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RESEARCH ARTICLE

COMPARING THE EFFICACY OF MODIFIED CONTINUOUS SMEAD-JONES VERSUS CONVENTIONAL CLOSURE OF MIDLINE LAPAROTOMY WOUND

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Abstract

Background: Disruption of abdominal incision is a serious event. Various methods have been employed in abdominal surgeries to close the abdominal wall. Abdominal wound dehiscence is a common complication of emergency laparotomy. There is an increase in the cost and hospital stays. Prevention of this complication is important in reducing post-operative morbidity and mortality.

Objectives: The study was carried out in the Department of General Surgery, MMC&RI, Mysuru.

1. To evaluate effectiveness of modified continuous Smead-Jones Technique.
2. To compare effectiveness of modified continuous Smead-Jones with conventional technique of abdomen wound closure on the basis of incidence of wound dehiscence.

Methods: The study was carried out on a total of 110 patients who were randomized in two groups of 55 each. 55 patients underwent closure of mid line laparotomy wound using modified continuous Smead-Jones technique (study group) and 55 patients underwent closure by conventional method (control group).

Results: The mean age group was 46 to 49. Male patients were more common compared to female. Out of the various causes of acute abdomen, Prepyloric perforation was the most common cause, followed by duodenal perforation. Out of 11 cases who had wound dehiscence, most of them were for Pre pyloric perforation (55%), second most common was ileal perforation (27%). Patients with risk factors had higher incidence of wound infection and wound dehiscence. Out of 110 patients, 32(29.1%) had wound infection, 12(21.8%) in the study group and 20(36.3%) in the control group. A total of 11(10%) patients had

wound dehiscence, only 2 (3.6%) patients in the study group, whereas 9 (16.3%) in the control group.

Interpretation and conclusion: Modified Smead-Jones technique decreases the incidence of wound dehiscence and can be used to close the midline laparotomy wound in cases requiring emergency midline laparotomy.

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..... **Introduction: -**

In a midline Laparotomy, the incision passes through different layers of the anterior abdominal wall from skin, subcutaneous tissue, linea alba and peritoneum. Healing can occur through primary or secondary intention. Whenever there is interference in the usual cascade of abdominal wound healing process, there is disruption in the abdominal wound that is also known as wound dehiscence.¹

Abdominal wound dehiscence or burst abdomen is a severe post-operative complication which is defined as post-operative separation of abdominal musculo-aponeurotic layers, which is recognized within days after surgery and requires some form of intervention. The incidence, as described in the literature, ranges from 0.4% To 3.5% with associated mortality of 9 to 44%. Prolonged hospital stays, high incidence of incisional hernia, and subsequent re-operations underline the severity of this complication.²

This abdominal wall disruption can be partial or complete. Partial disruption occurs when one or more layers have been separated but the underlying sheath and peritoneum remains intact. Complete disruption occurs when all the layers have disrupted which subsequently leads to visceral evisceration.

Various risk factors are responsible for wound dehiscence. General parameters like age, sex, nutritional status, pre-operative medical condition like anemia, diabetes, jaundice, renal failure, bad ASA (American Society of Anesthesiologists) scoring, type and duration of surgery and post-operative wound infection or increase in intra-abdominal pressure, intra-operative knot breakage, suture material rupture or suture cut through, emergency or elective surgery are the various factors leading to abdominal wall dehiscence.^{3,4}

The mass closure technique incorporates all layers of abdominal wall except skin in continuous technique offers certain benefits over the layered closure technique with respect to the time required for incision closure, incidence of wound dehiscence and incisional hernia. There are still controversies regarding the best method of midline abdominal wall closure in emergency, contaminated cases and no consensus exists about this issue.⁵

We have designed a study to compare the risk of wound infection and wound dehiscence between modified continuous Smead-Jones technique and conventional continuous technique in emergency midline laparotomy. We randomized two groups in 1:1 in which, Group A constituted modified Smead-Jones closure (far-near-near-far) and Group B constituted conventional abdominal closure studied on 110 patients who underwent midline laparotomies for different emergency indications.

Objectives:-

The study was conducted based on following moralities.

1. To evaluate effectiveness of modified continuous Smead-Jones Technique.
2. To compare effectiveness of modified continuous Smead-Jones with conventional technique of abdomen wound closure on the basis of incidence of wound dehiscence.

