with or without irrigation with antibiotic solution has shown to reduce the incidence of infection by active evacuation of infectious contents. However, various studies have proved that leaving the skin open facilitates drainage and uncompromising debridement of the abdominal wall, and is companionable with good recovery. Different surgeons have different techniques for abdominal wall closure, so there needs to establishment of a best for the patient. It has been seen based on many studies there is controversy regarding the best way of managing laparotomy wound in cases of perforation peritonitis. Hence, we need to establish which is the best technique for the closure of abdominal wall in presence of active peritonitis. This study is used as a platform to compare the subcutaneous negative suction, and conventional closure of skin and sub cutaneous planes after emergency laparotomy in cases of peritonitis. Here, we evaluate advantages and disadvantages of each of these methods with respect to surgical site infections, duration of hospital stay subsequent to surgeries and any other co-morbidity.

Materials And Methods

- Type of study: Comparative and Randomized study conducted in 2 groups.
- A total of 50 cases will be studied having undergone exploratory laparotomy for various surgical conditions presenting in emergency in a period of 2 years, operated in the Department. Of General Surgery.
- Subjects- In Group A: 25 patients were subjected to placement of suction drain in subcutaneous plane at the time of closure of abdomen in laparotomy surgery

In Group B: 25 patients were not subjected to placement of suction drain in subcutaneous plane at the time of closure of abdomen in laparotomy surgery

- Intra-abdominal drains were place in all these patients as usual
- The data was collected in terms of SSI, wound dehiscence, hospital stay, and any other comorbid condition.
- P value was determined.
- Results of both groups compared and analyzed.

Inclusion criteria

All the patients who are having exploratory laparotomy for various surgical conditions presenting in emergency in Department of Surgery.

Only adults of age > 18 years of both sexes were included in the study.

Exclusion criteria

- Patients of trauma
- Pediatric age Group
- Patients having abdominal surgeries in the past
- Immunocompromised patients

- Patients having stomas after Laparotomy.

Results

The study included a total of 50 patients divided randomly based of age, sex and later studied to know for statistically significant differences.

Table 1 shows distribution of patients according to their gender in group A Male were 19 and female 6, with their chi-square value 0.000, nevertheless there is no difference between the groups regarding gender which is not significant (p = 1.00).

Gender	Group A		Group B		Chi-squar test	p- value
	No. of patients	Percentage	No. of patients	Percentage		
Male	19	76%	19	76%	0.000	1.00NS
Female	06	24%	06	24%		
Total	25	100%	25	100%		

Table 1: *Distribution of patients according to gender in groups.*

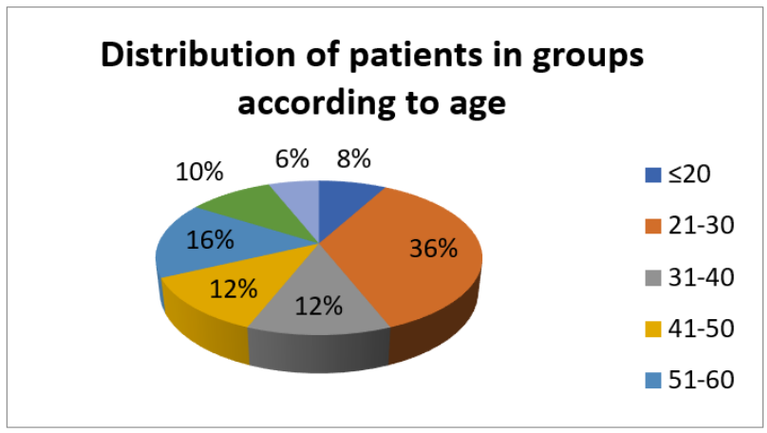
AGE

As shown in table 2, it may be observed that of the 50 subjects studied, there were 25 (50.0%) in the group A and 25 (50.0%) in the group B. These subjects were randomly selected with irrespective of their socioeconomic status, for group A Mean **± SD was 41.84±19.17 whereas for group B was 39.28±16.15.** Nevertheless, this marginal difference in the age between the two categories were statistically not significant (p value 0.344).

