Turkish Journal of Medical Sciences

Volume 31 | Number 5 Article 3

1-1-2001

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Turk J Med Sci
31 (2001) 391-394

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Received: July 02, 2001

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Abstract: Purpose: The aim this study was to investigate the effects of different suture techniques on the healing of abdominal wall wound.

Materials and Methods: 24 male Wistar albino rats were included in this study. The rats were divided into two groups. A 4 cm midline laparatomy was performed after ketamine HCl anesthesia. In Group I, the incision was sutured with 4/0 polypropylene interruptedly and in Group II, the wound was closed with 4/0 polypropylene continuously. The skin was sutured with an interrupted 4/0 silk suture. Then 2 cc of blood was withdrawn for biochemical and hematological tests by cardiac puncture. All the rats were killed on the 7th postoperative day. Tensile strength were measured and tissue samples were taken for hydroxyproline measurements and histopathological evaluation. Meanwhile intraabdominal adhesions were recorded.

Results: Tensile strength was 751±31 g in Group I and 622±28 g in Group II. The difference was significant ($p<0.05$). Hydroxyproline levels were 3.13±0.15 µg/mg tissue in Group I and 2.81±0.15 µg/mg tissue in Group II. The difference was significant ($p<0.05$). Intraabdominal adhesions were found in 3 rats in Group I and in 6 rats in Group II. There was a significant difference between the two groups regarding tissue fibroblast numbers ($p<0.05$). There was no significant difference between serological and hematological tests in the two groups.

Conclusion: Closing the abdominal wall wound with the interrupted suture technique gave better results than with the continuous suture technique.

Key Words: Dehiscence, Abdominal wall closure, Hydroxyproline, Fibroblast, Wound healing

Introduction

Incisional hernia is an important medical problem because of patient discomfort and may need urgent surgery due to ileus (1). The incidence of postoperative incisional hernia has been reported to be 10% (2). To decrease the occurrence of incisional hernia, the abdomen following an operation should be closed with a better technique. Otherwise, some life-threatening problems such as evisceration or eventration may occur during the early postoperative period and those problems may prolong the hospital stay.

Wound dehiscence occurs in 1-3% of abdominal surgical procedures. Systemic and local factors contribute to the development of this complication. Inadequate closure and deficient wound healing are the two most important local factors predisposing to wound dehiscence (3).

This study investigated the effects of different suture techniques on wound healing in abdominal wall closure.

Materials and Methods

This study was performed in the Experimental Medical Research Laboratory of Selcuk University by the Deparments of General Surgery, Biochemistry and Histology.

Twenty-four male Wistar albino rats, weighing 200-250 g (228±12 g), were used in this study. None of the rats died during the study. The rats were divided into two groups. All the rats were operated on under general anesthesia. Ketamine HCL (50 mg/kg) was used intramuscularly and 2-3 ml blood samples were taken by cardiac puncture for serological and hematological assays. A 4 cm long midline laparotomy was performed. After the exploration of the intestines, the abdominal wall was closed by a separate 4/0 polypropylene suture in Group I and by a continuous 4/0 polypropylene suture in Group II. The distances between the ties and from the incision line were 0.5 cm. The tie number was the same in two groups. The skin was sutured by using 4/0 silk ties in

both groups. The rats were left in their cages and given standard rat diet during postoperative seven days.

On the 7th postoperative day the rats were killed by cervical dislocation. The abdominal wall was excised in a standard size of 4x4 cm, including the previous wound line in the middle, and the abdominal cavity and suture line were overviewed for peritoneal adhesions.

Serological and Hematological Assays: Blood analysis for serum aminotransferase (AST), urea, albumin, ferrum (Fe) and zinc (Zn) was performed. Hemoglobin and white blood cell counts (WBC) were studied.

Tension Strength Test: After removal of skin sutures on postoperative day seven, the skin layer was separated from the underlying abdominal wall. The abdominal wall was excised in a 4x4 cm size. The sutures on the wound were also removed. Gradually increasing weight was applied to one side of the wound while the other side was fixed. The weight that completely separates the wound from the incision line is considered to be the tension strength (4).

Tissue Hydroxyproline Assay: After the measurement of tension strength, one part of the resting the tissue was used for tissue hydroxyproline assay. The tissue samples were stored in –80ºC in a freezer until the study day. The Bergman-Loxley method was used for the assessment of tissue hydroxyproline levels (5). Double measurements were made with neutralized hydrolizate for each sample and the mean was considered to be as the level of tissue hydroxyproline content.

Evaluation of Intraabdominal Adhesions: During the excision of the abdominal wall, adhesions between the abdominal viscera and the abdominal wall were evaluated and scored according to Granat adhesion score (6).

Histopathological Examination: Tissue samples were taken from the abdominal wall after the measurement of tension strength and were used for histopathological examination. The samples were fixed in 10% formalin solution until the histopathological examination. Paraffin blocks were prepared and 5 micron slices were taken and stained by Hematoxylin-Eosin (H&E) dye. All samples were examined by the same histologist in a blind fashion under a light microscope (x100 magnification). The number of fibroblast cells was counted.

