Sutureless Intraperitoneal Polypropylene Mesh Placement Decreases Adhesion Formation in Guinea Pigs

DİKİŞSİZ İNTRAABDOMİNAL MEŞ YERLEŞTİRİLMESİ KOBAYLARDA YAPIŞIKLIK FORMASYONUNU AZALTIR

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Summary

Objectives: 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 effects of ischemia on adhesion formation when repairing ventral hernias with mesh.

Material and Methods: A 15x25 mm full thickness defect at anterior abdominal wall was created in 30 guinea pigs (study and control groups of 15 each). In the control group, polypropylene mesh at proper size was sutured to the edge of the defect. In the study group, two layer large size polypropylene mesh attached to each other centrally with a poliglactin suture; was placed as it surrounded the abdominal wall defect edges internally and externally. The extraabdominal layer was attached to the anterior fascia with poliglactin sutures not involving the inner surface of abdominal wall. At 30 days, the animals were sacrificed and the prevalence, presence and resistance of the adhesions were evaluated by using a scoring system.

Results: The incidence of adhesions was lower in the study group and this difference was statistically significant ($p<0.005$). In the control group, omental adhesions were around the suture regions and vascularization was significant at suture points.

Conclusion: Our study shows that when repairing ventral hernias with mesh, tissue ischemia promoted adhesion formation.

Key Words: Adhesion formation, Polypropylene mesh, Hernia repair

T Klin J Med Res 2002, 20:104-108

Özet

Amaç: Mesh ile yapılan insizyonel herni onarımlarında postoperatif adezyonlar görülür. Değişik yayınlarda bu adezyonların meshin tipine bağlı olduğu belirtilirken, kliniğimizde yapılan bir çalışmada adezyon oluşumunun mesh tipinden çok iskemiye bağlı olduğunu düşündüren bulgular elde edilmiştir. Bu deneysel çalışmanın amacı ventral hernilerin mesh ile onarımlarında iskeminin adezyon oluşumuna etkisini belirlemektir.

Materyal ve IVletod: 30 kobayın batın ön duvarında 15x25 mm boyutlarında tam kat defekt oluşturuldu (15'i kontrol, 15'i çalışma grubu). Kontrol grubunda uygun boyuttaki polypropylene mesh defekt kenarlarına sürüre edildi. Çalışma grubunda defektten daha büyük boyuttaki ortalarından birbirine poliglaktin ile tutturulmuş iki mesh, batın duvarı arada kalacak şekilde internal ve eksternal olarak abdominal duvar defektine yerleştirildi. Ekstraabdominal tabaka anterior fasiaya, abdominal duvarın iç tabakasını içermeyecek şekilde poliglaktin sütürlerle tutturuldu. Her iki gruptaki hayvanlar postoperatif 30. günde öldürüldü ve adezyonlar, görünümü ve kopmaya karşı direnci temel alan bir skorlama ile değerlendirildi.

Bulgular: Çalışma grubunda adezyon insidansı daha düşüktü ve bu fark istatistiksel olarak anlamlı idi ($p<0.005$). Kontrol grubunda, omental yapışıklıklar dikiş bölgelerinde yoğunlaşmıştı. Bu alanların histopatolojik kesitlerinde vaskülarizasyon belirgindi.

Sonuç: Bu yapışıklıklara mesh ile onarım sırasında konulan dikişlerin yarattığı iskeminin yol açtığı kanısındayız.

Anahtar Kelimeler: Yapışıklık, Polipropilen mesh, Herni onarımı

T Klin Araştırma 2002, 20:104-108

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 (1,2). 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 (3-11). With the suggestion of adhesion formation at the suture sites caused by ischemia, 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 Ethics 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 2000 and April 2000. 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 midline. In each group, a 1.5x2.5 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 two 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 musculoaponeurotical tissue was sandwiched between the two pieces of mesh (dimensions-intraabdominal 3.0x4.5 cm, extraabdominal 2.0x3.5 cm). The two pieces of mesh were attached to each other in the midline with two polyglactin sutures. The anterior mesh placed externally was sutured to the edges of the defect. 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 technique for scoring quantifies adhesions by extent, type, and tenacity to obtain a composite adhesion score for each animal (4) (Table 1).

Table 1. Adhesion Scoring Table (Cristoforoni PM etal. 1996; ref. 4)

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

Maximum possible score = 11.

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

Score	**Study** (n_1=13)	**Control** (n_2=14)
0	2	
1		
2		
3	5	2
4	1	
5	**2**	**4**
6	1	**6**
7	2	2
Average Score ($p<0.005$)	3.8	5.4

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 guinea pigs of the study group and 14 quinea pigs of the control group are shown in Table 2.