Methodology:-

This was a comparative study conducted on 110 patients who underwent emergency midline laparotomy. After being inducted into the study population following informed written consent, patient will be subjected to a detailed history and clinical examination, followed by preoperative investigations and intraoperative findings were recorded in a spectrum of proforma.

Source of data

All the eligible patients admitted to Department of General Surgery, Krishna Rajendra Hospital, Mysore Medical College and Research Institute, Mysore, Karnataka.

Study design:

A Prospective comparative study.

Sample size:

110

Study place:

Department of General Surgery, MMC&RI, Mysore.

Study period: 1.5 years (1st December 2020 to 30th June 2022)

Inclusion criteria:

All the patients undergoing midline laparotomy between the age group of 18 to 70 years.

Exclusion criteria:

1. Presence or suspicion of abdominal compartment syndrome.
2. Patient undergoing re-laparotomy within the period of one month
3. Patients who died within 10 days after surgery
4. Patients who underwent surgery other than midline incisions.
5. Sampling technique and study population

Sampling technique: Purposive

1. All eligible patients were allocated to either study or control group alternatively till 55 patients in each group.
2. In group A, 55 patients will undergo closure of mid line laparotomy wound using modified continuous Smead-Jones technique and are taken as studygroup. This method comprises suture approximation of rectus sheath with peritoneum and muscle in one layer, in continuous fashion. The entry and exit of PDS is 2cm from wound edges and 1cm from the edge of linea alba on either side. The distance between two adjacent sutures is not more than 2cm and they are in continuous manner.
3. In group B, 55 patients will undergo closure of midline laparotomy wound by conventional method and are taken as control group. Conventional closure included closure of rectus fascia with muscle first in a continuous fashion. The sutures are placed 2cm from the edge of linea alba on both sides and 1cm is maintained between two adjacent sutures.
4. In both groups, no. 1 synthetic, monofilament, delayed absorbable polydioxonesuture (PDS) was used to suture the fascia, followed by closure of subcutaneous tissue using vicryl 2-0 interrupted suture and skin closed using ethilon 2-0 interrupted mattress suture.
5. Other infection control measures such as pre-operative surgical site preparation, asepsis, antibiotic prophylaxis were maintained in both groups.
6. Appropriate antibiotic and analgesics were given before and after the procedure.
7. Primary outcome measures the efficacy of modified continuous Smead-Jones technique on midline laparotomy wound closure by measuring the incidence of abdominal wall dehiscence clinically at the end of 15 days by evaluating surgeon.

Statistical analysis

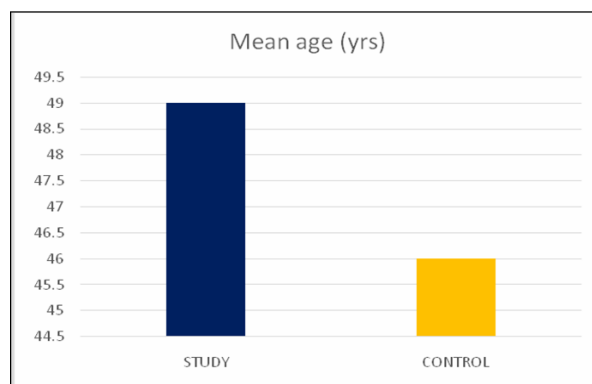
After calculating the sample size as described below, the data were collected from the study group and will be entered in Microsoft excel software program and each variable was analyzed using SPSS software version 21.0 and tabulated. Descriptive statistics, mean, standard deviation, percentage, test of proportion, bar charts, pie charts were used wherever applicable. And each variable was analyzed using SPSS software version 21.0 and tabulated. Descriptive statistics, mean, standard deviation, percentage, test of proportion, bar charts, pie charts were used wherever applicable.

Results: -

A total of 110 patients were included in the study. Results of the study are discussed according to various parameters as below.

Table 1:- Age distribution.

Groups	Number of patients	Mean age (years)
Study	55	49.09 + 14.22
Control	55	46.45 + 13.26
Total	110	

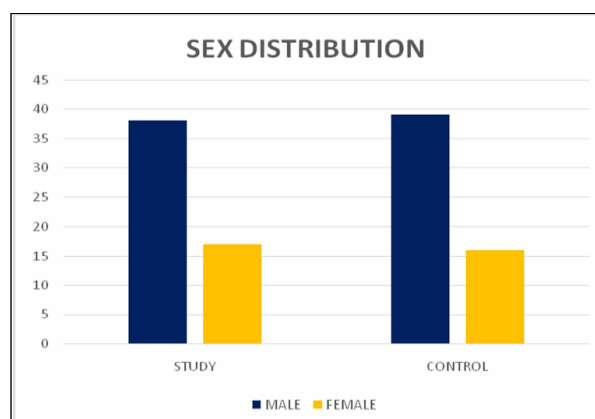
**Figure1: -** Age distribution.