Age group	Group A		Group B		Fisher's Exact Test	p- value
	No. of patients	Percentage	No. of patients	Percentage		
≤20	02	08	02	08	6.802	0.344 NS
21-30	09	36	09	36		
31-40	02	08	04	16		
41-50	02	08	04	16		
51-60	04	16	04	16		
61-70	05	20	00	00		
>71	01	04	02	08		
Total	25	100	25	100		
Mean ± SD	41.84 ± 19.17		39.28 ± 16.15			

Table 2: *Comparison of Mean Age of patients in groups.*

Table 2 can be depicted graphically as shown below:



Graph 1

In group A we used drain and in Group B no drain was used. Post-operative day 5 has percentage maximum number of drain removal contributing to 64% followed by day 7 at 32%.

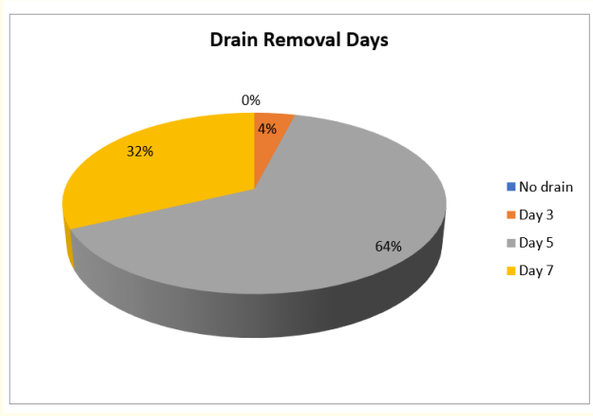
Group – A **Mean** ±SD	**Group – B** **Mean** ±SD	**t - value**	**P - value**
24.20**±1.61**	24.45**±2.79**	0.389	0.023

Table 3: *Distribution of patients according to BMI in groups:*
Nevertheless, this marginal difference in the BMI between the groups was statistically significant (p = 0.023).

	Group A		**Group B**	
	No. of Patients	**Percentage**	**No. of Patients**	**Percentage**
No drain	00	00	-	-
Day 3	01	04	-	-
Day 5	16	64	-	-
Day 7	08	32	-	-
Total	25	100	25	-

Table 4: *Distribution of patients according to drain removal day in groups.*

Table 4 can be depicted graphically as shown below:



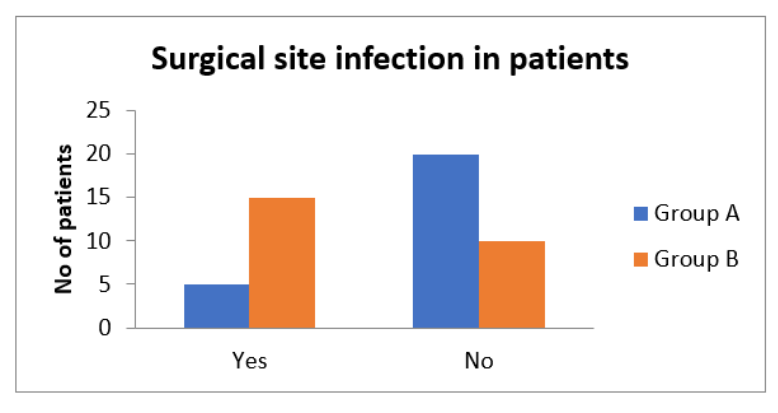
Graph 2

The total number of wound infected patients during post-operative period for group A is 20% and for group B is 60%, after statistical analysis it is found that post-operative wound infection is significant with chi square value 8.333 and p-value 0.004.

