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RESEARCH ARTICLE

COMPARATIVE STUDY BETWEEN MONOLAYER CLOSURE VERSUS DOUBLE LAYER CLOSURE IN MIDLINE LAPAROTOMY-IN A TERTIARY CARE HOSPITAL IN TRIPURA, INDIA.

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Manuscript Info

Abstract

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Introduction:-

Laparotomy is one of the most common surgery performed in an emergency as well as elective setting. Incision and suturing of the abdominal layers are the commonest exercises in operative surgery. Abdominal closure is very important and incision, technique of repair and use of newer suture material has created great interest to surgeons. Different suture techniques are used for closure of laparotomy wounds and each has its strong proponents. Ideal method of abdominal wound closure is modified frequently.

Various approaches have been employed to access the abdominal cavity during abdominal surgeries. Several types of incisions can be made to access the abdominal cavity guided by the type of surgery to be performed, one of them being midline incision; which is commonly used in abdominal operations.¹ There are nine layers in the anterolateral abdominal wall, from outside: skin, subcutaneous tissue, superficial fascia, external oblique muscle, internal oblique muscle, transversus abdominis muscle, transversalis fascia, pre-peritoneal adipose tissue and peritoneum. In the midline the three layers of muscles are adherent together by way of their aponeuroses to form the linea alba; which is attached superiorly onto xiphoid process and inferiorly onto symphysis pubis. In performing midline incision a vertical cut is made through the linea alba.

Abdominal wound closure following midline incision entails reconstructing these layers by different techniques using different suture materials. The goals of fascial closure include even distribution of tension along suture lines and maintenance of tensile strength across the wound until tissue tensile strength is adequate.² Closure can be achieved by reconstructing peritoneum and musculo-aponeurotic layer separately or by mass closure in which all the fascial layers are closed together leaving skin, which is closed separately. The latter technique is widely accepted as the standard abdominal wall closure. The ideal abdominal wound closure provides strength and a barrier to infection, in addition it should be efficient to perform and comfortable for the patient.³

Selection of a wound closure technique must also take into account the dynamic changes in wound length during distention which may lengthen the wound to some degree. A continuous suture can accommodate this increase in the length of the incision by having an adequate reserve of suture length in the wound. Consequently, a continuous suture distributes its tension throughout the wound, limiting the forces on the tissues encircled by the suture. With interrupted closure, the suture cannot easily accommodate these changes in incision length and the tension remains

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isolated to each suture loop.⁴ Time can be saved by closing the fascia in continuous rather than interrupted fashion without causing an increase in post operative wound separation or hernia formation.⁵

Wound disruptions are frequent as a result of fascial tearing at the site of suture, thus placing the sutures farther from the cut edges reduces the risk of disruption. Sanders and colleagues⁴ reported that placing sutures 5mm from the cut edges of the fascial wounds burst much more easily than placing 1 to 2cm from the fascial edges. The optimal depth of the suture bite is advocated to be at least 4mm and the ideal interval between the sutures be 6mm. Three-throw square knots are recommended and free suture end should be cut 3mm from the knot.

A midline incision is frequently used in abdominal surgery. It provides a relatively quick and wide access to the abdominal cavity and can be made with minimal damage to muscles, nerves and blood supply as these structures do not cross the midline.⁶⁻¹⁰

Techniques for closure of the midline abdominal incision have varied over time with better understanding of the physiology and engineering of closure of the abdominal wall and improvement in materials of surgical suture. The ideal wound closure provides strength and barrier to infection. To achieve that goal closure should be fast, efficient, performed without tension/causing ischaemia, comfortable to the patient, technically easier to surgeon and aesthetic. Hence, one should follow the principles of wound closure.¹⁰

The optimal strategy of abdominal wall closure after midline laparotomy has remained an issue of ongoing debate. To date, various randomized clinical trials and meta-analyses on abdominal wall closure strategies after midline laparotomy have been published with heterogeneous results. A recent meta-analysis identified several randomized clinical trials on techniques and materials of abdominal wall closure after midline laparotomy.⁸ Despite these meta-analyses and randomized clinical trials, the optimal technique and material for abdominal fascia closure after midline laparotomy remains inconclusive as a result, abdominal fascia closure is performed according to the surgeon's individual preference rather than according to evidence based data. Lack of guidelines for abdominal fascial closure leaves surgeons uncertain about the optimal technique and suture material to be used worldwide. Thus, practices of abdominal fascial closure differs greatly from one centre to another, differences also exists even among surgeons themselves in the same centre. Complications arising following abdominal fascial closure are fairly common especially in resource limited countries.¹¹

Since 1973, different workers have carried out comparative studies of these two methods with encouraging results and single layer closure was found to have definite advantages over conventional closure with regard to operating time, cost, morbidity and complications.

The objective of this study is to compare the mono layered closure with double layered closure in midline laparotomy on the basis of postoperative morbidity such as wound sepsis, wound dehiscence, stitch sinus formation, persistent wound pain and incisional hernia and to describe the frequency of complications after each procedure.

AIM:-

To compare monolayer and double layer closure of abdominal wall in cases of midline laparotomy

Objectives:-

To observe the post operative complications in monolayer closure versus double layer closure in midline laparotomy regarding following points -

1. Wound sepsis
2. Wound dehiscence
3. Stitch sinus formation
4. Persistent wound pain
5. Incisional hernia

Methodology:-

Study design

Hospital-based observational prospective study.

Study area

Department of Surgery, A.G.M.C & G.B.P. Hospital.

