



Study of Intra-Abdominal Adhesion After Hernia Repair with Propylene Mesh in Comparison with Amniotic Membrane Attached with Propylene Mesh in an Animal Model

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ABSTRACT

Adhesions after surgery are a common cause of surgical morbidity and can lead to mechanical small bowel obstruction, female infertility and chronic pelvic pain. The aim of this study is to compare the adhesion formation after repair of hernia with propylene mesh alone and propylene mesh attached to human amniotic membrane in rats to evaluate the effect of human amniotic membrane in reducing postoperative intra-abdominal adhesion. Twenty female non-pregnant healthy rats were randomized in the case (10) and control (10) groups, and full-thickness abdominal wall defect was created in each animal. In the case group, the defect was repaired with human amniotic membrane attached to propylene mesh, and in the control group with propylene mesh alone. The rats were re-operated one month later for investigation and measurement of the intra-abdominal adhesion band formation. Adhesion development was quantitated according to Nair's classification system (NCS). The data were also analyzed with Mann-Whitney U test. In the case group, 2 rats had grade 2 adhesions, and 8 had grade 3. In the control group, 3 had grade 2 adhesions and 7 had grade 3 adhesion bands. Besides, we had 3 infected wounds in the amniotic membrane group. Although amniotic membrane has shown good effect in some previous studies, in our investigation it was not effective. In addition, it increased the rate of infection in the case group, so more studies are recommended to have exact knowledge about effectiveness of amniotic membrane in reducing postoperative intra-abdominal adhesion.

Keywords: Amniotic Membrane, Mesh repair, Hernia

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INTRODUCTION

Adhesions after surgery are a common cause of surgical morbidity. Adhesions change normal anatomic relationships, which can lead to pain and necessitate additional corrective surgeries. Unfortunately, additional surgeries can deteriorate adhesions and cause additional and more severe complications. Many strategies have been tried to prevent adhesions that are consequence of intraoperative tissue manipulation and injury [1].

Peritoneal adhesions can lead to mechanical small bowel obstruction, female infertility and chronic pelvic pain. Moreover, adhesions make reoperation prolong and cause undesired intestinal rupture and related complications. Therefore, a method to reduce post-surgical adhesion formation would be of great benefit [2].

Szabo et al. reported that Human amniotic membrane (HAM) (a translucent and nonadhesive bioresorbable membrane) and HA/CMC membrane proved to be effective as anti-adhesive in mesh repair of abdominal wall hernia in a rat model [3].

Amniotic membrane has shown long-term survival with no evidence of immune reaction. It has low or no antigenicity when used as an allograft in peritoneal cavity or buried under skin [4].

The aim of this study is to compare the adhesion formation after repair of hernia with propylene mesh alone and propylene mesh attached to human amniotic membrane in rats to evaluate the effect of human amniotic membrane in reducing postoperative intraabdominal adhesion.

MATERIALS AND METHODS

Animals

Twenty-five non-pregnant female rats, weighing 190–230 g, were used as a model for postoperative adhesion formation. The Animal Investigation Committee of Shiraz University of Medical Sciences approved this study, which was carried out at the Animal Research Centre of Shiraz University of Medical Sciences. They were selected from the animal house and all were healthy.

Surgical procedure

Mice were randomized in 2 groups, 10 in the case group and 10 in the control group. They were anaesthetized by a single injection of ketamine hydrochloride (40 mg/kg; i.m). The amniotic membrane was prepared from placenta at the time of delivery by cesarean section [2]. It was manually separated from the chorion and was washed in a 0.025% solution of sodium hypochlorite and kept at 4°C in sterile solution including penicillin [4].

Then after prep and drep under sterile condition, the skin was opened a 5*5 cm defect was made in the abdominal wall. In the control group, it was repaired with propylene mesh and the mesh was fixed to the abdominal wall with nylon 4-0 in continuous manner. Then the skin was closed with nylon 4-0 in continues manner. In the case group, the defect was repaired with a propylene mesh that was covered with a layer of human amniotic membrane. It was fixed to the defect in a way that chorionic side of amniotic membrane was in contact with intra-abdominal viscera, and the mesh was fixed with nylon 4-0 in continuous manner. The skin was closed with nylon 4-0 in continuous manner.

