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Original Research Article

Wound Complication Outcome of Absorbable Suture Polydioxanone and Non-Absorbable Suture Polypropylene in Midline Laparotomy Wound Closure: Analytical Study

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Abstract

Introduction: Wound closure techniques have progressed tremendously, ranging from simple sutures to adhesive compounds. Thus, we aimed to compare the wound complication rates of absorbable suture polydioxanone vs nonabsorbable suture polypropylene in midline laparotomy wound closure.

Methodology: Eighty patients with emergency and elective laparotomies were enrolled. All the patients were equally divided into two groups, i.e., Group A had patients with even numbers in whom abdominal incisions were closed with absorbable suture material polydioxanone, and Group B had patients with odd numbers in whom abdominal incisions were closed with nonabsorbable suture material polypropylene. Data was collected based on postoperative wound complications and compared. Postoperative pain was recorded by using a VAS score.

Results: In this analytical study, in group A, most patients had no pain (90.00%) and mild pain (10.00%). On the contrary, patients in group B experienced moderate pain (5.00%). A significant difference was noted in immediate and late postoperative outcomes among groups.

Conclusion: Based on the observations of this study, the continuous mass closure technique employing no.1 Polydioxanone (PDS) suture material is superior to no.1 Polypropylene (PPL) suture material in preventing wound complications.

Keywords: Midline Laparotomy, Wound Complications, Wound Dehiscence, Abdominal Wound Closure, Polypropylene Suture Material, Polydioxanone Suture Material, Visual Analog Scale.

Introduction

The treatment of wounds is a crucial component of emergency medicine practice. The professionals treat wounds from basic and straightforward lacerations or abrasions to complex wounds. Wound closure techniques have progressed tremendously,

ranging from simple sutures to adhesive compounds. Additionally, wound closure techniques have improved. Wound healing following abdominal closure is a complex and dynamic process characterised by a changing wound environment and a fluctuating patient health status. After an operation, the procedure for closing the abdomen has frequently been disputed. An ideal closure should be simple, give sufficient strength, and serve as a barrier against infection. [1] The closure should be tension-free to prevent ischemia, and the patient should feel no discomfort. A laparotomy is an abdominal cavity surgical incision (cut). This procedure is conducted to check the abdominal organs and aids in identifying any conditions, including abdominal pain. [2-4] The abdominal wall muscle and skin are sutured once the laparotomy is complete. Polypropylene and polydioxanone are the two most popular suture materials to close a midline incision. The former is biocompatible and nonabsorbable, whereas polydioxanone is a mid-to long-lasting absorbable polymer substance (for around 180-230 days). Several new suture types have recently been created, including nonabsorbable and absorbable polymers with elastic qualities. These elastic materials have been evaluated in multicentre clinical studies [5,6], but follow-up periods have not been long enough to make definitive conclusions about their behaviour. The available sutures are classified into three categories: nonabsorbable or permanent, slowly absorbable, and quickly absorbable. Numerous investigations on closing abdominal fascia with various Sutures have been undertaken, however, no definitive recommendations for improved outcomes have been given. Numerous considerations must be made while selecting a suture, including knot tying, suture handling, cost-effectiveness, strength, and susceptibility. The durability of tensile strength is also a criterion that must be considered and is the most crucial. Thus, this study aimed to compare the wound complication rates of absorbable suture polydioxanone vs nonabsorbable suture polypropylene in midline laparotomy wound closure.

