Effects of nitrofurazone on correction of abdominal wall defect treated with polypropylene mesh involved by fibrous tissue[1]

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ABSTRACT

PURPOSE: To evaluate the effects of nitrofurazone on the correction of abdominal wall defect treated with polypropylene mesh involved by fibrous tissue in rats.

METHODS: A defect in the abdominal wall was created and corrected with polypropylene mesh in 20 rats. They were randomly distributed into four groups: control, fibrous mesh, nitrofurazone and nitrofurazone dip in the mesh. Euthanasia was performed in 21 post-operative days. The healing process was analyzed regarding the meshes and macroscopic and microscopic aspects.

RESULTS: All animals had adhesions. However, no statistically significant difference ($p>0.05$) when compared between groups. Similarly microscopic analysis, in which there was no statistical significance level for the evaluated parameters such as mono and polymorphonuclear lymphocytes, granuloma, fibrosis, necrosis and collagen proliferation.

CONCLUSION: There was no significant effect on the abdominal wall defect repair with polypropylene mesh surrounded by fibrous tissue when dipped in nitrofurazone 2%.

Key words: Surgical Mesh. Collagen. Wound Healing. Nitrofurazone. Rats.

Introduction

Defects in the abdominal wall are usually consequences of trauma, burns, debridement of necrotizing infections, treatment of compartment syndrome, removal of infected mesh, tumor resection[1], among other factors such as tissue ischemia, infection and reaction to foreign bodies. These are traumatic and predispose the formation of adhesions that serous, the peritoneum[2]. The adhesions process is formed from inflammatory response to offending agent[3].

Its therapy is surgical. The use of synthetic prostheses in hernia correction enabled surgeons to new forms of treatment, with the dual benefit of being a reinforcement to the suture and as a replacement of damaged or defective tissue[4].

Studies such as Araujo's paper evaluating the use of surgical meshes in the correction of abdominal hernias[5] are very important in clinical practice. The polypropylene, the most used mesh currently is a synthetic material that produces little tissue reaction and has good tensile strength, resistance that this is maintained for several years after its use in living organisms[6].

It is possible association between synthetic materials and autologous tissue to enhance the induced fibroplasia, responsible for the desired strengthening the correction of hernias[7].

It has been proven that the polypropylene mesh surrounded by fibrous tissue is effective in correcting induced abdominal hernia with lower degree of macroscopic adhesions when compared to polypropylene mesh[8].

Besides this, experimental studies have shown that the use of derivatives of nitrofurazone decreased the degree of peritoneal adhesions in dogs[9], probably by interfering in the healing process[9] and decreased the intensity and severity of adhesions on rats[10].

There was found no reports of mesh effects surrounded by fibrous tissue associated with nitrofurazone and may thus have more promising results, since both have been used in the defect correction in the abdominal wall. Thus, it becomes valid assessment of the effects of both techniques.

Methods

Before the start of the project, all procedures were submitted and approved by the Ethics Committee in the Use of Animals of Centro Universitário do Estado do Pará (CESUPA) (Protocol 03/2014). Twenty Wistar rats (*Rattus norvegicus*) were used, aged about 120 days and weight ranging from 250 to 350g, from the Animal Colony of the Experimental Research Center of CESUPA.

Groups distribution

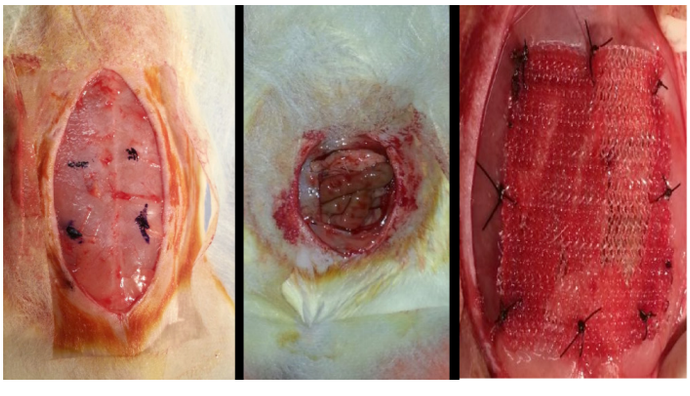
- Control group (CG), only treated with meshes.
- Fibrous mesh group (FMG), treated with a previously implanted polypropylene mesh subcutaneously for 21 days, being enveloped by fibrous tissue.
- Nitrofurazone group (NG), treated with polypropylene meshes dipped in nitrofurazone 0.2% for three minutes.
- Nitrofurazone and fibrous mesh group (NMG), treated with fibrous meshes dipped in nitrofurazone 0.2% for three minutes.