The rats were kept in animal lab for one month (30 days) and during the observation period, they were checked daily for signs of infection, seroma formation, or abscess formation. After that they were sacrificed with lethal dose of ethylene ether. The abdominal wall was opened via a Para midline incision far from the site of previous incision after entrance to the peritoneal cavity. The post-op adhesions were evaluated.

Adhesion development was quantitated according to Nair's classification system (NCS). (pic1)

0-no adhesion

1-single band of adhesion between viscera or from one viscus to abdominal wall

2-two adhesion band either between viscera or from one 'viscus to abdominal wall

3-more than two adhesion bands either between viscera or from one viscus to abdominal wall or whole of the intestine forming a mass without adherent to abdominal wall

4-viscera directly adherent to abdominal wall irrespective of number and extent of adhesion band

Statistical analysis

The analytical and descriptive statistics were carried out using SPSS 24.0 software (SPSS Inc., Chicago, IL, USA). Furthermore, Mann-Whitney U test was used to data analysis. $P < 0.05$ was measured to be statistically significant.

RESULTS

In our study, no significant difference was seen between the two groups in forming adhesions and also we had 4 infected wounds in the case group in which HAM was attached to PPM (Table 1).

Table 1. Frequency of Adhesion in tested groups according to the Nair's classification system

Group	Frequency of Adhesion N0	Frequency of Adhesion N1	Frequency of Adhesion N2	Frequency of Adhesion N3	Frequency of Adhesion N4
Control	0	0	2	8	0
Case	0	0	3	6	0
Sham	0	0	0	4	0

The results are shown in Figure 1, and as seen, the 2 groups had similar degrees of adhesion formation (Figure 2). The data were also analyzed with Mann-Whitney U test. Comparing

the case and control groups showed a p-value of 0.270, showing no significant difference between the two groups.

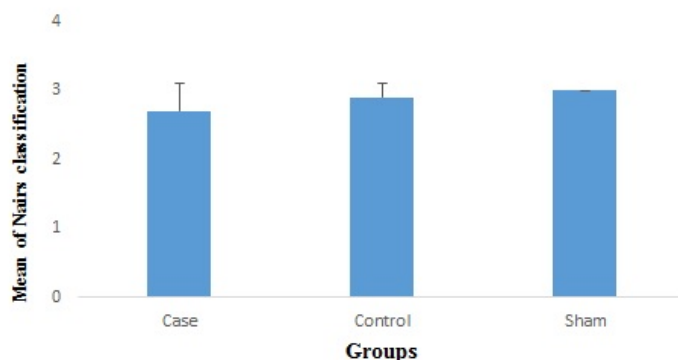


Figure 1. Comparison of adhesion of the three groups studied based on Nair's classification system



Figure 2. Forming adhesions in tested animals.

DISCUSSION

Surgical adhesions result in significant morbidity and can cause dysfunction of organs and chronic pain syndromes. Adhesion-related morbidity is increased after repeat surgeries for complications that are related to abnormalities caused by adhesions [5,6]. Preventing adhesion formation and reformation in surgery is still an obstacle surgical problem. Many treatment modalities, include absorbable and nonabsorbable synthetic barriers; absorbable biologic barriers; locally applied, drug-containing gels and systemic steroids; and other anti-inflammatory medicines have shown limited success [1, 7]

HAM has been shown to be an effective anti-adhesive membrane in mesh repair of abdominal hernia, as A. Szabo et al. showed that animals undergoing hernia repaired with HAM- or Seprafilm-covered PPM has nearly 100% adhesion reduction, in comparison with animals treated with uncovered PPM in which 56% of

the graft area was covered by adhesions. Both HAM and Seprafilm were nearly equally effective [3]. In this study, we compared propylene mesh alone and amniotic membrane attached to propylene mesh in repairing abdominal hernia in an animal model that not only did not reduce postoperative intra-abdominal adhesion, but also increased the rate of post-operative wound infection. This study shows that much more investigations should be done on using amniotic membrane and its effectiveness in reduction of post-operative adhesion.

Compliance with Ethical Standards

All the procedures performed in the studies involving animals were in accordance with the ethical standards of the institution or practice at which the studies were conducted.

Conflict of interest

The authors have no conflict of interests.

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