Material and Methods

This study was conducted at the Department of General Surgery, Hind Institute of Medical Science, Safedabad, Barabanki, for 15 months. After obtaining HIMS IHEC`S approval and informed consent, 80 patients older than 14 who were operated on by midline laparotomies during the study period were included. Patients with Age >70 years, Frank purulent peritonitis, raised intra-abdominal pressure, which required tension suture closure, pre-existing cause of raised intra-abdominal pressure, Co-morbidities like - malignancy, malnutrition, diabetes mellitus, end-stage renal disease, cirrhosis of the liver, chronic obstructive pulmonary disease and ischemic heart disease, Immune Compromised, Laparotomy with stoma were excluded. Further, we divided all patients into two groups according to absorbable and nonabsorbable sutures. Preoperative investigations were done, including –Serum amylase/ Serum lipase, PT/PC/INR, Complete blood count, Serum electrolytes, Blood sugar, Blood urea and serum creatinine, LFT, KFT, X-ray of erect abdomen, Chest X-ray, Electrocardiogram, CECT Whole abdomen if required. In emergency operations, like peritonitis, fluid from the peritoneal cavity was collected for culture and sensitivity. The empirical broad-spectrum antibiotic was administered, followed by an antibiotic based on a culture sensitivity test. The wound was inspected in the immediate postoperative period (DAY-2) for evidence of infection. Discharge, if any, was sent for culture and sensitivity. Postoperative pain was recorded by using a visual analog scale. Subsequently, patients were followed up regularly at intervals of 2

weeks, 4 weeks and once in 3 months up to 1 year. During the subsequent follow-up period, wound pain, infection, dehiscence, suture sinus formation, stitch granuloma, and the incisional hernia was inspected and recorded for one year.

Statistical Analysis

Data were entered in Microsoft Excel and analyzed using statistical software SPSS version 26 (SPSS Inc., Chicago, IL, USA). The continuous variables were evaluated by mean (standard deviation) or range value when required. The dichotomous variables were presented in number/frequency and were analyzed using the Chi-square test. For comparison of the means between the two groups, analysis by Student t-test was used. A p-value of <0.05 or 0.001 was regarded as significant.

Results

In both groups, males outnumbered females, and the majority of participants in groups A (35%) and B (40%) were between the ages of 31 and 40. A comprehensive clinical investigation revealed no significant differences between groups except for platelet count, calcium, and sodium. [Table-1] In both group A [36 (90.00%)] and group B [23 (57.50%)], the majority of patients did not experience any pain. In group A, patients experienced only mild pain [4(10.00%)], whereas, in group B, moderate pain was also reported [2(5.00%)]. Serosanguinous discharge was observed in only one patient in group A, whereas five patients in group B exhibited this phenomenon. In group A, abdominal distension was observed in a single patient, whereas in group B, it was observed in seven patients. In addition, only four and three patients in group B, respectively, exhibited abdominal rupture and peritonitis. In group A, only two patients experienced pain and the formation of suture sinuses. Simultaneously, seven patients in group B experienced pain, and eight had sinus formation with sutures. Two patients in group A and ten patients in group B experienced dehiscence. [Table-2; Figure-1-3] VAS, postoperative, and final outcomes differed substantially.

Table 1: Clinico-Demographical parameters of enrolled patients

		GROUP-A [N=40]		GROUP-B [N=40]		P-VALUE
		Mean/ N	SD/ %	Mean/ N	SD/ %	
AGE (years)	14- 20	3	7.50%	2	5.00%	X=0.5826 p=0.9650
	21-30	11	27.50%	10	25.00%	
	31-40	14	35.00%	16	40.00%	
	41-50	8	20.00%	9	22.50%	
	51-60	4	10.00%	3	7.50%	
GENDER	Male	29	72.50%	23	57.50%	X=1.978 p=0.1596
	Female	11	27.50%	17	42.50%	
ENZYMES (U/L)	Serum Amylase	37.78	6.63	38.02	6.59	t=0.1624 p=0.8714
	Serum Lipase	28.63	5.35	28.13	5.25	t=0.4219 p=0.6743