Technical procedures

The animals were anesthetized with ketamine hydrochloride (70mg/kg) and xylazine hydrochloride (10mg/kg), administered intraperitoneally. Once animals' anesthesia was confirmed, the surgical procedure was started.

In the FMG and NMG, 21 days before the primary surgical procedure, an incision of the skin of the dorsal region, dissection of subcutaneous tissues with polypropylene mesh implant 3x3 cm in the subcutaneous tissue. After hemostasis, the skin was sutured with nylon 4-0. On the main surgical procedure, the animals underwent resection mesh surrounded by fibrous tissue adjacent to the dorsal region, in accordance with a model already established[8]

The primary surgery was performed by the epilation abdominal region, followed by antisepsis of the skin. Subsequently, was performed four centimeters incision on both sides and the exposure of the aponeurotic muscle layer. Was followed with



the excision of the ventral part of the abdomen, involving the

aponeurotic muscle layer and the peritoneum with two centimeters longitudinal axis and two centimeters transversal axis, in order to create a defect in the aponeurotic muscle[11] (Figure 1).

FIGURE 1 – Defect creation in the abdominal wall. Source: protocol research.

This defect was corrected in all groups with the placement of polypropylene meshes (Prosthetic mesh Intracorp®, 100% polypropylene monofilament and unabsorbed) with three centimeters longitudinal axis and three centimeters transversal axis, attached at the edges with eight stitches (4-0 nylon thread) separated, equidistant, needled and atraumatic, with five semi-knots in each stitch, leaving the prosthesis margins over the anterior aponeurotic plane. For the NG and NMG, the meshes were dipped in nitrofurazone 0.2% for three minutes before attaching them to the animals.

Was realized the macroscopic analysis, studying the presence of incision hernias infections, dehiscences or fistulas, and the number of adhesions. After animals' euthanasia, according to the scheduled date for each subgroup, was removed a fragment from the abdominal wall containing the entire mesh.

The adhesions were evaluated according to the modified classification of Pundek[12] and Yasojima[11] as 0: complete absence of adhesions; 1: single adhesion between two organs or between an organ and the abdominal wall; 2: two adhesions between organs between themselves or between organ and the abdominal wall; 3: more than two adhesions between organ or together with the abdominal wall or a mass of widespread adhesions of the intestine without adhering to the abdominal wall; 4: generalized adhesions between organs and the abdominal wall.

This fragment was stored in 10% buffered formaldehyde and used for histopathological analysis by means of hematoxylin, eosin and Masson's trichrome coloration.

The histological analysis was done blindly by evaluating of a single pathologist. Inflammatory response parameters were analyzed (type of granuloma, fibrosis, and collagen fibers intensity) and necrosis. These parameters were classified as 0: absence; 1: mild; 2: moderate; and 3: intense. The results were analyzed by Kruskal-Wallis test adopting 5% significance level.

Results

Through macroscopic analysis, it was observed that not all animals studied had incision hernias, infections, dehiscences or fistulas. However, all animals studied had formation of adhesions between the meshes and the abdominal organs (Figure 2). Not showing statistical difference between the groups in the three periods studied (Table 1).