Study sample

Patients who under-went midline laparotomy in Department of Surgery, A.G.M.C & G.B.P. Hospital between January 2015 to December 2015. All patients were followed up after surgery for 6 months, concluding in June 2016.

Study duration

The study will be conducted from January 2015 to June 2016

Inclusion criteria

Patients underwent midline laparotomy in Department of Surgery, A.G.M.C & G.B.P.

Hospital, during the study period, who consented to participate in the study were included.

Exclusion criteria

Those with previous abdominal incisions.

Patients with advanced malignancies (inoperable malignancies), immunocompromised patients, diabetic patients.

Patients who underwent obstetric procedures.

Patients who didn't gave the consent.

Materials and Method:-

1. Patient who fulfill the inclusion criteria were enrolled for study following recording of the relevant data in a structured questionnaire and valid consent was taken.

2. Procedure:-

Mono layer closure- In this all the fascial layers are closed together leaving skin which was closed separately.

Double layer closure- In this the peritoneum and the musculoaponeurotic layers are closed separately making two layers and leaving skin which was again closed separately.

3. Suture Material Used- Resorbable suture material (Vicryl)

4. Follow up of the patient for a period of 6 month and following points were noted:-

1. Wound dehiscence
2. Wound sepsis
3. Stitch sinus formation
4. Persistent wound pain
5. Incisional hernia

Skin was closed with non-absorbable monofilament material (Ethilon) using interrupted mattress sutures in both groups of patients.

Drains were used wherever necessary, through a separate stab incision.

Post operative:-

All the patients received antibiotics suitable for the case parenterally, usually for 2-3 days and orally for 5-7days. Antibiotics were continued only whenever indicated after 10 days.

The wound was examined on 3rd, 5th, 7th and 9th or 10th day and the condition of the wound noted. Drains wherever employed were removed on 2nd or 3rd day unless required.

The sutures were removed between 7th to 10th days in both the groups.

During the post operative period, the patients were examined for abdominal distension, vomiting, hiccup and chest infection. Wound sepsis was also noted. Regular examination of the wounds for signs of wound dehiscence and stitch sinus formation was done.

In this study:-

Wound sepsis was considered if any one of the following criteria was fulfilled: purulent drainage from the incision, at least one of the following signs or symptoms of infection: pain or tenderness, localized swelling, redness, or heat. Wound dehiscence was considered when wound infection reached muscle and there was separation of the skin and wound edges.

Stitch sinus formation was considered when there is narrow connection from a deep infection to the skin.

Persistent wound pain was considered when wound pain was causing any degree of limitation to activities beyond one month.

Incisional hernia was considered to be present when a protruding swelling was noticed and a fascial defect was palpable in the wound during postoperative follow up of the patient, in supine position, lifting both legs, head raising test or expansile impulse on coughing.

Follow up: Regular monthly follow up was done for first 3 months, then at the end of 6th month. During the follow up, the patients were examined for scar, persistent wound pain and incisional hernia.

Data Analysis:-

The data was analyzed for comparison between single layer closure and double layer closure of laparotomy wounds by using incidence rate and un-paired student T test for continuous numerical values, and chi square test for categorical value.

Information from the questionnaires was entered into the computer by using SPSS version 21 programme. Frequency tables and tests for significance (t-test, chi square test, etc.) were used for analysis.

Results:-

In this study, ages of the patients were ranged from 15 to 65 years in both groups.

Male: Female ratio in this study was 4: 1.

Number of patients repaired with monolayer or double layer closure in emergency or elective midline laparotomy:

Type of Surgery	Type of Closure		Total
	Mono layer	Double layer	
Elective	23	24	47
Emergency	27	26	53
Total	50	50	100

Table 1:-Type of surgery in patient undergoing laparotomy

Time taken for suture removal following midline laparotomy:

Time taken for suture removal	Type of closure		Total
	Mono layer	Double layer	
7 days	27	26	53
8 days	12	13	25
9 days	8	7	15
10 days	3	4	7
Total	50	50	100

Table 2:-Time taken for suture removal following laparotomy

In this study, 53% of patients undergoing laparotomy had suture removal done on 7th post operative day and 25% on 8th post operative day. The mean time taken was 7.74 days for mono layer closure method and 7.75 days for double (conventional) layered closure method.