Statistical Analysis: The T-test was used for comparison of mean differences in both groups. A p value <0.05 was considered statistically significant.

Results

Preoperative blood levels of AST, urea, WBC, hemoglobin, Fe, Zn and albumin were not different in the two groups (Table 1).

On postoperative day 7, the tissue hydroxyproline level was lower in the second group that in the first group and the difference was statistically significant ($p<0.05$). Tissue tension strength was also significantly lower in the second group than in the first group and the difference was statistically significant ($p<0.05$) (Table 2).

In the histopathological examination, the fibroblast cell count was significantly lower in the second group than in the first group ($p<0.05$) (23.5 ± 4.7 cells versus 29.6 ± 3.9 cells, x100 magnification).

Intraabdominal adhesions were observed in 3 rats in Group I, and in 6 rats in Group II. The difference was significant ($p<0.05$).

Discussion

Incisional hernia appears in 2-10% of patients who have undergone an abdominal operation and is a severe complication (2,7). Several factors are suspected of causing incisional hernia formation. Among these, age, existence of systemic disease (such as diabetes mellitus, uremia, immune suppression, jaundice, sepsis, hypoalbuminemia and cancer), wound infection following the operation and inadequate surgical technique are the leading causes (2,7,8).

Table 1. Serological and hematological parameters of two groups (x ± SD).

Group	AST (u/L)	Urea (mg/dL)	Alb. (g/dL)	Fe (µg/dL)	WBC (/ml)	Hemglb. (g/dL)	Zn(µg/dL)
I	20.7±6.2	26.7±5.5	4.2±0.4	85.5±22.8	6828±825	13.8±0.1	94.8±14.6
II	19.6±5.8	26.3±5.1	4.5±0.3	95.8±24.0	7102±637	13.9±0.5	93.5±13.0

Table 2. Tissue tension strength and hydroxyproline levels (x±SD).

Group	Tension Strength (g)	Hydroxyproline (µg/mg)
I	751.0 ± 31.0	3.12 ± 0.14
II	622.3 ± 27.6	2.81 ± 0.15

Inadequate closure is the single most important factor. The fascial layers give strength to a closure, and when the fascia is disrupted, the wound separates (2).

Prevention is the main step of the incisional hernia treatment. For this reason, the risk factors should be eliminated before surgery and an adequate surgical technique should be used (2,9)

There are several factors that have an influence on wound healing. The most important of these is the nutritional status of the patient (3,10). Granulation tissue occurs by fibroblast and vascular endothelial cell proliferation within 5 days of an injury. Proliferated fibroblasts in the granulation tissue contain an increased amount of granular endoplasmic reticulum and this can be observed in the histological sections (11). The role of fibroblasts in wound healing involves the synthesis of proteoglycan and collagen fibers (12). The fibroblast count was significantly increased in the separated suture group in our study. This will result in increased collagen synthesis and better wound healing. The increased hydroxyproline level and tissue tension strength in the first group support this conclusion.

In this study, tension strength was significantly higher in the separately sutured group than in the continuously sutured group. Based on this result, we may assume that the separate suture technique provides better wound healing.

Tissue hydroxyproline level is the best indicator of collagen synthesis. Hydroxyproline is an amino acid and a subproduct of collagen synthesis. Hydroxyproline level shows a parallel increase with collagen synthesis (5,13,14). In the present study, the hydroxyproline level showed a significant increase in the first group. This result supports the conclusion that wound healing is superior in the separated suture technique than in continuous suturing. As the tissue hydroxyproline assay presents a parallel increase with tissue collagen level, hydroxyproline measurement is an important test for wound healing (5,14).

In our study, intraabdominal adhesions were more frequent in the second group and hence the difference was statistically significant. There are many factors causing intraabdominal adhesions, and inadequate blood supply (ischemia) is the most important. Based on this fact, we also assumed that the continuous suture technique causes decreased blood flow to the suture line, and deficient wound healing.

The deficiencies of vitamins, trace elements and minerals may deteriorate the wound healing (15). Serological and hematological parameters were similar in the two groups in our study and there was no systemic differences between the groups. We believe that the differences between tension strength, tissue hydroxyproline level, fibroblast count and peritoneal adhesion are directly related to the applied suture techniques. We think that continuous sutures cause high pressure through the whole suture line, and this deteriorates tissue blood supply. Inferior and superior epigastric arteries go longitudinally and give transverse terminal branches (16). An interrupted continuous suture ties all the terminal branches and causes ischemia. This ischemia results in poor wound healing and dehiscence (17,18). Ischemia is also considered to be the main cause of peritoneal adhesions (19,20). We found peritoneal adhesions in a high incidence in the continuous suture group

In conclusion, the continuous suture technique causes bad tissue repair and inadequate wound healing. This can cause an increase in the incisional hernia incidence. The separate suture technique is superior to the continuous suture technique.

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