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A retrospective analysis of early and late term complications in patients who underwent application of retention sutures for gastrointestinal tract malignancies

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ABSTRACT

Objective: Complications associated with wound healing after abdominal tumor operations continue to be a significant problem. This study aimed to determine the significance of retention sutures in preventing these complications. For this purpose, early and late term results of patients who underwent application of polydioxanone (PDS) and additional retention sutures for abdominal closure were retrospectively evaluated.

Material and Methods: Clinical files of 172 patients who were operated due to gastrointestinal tract malignancies in our clinic between January 2007 and January 2011 were retrospectively analyzed. Patients in whom the fascia was repaired only with PDS (Group 1) were compared to patients in whom the fascia was repaired with PDS and retention sutures (Group 2) in terms of age, gender, postoperative evisceration-wound infection (<1 month), incisional hernia (>1 month), incision type, co-morbid factors, and operative time.

Results: There was no significant difference between the two groups in terms of age or gender (p=0.680 and p=0.763). No significant difference was detected in terms of postoperative incisional hernia (p=0.064). Evisceration and post-operative wound infection were significantly lower in Group 2 as compared to Group 1 (p=0.008 and p=0.002). Operative time was significantly longer in Group 1 than in Group 2 (p<0.0001). Co-morbid features were significantly higher in Group 2 than in Group 1 (p<0.0001). There were no significant differences between the groups in terms of incision type (p=0.743).

Conclusion: In the presence of co-morbid factors that disrupt wound healing in surgical patients with gastrointestinal malignancy, retention suture can be safely used as a supplement for optimal wound care.

Key Words: Abdominal wound dehiscence, hernia, polydioxanone, wound closure techniques

INTRODUCTION

Wound dehiscence after abdominal operations is a multi-factorial problem in which local and systemic factors are involved. Prolonged hospital stay, increased incisional hernia incidence and the consequent required revision surgeries may provide an idea about the extent to which wound recovery deteriorates post-operative comfort (1, 2). Implemetantion of additional preventive techniques may be required to prevent wound dehiscence which may increase in incidence due to diabetes, malignancy, steroid use, smoking, male sex, obesity, elderly age (>64), pulmonary disease, chronic renal failure, hemodynamic instability, low preoperative protein and albumin levels, incision type and abdominal closure technique (continuous, single). Wound dehiscence may also develop secondary to hematoma causing suture loosening, increased intra-abdominal pressure due to post-operative persistent cough or vomiting (3, 4). In a majority of the cases, inadequate fascia sutures were indicated as the reason for wound dehiscence (29%). Other reasons are listed as wound infection (9%), broken sutures (8%), fascia necrosis (6%) and loose knots (4%) (5, 6). Abdominal closure using retention sutures for reinforcement is a conventional surgical method that has been discussed for long years in medical literature in various aspects, and is still being performed by using new and more superior materials offered by the contemporary industrial developments.

Ventrofil suture is a polyethylene-coated, non-absorbable suture, made of twisted stainless steel with a diameter of 1.3 mm, and sterilized with gamma radiation. It is used to relieve tension on the edges of the wound and prevent wound dehiscence following laparotomy as a retention reinforcement. It is used for patients with a high potential for wound dehiscence (emergency laparotomies, revision laparotomies, peritonitis/ileus, elderly patients, bronchopulmonary infections, malignancy operations, operations that last long, coagulation abnormalities). As for polydioxanone (PDS®), it is a type of suture made of monofilament polyester, which is used for especially abdominal fascia repair when the combination of long-term wound reinforcement and absorbable suture is required; it is manufactured at various diameters and can be absorbed with slow hydrolytic reaction (nearly 200 days). In our study, patients diagnosed with gastrointestinal system (GIS) malignancy and abdomen closure by using only PDS® and patients who received PDS® as well as reinforcement with retention sutures were compared in terms of early and late post-operative complications.

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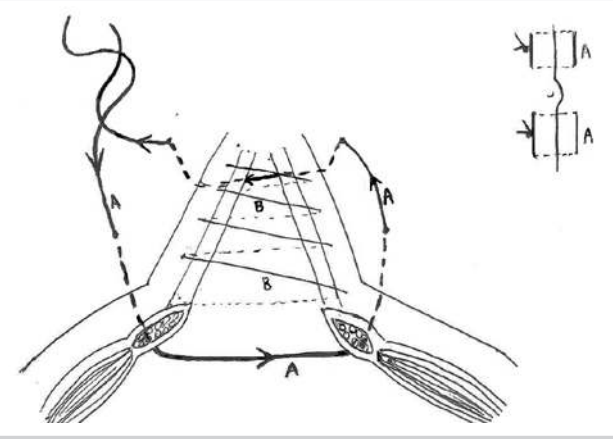