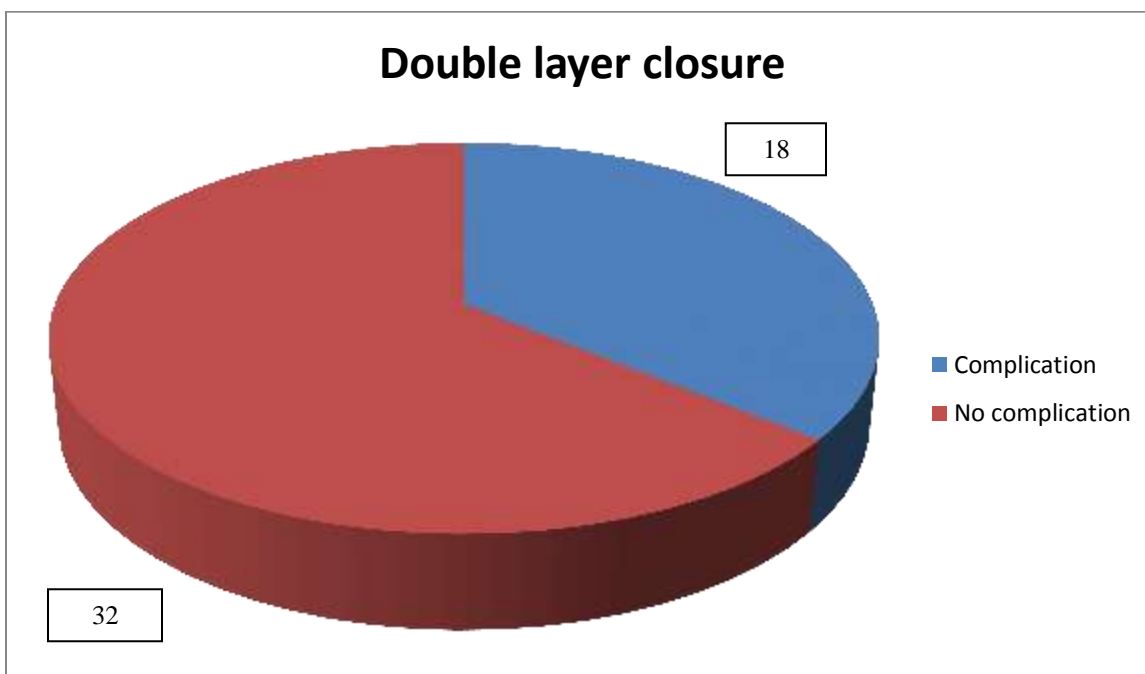
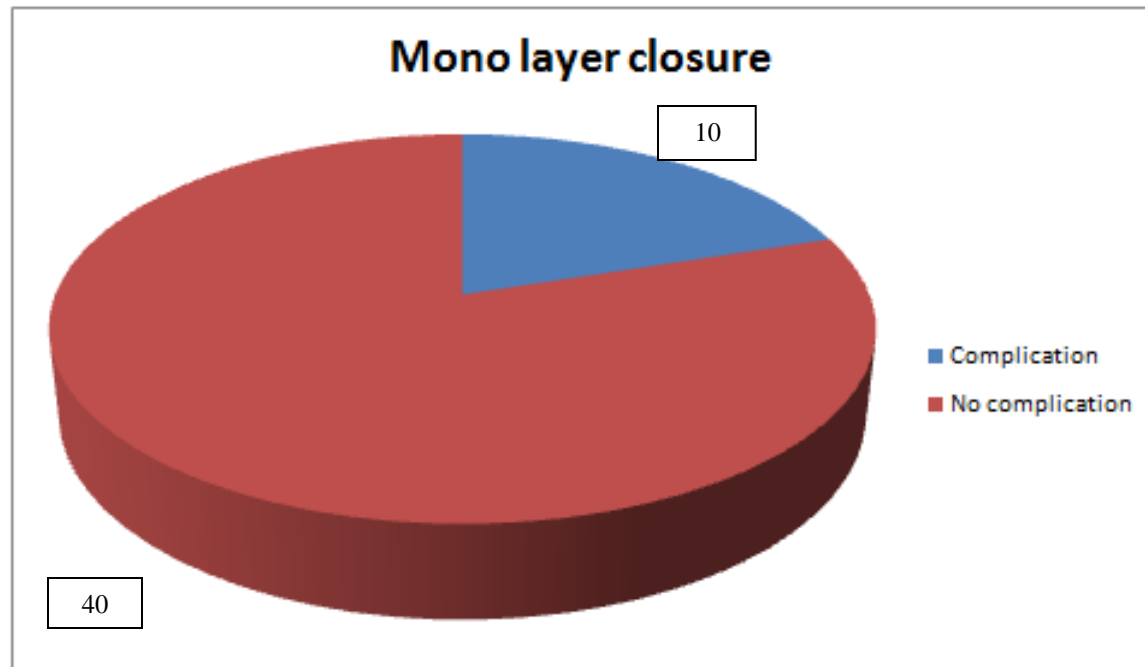
Factors affecting wound healing in this study are - anemia, hypertension, uremia, hyper bilirubinemia, chest infection and cough and hypoproteinemia.

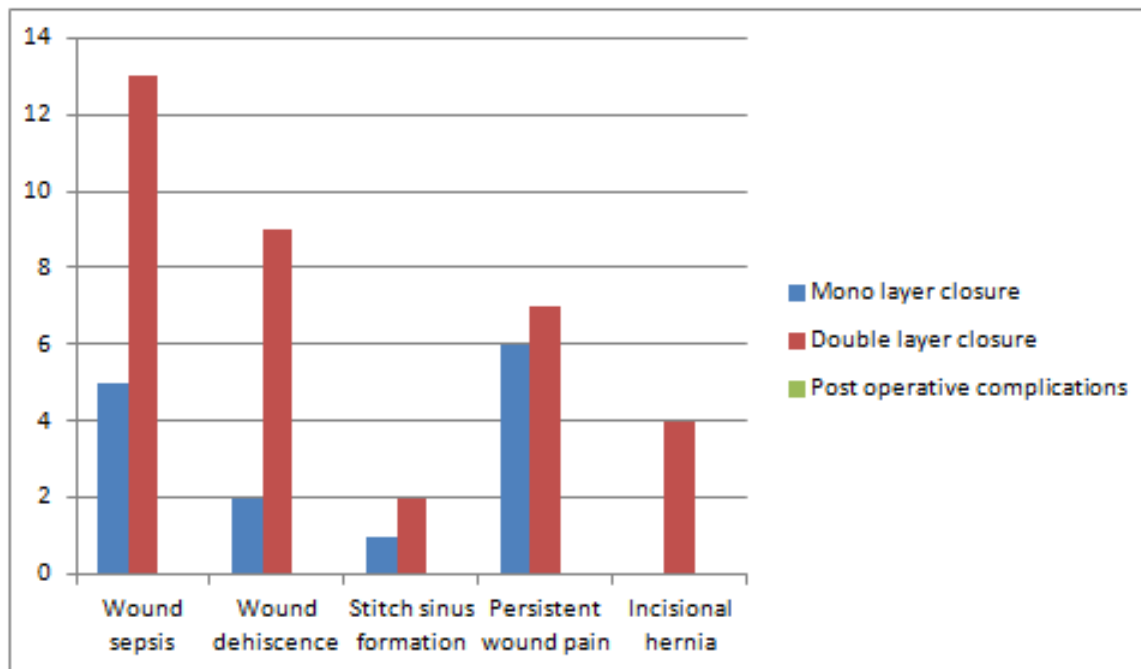
Factors	Type of closure		Total
	Mono layer	Double layer	
Anemia	12	11	23
Hypertension	2	3	5
Uremia	2	1	3
Hyperbilirubinemia	4	3	7
Chest infection and cough	3	3	6
Hypoproteinemia	0	1	1

