

Incidence and risk factors for incisional hernia after abdominal aortic aneurysm and aortic occlusive disease surgery

Abdominal aort anevrizması ve aorto-oklüziv hastalık cerrahisi sonrası gelişen insizyonel herni insidansı ve risk faktörleri

Volkan Sayur¹, Erkan Güler², Hakan Posacıoğlu³, Taylan Özgür Sezer¹, Özgür Fırat¹, Muhtar Sinan Ersin¹

Institution where the research was done:
Ege University Faculty of Medicine, Izmir, Turkey

Author Affiliations:

¹Department of General Surgery, Ege University Faculty of Medicine, Izmir, Turkey

²Department of General Surgery, Mersin University Faculty of Medicine, Mersin, Turkey

³Department of Cardiovascular Surgery, Ege University Faculty of Medicine, Izmir, Turkey

ABSTRACT

Background: This study aims to investigate incisional hernia incidence and risk factors after abdominal aortic aneurysm and aortic occlusive disease surgery via a midline laparotomy.

Methods: A total of 110 patients (66 males, 44 females; mean age: 69.3±8.8 years; range, 36 to 88 years) who underwent open elective surgery for aortoiliac occlusive diseases or abdominal aortic aneurysm between January 2005 and December 2016 were retrospectively analyzed. Both patient groups were compared in terms of surgical procedures, sex, age, American Society of Anesthesiologists score (1-3), body mass index (<25 vs. ≥25 kg/m²), smoking (non-smoker <1 pack/day, smoking ≥1 pack/day), and time to incisional hernia development.

Results: Incisional hernia occurred in 14.3% of the patients operated for aortoiliac occlusive disease and in 17.6% of the patients operated for abdominal aortic aneurysm (p=0.643). Incisional hernia was seen in three (5.7%) of 53 patients with a body mass index of <25 kg/m² and was in 15 (26.3%) of 57 patients with a body mass index of ≥25 kg/m² (p=0.03).

Conclusion: High body mass index is a risk factor for incisional hernia in patients undergoing aortic reconstructive surgery.

Keywords: Abdominal aortic aneurysm, body mass index, incisional hernia.

ÖZ

Amaç: Bu çalışmada orta hat laparotomisi ile abdominal aort anevrizması ve aorto-oklüziv hastalık cerrahisi sonrasında insizyonel herni insidansı ve risk faktörleri araştırıldı.

Çalışma planı: Ocak 2005 - Aralık 2016 tarihleri arasında aortiliyak oklüziv hastalıklar veya abdominal aort anevrizması nedeniyle açık elektif cerrahi uygulanan toplam 110 hasta (66 erkek, 44 kadın; ort. yaş: 69.3±8.8 yıl; dağılım, 36-86 yıl) retrospektif olarak incelendi. İki hasta grubu cerrahi işlemler, cinsiyet, yaş, Amerikan Anesteziyoloji Derneği skoru (1-3), vücut kütle indeksi (<25 ve ≥25 kg/m²), sigara içiciliği (sigara içmeyen <1 paket/gün, sigara ≥1 paket/gün) ve insizyonel herni gelişme süresi açısından karşılaştırıldı.

Bulgular: Aortiliyak oklüziv hastalık nedeniyle ameliyat edilen hastaların %14.3'ünde ve abdominal aort anevrizması nedeniyle ameliyat edilen hastaların %17.6'sında insizyonel herni gelişti (p=0.643). Vücut kütle indeksi <25 kg/m² olan 53 hastanın üçünde (%5.7) ve vücut kütle indeksi ≥25 kg/m² olan 57 hastanın 15'inde (%26.3) insizyonel herni izlendi (p=0.03).

Sonuç: Yüksek vücut kütle indeksi, aortik rekonstrüktif cerrahi geçiren hastalarda insizyonel herni gelişimi için bir risk faktörüdür.

Anahtar sözcükler: Abdominal aort anevrizması, vücut kütle indeksi, insizyonel herni.

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Correspondence: Erkan Güler, MD, Mersin Üniversitesi Tıp Fakültesi, Genel Cerrahi Anabilim Dalı, 33343 Yenişehir, Mersin, Türkiye.