COAGULATION PROFILE	Prothrombin time (Sec)	12.25	0.89	11.93	0.75	t=1.739 p=0.0860
	Prothrombin Concentration (%)	91.53	0.67	91.41	0.42	t=0.9598 p=0.3401
	International Normalized Ratio (INR)	0.87	0.07	0.86	0.05	t=0.7352 p=0.4644
COMPLETE BLOOD COUNT	RBC (10^6)	4.28	0.89	4.51	0.77	t=1.236 p=0.2202
	Haemoglobin (g/dL)	11.62	1.68	11.57	1.46	t=0.1421 p=0.8874
	TLC (mm^3)	8632.3	1129.3	8162.7	1276.8	t=1.742 p=0.0854
	Platelets (10^3)	327.2	110.5	232.3	116.7	t=3.735 **p=0.0004***
BIOCHEMICAL EXAMINATION	Total Protein (g/dL)	7.63	1.88	7.76	1.27	t=0.3624 p=0.7180
	Serum Albumin (g/dL)	4.66	1.87	4.72	1.98	t=0.1393 p=0.8895
	RBS (mmol/L)	124.63	7.53	122.52	6.37	t=1.353 p=0.1800
KIDNEY FUNCTION TESTS (KFT)	Calcium (mg/dL)	1.06	0.02	1.04	0.01	t=5.657 **p<0.0001***
	Sodium (mmol/L)	139.82	2.78	138.15	2.25	t=2.953 **p=0.0042***
	Chloride (mmol/L)	103.27	2.52	102.63	2.01	t=1.256 p=0.2130
	Potassium (mEq/L)	4.12	0.73	3.98	0.95	t=0.7390 p=0.4621
	Blood Urea (mg/dl)	16.62	2.31	15.87	2.87	t=1.288 p=0.2017
	Serum Creatinine (mg/dL)	0.83	0.07	0.86	0.09	t=1.664 p=0.1001
LIVER FUNCTION TESTS (LFT)	Total Bilirubin (mg/dL)	0.63	0.08	0.65	0.07	t=1.190 p=0.2377
	ALP (U/L)	82.93	5.84	80.88	6.68	t=1.461 p=0.1480
	SGOT (U/L)	23.76	3.38	24.73	4.39	t=1.107 p=0.2716
	SGPT (U/L)	27.87	5.63	28.99	5.02	t=0.9391 p=0.3506

X-RAY ERECT ABDOMEN	GAS UNDER DIAPHRAGM	7	17.50%	5	12.50%	X=0.3922 p=0.5312

Table 2: Visual Analog Scale score and Postoperative findings of enrolled patients

		GROUP-A [N=40]		GROUP-B [N=40]		P-VALUE
		N	%	N	%	
VAS SCORE	No pain	36	90.00%	23	57.50%	X=11.23 **p=0.0036***
	Mild	4	10.00%	15	37.50%	
	Moderate	0	0.00%	2	5.00%	
	Severe	0	0.00%	0	0.00%	
POST-OP FINDINGS	Serosanguinous discharge	1	2.50%	5	12.50%	X=2.883 p=0.0895
	Burst abdomen	0	0.00%	4	10.00%	X=4.211 **p=0.0402***
	Abdominal distension	1	2.50%	7	17.50%	X=5.00 **p=0.0253***
	Peritonitis	0	0.00%	3	7.50%	X=3.117 p=0.0775
FINAL OUTCOMES	Pain	1	2.50%	7	17.50%	X=5.00 **p=0.0253***
	Suture sinus formation	1	2.50%	8	20.00%	X=6.135 **p=0.0133***
	Wound dehiscence	2	5.00%	10	25.00%	X=6.275 **p=0.0122***