Figure 1. Ventrofil application technique

MATERIAL AND METHODS

The files of 176 patients who were operated on at our clinic between January 2007 and January 2011 due to GIS malignancy were retrospectively examined after obtaining informed consent. Four patients were excluded from the study due to either early period mortality or being lost to follow-up. The period of 1 month after the operation was considered as the early period and the period after the 1st month was considered as the late period. The first endpoint was targeted as early period evisceration and late period incisional hernia development, and the second endpoint as the early period post-operative wound infection. The patients were divided into two groups: the control group that received fascia repair with only loop PDS® [PDS™ II (polydioxanone) suture, Ethicon] (Group 1, n=101) and the group in which retention sutures (Ventrofil suture, Braun Medical) were used in addition to PDS® (Group 2, n=71).

The age, sex, diagnosis, incision type, co-morbid factors, operation time and follow-up duration of patients were identified. The two groups were compared in terms of post-operative wound infection, evisceration and incisional hernia. In the control group, fascia repair was performed using number 1 loop PDS® in the form of continuous sutures. In the other group, 1 to 3 U-shaped Ventrofil sutures were placed according to the size of the incision, at approximately 2.5 cm from incision edges, 4 cm in length-parallel to the incision, through the entire abdominal wall layers including the cutaneous, subcutaneous, superficial fascia, muscle and deep fascia in addition to PDS® sutures (Figure 1). The incisions were performed in the form of only upper abdominal median, only lower abdominal median and upper + lower abdominal median laparotomy.

Diabetes, hypertension, chronic renal failure, coronary artery disease, chronic obstructive pulmonary disease, obesity and elderly age (>64) were recorded as co-morbid factors. The body mass indexes of patients were calculated; patients with values at and above 30 were considered obese.

Statistical Analysis

In the study, the Statistical Package for Social Sciences (SPSS Inc., Chicago, IL, USA) for Windows 17.0 software program was used for statistical analyses. The Student-t test was used for independent groups in comparing quantitative data in addition to descriptive statistical methods (average, standard deviation, frequency, percentage). The chi-square test was used for the comparison of qualitative data. The results were assessed with a confidence interval of 95% and a significance level of $p<0.05$.

Table 1. Basic parameters of the control and ventrofil groups

	Control group	Ventrofil group
Mean age	64.6±9.3	65.3±11.9
Gender (M/F)	60/48	6/58
Upper GI malignancy	38 (37.62%)	26 (36.62%)
Colon malignancy	63 (62.38%)	45 (63.38%)
Co-morbidity	88 (87.13%)	63 (88.73%)
Previous abdominal surgery	20 (19.8%)	38 (53.52%)
Mean operative time (min)	235.46±38.75	163.81±45.55
Mean follow-up period (months)	39 (13-57)	33 (11-62)
Postoperative wound infection	18 (17.82%)	4 (5.63%)
Incisional hernia	12 (11.88%)	4 (5.63%)
Evisceration	11 (10.89%)	0

M: male; F: female; GI: gastrointestinal

RESULTS

The mean age of 108 patients in the control group (60 men, 48 women) was 64.6±9.3. Out of these patients, 38 (37.62%) had upper GIS malignancy, 63 (62.38%) had colon malignancy and 88 (87.13%) had co-morbidities. 20 patients (19.80%) had received prior abdominal surgery. The operation time was 235.46±38.75 minutes on average and the mean follow-up duration was 39 months (minimum 13 months - maximum 57 months). Post-operative wound infections developed in 18 patients (17.2%). Incisional hernia was observed in 12 patients (11.88%). 11 patients (10.89%) were identified to have evisceration (Table 1).

The mean age of 64 patients (6 male, 58 female) in the Ventrofil group was 65.3±11.9. Out of these patients, 26 had (36.62%) upper GIS malignancy, 45 (63.38%) had colon malignancy and 63 (88.73%) had co-morbidities. Thirty eight patients (53.52%) had previously received abdominal surgeries. The operation time was 163.81±45.55 minutes on average and the mean follow-up duration was 33 months (minimum 11 - maximum 62 months). Four patients (5.63%) developed postoperative wound site infections. Incisional hernia was observed in 4 patients (5.63%). Evisceration was not observed in any patients (Table 1).

No significant differences between the two groups in terms of age, sex and post-operative incisional hernia were detected (p=0.680; p=0.763; p=0.064, respectively) (Table 2).