The mean age of patients was 47 years.

The mean age among the study group was 49 years and the mean age among the control group was 46 years.

Table2: - Sex distribution.

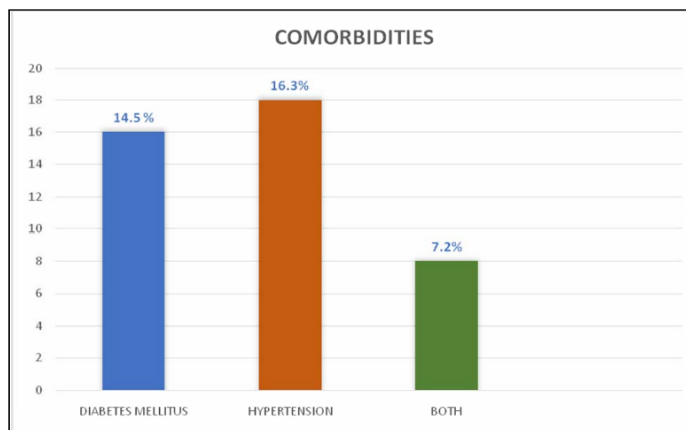
Groups	Total Number	Male		Female	
		Number	Percentage (%)	Number	Percentage (%)
Study	55	38	69.1	17	30.1
Control	55	39	70.1	16	29.1
Total	110	77	70	33	30

**Figure2: -** Sex distribution.

Among 110 patients, 77(70%) were male and 33(30%) were female.

Table3:- Comorbidities.

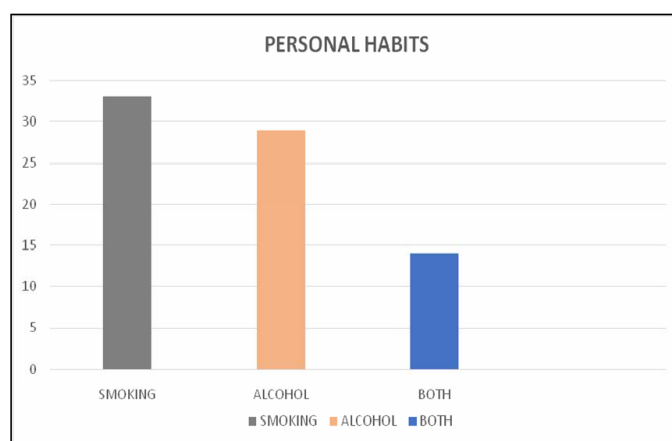
Groups	TotalNumber	Diabetes		Hypertension		Both	
		No.	%	No.	%	No.	%
Study	55	9	16.3	9	16.3	4	7.2
Control	55	7	12.7	9	16.3	4	7.2
Total	110	16	14.5	18	16.3	8	7.2

**Figure3:-** Comorbidities.

Among 110 patients, 16(14.5%) were diabetic and 18(16.3%) were hypertensive, whereas 8(7.2%) were both hypertensive and diabetic.

Table 4:- Personal habits.

Groups	TotalNumber	Smokers		Alcoholic		Both	
		No.	%	No.	%	No.	%
Study	55	18	32.7	14	25.4	8	14.5
Control	55	15	27.2	15	27.2	6	10.9
Total	110	33	30	29	26.3	14	12.7

Figure4: - Personal habits.

Among 110 patients, 33(30%) were smokers and 29(26.3%) consumed alcohol regularly, while 14(12.7%) had a history of both smoking and consumed alcohol regularly.

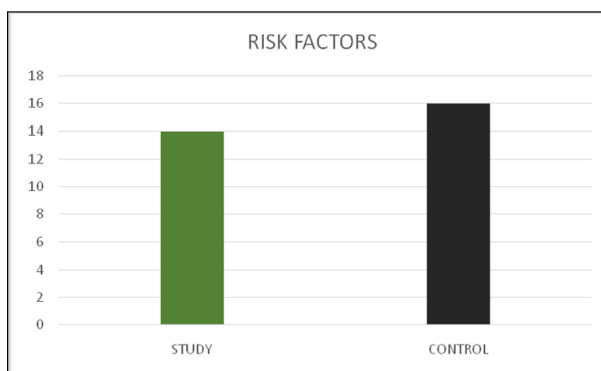
In the study group, 18(32.7%) were smokers, 14(25.4%) were alcoholics and 8(14.5%) consumed both.