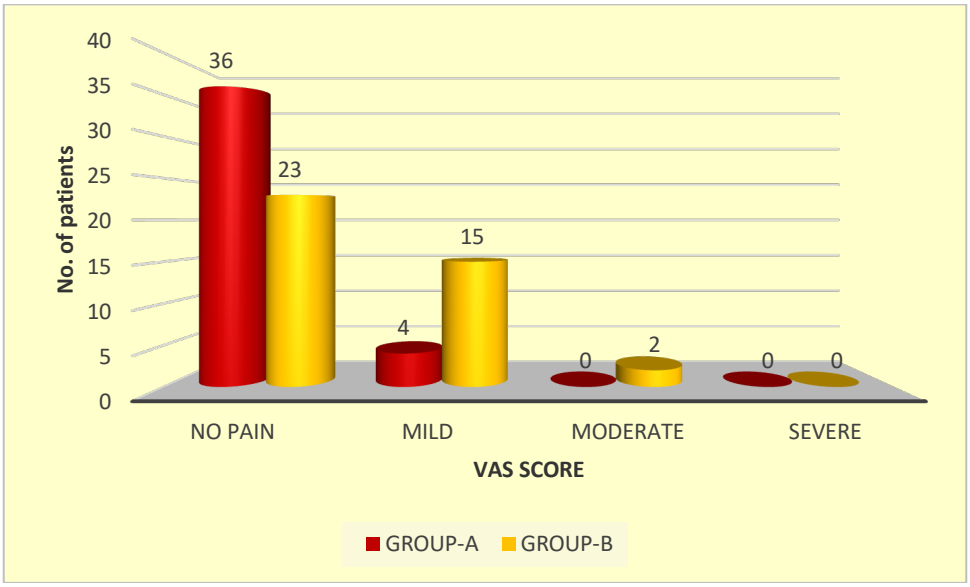

Figure 1: Visual Analogue Scale score of enrolled patients

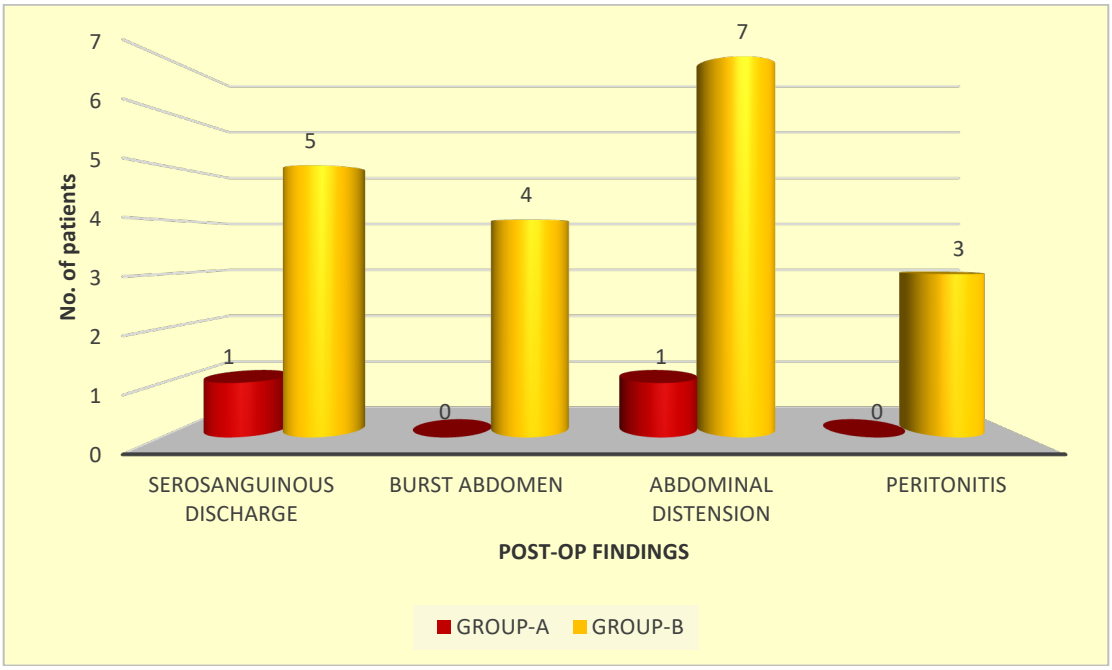

Figure 2: Postoperative findings of enrolled patients

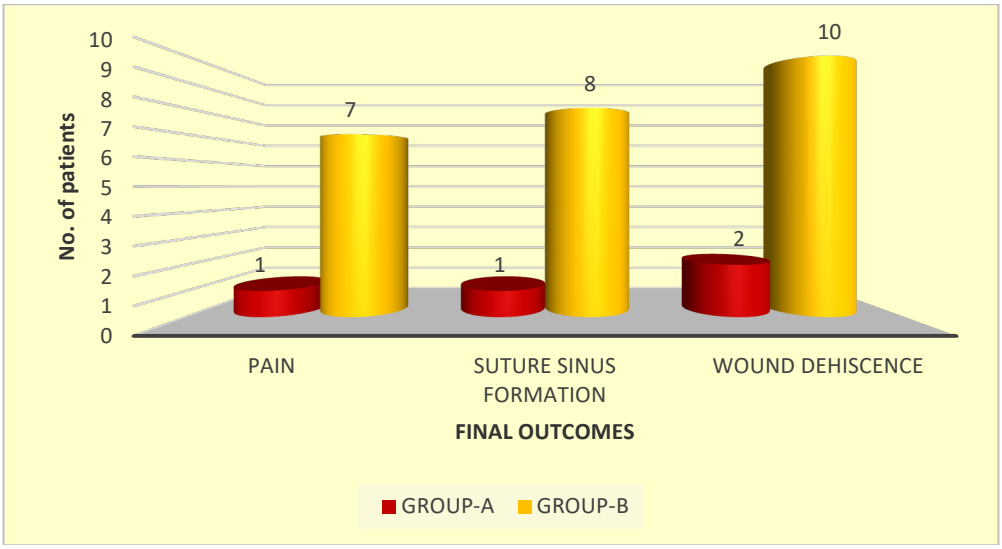

Figure 3: Final outcomes of enrolled patients

Discussion

In the present study, in group A, the majority of the patients [14(35.00%)] were aged between 31-40 years, followed by 21-30 years [11(27.50%)], 41-50 years [8(20.00%)]. In group B, the majority [16(40.00%)] were also aged between 31-40 years, followed by 21-30 years [10(25.00%)], 41-50 years [8(22.00%)]. Male preponderance was observed in both group A [29(72.50%)] and group B [23(57.50%)]. Similarly, S Mohan *et al.* observed that most patients were aged 36-45 in both groups, and male dominance was also noted. [7] It was reported that the patients in the PPL group were 52.52±11.72 years, and in the PDS group, it was 51.86±12.39 years. [8] They

also noted male dominance in both PDS [34(60.7%)] and PPL group [28(63.6%)]. Further, Naz S *et al.* recorded a higher mean age [33.99±14.86] in the PPL group compared to the PDS group [31.81±14.378]. [9] The majority of the patients were male in the PDS group [168(54.2%)] and PPL group [165(53.2%)]. In the present study, the mean serum amylase level was higher in group B [38.02±6.59] than in group A [37.78±6.63]. At the same time, serum lipase was higher in group A [28.63±5.35] than in group B [28.13±5.25]. In the present study, the coagulation profile showed that the mean prothrombin time was higher in group A [12.25±0.89] compared to group B [11.93±0.75]. The prothrombin concentration and International Normalized Ratio were also higher in group A [91.53±0.67; 91.41±0.42] compared to group B [0.87±0.07; 0.86±0.05]. In the present study, the mean RBC was higher in group B [4.51±0.77] than in group A [4.28±0.89]. The mean Haemoglobin level was also higher in group A [11.62±1.68] than in group B [11.57±1.46]. Also, the mean TLC was higher in group A [8632.3±1129.3] than in group B [8162.7±1276.8]. Platelet count was strikingly higher in group A [327.2±110.5] than in group B [232.3±116.7]. In the present study, the mean total protein was higher in group B [72.76±4.27] than in group A [71.63±3.88]. At the same time, serum albumin was higher in group A [46.66±2.87] than in group B [45.72±2.98]. Random blood sugar