No significant differences were observed between the presence of co-morbidity and development of hernia in the Ventrofil group (p=0.892). In the control group, a statistically significant correlation was identified between hernia development and co-morbidity (p=0.016) (Table 3).

In the Ventrofil group, evisceration and post-operative wound infection were observed at a significantly lower rate as com-

Table 2. Presence of incisional hernia and ventrofil suture

	Incisional hernia			
	Yes	No	Total (n)	p
Ventrofil group	2	62	64	
Control group	12	96	108	
Total (n)	14	158	172	0.064

Table 3. Correlation of presence of incisional hernia with ventrofil suture usage and comorbidity

			Comorbidity		Total
			Yes	No	(n)
Ventrofil group	Incisional hernia	Yes	1	1	2
		No	34	28	62
	Total (n)		35	29	64
					p=0.892
Control group	Incisional hernia	Yes	7	5	12
		No	24	72	96
	Total (n)		31	77	108
					p=0.016

Table 4. Evisceration and ventrofil application

	Evisceration			
	Yes	No	Total (n)	p
Ventrofil group	0	64	64	
Control group	11	97	108	
Total (n)	11	161	172	0.008

Table 5. Postoperative wound infection and ventrofil application

	Postoperative wound infection			
	Yes	No	Total (n)	p
Ventrofil group	2	62	64	
Control group	21	87	108	
Total (n)	23	149	172	0.002

Table 6. Correlation of presence of evisceration with ventrofil suture usage and comorbidity

			Comorbidity		Total
			Yes	No	(n)
Ventrofil group	Evisceration	Yes	0	0	0
		No	35	29	64
	Total (n)		35	29	64
Control group	Evisceration	Yes	8	3	11
		No	23	74	97
	Total (n)		31	77	108
					p=0.001

pared to the control group (p=0.008 and p=0.002, respectively) (Tables 4, 5). None of the patients in the Ventrofil group developed evisceration; hence its association with co-morbidity could not be identified. A significant correlation was identified between the presence of co-morbidities and evisceration in the control group patients (p=0.001). It was identified that the development of evisceration was higher in the presence of co-morbidities in the control group (Table 6).

The co-morbidity factors were statistically significantly higher in the Ventrofil group as compared to the control group (p<0.0001). No significant differences were observed between groups in terms of incision types, incisional hernia and evisceration (p=0.743). The operation time was found to be significantly longer in the control group (p<0.0001).

DISCUSSION

An adequate wound healing depends on an effective, adequate and good hemostasis, inflammation, proliferation and remodeling process. There are certain uncontrollable factors which affect wound healing before and after the operation; however, there are also controllable factors such as the technique and suture material used during the operation. Acute wound dehiscence emerges in cases where the total load on the wound edges is excessive given the resistance capacity of the suture line and the wound matrix. Wound dehiscence may also develop when there is an abnormal progression in acute tissue repair phases (3).

In the studies conducted, it was seen that variables such as elderly age (>64), male sex, hypertension, chronic pulmonary disease, presence of ascites, anemia, jaundice, corticosteroid use, sepsis, emergency surgery, post-operative persistent cough, wound site infection, uremia, operation time and surgical method were seen to constitute a significant difference in the acute wound dehiscence group as compared to the control group (4, 5). In our study, none of the patients in the Ventrofil group developed evisceration; therefore, its correlation with co-morbidity was not investigated. Additionally, a significant correlation between presence of co-morbidities and development of evisceration was identified in the control group patients, parallel with the literature (p=0.001).

Abdominal fascia reaches 51-59% of its former matrix tension strength at 42 days, 70-80% at 120 days and 73-93% at 140 days after the operation. It can never become stronger than 93% (6). Incisional hernia and evisceration are frequently encountered problems following abdominal operations. The incidence of incisional hernia ranges between 2% and 11% according to various references and it negatively affects the quality of life (7). In our study, the incidence of incisional hernia was 8.1%, which was in accordance with the literature. Furthermore, no significant differences were identified between groups 1 and 2, in terms of the identification of incisional hernias (p=0.064). In the Ventrofil group, no significant correlations were identified between the presence of co-morbidity and development of incisional hernia (p=0.892). As for the patients in the control group, a significant correlation was identified between the development of incisional hernias and co-morbidity (p=0.016).

