DESCRIPTION OF THE SPONTANEOUS REPAIR OF THE INTERNAL *Rectus abdominis MUSCLE* SHEATH AND PERITONEUM IN DOGS. SURGICAL IMPLICATIONS

Descripción de la Reparación Espontánea de la Aponeurosis Interna del Músculo *Rectus abdominis* y el Peritoneo en Perros. Implicaciones Quirúrgicas

***Saul Dorfman Gemer*[1], *Denny Dorfman*[3], *José Cardozo*[2], *Lorena Rivas*[2], *Eduardo Mora La Cruz*[3], *Crisola Marcano*[3] y *Marco Lombardi*[3]**

[1]*Departamento de Cirugía, Hospital General del Sur, Apartado 10317.* [2]*Departamento de Histopatología, Hospital General del Sur.* [3]*Facultad de Medicina, Universidad del Zulia, Maracaibo 4005-A, Edo. Zulia, Venezuela*

ABSTRACT

Thirty female dogs underwent abdominal surgery, which consisted of a lateral and transverse incision below the umbilical scar in order to ascertain the healing of the peritoneum and internal *rectus abdominis* muscle sheath by secondary intention based on the premise that healing of peritoneal defects depends on the proliferation of the underlying connective cells, whereas aponeurosis heals by ingrowth of cells from the cut edges. The wound was closed by suturing the external aponeurosis of the *rectus abdominis* muscle and the skin. The animals were sacrificed at days 1,3,8 and 90 days after surgery. The scar tissue was studied microscopically. Wound healing was complete at 90 days because two different mechanisms of repair contribute to a common healing process. The absence of wound dehiscense and incisional hernia in the animals allows to conclude that in the closure of the abdominal wall, the peritoneum and the internal *rectus abdominis* muscle sheath have little relevance in the healing process and the subsequent strength of the laparotomy scar.

Key words: Peritoneum, internal *rectus abdominis* muscle sheath, wound healing.

RESUMEN

Treinta perras fueron intervenidas, realizando una incisión lateral e infraumbilical, con el objeto de observar el proceso de cicatrización de la hoja interna de la aponeurosis de los músculos *rectus abdominis* y el peritoneo, por segunda intención. La cicatrización del peritoneo se realiza a partir de las células que se encuentran en el fondo de la lesión. La aponeurosis cicatriza a partir de las células que se encuentran en el borde la lesión. La síntesis de la herida se realizó suturando la aponeurosis externa de los músculos *rectus abdominis* y la piel. Los animales fueron sacrificados a los días 1,3, 8 y 90 días. La herida quirúrgica fue estudiada microscopicamente. La cicatrización fue completa a los 90 días, porque dos mecanismos de cicatrización diferentes contribuyeron a un mecanismo de cicatrización común. La ausencia de dehiscencia y hernias incisionales, permite concluir que en el cierre de la pared abdominal, el peritoneo y la hoja interna de los músculos *rectus abdominis* tienen poca relevancia en el proceso de cicatrización y la fuerza tensil de la herida quirúrgica.

Palabras clave: Peritoneo, aponeurosis interna de los músculos *rectus abdominis*, cicatrización.

Recibido: 23 / 07 / 99. Aceptado: 05 / 10 / 99.

INTRODUCTION

The suture of every layer of the abdominal wall has been considered to be of paramount importance in surgical practice. Although it has been widely accepted, the rational basis for some steps is difficult to determine. Traditional reasons for advocating layer-by-layer closure include: waterproofing of the wound, contribution to wound strength, and leakage prevention [2]. Some authors state that adhesions to the wound are reduced by peritoneal suture, despite the clinical and experimental evidence to the contrary [5,15].

It has been shown that the healing of peritoneal defects takes place *de novo* by differentiation of underlying connective cells, which become flattened mesothelial cells shortly after the production of the defect [4,6,9]. Epithelial wounds and fascia heal by ingrowth of cells from the cut edges [4,9].

The purpose of this investigation is to describe the healing of the peritoneum and internal *rectus abdominis* muscle sheath by secondary intention.

MATERIAL AND METHODS

Thirty adult female dogs, varying in weight between 10 and 20 k, were used. All operative procedures were performed under penthobarbital anesthesia, and were carried out under full aseptic precautions.