Table 5 can be depicted graphically as shown below:

Infection	Group A		Group B		Chi-square test	P-value
	No. of Patients	Percentage	No. of Patients	Percentage		
Yes	05	20.0	15	60.0	8.333	p=0.004 S
No	20	80.0	10	40.0		
Total	25	100	25	100		

Table 5: *Distribution of patients according to Surgical Site Infection in Groups.*



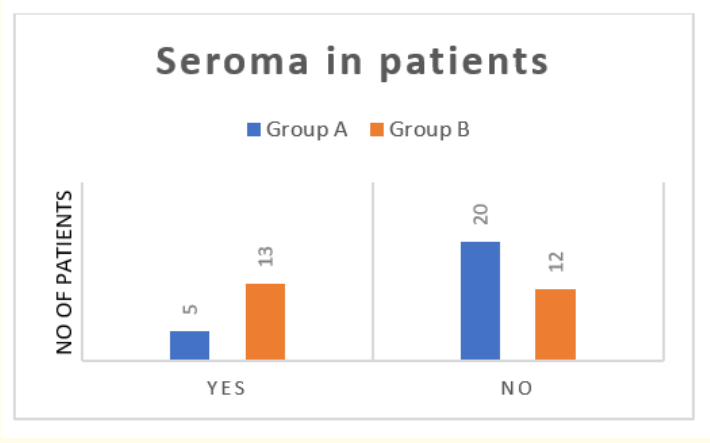
Graph 3

The total number of patients with seroma in wound during post-operative period for group A is 20% and for group B is 52%, after statistical analysis it is found that post-operative seroma in wound is significant with chi square value 5.556 and p-value 0.018.

Table 6 can be depicted graphically as shown below:

Seroma	Group A		Group B		Chi-square test	P-value
	No. of Patients	Percentage	No. of Patients	Percentage		
Yes	05	20.0	13	52.0	5.556	p=0.018 S
No	20	80.0	12	48.0		
Total	25	100	25	100		

Table 6: *Distribution of patients according to Seroma in groups.*



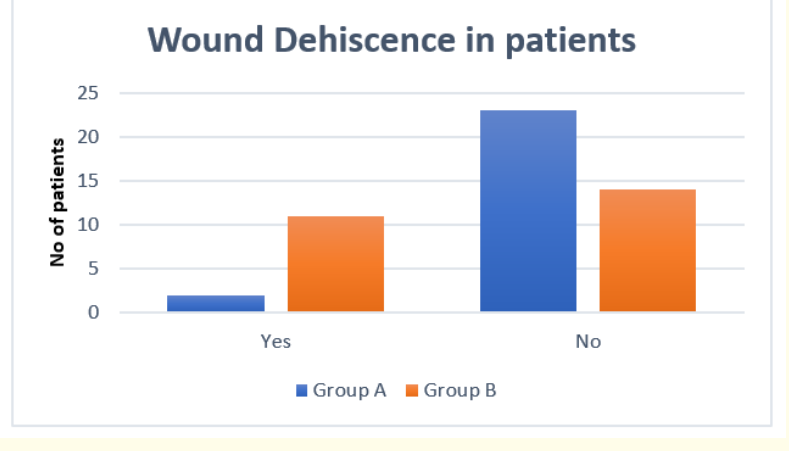
Graph 4

The total number of wound dehiscence in wound during post-operative period for group A is 08% and for group B is 44%, after statistical analysis it is found that post-operative wound dehiscence in wound is significant with chi square value 8.420 and p-value 0.004.

Table 7 can be depicted graphically as shown below:

Wound dehiscence	Group A		Group B		Chi-square test	P-value
	No. of Patients	Percentage	No. of Patients	Percentage		
Yes	02	8.00	11	44.0	8.420	p= 0.004 S
No	23	92.0	14	56.0		
Total	25	100	25	100		

Table 7: *Distribution of patients according to Wound Dehiscence in groups.*



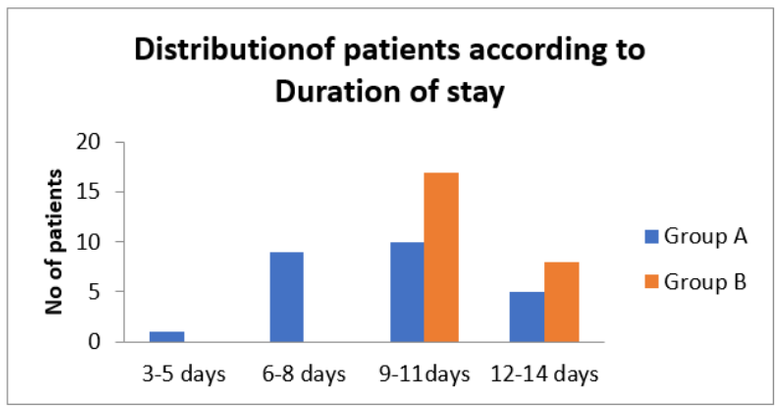
Graph 5

The duration of stay in hospital in group-A is 9.08**±2.75 and in group- B is 11.16±1.02 and z-value of this is x and p value are 0.006 which is significant.**