Table 3:-Factors affecting wound healing in study groups

Post Operative Complication in the Study Group:-

In this study, in single layer closure group, total 10 patients (20%) and in double (conventional) layered closure group, 18 patients (38%) had post operative complication like wound sepsis, wound dehiscence, stitch sinus formation, persistent wound pain and incisional hernia.





Wound sepsis:-

In mono layer closure group, all the 5 patients who had wound sepsis underwent emergency surgery. In that 2 patients was anemic and 1 patient had uremia. In double layer closure group, out of 13 patients who had wound infection 8 underwent emergency surgery and 5 patients had anemia.

Wound gaping:-

In mono layer closure group, both the patients who had wound gaping underwent emergency surgery and both had chest infection with cough. One patient was anemic and the other was hypertensive.

In double layer closure group, out of 9 patients who developed wound gaping, 6 patients underwent emergency surgery, 2 patients was anemic and 1 patient was hypertensive in this group.

Stitch sinus formation:-

In mono layer closure group, 1 patient who developed stitch sinus formation underwent emergency surgery and was anemic. In double layer closure group, 2 patients had stitch sinus formation, 1 had anemia, other one had hypoproteinemia and both underwent emergency surgery.

Persistent wound pain:-

In mono layer closure group, persistent wound pain occurred in 6 patients. These patients underwent emergency surgery.

In double layer closure group, persistent wound pain occurred in 7 patients, all operated on an emergency basis.

Incisional hernia:-

None of the patient in mono layer closure group had incisional hernia.

In double layer closure group, 4 patients had incisional hernia 4 months after the surgery. 1 patient underwent emergency surgery for intestinal obstruction with gangrenous jejunal segment. He also had uremia and chest infection and had developed wound sepsis and dehiscence in the immediate postoperative period.

Study	Wound sepsis		Wound dehiscence		Stitch sinus formation		Persistent wound pain		Incisional hernia	
	MLC	DLC	MLC	DLC	MLC	DLC	MLC	DLC	MLC	DLC
Togart 1967	17%	29%	0.87%	3.4%	-	-	-	-	-	-
Shukla et al 1981	0.5%	16.9%	2%	13%	-	-	-	-	0%	3%
Singh et al 1981	6.6%	16.6%	0%	10%	-	-	-	-	0%	6.6%
Choudhary & Choudhary 1994	22.5%	47.5%	-	-	-	-	-	-	-	-
Chalya et al 2015	42%	40%	6.9%	33.3%	16.7%	17.2%	11.8%	13.3%	4.4%	30%
Present study	10%	26%	4%	18%	2%	4%	12%	14%	0%	8%

Table 4:-Comparison of postoperative complications in earlier studies with present study