The abdomen was opened through a 3 cm lateral and transverse incision below the umbilical scar and was closed afterwards by suturing the external *rectus abdominis* muscle sheath with polyglactin 000. The skin was closed with interrupted silk 000 suture. Postoperatively, 50 mg/k of intramuscular cloranphenicol was administered every 8 hours for 2 days.

The animals were sacrificed in groups consisting of four animals each, using a massive penthobarbital dose at intervals of 1,3,8 and 90 days. Following death, the abdominal cavity was opened and after observation of the gross appearance of the surgical sites, the surgical wound was excised *in toto* and pinned to pieces of flat cork to avoid shrinkage artifice. Five micron thick serial sections were obtained from each area and stained with hematoxylin and eosin, and Mason trichrome.

RESULTS

Neither wound infection nor peritonitis was observed in the animals at the time they were sacrificed. Flimsy adhesions were found in the animals killed at days 1 and 3, respectively.

Microscopically, the samples at 24 hours revealed a dense polymorphonuclear neutrophil infiltrate in the fascia, subserosa and peritoneum. In addition, neovascularization, adult adipose tissue, scattered young fibroblasts, and a vascular endothelial proliferation were also observed, FIG. 1.

Proliferation of fibroblasts and endothelial cells was more prominent at 72 hours, FIG. 2, The polymorphonuclear neutrophil infiltrate persisted in the loose stroma surrounding the lesion. Neither epithelization of the peritoneum nor healing of the fascia was seen at this stage.

Reepithelization of the peritoneum was observed at 8 days, FIG. 3. Granulation tissue consisting of adult fibroblasts, neovascularization, dense collagenous tissue and a moderate polymorphonuclear neutrophil infiltrate was observed at the aponeurotic lesion.

In the tissue obtained at 3 months, FIG. 4, there was an increase of the extracellular matrix. The number of active fibroblasts was decreased and the inflammatory elements were scant. At this stage the healing of the peritoneum and the repair of the fascia was complete.

DISCUSSION

The results of the present study reveal that the surgical wound inflicted in the internal *rectus abdominis* muscle sheath and peritoneum heal because two repair mechanisms contribute to a common healing process.

It has been reported that peritoneal healing differs from healing of skin and fascia . In the peritoneum, the repair pro-

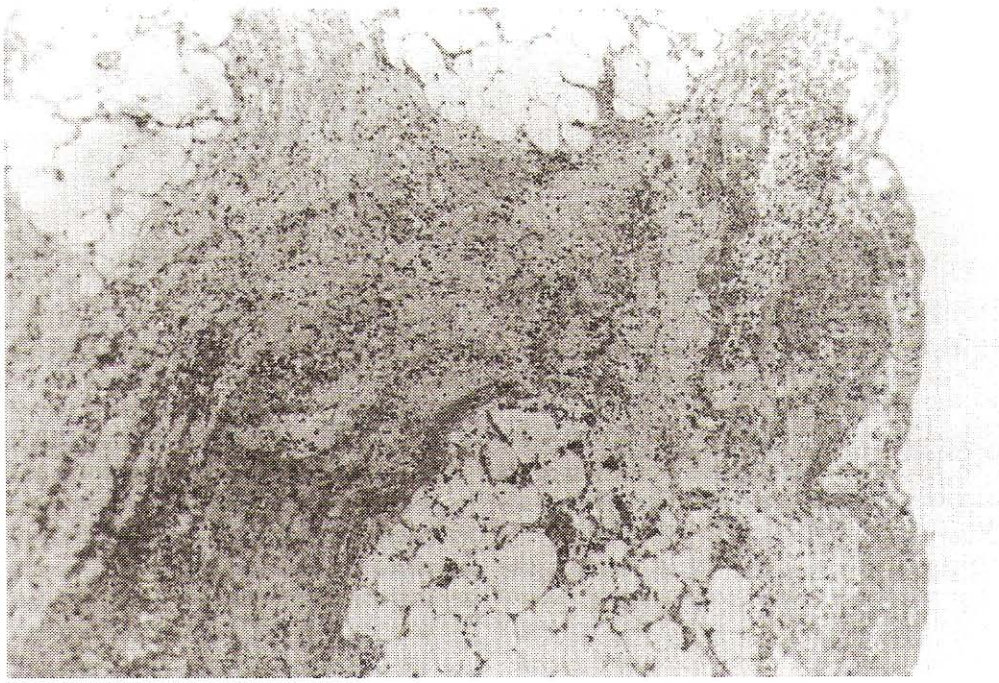

FIGURE 1. SURGICAL WOUND SURROUNDED BY ABUNDANT NEUTROPHILS, YOUNG FIBROBLASTS AND ADULT ADIPOSE TISSUE (24 HOURS). HE: 100X.