In the control group, 15(27.2%) were smokers, 15(27.2%) were alcoholics and 6(10.9%) consumed both.

Among 110 patients, 16(14.5%) were diabetic and 18(16.3%) were hypertensive, whereas 8(7.2%) were both hypertensive and diabetic.

Table 5:- Risk factors.

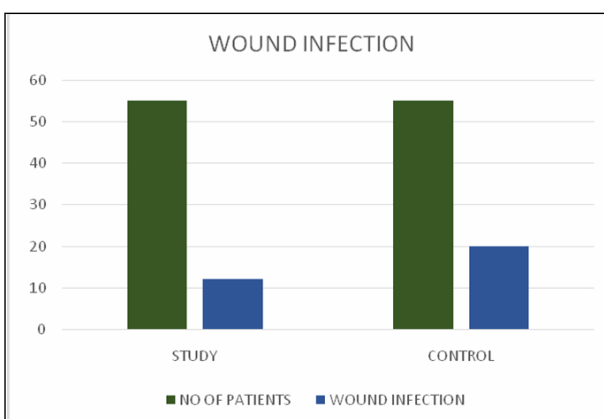
Groups	Total Number	Patients with risk factors	
		Number	Percentage
Study	55	14	25.4
Control	55	16	29.1
Total	110	30	27.2

**Figure5: - Risk factors.**

Risk factors (other than smoking, alcoholism, DM, HTN) such as Anemia, COPD, Chronic liver disease, immunosuppression, renal failure, hypoalbuminemia, malnutrition, radiation exposure was identified. Among 110 patients 30 (27.2%) of the patients has at least 1 risk factor. In the study group, 14(25.4%) of the patients had at least 1 risk factor. In the control group, 16(29.1%) of the patients had atleast 1 riskfactor.

Table 6:- Wound infection.

Groups	Total Number	Wound infection	
		Number	Percentage
Study	55	12	21.8
Control	55	20	36.36
Total	110	32	29.1

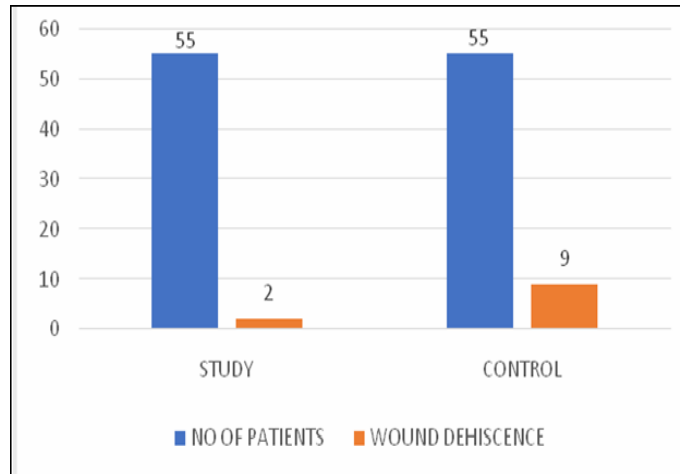
**Figure6:- Wound infection.**

Out of 110 patients, 32(29.1%) had wound infection.

In the study group, 12(21.8%) had wound infection, whereas 20(36.3%) had wound infection in the control group.

Table7:- Wound dehiscence.

Groups	Total Number	Wound dehiscence	
		Number	Percentage
Study	55	2	3.6
Control	55	9	16.3
Total	110	11	10

**Figure7:-** Wound dehiscence.

A total of 11(10%) patients had wound dehiscence. Only 2 (3.6%) patients in the study group had wound dehiscence whereas 9(16.3%) patients had wound dehiscence in the control group. P-value <0.05 and is statistically significant.

Chi-Square Tests				
	Value	df	Asymp.Sig.(2-sided)	Exact Sig. (2-sided)
Pearson Chi-Square	4.949	1	.026	
Fisher's Exact Test				.050

Thus, the statistical analysis concludes that midline laparotomy wound closure with modified Smead-Jones technique is better in preventing the incidence of wound dehiscence.

Table8:- Wound infection and dehiscence among patients with risk factors.

