



ARAŞTIRMA / RESEARCH

Omega-3 fatty acid covered polypropylene mesh for abdominal wall hernia repair: a prospective analysis of 30 patients

Abdominal duvar hernilerinin tamirinde omega-3 yağ asidi kaplı polipropilen mesh: 30 hastanın prospektif analizi

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Cukurova Medical Journal 2017;42(2):314-319

Abstract

Purpose: The main principle in abdominal wall hernia repair is achieving a tension free repair. To reduce adhesion risk caused by polypropylene mesh, meshes with anti-adhesive barrier have been introduced into clinical practice. The present study aimed to analyze postoperative outcomes in patients operated with omega-3 fatty acid covered polypropylene mesh for abdominal wall hernia repair.

Materials and Methods: This study was prospective cohort conducted by examining the data of patients operated with omega-3 fatty acid covered polypropylene mesh between November 2010 and July 2015. The patients divided into two groups according to the operative technique. Primary parameters included complications, i.e., hernia recurrence, mesh adhesion, mesh infection and surgical site infection.

Results: This study enrolled 30 patients (15 men, 15 women) with a mean age of 56.2 ± 14.5 (range 17-83) years. Group 1 had eight patients (27%) who had laparoscopically repaired abdominal wall hernias, and group 2 included 22 (73%) patients who had abdominal wall hernias un-repairable by primary suture. Nine (30%) patients developed a complication. Age, sex and operative technique did not significantly affect complication rate. In patients who developed complication, defect size was significantly greater.

Conclusion: The long-term effects of meshes with anti-adhesive barrier are unknown. It should be noted that this meshes have the potential to cause morbidity, serious health problems or even death.

Key words: Composite mesh, anti-adhesive barrier, abdominal wall hernia.

Öz

Amaç: Abdominal duvar hernilerinin tedavisinde temel prensip gerilimsiz onarımdır. Polipropilen mesh nedeniyle oluşan adezyon riskini azaltmak için antiadeziv bariyerli meshler kullanılmıştır. Bu çalışmanın amacı, omega-3 yağ asidi kaplı polipropilen mesh kullanılarak ameliyat edilen hastaların postoperatif takip sonuçlarının analiz edilmesidir.

Gereç ve Yöntem: Bu çalışma, Kasım 2010 – Temmuz 2015 yılları arasında omega-3 yağ asidi kaplı polipropilen mesh kullanılarak opere edilen hastaların, digital veri bankasında taraması ile prospektif olarak yapıldı. Uygulanan ameliyat tekniğine göre hastalar iki gruba ayrıldı (grub 1: laparoskopik, grub 2: açık cerrahi). Mesh olarak omega-3 yağ asidi kaplı polipropilen mesh kullanıldı (C-QUR™ Mesh, Atrium Medical Corporation, Hudson, NH, USA). Postoperatif komplikasyonlar irdelendi.

Bulgular: Çalışmaya 30 hasta dahil edildi. Erkek-kadın oranı eşit olup yaş ortalaması 56.2 ± 14.5 (aralığı: 17-83) idi. Yirmi iki hastada (%73) primer sütür ile onarılamayan abdominal duvar hernisi (grub 2), 8 inde (%27) laparoskopik onarılan abdominal duvar hernisi (grub 1) vardı. Dokuz hastada (%30) komplikasyon gelişti. Yaş, cinsiyet ve uygulanan cerrahi tekniğin komplikasyon gelişimine etkisi istatistiksel olarak anlamlı bulunmadı. Komplikasyon gelişen hastalarda defekt boyutu istatistiksel olarak anlamlı derecede yükseldi.

Sonuç: Antiadeziv bariyerli meshlerin uzun dönem sonuçları bilinmemektedir. Bu tip meshlerin de komplikasyon, sağlık problemi ve hatta ölümle bile neden olma potansiyeli olduğu unutulmamalıdır.

Anahtar kelimeler: Antiadeziv bariyer, omega-3 yağ asidi kaplı polipropilen mesh, abdominal duvar hernisi.

INTRODUCTION

Abdominal wall hernias, in which abdominal organs bulge out of the abdominal cavity, are commonly encountered in general surgery practice. The basic principle of hernia treatment lies in the tension-free repair of a defect causing the hernia. In cases where a tension-free repair is not possible by primary suture, synthetic meshes such as polypropylene or polyester meshes are used. Although they are typically intended for extraperitoneal use, these meshes may cause adhesions to intra-abdominal organs, resulting in serious complications such as intestinal obstruction, mesh migration, and enterocutaneous fistula when used intraperitoneally^{1,2}.