Table 8 can be depicted graphically as shown below:

Duration of stay	Group A		Group B		Fisher's Exact Test	P value
	No. of Patients	Percentage	No. of Patients	Percentage		
3-5 days	1	04	00	00	13.224	p=0.002 S
6-8 days	09	36	00	00		
9-11days	10	40	17	68.0		
12-14 days	05	20	08	32.0		
Total	25	100	25	100		
Mean**± SD**	9.08**± 2.75**		11.16**± 1.03**			

Table 8: *Distribution of patients according to duration of stay.*



Graph 6

The total no. of patients without any co-morbidities in group A (19) and B (20) were found be almost the same. While the no. of patients having hypertension in group A were twice the no. in group B i.e., 08 and 04 respectively. Alternatively, the no. of patients having both type 2 diabetes mellitus and hypertension were double in group B (08) compared to those in group A (04). Percentage of patients having only type 2 diabetes mellitus in group A (12%) was relatively higher than those in group B (08%).

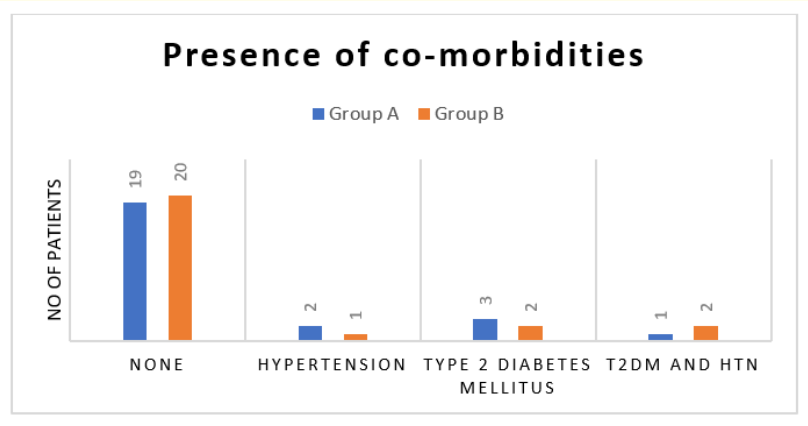
Table 9 can be represented graphically as shown below:

Co-morbidities	Group A		Group B		Fisher's Exact Test	p-value
	No. of patients	Percentage (%)	No. of patients	Percentage (%)		
None	19	76	20	80	1.116	1.00
Hypertension	02	08	01	04		
Type 2 diabetes mellitus	03	12	02	08		
T2DM and HTN	01	04	02	08		

Table 9: *Distribution of patients according to presence of co-morbidities.*

HHH Status	Group A		Group B		Fisher's Exact Test	p-value
	No. of patients	Percentage	No. of patients	Percentage		
None	21	84	22	88	.531	1.000
HCV +	03	12	02	08		
HbSAG+	01	04	01	04		
HIV	00	00	00	00		

Table 10: *Distribution of patients according to their HHH status.*



Graph 7

The no. of patients having HHH status as non-reactive were almost the same in both the groups, 21 and 22 in group A and B respectively. In group A, 12% of patients were HCV positive while that in group B were 08%. The percentage of patients having HbSAG positive were same in both the groups i.e. 04%. None of the patients from either of the groups had HIV.

The association of type of incision wound and surgical site infection in both the groups was compared. It is clear from the values that the number of patients infected with dirty wound in group B (10) were nearly three times more than the patients in group A (03). Also, patients having clean contaminated wound in group B (04) were twice the number in group A. Overall, there is significant relationship between the infection rate and type of incision wound as the p value is < 0.05 (0.003).