was also higher in group A [124.63±7.53] compared to group B [122.52±6.37]. In the present study, the KFT showed higher calcium, sodium, chloride, potassium and blood urea levels in group A compared to group B. In contrast, serum creatinine was elevated in group B [0.86±0.09] than in group A 61 Discussion [0.83±0.07]. In the present study, the LFT showed a higher mean level of Alkaline phosphatase (ALP) higher in group A [82.93±5.84] than in group B [80.88±6.68]. Although the total bilirubin level, serum glutamic-oxaloacetic transaminase (SGOT) and serum glutamic-pyruvic transaminase (SGPT) were noted higher in group B compared to group A. The biochemical and other test findings were comparable among both groups. Statistically, a significant difference was observed in platelet count [p=0.0004*], calcium level [p=0.0085*] and sodium level [p=0.0042*] among groups. In the present study, the X-ray of the erect abdomen showed gas under the diaphragm in [7(17.50%)] patients of group A and [5(12.50%)] patients of group B. In the present study, the majority of the patients had no pain in both groups A [36(90.00%)] and B [23(57.50%)]. In group A, patients only had mild pain [4(10.00%)], while in group B, moderate pain was also experienced by patients [2(5.00%)], and this was statistically significant. In contrast, Shankar KH noted that all patients continued to feel modest wound pain and required analgesics for an extended period. [10] In group B, which included 100 patients, the pain was mild in 96% of cases and moderated in 4% of subjects in the immediate postoperative period. None of the patients suffered wound pain in the delayed postoperative period, necessitating a shorter time of analgesic use. In both groups, patients were administered the same class of analgesics. Based on the visual analogue pain scale, group A (PDS) has a high incidence of mild and moderate pain, while group B has a high incidence of severe pain (PPL). Overall, the incidence of pain is greater in group B (PPL) than in group A (PDS), as indicated by a literature review. [11-13] A study by Chalye PL *et al.* also indicates that PPL is associated with a higher incidence of pain during midline fascial closure. [14,15] One PPL suture requires five to seven knots for proper strength, and these knots can be painful. Compared to PDS, it does not assimilate and provokes a painful