Thanks to continuous research aimed at minimizing these complications, meshes containing anti-adhesive barriers on one side have been developed, i.e., the composite dual mesh³. In addition to preventing recurrences, these meshes are also expected to prevent mesh adhesions to intra-abdominal organs and associated complications. The question is, therefore, do these meshes really achieve the desired results? Just a few studies have examined complication rates of meshes with anti-adhesive barriers. The aim of the present study was to analyze the characteristics of complications of omega-3 fatty acid covered polypropylene mesh repair.

MATERIALS AND METHODS

We designed a prospective cohort study conducted by examining the patients operated with the use intraperitoneal of mesh containing anti-adhesive barrier because of abdominal wall hernia between November 2010 and July 2015 in a tertiary education and research hospital. The patients' data included in the study were obtain from medical records. The research was conducted according to the principles of the World Medical Association Declaration of Helsinki and the universal principles of the Helsinki Declaration. Informed consent was obtained from each patient before the operation.

The study patients were divided into two groups; group 1: patients who were eligible and received laparoscopic surgery (laparoscopy), group 2: patients

who received open surgery (laparotomy). Polypropylene mesh with the visceral surface covered by omega-3 fatty acid (C-QUR™ Mesh, Atrium Medical Corporation, Hudson, NH, USA) was used as the mesh with an anti-adhesive barrier. The patients were followed with physical examinations or telephone interviews. Computed tomography was performed in the presence of peritonitis symptoms or intestinal obstruction. Demographic data, operative technique (laparoscopic or open surgery), mean follow-up duration, size of fascial defect, and perioperative and postoperative morbidity and mortality rates were analyzed. Main parameters included hernia recurrence, mesh adhesion, mesh infection and surgical site infection.

Statistical analysis

Statistical calculations were performed using IBM SPSS 22 software (IBM SPSS, USA). Variables were expressed as mean \pm standard deviations (SD) or as medians (range), depending on their distribution. Categorical variables were expressed as frequencies and percentages. The Chi-square and Fisher's exact tests were used for comparison of continuous parametric variables. The Mann-Whitney U test was used for the comparison of those parametric variables that lacked a normal distribution. The statistical results were reported within a 95% confidence interval. The differences were considered statistically significant when the p-value was less than 0.05.

RESULTS

The study included 30 patients. Of these, 15 (50%) were men and 15 (50%) were women. The mean age of the study population was 56.2 ± 14.5 (range 17 – 83) years. Group 1 contained eight (27%) patients who had laparoscopically repaired abdominal wall hernias, group 2 contained 22 (73%) patients who had abdominal wall hernias unrepairable by primary suture. No age or gender differences were detected between groups ($p=0.320$ and $p=0.682$, respectively). Average defect size for study population was $10.3\text{cm} \pm 6.5\text{cm}$, median 9.5cm , ranging from 2cm to 25cm. The defect size was greater in group 2 ($12.6\text{cm} \pm 5.9\text{cm}$) than in group 1 ($3.9\text{cm} \pm 1.6\text{cm}$) ($p=0.001$) (Table 1).

Table 1. Characteristics of groups

	Group 1 n=8	Group 2 n=22	p	Total
Age, Mean±SD	51.7±14.6	57.8±14.5	10.320	56.2±14.5
Gender, M/F (ratio)	3/5 (0.6)	12/10 (1.2)	20.682	15/15 (1)
Indications, n				
Incisional hernia	4	21	20.011	25
Epigastric/Umbilical hernia	4	1		5
Defect size, cm				
Mean±SD	3.9±1.6	12.6±5.9	3.0001	10.3±6.5
Median (range)	3 (2-7)	10 (5-25)		9.5 (2-25)

SD: Standard deviation, ¹ t-test, ² Fisher exact test, ³ Mann Whitney U test, * p< 0.05

We detected nine (30%) complications in the study. No complications were observed in group 1, while nine (41%) patients in group 2 developed a complication (Table 2). Hernias recurred in two (6.6%) patients, one of whom underwent repair again using a mesh with anti-adhesive barrier. Two (6.6%) patients developed intestinal obstruction and small bowel perforation due to mesh adhesion,

which required bowel resection and mesh excision (Figure 1). Two (6.6%) patients experienced mesh infection, and the meshes were surgically excised. Two (6.6%) patients suffered a wound site infection that recovered with medical treatment without the need for surgical intervention. One (3.3%) patient developed seroma which was evacuated by puncture.