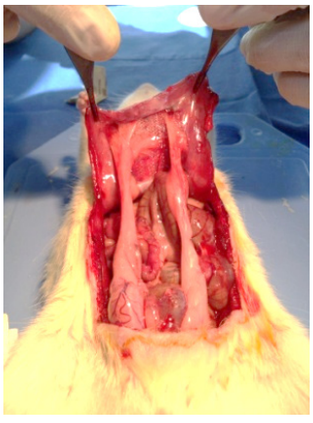


FIGURE 2 – Abdominal adhesions. Source: protocol research.

TABLE 1 – Average number of adhesions between the mesh and the abdominal organs in accordance with the groups.

Group	Adhesions
CG	2.2
FMG	1.6
NG	2.8
NMG	1.8

p=0.2280 (Kruskal-Wallis test)

There was no significant statistical difference for microscopic analysis, among which stand out mono and polymorphonuclear lymphocytes, granuloma, necrosis, fibrosis, and collagen tissue proliferation between the groups (Table 2).

TABLE 2 – Average of the main microscopic parameters analyzed between groups.

Parameters	CG	FMG	NG	NMG	p-value
Monomorphonuclear	2.6	2.4	2.4	2.4	0.9746
Polymorphonuclear	0.6	0.6	0.4	0.6	0.9615
Granuloma	1.2	1.6	2.0	1.6	0.5646
Necrosis	1.8	0.6	0.6	0.4	0.5453
Fibrosis	1.8	1.0	1.6	1.0	0.2272
Collagen proliferation	2.8	2.4	2.0	2.2	0.4169

Kruskal-Wallis test

Discussion

There are several techniques to repair abdominal wall hernias. However, usually at the end of the operation, there is a great tension on the suture thread, taking into account also

the suture is made deficient tissues, which favors recurrences[4]. Therefore, the study of correction of the complications involved in the technical and material becomes of great value to scientific knowledge.

Throughout the experimental part of this article, all animals have evolved well postoperatively, be it 21 or 42 days without causing eviscerations or replacement of animals to the study, confirming the protective properties and containment of intra-abdominal viscera the polypropylene mesh.

There was no significant histological difference between the groups, especially the FMG compared to the CG, similar to Ricciardi[8]. This may express the lack of a factor that acts by modifying the cellular dynamics. In the case of NG and NMG groups, perhaps the soaking time of three minutes from nitrofurazone solution 0.2%, was not enough.

The adhesions are the result of exudate of fibrin and happen in any type of trauma. These exudates form temporary adhesions and can delay the healing process. Almost all meshes produce adhesions when in touch to intestine surface and it is determined by the size of pores, by structure and surface area of the mesh[13].

The serous surfaces, such as the peritoneum, are constituted of mesothelial cells that produce surfactant phospholipid compounds that have fibrinolytic activity and protect against adhesion and thrombosis, besides producing cytokines that participate in tissue repair and in the renewal of the extracellular matrix. When the peritoneal surface is damaged, the coagulation cascade leads to the formation of fibrin deposits. Polymerized fibrin monomers form a network that serves as a model for wound healing or as a bridge to the development of tissue adhesions[14].

On the macroscopic analysis, the authors of this paper have opted for Pundek[12] and Yasojima[11] modified classification instead of D'oliveira[9] because the first proved to be more objective. The macroscopic analyzes all rats show some degree of adhesion. Although statistically insignificant, the NMG group, by combining the two techniques, showed great homogeneity in the macroscopic findings, different from the other groups.

NG group showed no decrease in the intensity or frequency of adhesions, opposing these findings with Diogo-Filho[10]. This may be due to the soaking time factor cited above.

In this paper, there was no statistical significance for the presence of infection, once it has detected an abscess, which occurred only in FMG group. The minimum incidence of infections in procedures confirms the results of Pundek[12]. These are based on satisfying job aseptic and antiseptic techniques pre and intra-operative.

Conclusion

There was observed no significant beneficial effect of polypropylene mesh pool surrounded by fibrous tissue and dipped in nitrofurazone compared to isolated use of these techniques for defect correction in the abdominal wall in rats.

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Errata:

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