tissue reaction against the foreign body. Furthermore, a meta-analysis by Van't Riet M *et al.* supports our findings. [16] There is a statistically significant difference ($p<0.005$) in the occurrence of wound discomfort following midline abdominal facial closure. The incidence of wound discomfort is greater with nonabsorbable (PPL) sutures than with slowly absorbable sutures (PDS). In the present study, in group A, Serosanguinous discharge was noted in only 1 patient, while in group B, it was observed in [5(12.50%)] patients. Abdominal distension was also indicated in group A in 1 patient only, whereas, in group B, it was observed in [7(17.50%)] patients. Burst abdomen and peritonitis were observed in group B only. Statistically, a significant difference was observed in the burst abdomen and abdominal distension. In contrast, Bloemen *et al.* observed no difference in postoperative findings between PDS and PPL groups. [17] Many other studies were also noted to have no difference in post-op complications. [5,8,16,18,19] Similarly, Shankar KH observed all 4 cases of burst abdomen in patients whose midline was closed using polypropylene suture material. [10] In the delayed postoperative period, the incidence of suture sinus formation was greater with polypropylene suture material (9/100) than with polydioxanone suture material (2/100). The incidence of burst abdomen (wound dehiscence) was relatively low. Only two patients in the PDS group and 1 in the PPL group experienced abdominal rupture. This information was insufficient for drawing any meaningful conclusions. Others have reported no difference between absorbable and nonabsorbable suture materials in the incidence of wound dehiscence. [16,18-20] Some studies have found a greater rate of wound dehiscence while using Polydioxanone for abdominal fascial closure compared to nonabsorbable sutures (polypropylene or nylon). [5,14,21,22] In contrast to our study, many other studies also noted the incidence of palpable knots that to was greater in the polypropylene suture material (23% out of 100) than the polydioxanone suture material, for which no cases were observed during the delayed postoperative period follow-up of patients. [9,10] In the present study, the outcome of patients showed that in group A, only two patients had pain and suture sinus formation. At the same time, in group B, 7 patients had pain, and 8 had suture sinus formation. Wound dehiscence was noted in [2(5.00%)] patients of group A and [10(25.00%)] patients of group B. Statistically, a significant difference was found in outcomes. Similarly, Chalya *et al.* found a greater rate of stitch sinus development when PPL was used for abdominal fascial closure compared to PDS. [14] Agarwal *et al.* found an increased incidence of stitch sinus formation after using PPL in their research; however, they compared PPL to Polyglactin for abdominal fascial closure. [21] Bucknall *et al.* observed a greater incidence of surgical site infection with nonabsorbable (nylon) sutures than with absorbable (Polyglycolic acid) sutures. [23]

Conclusion

Based on the findings of this study, it has been determined that the continuous mass closure technique employing no.1 Polydioxanone (PDS) suture material is superior to no.1 Polypropylene (PPL) suture material in preventing wound complications such as postoperative wound dehiscence, wound pain, burst abdomen, suture sinus formation, serosanguinous discharge and abdominal distension. However, this study had several drawbacks, such as palpable knots were not noted, if any; the study population was also low. In addition, more clinical trials are required to study the closure technique and its benefits.

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