Table 2. Complications and appearance times in group 2

	n	Mean (month)
Wound infection	2	12.5
Mesh adhesion	2	7.5
Mesh infection	2	6
Hernia recurrence	2	13
Seroma	1	30

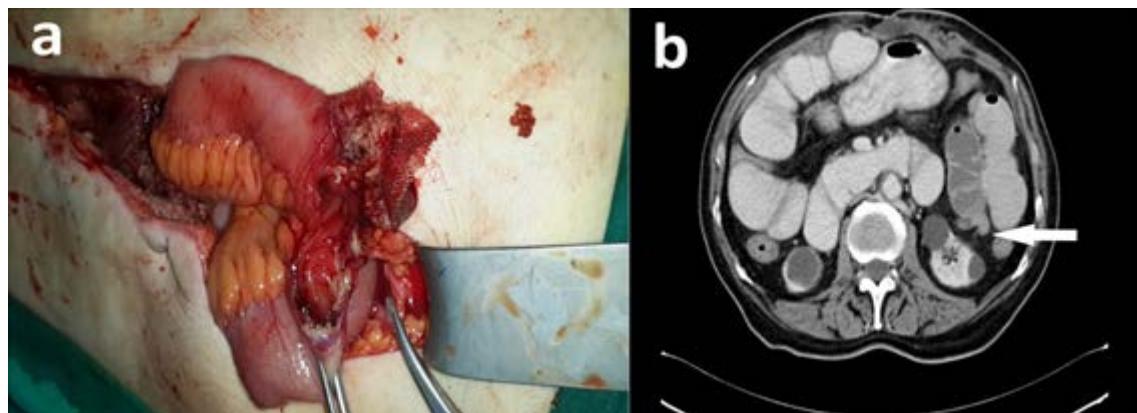
**Figure 1: Small bowel perforation (a) and obstruction (b) due to mesh adhesion**

Table 3 summarized the analysis of complications for the study patients. Age and gender did not significantly affect the complication rate ($p=0.847$

and $p=0.108$, respectively). Operative technique (laparoscopic vs. open surgery) was also not a significant predictor of complications ($p=0.066$).

The defect size was significantly greater in patients who developed complications compared to those who did not ($p=0.009$) (Table 3). Subgroup analysis of group 2 for complications is summarized in table

4. Age, gender or defect size did not significantly affect the complication rate ($p=0.832$, $p=0.099$ and $p=0.176$, respectively).

Table 3. Characteristic changes according to complications in the whole study population

	Complications (n=9)	Non-Complications (n=21)	p
Age, Mean±SD	57.0±16.9	55.9±13.8	10.847
Gender			
Male, n (%)	7 (47)	8 (33)	20.108
Female, n (%)	2 (13)	13 (87)	
Surgical technique			
Laparotomy, n (%)	9 (41)	13 (59)	20.066
Laparoscopy, n (%)	0 (0)	8 (100)	
Defect size			
Mean±SD	14.2±5.6	8.6±6.2	30.009*
Median (range)	12 (8-25)	7 (2-25)	

SD: Standard deviation, 1 t-test, 2 Fisher exact test, 3 Mann Whitney U test, * $p<0.05$

Table 4. Subgroup analysis of group 2 for complications

	Complications (n=9)	Non-Complications (n=13)	p
Age, Mean±SD	57.0±16.9	58.4±13.2	10.832
Gender			
Male, n (%)	7 (58)	5 (42)	20.099
Female, n (%)	2 (20)	8 (80)	
Defect size			
Mean±SD	14.2±5.6	11.5±6.2	30.176
Median (range)	12 (8-25)	7 (5-25)	

SD: Standard deviation, 1 t-test, 2 Fisher exact test, 3 Mann Whitney U test

One (3%) patient was died after being operated with open surgery for an abdominal wall hernia and complicated by intestinal obstruction and small bowel obstruction secondary to mesh adhesion 5 months after the operation. The mean follow-up duration was 22.9 (range 3-53) months.

DISCUSSION

Main challenge for the surgeon is to close abdomen with tension free repair. Defect size may be major determinative factor for this issue. In this study, we compared laparoscopic and open surgery for complications in hernia repair with omega-3 fatty acid covered polypropylene mesh. Although we detected significant difference for defect size between laparoscopic and open surgery, subgroup analysis of open surgery did not reveal difference.