Groups	Number	Wound infection		Wound dehiscence	
		Number	Percentage (%)	Number	Percentage (%)
Smokers	33	13	40	6	54.5
Alcoholic	29	13	40	5	45.4
DM	16	7	21.8	2	18.1
HTN	18	9	28.1	3	27.2
Other risk factors	30	23	71.8	9	81.1

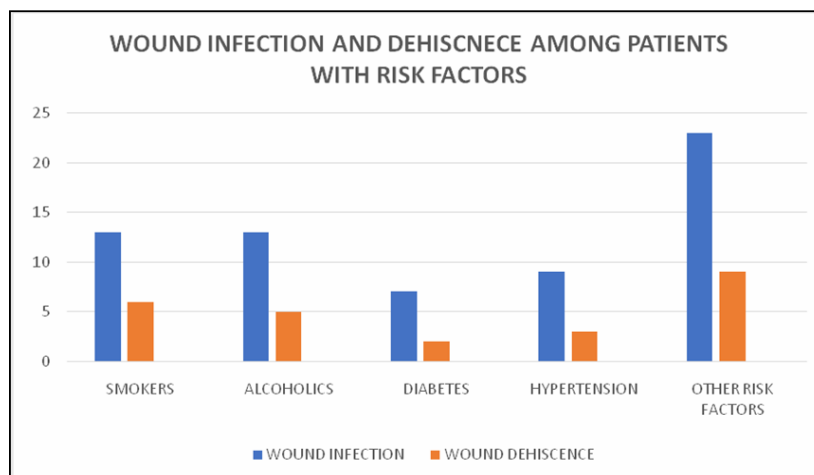


Figure8:- Wound infection and dehiscence among patients with risk factors.

Among the patients who had wound infection and wound dehiscence, patients with risk factors had higher incidence of wound infection and wound dehiscence. Wound infection among smokers and alcoholics was 40%. Similarly, wound dehiscence among smokers and alcoholics was 54.5% and 45.4% respectively. Incidence of wound infection among non-smokers was 25.9% and non-alcoholics was 24.6%.

Table 9:- Abdominal wound dehiscence according to underlying intra-abdominal pathology.

Intraabdominal pathology	Study	Control	Total
Prepyloric perforation	1	5	6
Rutured splenic abscess	0	1	1
Ileal perforation	1	2	3
Duodenal perforation	0	1	1
Total	2	9	11

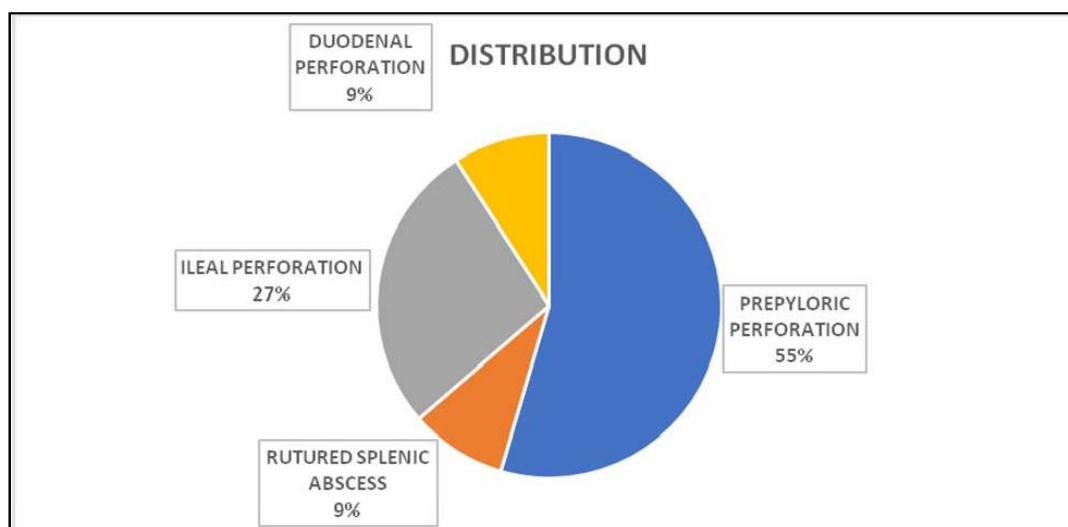


Figure 9:- Abdominal wound dehiscence according to underlying intra-abdominal pathology.

Out of 11 cases who had wound dehiscence of midline laparotomy wound, most of them were for Pre pyloric perforation (55%), second most common was ileal perforation (27%), followed by ruptured splenic abscess and duodenal perforation.