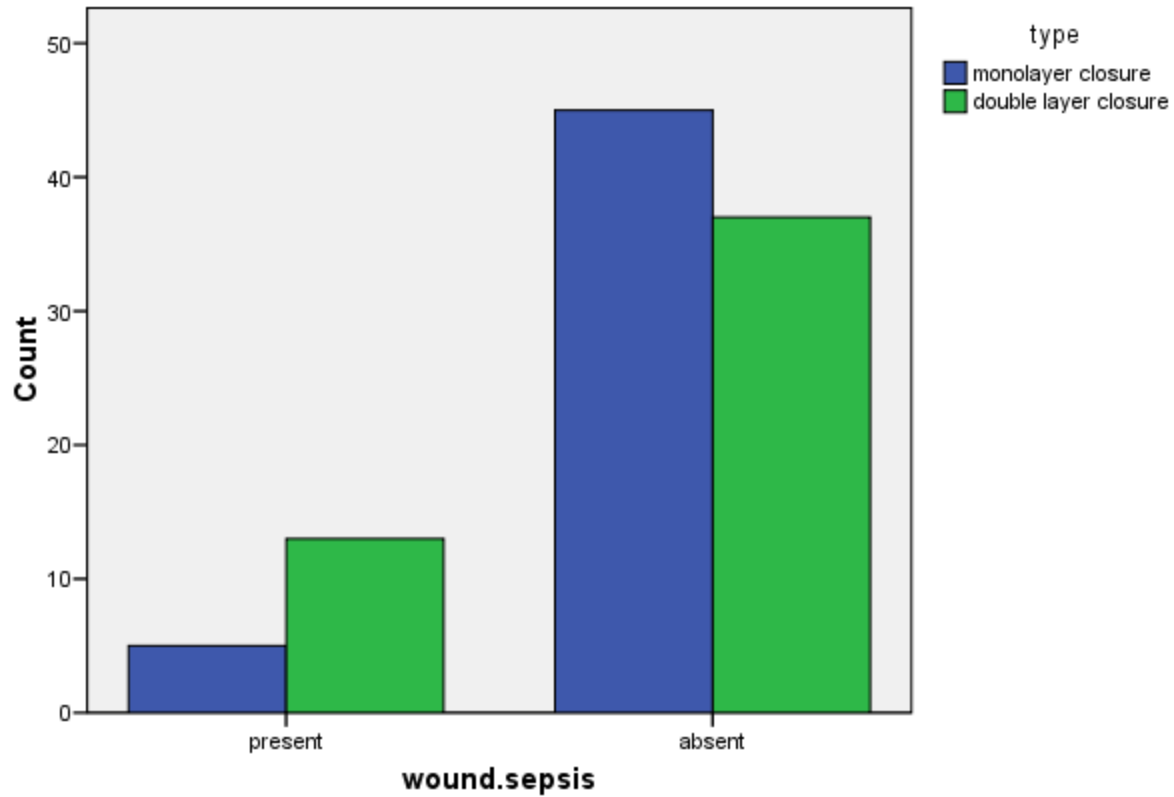
wound.sepsis * type Crosstabulation

Count

Wound sepsis		type		Total
		monolayer closure	double layer closure	
wound.sepsis	present	5	13	18
	absent	45	37	82
Total		50	50	100

P value: 0.037(P<0.05). Significant

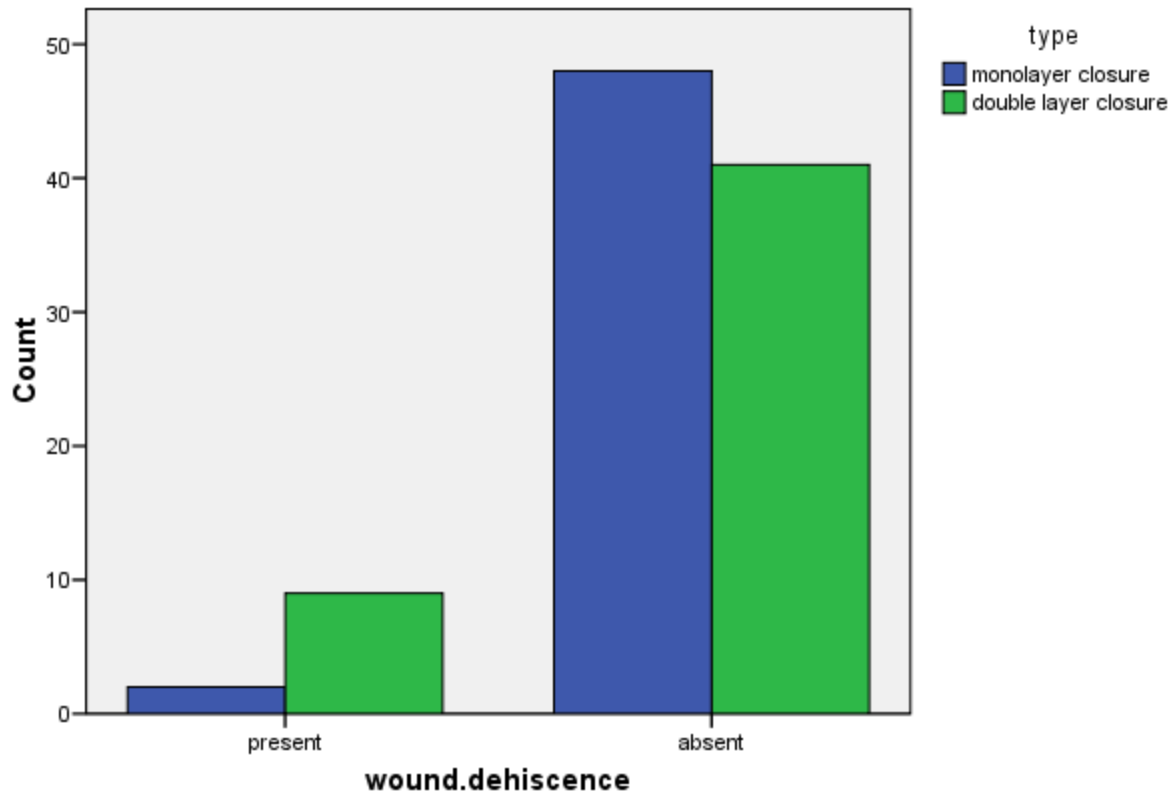
Bar Chart



wound.dehiscence * type Crosstabulation

Wound dehiscence		type		Total
		monolayer closure	double layer closure	
wound.dehiscence	present	2	9	11
	absent	48	41	89
Total		50	50	100