About 20% of patients undergoing abdominal

surgery develop incisional hernia^{4,5}. In about a third of these, problems such as intestinal obstruction, acute strangulation, pain, and aesthetic problems arise^{6,7}. Tension-free repair is an important goal of abdominal wall hernia surgeries. Recurrence rates as high as 60% have been reported in patients repaired tensely by primary suture^{6,8,9}. Tension-free repair operations using prosthetic meshes reduce the recurrence rate by 50%¹⁰. When used intra-abdominally, however, these meshes may form a strong foreign-body reaction that induces adhesion formation between the abdominal organs and mesh, which leads to serious complications such as obstruction, enteric fistula, mesh migration, and chronic pain^{1,2,11-13}.

Meshes having their one side covered by an anti-adhesive barrier have been introduced into clinical practice to prevent mesh-induced adhesions. The external surface of these meshes is made of

polypropylene or polyester, whereas their interior surface contains a barrier covered by an anti-adhesive material. However, although these meshes are intended to prevent adhesions, they may cause adhesions at a rate of up to 80%^{14,15}. We do not have adequate information as to what extent meshes with anti-adhesive barrier contribute to formation of adhesions, how they affect the severity of adhesions, and when adhesions tend to develop. Information obtained from imaging modalities such as computed tomography, magnetic resonance imaging, and ultrasonography is also limited^{16,17}. We can detect a mesh-induced adhesion in a patient only when a laparotomy is performed for other indications, and this causes our knowledge and experience with mesh-associated adhesions to remain limited. Animal studies have examined the short-term effects of meshes with anti-adhesive barrier and found conflicting results. However, the long-term results of mesh-associated adhesion are not known¹⁸⁻²².

Our Pub-Med search for Omega-3 fatty acid-covered polypropylene mesh revealed only a few studies. "In one of them, Schreinemacher et al.²² examined six different meshes (Prolen, Timesh, Ultrapro, Proceed, Parietex Composite and C-Qur) in mice." That study found that Parietex Composite and C-Qur caused less adhesion than other meshes in a short timescale. Nevertheless, their short-term protective effect declines over time. In another study on rats by Pierce RA et al., C-Qur, Mesh ProLite Ultra, Composix, Parietex, Proceed, Sepramesh and Dual Mesh were studied²¹. That study also revealed that C-Qur had better adhesion characteristics. Kist C et al. compared polypropylene and omega-3 fatty acid-covered polypropylene mesh in an experimental study and found no significant difference between the two meshes²⁰. It was noted that only the omega-3 covered polypropylene mesh caused mild adhesion. No clinical study using this type of mesh has been encountered in the literature. In a study by Halm et al., which examined the complications associated with intraperitoneal placement of polypropylene mesh, 62% (24/39) of the patients were found to have adhesions and 20% (8/39) of them required intestinal resection. Two (5%) patients developed intestinal perforation associated with mesh erosion². Meshes with anti-adhesive barriers can prevent adhesion formation in the short term. However, this anti-adhesive effect declines over time and its long-term effectiveness remains unclear. Moreover, there is no marked difference between meshes with anti-adhesive

barriers with respect to the adhesion rate. In our study, we used omega-3 fatty acid covered polypropylene mesh to all patients and detected a complication at 30% of the patients. Six-point-six percent of them had diffuse adhesions between mesh and small bowel, which was observed at the operation. There was also adhesion-associated intestinal obstruction and small bowel perforation in the patients with adhesions. Six-point-six percent of the patients developed mesh infection that required mesh removal. We detected a recurrence in 6.6% of the patients. No complications were detected in laparoscopic group. The absence of any complication in our laparoscopy group was attributed to the fascial defect sizes being smaller. Main limitation of this study was low volume of patients to further analysis.

In conclusion, meshes with anti-adhesive barriers can prevent adhesion formation in the short term. However, this anti-adhesive effect declines over time and its long-term effectiveness remains unclear. Moreover, there is no marked difference between meshes with anti-adhesive barriers with respect to the adhesion rate. It should be noted that even though they can be utilized in compelling situations, i.e., large defects, these meshes have the potential to cause morbidity up to 30%. These findings may challenge the other studies and should be further clarified by studies with a larger sample size and longer follow-up.

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