Tel: +90 535 - 034 49 39 e-mail: drerkangler@gmail.com

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Incisional hernia is a well-known complication of abdominal surgery, occurring in 2 to 37% of patients.¹¹⁻⁶¹ Many previous studies have shown that the prevalence and incidence of incisional hernia are higher in patients having an abdominal aortic aneurysm (AAA) operation than patients undergoing aortoiliac occlusive disease (AOD).¹¹⁻³¹ One of the hypotheses regarding this condition is that the pathogenesis of both aortic aneurysm and incisional hernia development may be related to connective tissue metabolism disorder. This pathogenesis has not been elucidated, yet.^{16,71} In some small-scale studies, there is no significant difference between AAA and AOD in terms of incisional hernia development.^{14,51}

Risk factors for incisional hernia in several studies are male sex, smoking, postoperative wound infections, abdominal closure techniques, obesity, advanced age, postoperative pulmonary complications, abdominal distension, emergency operation, previous operations, steroid use, pregnancy, postoperative chemotherapy, malnutrition, acid, and peritoneal dialysis.¹⁵⁻⁷¹

In the present study, we aimed to investigate differences between AAA and AOD groups for

incisional hernia development after abdominal reconstructive surgery and risk factors for incisional hernia in both groups.

PATIENTS AND METHODS

This single-center, retrospective study was conducted at Ege University Faculty of Medicine University, Faculty of Medicine, Department of Cardiovascular Surgery between January 2005 and December 2016. A total of 287 patients older than 18 years old who underwent elective open abdominal surgery due to AOD or AAA were included. Data including age, sex, American Society of Anesthesiologists (ASA) score, body mass index (BMI), smoking status, and type of surgery were retrieved from the hospital database. Patients were excluded, if they had previous abdominal surgery, emergency surgery, or a retroperitoneal approach and a transverse incision. Open elective surgeries that performed transabdominally with a midline incision for AAA and AOD repair were included. Ninety-four of these patients were excluded due to previous abdominal surgery and emergency surgery. Eighty-three patients were excluded from the study due to a retroperitoneal approach or a

Table 1. Data of the patients

	Aortoiliac occlusive disease (n=42)		Abdominal aortic aneurysm (n=68)		p	p*
	n	Mean±SD	n	Mean±SD		
Age (year)		70.1±10.1		68.7±9.6	0.416	
Sex					0.749	
Male	26		40			
Female	16		28			
ASA score						0.091
1	12		16		0.56	
2	20		22		0.11	
3	10		30		0.03	
BMI (<25 kg/m ²)	17		40		0.061	
BMI (≥25 kg/m ²)	25		28			
Smoking						0.928
++	20		30		0.72	
+	12		20		0.93	
-	10		18		0.76	
Types of surgical procedures						0.895
Aortobifemoral	20		38		0.39	
Aortofemoral	14		18		0.44	
Aortobiiliac	5		6		0.6	
Aortoiliac	2		4		0.8	
Aortoiliac and femoral	1		2		0.86	

SD: Standard deviation; ASA: American Society of Anesthesiologists; BMI: Body mass index; * P-value indicates whether there is a significant difference between the groups in three or more groups; ++: ≥1 Pack/day; +: <1 Pack/day -: Non-smoker.

transverse incision and missing data. Finally, a total of 110 patients (66 males, 44 females; mean age: 69.3±8.8 years; range, 36 to 88 years) who met the inclusion criteria were included in the study. The patients were divided into two groups: those operated for AOD and those operated for AAA. Both groups were compared in terms of surgical technique (bypass procedures: aorto-aortic, aortobifemoral, aortofemoral, aortobiiliac, aortoiliac, aortoiliac and femoral), sex (female-male), age, ASA score (ASA 1-3), BMI (<25 vs. ≥25 kg/m²), smoking (no smoker, smoking <1 pack/day, smoking ≥1 pack/day). The follow-up period was from the vascular operation to the incisional hernia development. A written informed consent was obtained from each patient. The study protocol was approved by the Ege University Faculty of Medicine Ethics Committee (No: 02-11-2018-E.314087-4792). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 25.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean ± standard (SD), median (min-max) or number and frequency. Categorical variables were analyzed using the chi-square test or Mann-Whitney U test. Continuous variables were analyzed using the Student t-test. Univariate analysis including sex, age, ASA score, BMI, smoking, and types of surgical procedure was performed to evaluate the risk of incisional hernia development. A *p* value of <0.05 was considered statistically significant.