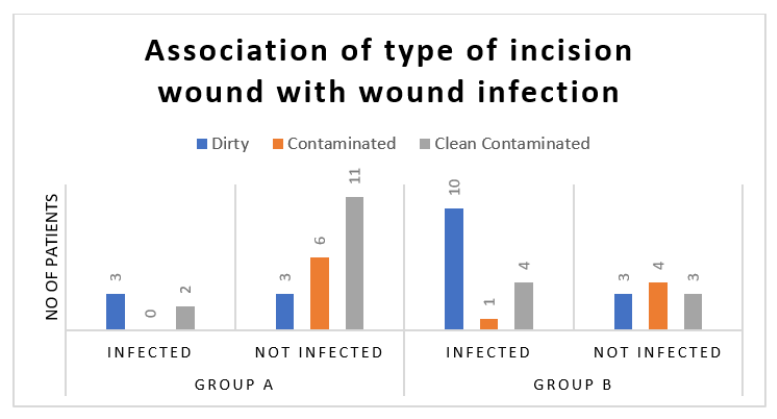
Table 11 can be depicted graphically as shown below:

Type of Incision Wound	Group A		Group B		z-proportion	p-value
	Infected	Not infected	Infected	Not infected		
Dirty	03	03	10	03	1.14	.252
Contaminated	00	06	01	04	1.12	.264
Clean Contaminated	02	11	04	03	1.97	.049*
Total	05	20	15	10	3.16	.002**

Table 11: *Association of type of Incision Wound & Surgical site infection in groups.*

Type of Incision Wound	Seroma in Group A		Seroma in Group B		z-proportion	p-value
	Present	Absent	Present	Absent		
Dirty	04	02	09	04	.11	.912
Contaminated	00	06	01	04	1.12	.264
Clean Contaminated	01	12	03	04	1.75	.080
Total	05	20	13	12	2.50	.012*

Table 12: *Association of type of Incision Wound and Seroma in groups.*



Graph 8

The association of type of incision wound and seroma formation in both the groups was compared. P value of 0.001 clearly shows highly significant relationship between the rate of seroma formation and type of incision wound.

Type of Incision Wound	Wound Dehiscence in Group A		Wound Dehiscence in Group B		z-proportion	p-value
	Present	Absent	Present	Absent		
Dirty	01	05	09	04	2.64	.008**
Contaminated	00	06	01	04	1.12	.264
Clean Contaminated	01	12	01	06	0.44	.663
Total	02	23	11	14	3.18	.001**

Table 13: *Association of type of Incision Wound and wound dehiscence in groups.*

The association of type of incision wound and wound dehiscence in both the groups was compared. P value (0.567) clearly shows that there is no significant relationship between the type of incision wound and the rate of wound dehiscence.

Discussion

In post-emergency laparotomy wound Surgical site infection, seroma formation and wound dehiscence remain to be the most common complications.

Development of a surgical site infection has a large impact on morbidity and mortality as well as healthcare costs, patient inconvenience and dissatisfaction.

Infectious complications are the main causes of post-operative morbidity in abdominal surgery wound, most common being superficial wound infection occurring mostly in the first week of surgery.

The use of negative suction drain in subcutaneous plane has shown significant reduction in the incidence of SSI, seroma formation and wound dehiscence.

M Vashist et. al study was done for abdominal wall closure and role of negative suction. In this study, age of patients ranging from 16 to 71 were taken and the maximum number of patients were in the age group between 20 and 40yrs which was 58% [15].

In our study, age group from 18 years to 80 years was taken and maximum number of patients ranged in the age group of 21 - 30 years (72%).

In our study, the rate of seroma formation in study group is 20% and in control group is 52% which shows a significant relationship like other studies mentioned below.

Nisar Ahmad et.al study shows seroma formation in surgical wound after laparotomy surgery was 16.74% in study group, in which negative suction drain was placed in subcutaneous plane and 72% in control group, in which no such drain was used [16].

Ramsey et.al study from April 2001 to 2004 shows that seroma formation in surgical wound 10.6% in control group and 9.8% in study group.