Discussion:-

Separation of abdominal wounds (i.e., dehiscence) with or without protrusion of intra-abdominal contents (i.e., evisceration) causes significant morbidity and mortality. The mean time to wound dehiscence is 8 to 10 days after operation. Wound dehiscence is characterized by pink serosanguinous discharge from the wound. Sometimes it may present acutely with a large subcutaneous hematoma or a swelling that distends the wound reflecting herniation of bowel through the walls of the abdomen.

Risk factors for wound dehiscence include advanced age (>65 years), ascites, obesity, steroid use, hypoalbuminemia, anemia, prolonged ileus, coughing, wound infection, COPD, pneumonia, stroke with residual deficit, emergency operation and operative time greater than 2.5 hours.

Acute wound failure is often related to technical errors in placing sutures too close to the edge, too far apart, or under too much tension.

Acute wound failure can be prevented by proper spacing of the suture, relaxation of the patient during closure, adequate depth of bite of the fascia and achieving a tension-free closure. Interrupted closure is a wise choice for very high-risk patients. Alternative methods of closure must be selected when primary closure is impossible without undue tension.

In post-operative period when abdomen distends, the continuous sutures readjust themselves because of its inherent elasticity in such a way that there is uniform distribution of tension along the suture line by to and fro movements of loops of suture.

A randomized control study conducted by Raxith Sringeri et al in 2017, on 100 consecutively enrolled patients who underwent emergency midline laparotomy and laparotomy wound was closed by modified Smead-Jones technique in study group and conventional technique in control group. The study showed that among the causes of peritonitis, duodenal ulcer perforation was the most common cause and also showed that rate of wound dehiscence in study group (1%) was much lesser than that in control group (14.9%). The study concluded that modified version of Smead-Jones technique of laparotomy wound closure with prolene loop has very low incidence of early complication and may reduce the late complication and this technique was superior to other conventional method of closure.⁶

A prospective comparative study was conducted by Chirag B Aghara et al, in 2020 on 100 patients concluded that Modified Smead-Jones technique is better than conventional continuous technique in management of midline laparotomy closure with respect to wound infection and wound dehiscence.⁷

A systematic review and meta-analysis of randomized control trials conducted by Nicole CF Hodgson onto determine which suture material and technique reduce the odds of incisional hernia, concluded that abdominal fascial closure with continuous non absorbable suture significantly reduces the rate of incisional hernia.⁸

Smead proposed interrupted double loop fascial closure, which was later popularized by Jones in 1941. In this technique there is no much loss in elasticity or compliance of suture material and it causes more secure approximation of fascial edges. Wound edges remain well approximated due to distribution of the tension between two loops and the suture does not cut through the fascia.

We modified original interrupted Smead-Jones to continuous Smead-Jones as continuous suturing is faster and simultaneously preserving advantages of original Smead-Jones technique of distributing tension load uniformly along the suture line and thereby effective in preventing abdominal wound dehiscence.

In our study we found that wound dehiscence rate in conventional closure was about 16.3% and in modified continuous Smead-Jones technique was 3.6% and the difference is statistically significant ($p < 0.05$), thus inferring that modified continuous Smead-Jones technique is better than the conventional closure.

We did not study the late complications (i.e., development of incisional hernia) in both groups as it requires longer follow up period, but studies show that the rate of development of incisional hernia is proportional to rate of incidence of wound dehiscence.

According to us, modified Smead method of closure can be used as a preferential method of abdominal wall closure in all midline laparotomy incisions, even in cases more prone for abdominal dehiscence due to patient factors such as abdominal sepsis.

Conclusions:-

In our study, 110 cases that underwent midline laparotomy for acute abdomen during the period of one and half year, the following observations were made:

1. The present study showed that among the patients who underwent midline laparotomy, the mean age group was 46-49 years.
2. Male patients were more common as compared to female.
3. Out of the various causes of acute abdomen, Pre pyloric perforation was the most common cause, followed by duodenal perforation.
4. Out of 11 cases who had wound dehiscence of midline laparotomy wound, most of them were for Pre pyloric perforation (55%), second most common was ileal perforation (27%),
5. In emergency setting, patients with generalized peritonitis need special attention to wound closure. Our new technique of closure of midline laparotomy wound, especially in Indian setup, decreases the incidence of wound dehiscence.
6. Thus, our study concludes that modified continuous Smead-Jones technique of midline laparotomy wound closure had low incidence of wound dehiscence and might also decrease the incidence of incisional hernia on longterm.

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