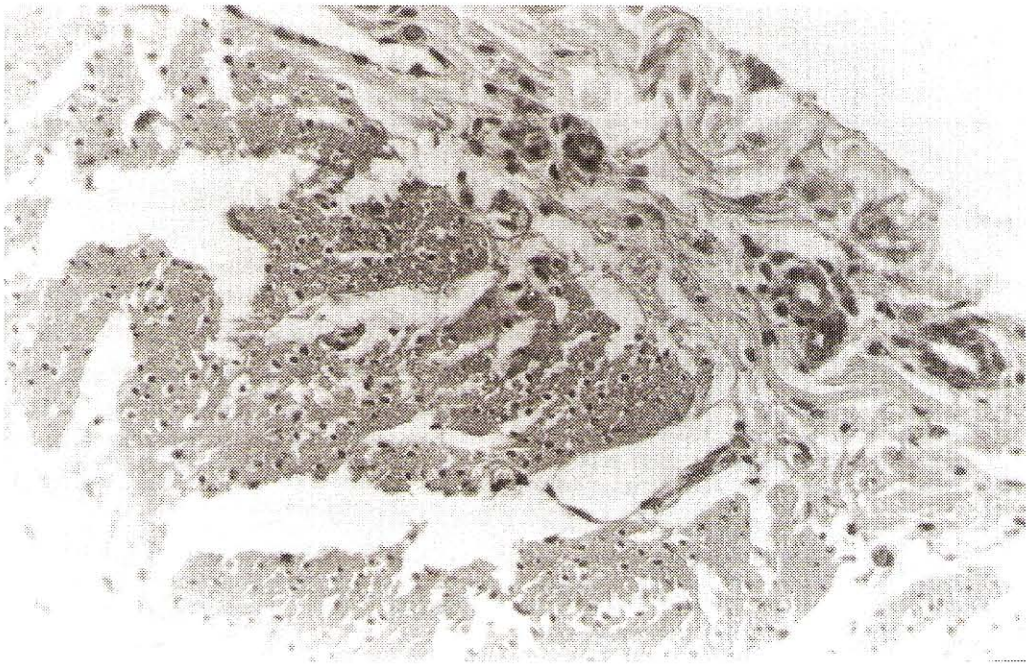

FIGURE 2. PROLIFERATION OF COLLAGENOUS CONNECTIVE TISSUE AND YOUNG FIBROBLASTS (72 HOURS). HE: 100X.

FIGURE 3. REEPITHELIZATION OF THE PERITONEUM. DENSE CONNECTIVE TISSUE. NEOVASCULARIZATION (8 DAYS). HE: 100X.

cess occurs simultaneously over the denuded areas and is entirely dependent on the proliferation of the underlying cells [4,6,9]. Both in the skin and fascia, the healing process is determined by the growth of cells from the cut edges [8,11]. Our findings support these reports. At 24 hours, the defect was covered with a layer of fibrin and polymorphonuclear neutrophils. This acute inflammatory response lasted 48 hours and was complete by the second week. The microscopic appearance may be misinterpreted as a bacterial infection by an inexperienced pathologist [13]. At 48 hours, the findings were similar, with the addition of occasional young fibroblasts. At 72 hours, a remarkable change took place: most of the inflammatory cells had disappeared, whereas abundant fibroblasts were seen. At 8 days, the peritoneal defect was covered by a layer of mesothelial cells with no evidence of the initial lesion. The granulation and scar that appears around the edges of the skin wounds does not take place during peritoneal healing [4]. At 90 days, scarring of both peritoneum and fascia was complete. During the healing period no incisional hernia was seen in the animals.