P value: 0.025(P<0.05) Significant

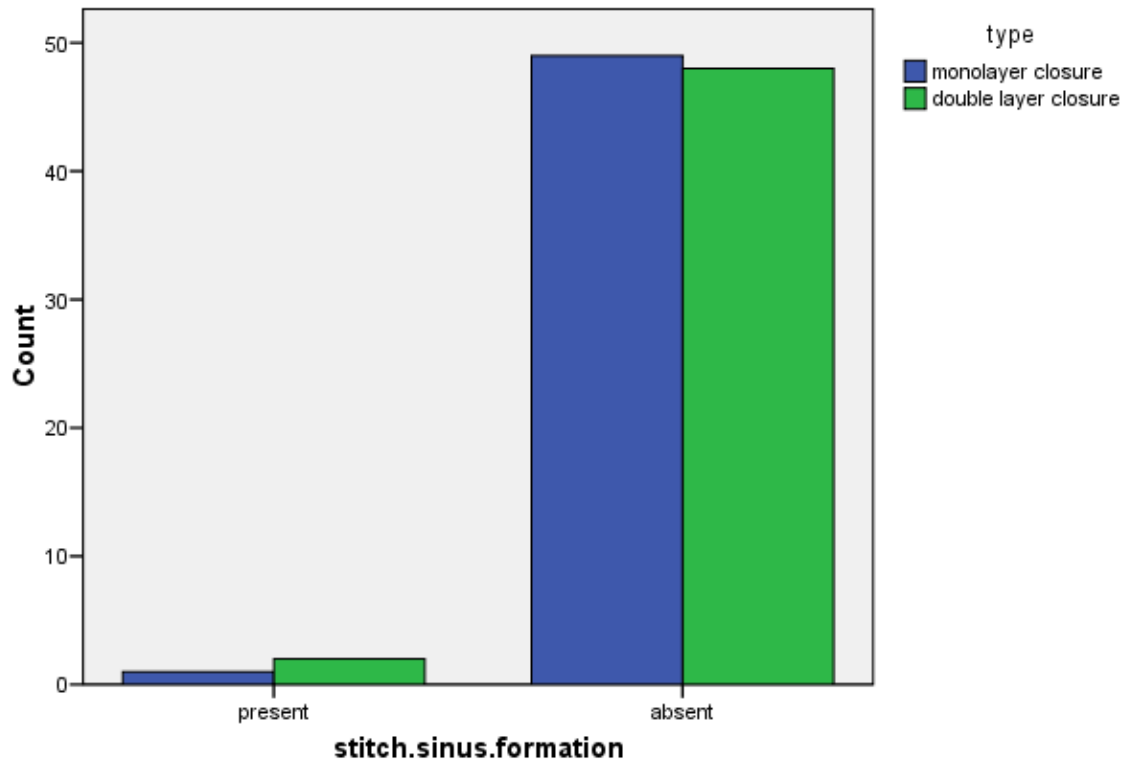
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Stitch sinus formation
stitch.sinus.formation * type Crosstabulation

Count		type		Total
		monolayer closure	double layer closure	
stitch.sinus.formation	present	1	2	3
	absent	49	48	97
Total		50	50	100

P value: 0.55 ($p > 0.05$) Not significant

Bar Chart

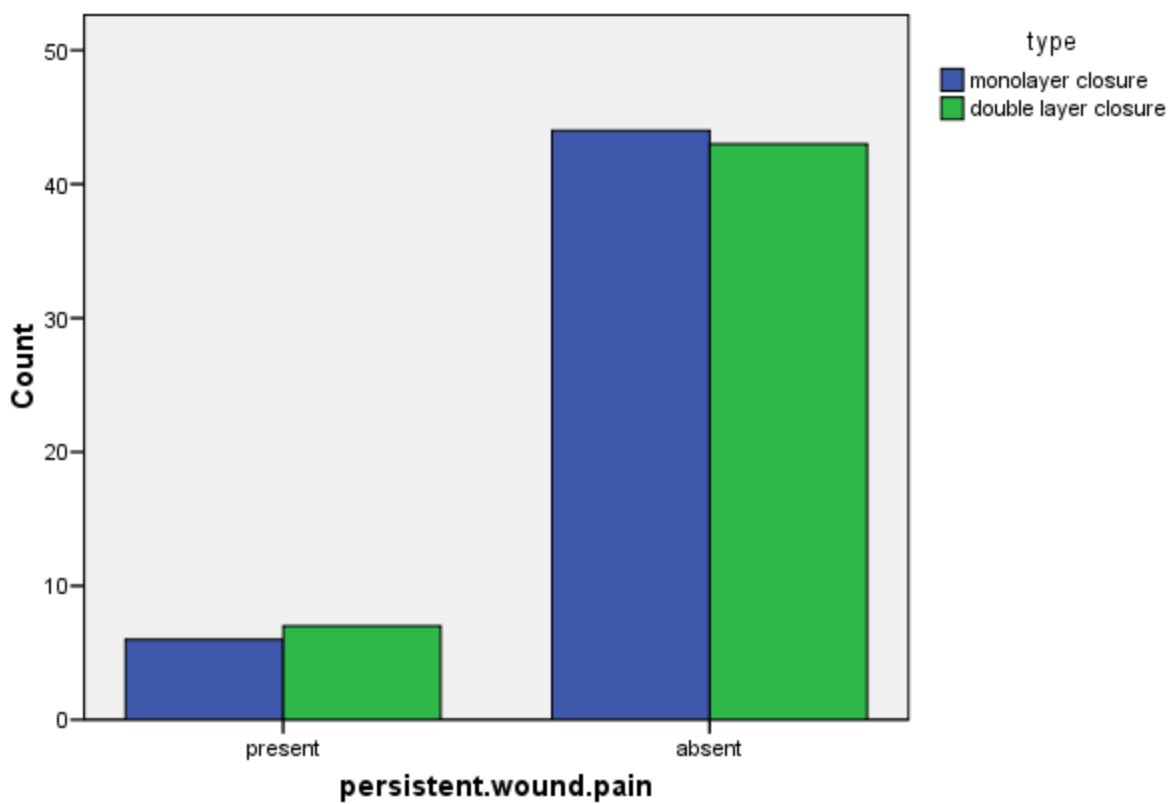


persistent.wound.pain * type Crosstabulation

Persistent wound pain		type		Total
		monolayer closure	double layer closure	
persistent.wound.pain	present	6	7	13
	absent	44	43	87
Total		50	50	100