Study	Study group	Control group
In present study	20%	52%
Nisar Ahmad., *et al* [16]	16.74%	72%
Ramsay., *et al* [17]	10.6%	9.8%

Table 14: *Seroma formation in different study.*

In our study, the rate of seroma formation in study group is 20% and in control group is 52% which shows a significant relationship like other studies mentioned below.

Yagnesh Vaghani., *et al* [18] study shows, surgical site infection rate was 25% in study group and 57.7% in control group.

Another study was done by Takaaki Fuji., *et al* at department of general surgical science, graduate school of medicine, Gunma university Japan [19]. In this study surgical site infection rate was 14.3% in study group, and 38% in control group.

Study	Study group	Control group
In present study	20%	60%
Yagnesh et al	25%	57.7%
Takaaki et al	14.3%	38.0%

Table 15: *Comparisons of surgical site infection in different studies.*

In our study, the rate of wound dehiscence in study group is 20% and in control group is 52% which shows a significant relationship like other studies mentioned below.

Ramsey et.al study shows that wound dehiscence in study group was 21.8% and in control group was 15.3% which is not significant in this study.

Study	Study Group	Control Group
In present study	8%	44%
Ramsey., *et al.*	21.8%	15.3%

Table 16: *Comparisons of wound dehiscence in different studes.*

In our study, study group show that hospital stay is9.08 **± 2.75 days and in control group is 11.1 ± 1.02 days which also shows significance in two groups.**

Yagnesh., *et al* study shows that hospital stay for study group (Group A) was 12.0 ± 1.5 days and control group (Group B) was 18 ± 1.5 days.

Study	Study Group	Control Group
In present study	9.08 **± 2.75 days**	11.1 **± 1.02 days**
Yagnesh., *et al.*	12.0 **± 1.5 days**	18.0 **± 1.5 days**

Table 17: *Comparison of hospital stay in different studies.*

Our Study also shows the infection rate, seroma formation and wound dehiscence according to classification of incision wound.

In our study, it was found that the rate of surgical site infection and seroma formation is lower in all the types of wound as compared to control group as p value was < 0.05. while there is no statistical relationship found between the type of incision wound and the wound dehiscence as the p value was > 0.05 (0.567).

Summary And Conclusions

The present study was conducted on fifty patients to assess the role of negative suction drain in subcutaneous plane in reducing post laparotomy wound infection in the Department of General surgery.

Patients were randomly divided into two groups of twenty-five patients each, irrespective of their sex and were categorized into different age groups ranging from 18 to 80 years. Detailed history was taken and relevant investigations were carried out.

Group A (Study group), comprising of 25 cases of Emergency Exploratory laparotomy where Romovac negative suction drain was placed in subcutaneous space.

Group B (Control group), comprising of 25 cases of Emergency Exploratory laparotomy where no negative suction drain was placed.

- Daily observation of surgical site and drain output and content was done post operatively. The drain was removed on post-operative day 3 or till collection in drain was < 5ml over 24hrs. All patients were studied postoperatively in terms of surgical site infection, seroma formation and wound dehiscence. The result from both the groups compared and analyzed.

- The result of our study shows that surgical site infection rate was 20% in study group as compared to 60% in control group with p value 0.004 which is significant.

- Similarly, the rate of seroma formation in study group was 20% while that in control group was 52% with a p value of 0.018 with statistical significance.
- The incidence of wound dehiscence was found to be 8% in study group as compared to a very high rate of 44% in control group with p value of 0.004 which also is statistically significant.
- The mean duration of hospital stay in study group was 9.08± 2.753 while that in control group was 11.16± 1.02. It depicts early discharge of patients from hospital in study group.
- The association of the incidence of surgical site infection, seroma formation and wound dehiscence with type of incision wound was done.
- There was a significant relationship between the rate of surgical site infection, seroma formation and type of incision wound as the p value was < 0.05 which was not in the case of wound dehiscence as the p value was found to be 0.567 i.e., greater than the level of significance 0.05.

We conclude from the present study that the use of negative suction drain in subcutaneous plane during Emergency laparotomy surgery significantly reduces the incidence of post-operative surgical site infection, seroma formation, wound dehiscence and hospital stay.

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