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Affect of Ischemia on Adhesion Formation for Hernia Repair with Polypropylene Mesh

Propilen Mesh ile Yapılan Fıtık Onarımlarında İskeminin Adezyon Formasyonuna Etkisi

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SUMMARY

Postoperative adhesions are seen after mesh repairs for incisional hernia. While a correlation between adhesion formation and type of mesh has been reported, our study shows that adhesion formation is related to ischemia rather than mesh type. The aim of this study is to point out the affects of ischemia on adhesion formation for when repairing ventral hernias with mesh.

Key Words: *Adhesion, polypropylene mesh.*

ÖZET

Mesh ile onarılan insizyonel hernilerden sonra postoperatif adezyonlar görülür. Adezyon oluşumu ile mesh tipleri arasında bir ilişki bildirilmesine rağmen,bu çalışmamız göstermiştir ki; adezyon oluşumu mesh tipinden ziyade iskemi ile ilişkilidir. Bu çalışmanın amacı ventral hernilerin mesh ile tamiri sırasında, iskeminin adezyon oluşumu üzerindeki etkilerine dikkat çekmektir.

Anahtar Kelimeler: *Adezyon, polipropilen mesh.*

INTRODUCTION

The treatment of major abdominal wall defects or incisional hernias is a major problem facing surgeons. Wall defects or incisional hernias are treated by primary musculofascial repair, however, mesh implantation has become more common, especially in recurrences. After mesh repair of incisional hernias, serious postoperative adhesions have been observed. It has been reported that the adhesions are caused by the type of mesh materials, some materials are reported to be associated with adhesions more than others (1-9).

In previous research done at our clinic, the adhesions were formed at the suture points between the mesh and the abdominal wall. The cause of adhesions at these sites was shown to be ischemia.

With this observation in mind, this study was designed to determine the rate of the formation of adhesions after treatment of incisional hernias with mesh without suturing to the intraabdominal surface.

MATERIALS and METHODS

After obtaining approval from Ankara Training and Research Hospital Ethic Committee, thirty 400 g male Hartley Guinea pigs were used for this experimental study which was conducted at the experimental laboratory of Ankara Training and Research Hospital between Jan 2005 and April 2005. The animals were fed with standard rat food and water for 30 days after operation.

The Guinea pigs were randomized into the study and the control groups. The skin was shaven and sterilized using 10% povidone-iodine for operation. Under ketamin (ketamin HCL 37.5 mg/kg) and rompun (xylazine HCL 5mg/kg) anesthesia, the abdomens of the animals were incised over the mid-

line. In each group, a 1.5 x 2.5 cm full thickness section was cut from the left rectus muscle. In the control group, the defect was repaired by appropriate dimensions of polypropylene mesh with 3/0 polyglactin sutures. In the experimental group, the repair was made by placing 2 pieces of polypropylene meshes. The mesh was larger than the abdominal wall defect and one piece was placed intraabdominally while the other was placed extraabdominally. The abdominal wall musculoskeletal tissue was sandwiched between the 2 pieces of mesh (diamensions-intraabdominal 3.0 x 4.5 cm, extraabdominal 2 x 3.5 cm). The 2 pieces of mesh were attached to each other in the midline with 2 polyglactin sutures. The anterior mesh, placed in the intraabdominal zone, was sutured to the edges of the anterior abdominal wall without causing ischemia. All the animals in two groups were sacrificed by high dose ether anesthesia, on 30th postoperative day. The anterior of abdominal wall was opened with a broad flap incision from rib cage to pelvis. The tecnique for scoring quantifies adhesions by extent, type, and tenacity to obtain a compozite adhesion score for each animal (4) (Table 1).

The results of the study were evaluated with Mann Whitney U test.

RESULTS

One animal in the control group died on postoperative day 5 due to infection. Two animals in the study group died. One died on postoperative day 5 due to infection and one on postoperative day 1 due to evisseration. The adhesion scoring results of 13 quinea pigs of the study group and 14 quinea pigs of the control group are shown in (Table 2).