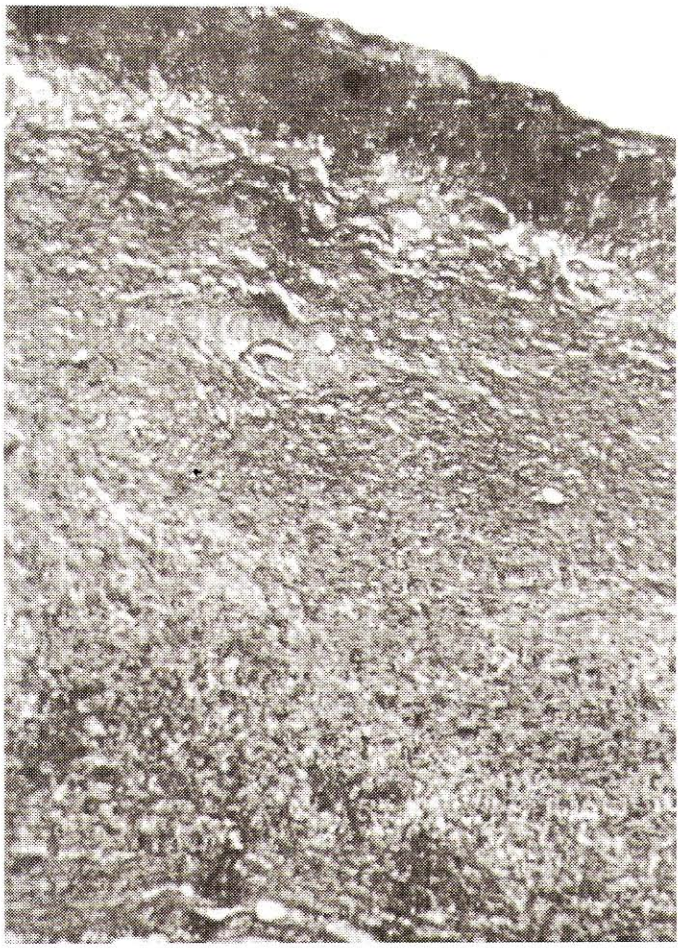

FIGURE 4. COMPLETE REPAIR OF THE LESION. REEPITHELIZATION OF THE PERITONEUM AND FASCIA (90 DAYS). MASSON TRICHROME: 100X.

The incidence of the incisional hernia in clinical practice continues to be high. The pathogenesis includes wound infection, abdominal distention, pulmonary infection, the use of absorbable suture material for closure of the aponeurosis, drains in the incision, bleeding and haematoma, multiple operations and obesity [3].

The importance of the external *rectus abdominis* sheath has been emphasized. It has been shown that inappropriate closure, especialy when chromic catgut is used, is an important predisposing factor in incisional hernia [3]. It is essential, indeed, that the external *rectus abdominis* muscle sheath should be closed with an adequate technique, using material with high tensile strength [3,10]. The repair of the incisional hernia is based upon the utilization of this structure for the reconstruction of the *linea alba* and the restoration of the *rectus abdominis* muscle [1]. Experimental and clinical studies have stressed that most of the tissue strength of the anterior abdominal wall relies upon the external rectus sheath rather than the internal rectus sheath and peritoneum [7,12,14].

This experience has demonstrated that although the spontaneous repair of the internal rectus sheath is complete at 90 days, the absence of incisional hernia in the animals supports the theory that the abdominal wall strength relies in the external rectus sheath rather in the internal one.

CONCLUSIONS

The above observations allow to conclude that in the closure of the abdominal wall, the internal rectus sheath and peritoneum has little relevance in the healing of the abdominal wall and the subsequent strength of the laparotomy scar. The use of polyglactin 910 and a good closure technique proved to be of the utmost importance in the prevention of incisional hernia, in spite of the fact that neither of the internal aponeurotic sheath nor the peritoneum was sutured.

RECOMENDATIONS

To further investigate and submit to clinical trial in animal or humans, the need, or lack of it, to close the peritoneum or fascia following abdominal surgery, to provide a definitive answer.

ACKNOWLEDGEMENT

To Guy's and St. Thomas Medical School, Division of Anatomy and Cell Biology. Financial support of the Centro de Cirugía Experimental and the Consejo de Desarrollo Científico y Humanístico of the Universidad del Zulia (CONDES) (Grant 2237-94).

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