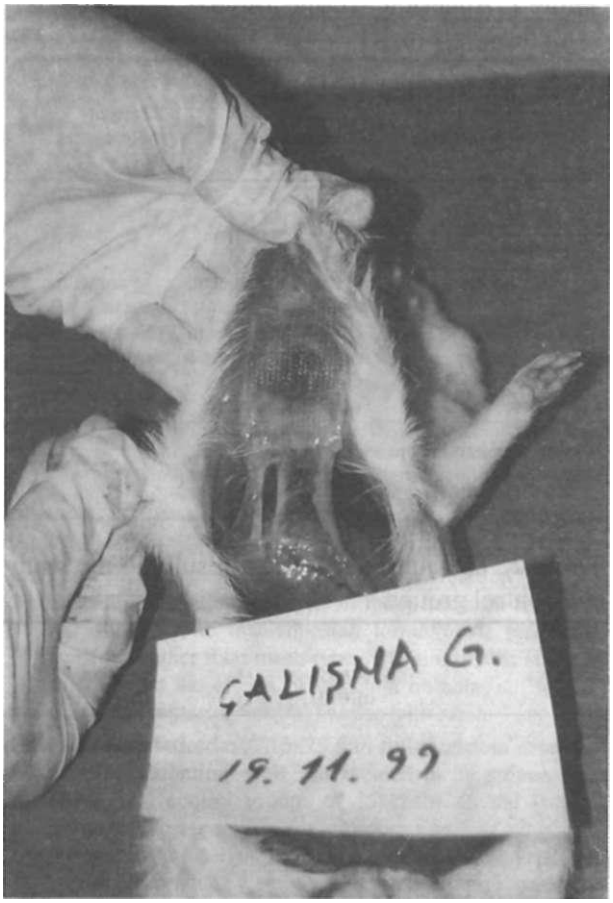

Figure **1.** Omental adhesions localized to superior pole of the mesh in the animals of the study group.

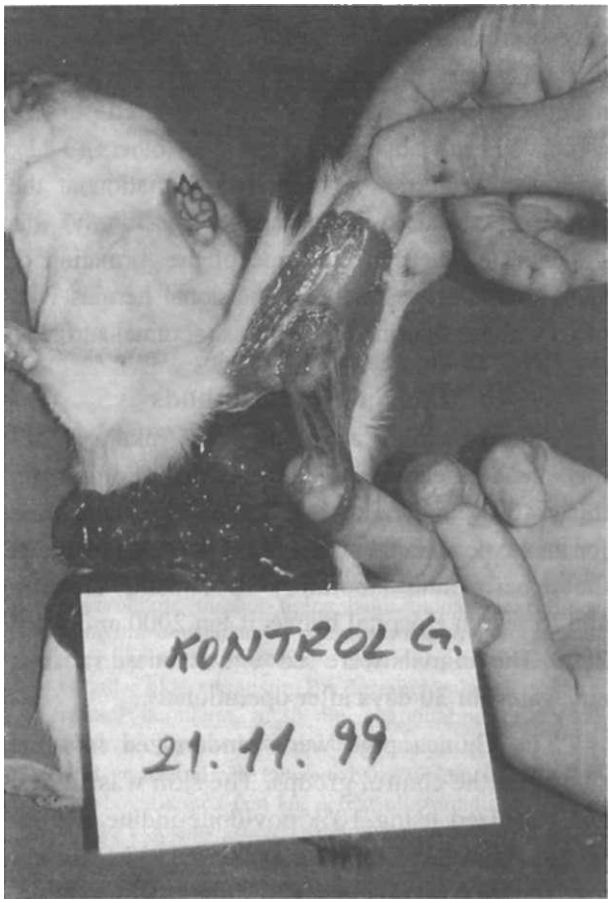

Figure **2.** Increased omental adherence especially at the suture sites of the mesh edges and significant vascularisation.

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.

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 (Figure 1). 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 which 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 other 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 adhérences were increased especially at the suture zone of mesh edges and vascularisation was significant (Figure 2).

Discussion

In the study group, the mesh was placed intraabdominally without suture and there was less adhesion fonnation when compared to the control group. In the control group, the mesh was sutured 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 fonnation compared to full layer suture (12).

According to Ellis, peritoneal defects would recover without adhesion formation if they were unrepaired. 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 (13). In another article, healing was mediated by free mesothelium cells in intraabdominal cavities and monocytes and macrophage cells transformed to mesothelium cells (14). A11 these papers consider that using sutures for peritoneum repair is not only unnecessary but also harmful.

In his study determining the importance of blood supply, Dabrowiecki suggests that mesh implants should be placed in apposition to muscles in order to obtain well-vascularized healing (15). 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. 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 trauma to serosa and peritoneum. We tried to keep intraabdominal sutures at minimum 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 fonnation of adhesion must be investigated.

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Received: Feb. 7, 2002

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