P value: 0.76 (P>0.05) Not significant

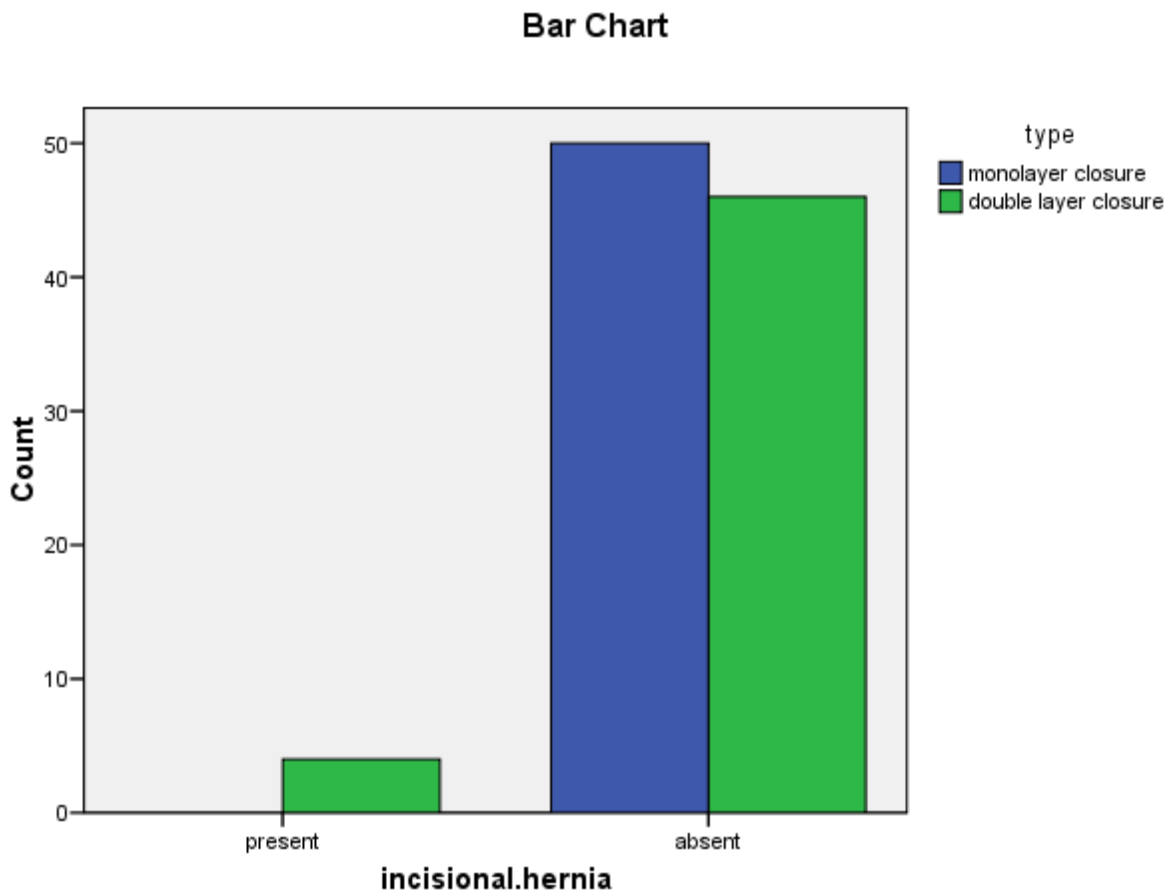
Bar Chart



incisional.hernia * type Crosstabulation

Incisional hernia		type		Total
		monolayer closure	double layer closure	
incisional.hernia	present	0	4	4
	absent	50	46	96
Total		50	50	100

P value: 0.017(P<0.05) Significant.



Discussion:-

The present study was aimed at comparing the techniques of midline laparotomy wound closure. The technique of laparotomy wound closure is one of the important factor in preventing post operative complications like wound sepsis, wound dehiscence, stitch sinus formation, persistent wound pain and incisional hernia. Prevention of herniation of abdominal contents through the incisional wound, resulting in wound dehiscence or herniation through a weak scar resulting in incisional hernia are the main aims of a surgeon closing laparotomy wounds.

Literature review shows, almost since the beginning of abdominal surgery the masters of technique have preached the importance of meticulous layer by layer closure of abdominal wall and indeed this certainly has strong aesthetic appeal. It is interesting that Smead, a resident to Finney in Baltimore, first used the “far near” stitch in 1900, a technique often referred to in the United States as the “Smead Jones Technique”. In 1941, Jones¹² and associates reported a burst abdomen rate of 11% when incisions were sutured with two layers of catgut, and 7% when sutured with catgut for peritoneum and interrupted steel wire for the anterior rectus sheath. However, only one burst abdomen occurred in 81 operations after steel wire closure with interrupted mass far near sutures incorporating all layers, apart from skin. Dudley¹³ in 1970 observed that ischemic necrosis in relation to a suture is the outcome of de-vascularisation of tissue in the bite and continued pressure exerted by any distractive force at the suture tissue interface.