The rate of evisceration has been reported to be around 1% in various references and the rate of mortality in presence of evisceration is in the range of 10-30% (8, 9). In the randomized studies by Khorgami et al. (10), similar to our study, retention suture reinforcement was used in 147 of median laparotomies, the fascia of 148 patients was closed with only number 1 loop nylon continuous sutures and the groups were compared in terms of post-operative wound dehiscence, evisceration, wound infection, post-operative pain, mortality secondary to wound dehiscence and post-operative late period incisional hernia. Abdominal evisceration was seen in only 1 (%0.7) of the patients that received retention sutures and in 4 (2.7%) of those who did not, no differences were identified between groups (p=0.371). In the same study, no significant differences were found between groups in terms of wound infection and incisional hernia development. The post-operative pain score showed a significant difference between groups after day 4. The rate of evisceration development in our study was 6.4%, which is higher than the literature rate. We believe this finding to be due to all our patients having GIS malignancies. On the other hand, absence of evisceration in patients for whom Ventrofil sutures were used (p=0.008) was identified as one of the positive effects of the use of retention sutures. Additionally, post-operative wound infection in the Ventrofil group was identified at a lower rate as compared to the control group (p=0.002).

The technique used in an ideal abdominal closure should offer the strength to prevent wound dehiscence and the adaptability to increased intra-abdominal pressure (11). In several experimental and clinical studies, abdominal closure techniques with or without retention sutures were compared in terms of surgical indications, co-morbidity status, suture types, and suturing techniques, and different results have been reported.

In a meta-analysis, it was concluded that continuous fascial closure using non-absorbable suture materials was the most effective method in preventing abdominal fascial dehiscence by minimizing specific morbidity, post-operative pain and discomfort (12).

Rink et al. (13) conducted a prospective, randomized study including 95 patients (44 trial, 51 control) where they applied a plastic-covered, steel-core suture material in full layer retention reinforcement excluding the peritoneum. They reported that the experiment group had intolerable post-operative pain and more maceration and purulent discharge from the skin in comparison with the control group. They concluded that the use of retention sutures were disadvantageous in subjective and objective terms, which is contrary to our study. We believe that such a conclusion might have been reached due to erroneous application of the technique.

Gäddnäs et al. (14) conducted a retrospective study including 16 open abdomen cases, in whom continuous retention sutures with number 1 monofilament suture (PDS® or Maxon) was used to ensure late fascial closure; they observed full fascial recovery in 9 and partial fascial recovery in 1 out of 11 patients that survived and 1 patient, who had infectious pancreatic necrosis, did not have fascia recovery despite the retention suture. The average time that elapsed until the start of fascia closure in open abdomen patients was 12 days (5-36) and a successful fascial recovery was recorded at 12 days (3-29) on average. Five patients were identified to have abdominal compartment syndrome before the fascial recovery, they died for various unrelated reasons and were excluded from the study. The patients were not observed to have fascia necrosis secondary to retention suture and ventral hernia was encountered in 1 patient during the mean 35-month post-operative follow-up period. In our study, none of the patients were observed to have fascia necrosis.

Rappaport et al. (15) conducted an experimental study on rats where they divided the rats receiving midline laparotomy into two groups, closed the abdomen using retention sutures parallel to the incision in the experimental group and using classical through-and-through retention sutures forming an angle perpendicular to the incision in the control group; they recorded that the wound rupture pressure was significantly lower in the experiment group in the first five days. Additionally, they also observed more inflammatory reaction and suture pressure-related necrosis in the control group. In our study, we applied retention reinforcement not in a continuous, perpendicularly angled way but in the form of all layers, single U-sutures parallel to the incision.

Our opinion is that the operation time was kept significantly shorter in the Ventrofil group by the surgical team, in order to reduce peri-operative mortality since the co-morbidity factors were statistically higher in the Ventrofil group (p<0.0001). On the other hand, the fact that the operation time in the Ventrofil group was kept short could also be one of the reasons why wound infection and evisceration were seen at a significantly lower rate.

CONCLUSION

In this study, definite findings indicating that Ventrofil sutures prevent the development of evisceration and wound infection in the short term have been identified. On the other hand, no findings showing its efficacy in preventing the development of incisional hernia in the long term have been encountered. Considering that the presence of malignancy is an important factor that deteriorates wound healing and if co-morbid factors deteriorating wound healing are present, retention suture reinforcement can be safely applied in patients for whom intra-abdominal infection has been ruled out under optimal care and follow-up conditions.

Ethics Committee Approval: This study is retrospective; furthermore in that period, all ethics committees across the country has entered a restructuring process. Thus the ethical approval has not been received.

Informed Consent: Written informed consent was obtained from patients who participated in this study.

Peer-review: Externally peer-reviewed.

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