Adhesion formation in the study group was significantly less than the control group ($p< 0.005$). Omental adhesions were increased around the suture zones and vascularisation was evident at these areas in the control group.

Table 2. The adhesion scoring results in the study and control groups.

Score	Study (n1= 13)	Control (n2= 14)
0	2	-
1	-	-
3	5	2
4	1	-
5	2	4
6	1	6
7	2	2

Two animals had higher scores in the study group, compared to the control group and one of them was localized to defect zone and had intestinal adhesion. In one animal there was skin necrosis over the defect in the early post-operative period and secondary healing was seen. There were omental adhesions in the other animals and these were localized to superior pole of the mesh. There were no adhesions in two animals. In one animal, the mesh had folded so the inferior portion was overlying the superior portion. In all the other animals the mesh had adhered to abdominal wall and the inner surface adjacent to abdomen was peritonealized.

In the control group, all the animals had omental adhesions. Omentum, distal stomach and small intestine had adhered to mesh in one animal and in another two, only small intestine had adhered to mesh. In one, who had small intestine adherence, there was chronic subcutaneous infection at the mesh area. Omental adherences were increased especially at the suture zone of mesh edges and vascularisation was significant.

In the cross sectioning of pathological samples taken from the two groups the following observations

Table 1. Adhesion scoring table (4)

Score	Extent (Pecentage of the surface)	Type (Appearance)	Tenacity
0	None	None	None
1	< 25%	Filmy, transparant, avasculer	Fall apart
2	< 50%	Opaque, translucent, avasculer	Lysed with traction
3	< 75%	Opaque, translucent, capillaries	Sharp dissection required
4	> 75%	Opaque, larger vessels present	

were made: First, there was oedema around the cystic cavities formed by polypropylene mesh localized to striated muscle fibers and multilayer flattened ephitelium over the surface. Second, an increase in fibroblastic activity, vascular proliferation and multinuclei giant cells as foreign bodies are reported. The meshes were peritonealized and more inflamation was seen around the suture material in either group.

DISCUSSION

In the study group, the mesh was placed intraabdominal without suture and there was less adhesion formation when compared to the control group. In the control group, the mesh was sutujed to the edges of fascia and this caused ischemia at the suture site. The increase in adhesions at the suture sites is likely due to the corresponding ischemia. Rayner, in his study in 1974, reported that placement of mesh like "onlay" style to anterior abdominal wall would decrease the ischemia and there was less adhesion formation compared with full layer suture (10).

According to Ellis, peritoneal defects would be recovered without adhesion formation if they were kept without repair. The healing would be with serious adhesions, if peritoneum was sutured to repair the defect. The ischemic tissue formed by sutures, produces a stimulus for adhesions (11). There is some data about healing after peritoneal defect formation, depending upon fibroblasts originated from perimysium (12,13). In another article, healing was mediated by free mesotelium cells in intraabdominal cavities and monocytes and macrophage cells transformed to mesotelium cells (14,15). All these papers consider that using sutures for peritoneum repair is not only unnecessary but also harmful.

In our study, increased omental adhesions and significant vascularisation at suture sites point out the importance of ischemia in adhesion formation. In the presence of ischemia, vascularisation must be achieved for prevention of developing necrosis. Only the omentum can provide new vascularisation quickly to ischemic areas in intraabdominal cavity (16). This opinion explains the omental adhesions seen in all the animals except in two in the study group.

Adhesion formation can be decreased with minimum travma to serosa and peritoneum. We tried to keep intraabdominal sutures to a minimal to decrease peritoneal ischemia. Although adhesion formation was evidently decreased, it could not be prevented completely.

As a result, in the repair of incisional hernias with mesh, adhesion formation is an important problem, and ischemia is an important factor. Adhesions.can be decreased by avoiding unnecessary sutures and providing optimal tension in mesh hernioplasty. As ischemia is not the only cause, other factors in formation of adhesion must be investigated.

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