In mass closure, a deep bite of tissue provides more cushioning effect and therefore less strangulation of tissue. Kirk¹⁴ in 1972 had no wound disruption in 186 laparotomies closed with continuous all coat nylon. He also noted that the technique of mass closure with nylon significantly reduced the rate of wound dehiscence. Martyak and Curtis¹⁵ in 1976 closed 280 midline wounds with all coats continuous nylon, again without a single wound dehiscence and a similar finding was reported by Leaper¹⁶ in 1977 in 120 laparotomies subjected to mass closure using steel wire.

Most remarkable achievement of only one wound dehiscence in a series of 1505 closures using all coats nylon was reported by Jenkins¹⁷ in 1976. The introduction of this technique produced quite dramatic improvements in the results of Bucknall TE, Cox PJ and Ellis H.¹⁸ In their study from 1975 to 1977, 341 layered closures were performed with 13 burst abdomens (3.8%) and from 1977 to 1980 the mass closure technique was used in 788 patients with 6 burst abdomens (0.8%). Ellis¹⁹ in 1977, Gilbert²⁰ in 1987 and TB Hugh²¹ in 1990 reported no significant statistical difference in laparotomy closures with peritoneum closed or open.

Hugh TB et al concluded that single layer closure of abdominal wall was quicker, less costly and safer than layered closure. Poole GV et al²² in 1984 found that simple interrupted suture technique was unaffected by suture tension, but was generally inferior to the running stitch in terms of wound bursting strength. They recommended that closing midline abdominal fascial wounds with a running suture may be a superior method of closure in clean, incised wounds. Trimbo JB et al²³ in 1992 found that continuous closure of laparotomy wound was faster.

Weiland DE, Bay RC and Del Sordi S²⁴ from their meta-analysis study in 1998 suggested that mass closure was superior to layered closure.

Rucinski et al²⁵ in their meta-analysis of optimal technique for closure of abdominal midline fascia compared absorbable and non absorbable sutures.

They found no statistically significant difference between nonabsorbable and monofilament absorbable sutures with regard to postoperative wound infection, dehiscence and incisional hernia. There was, however, a higher incidence of wound infection and incisional hernia formation when braided absorbable suture material was used. There was a higher incidence of incision area pain and suture sinus formation when non absorbable suture material was used. They advocated a continuous mass closure with absorbable monofilament suture material for laparotomy wounds. But results of larger studies showing the advantages of absorbable sutures over non absorbable sutures are still awaited. In the present study, we used monofilament, resorbable continuous sutures (vicryl No.1) for closure of laparotomy wounds. Different studies have reported postoperative complication rates which are definitely less in single layer closure than in double layered closure. Irvin et al²⁶ found that wound infection was responsible for tenfold rise in the incidence of burst abdomen and incisional hernia. Tearing through the weak infected tissues with intact suture is the main cause for wound dehiscence.

The wound sepsis rate for Togart²⁷ was 17% and 29%, Shukla et al²⁸ was 0.5% and 16.9%, Singh et al²⁹ was 6.6% and 16.6% and for Chowdhury and Chowdhury³⁰ was 22.5% and 47.5% in single layer closure and double (conventional) layer closure respectively. In the present study, the incidence of wound sepsis was 10% in single layer closure and 26% in double layer closure, showing higher incidence in double layer closure. Incidence of wound dehiscence was 0.87% and 3.4% for Togart;²⁷ 2% and 13% for Shukla et al²⁸ and 0% and 10% for Singh et al²⁹ in single layer closure and double layer closure respectively. In the present study, the incidence of wound dehiscence was 4% in single layer closure and 18% in double layer closure, again showing higher incidence in double layered closure group. Peritonitis requiring emergency surgery along with other associated factors like chest infection with cough, anemia and hypertension were thought to be the causative factors for a higher incidence of wound dehiscence in this study.

Stitch sinus formation was 16.2% in mono layer closure and 17.2% in double layer closure in the study of Chalya et al.³¹ In present study it is 8% in mono layer closure and 16% in double layer closure.

Persistent wound pain was 11.8% in monolayer closure and 13.3% in double layer closure in the study of Chalya et al.³² In present study it is 12% and 14% respectively in monolayer and double layer closure.

Incisional hernia is common after wound infection. 88% of patients requiring repair of incisional hernia had wound infection in the study of Fischer and Turner.³³ Grace and Cox³⁴ found that burst abdomen was an important predisposing factor for the occurrence of incisional hernia. No incisional hernia occurred in the single layer closure study group of Shukla et al²⁸ and Singh et al.²⁹ However in double layered closure group Shukla et al²⁸ had 3% and Singh et al²⁹ had 6.6% of incisional hernias. In the present study no incisional hernia occurred in single layer closure group and in double layered closure group the incidence of incisional hernia was 8%.

Overall incidence of incisional hernias in the best centres has been at least 10% according to the literature³⁵. Still, longer period of follow up is necessary for the present study to know the exact incidence of incisional hernias in the comparison groups.

Conclusion:-

In this study, the incidence of post-operative complications like wound sepsis is 10% in monolayer closure while 26% in double layer closure; wound dehiscence is 4% in monolayer closure while 18% in double layer closure; stitch sinus formation is 2% in monolayer closure while 4% in double layer closure; Persistent wound pain is 12% in monolayer closure while 14% in double layer closure and incisional hernia is 0% in monolayer closure while 8% in double layer closure.

Thus the incidence of post operative complications like wound sepsis, wound dehiscence, stitch sinus formation, persistent wound pain and incisional hernia were less in monolayer closure. However longer study period is required to know the exact incidence of incisional hernia.

Hence, mono layer closure technique is better than double layer closure of midline laparotomy wound in terms of post-operative complications.

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