RESULTS

Of a total of 110 patients, 42 (38.16%) were operated with the diagnosis of AOD, while 68 (61.81%) were operated with the diagnosis of AAA.

Table 2. Variables associated with incisional hernia development

	Hernia group (n=18)		No hernia group (n=92)		<i>p</i>	<i>p</i> *
	n	Mean±SD	n	Mean±SD		
Age (year)		69.8±10.2		69.2±8.6	0.77	
Sex					0.92	
Male	11		55			
Female	7		37			
ASA score						0.52
1	4		24		0.73	
2	9		33		0.26	
3	5		35		0.41	
BMI (<25 kg/m ²)	15		42		0.003	
BMI (≥25 kg/m ²)	3		50			
Smoking						0.41
++	9		41	0.67		
+	3		29	0.2		
-	6		22	0.4		
Types of surgery				0.64		
AOD	6		36			
AAA	12		56			
Types of surgical procedures						0.95
Aortobifemoral	9		49		0.8	
Aortofemoral	5		27		0.89	
Aortobiiliac	2		9		0.86	
Aortoiliac	1		5		0.98	
Aortoiliac and femoral	1		2		0.42	

SD: Standard deviation; ASA: American Society of Anesthesiologists; BMI: Body mass index; AOD: Aortoiliac occlusive disease; AAA: Abdominal aortic aneurysm; * *P*-value indicates whether there is a significant difference between the groups in three or more groups; ++: >1 Pack/day; +: <1 Pack/day -: Non-smoker

There was no statistically significant difference between the two groups regarding age, sex, ASA 1, ASA 2, BMI, smoking, and types of surgical procedures ($p>0.05$). However, the number of patients with ASA 3 was significantly higher in the AAA group than in the AOD group ($p=0.03$). Table 1 summarizes the demographic and baseline data of the patients.

Variables associated with incisional hernia development are listed in Table 2. A BMI of ≥ 25 kg/m² was a risk factor for incisional hernia development ($p=0.003$), whereas no significant difference was found between the patients regarding to age, sex, ASA score, smoking, types of surgery, and types of surgical procedures (Table 2).

The incisional hernia occurred in six (14.3%) patients in the AOD group (five of whom had a BMI of ≥ 25 kg/m²) and 12 (17.6%) patients in the AAA group (10 of whom had a BMI of ≥ 25) (Table 2). Although the incisional hernia development rate was higher in the AAA group, it did not reach statistical significance ($p=0.643$).

Incisional hernia occurred in 18 patients (mean age: 69.8 ± 10.2 years). The mean age of 92 patients without an incisional hernia was 69.2 ± 8.6 years ($p=0.767$). The mean time from primary surgery to the incisional hernia repair was 22.7 ± 9.1 months in the AOD group and 20.8 ± 10.0 months in the AAA group, indicating no statistically significant difference between the two groups ($p=0.713$).

In the AAA group, aortobifemoral bypass was performed in 38 (55.9%), aortofemoral bypass in 18 (26.5%), aortobiiliac bypass in six (8.8%), aortoiliac bypass in four (5.9%), and aortoiliac and femoral bypass in two (2.9%) patients. There was no statistically significant difference between the two groups according to types of surgical procedures ($p=0.895$). In addition, there was no significant correlation between the types of aortic surgical procedures and incisional hernia development ($p=0.951$) (Table 2).

DISCUSSION

The main findings of the current study are that there was no statistically significant difference between the AAA and AOD groups in terms of incisional hernia development, and high BMI (≥ 25 kg/m²) was found to be an independent risk factor for incisional hernia development in patients undergoing elective aortic reconstruction surgery.

The relationship between incisional hernia and AAA has been frequently questioned in the literature.

A total of 17 articles were reviewed in a systematic review and meta-analysis published earlier this year, and 107,578 patients were eligible for meta-analysis.^[7] In four of these studies investigating AAA incidence, AAA was more common in hernia patients than patients without hernia. Among the 13 studies comparing patients with AAA and no AAA, hernia incidence was higher in AAA patients than in those without.^[7] However, some studies did not indicate an increased risk in the AAA group than other abdominal surgery groups. These studies showed that the abdominal wall closure technique played a more critical role.^[5,8] However, these studies are very few with relatively small sample sizes.

In the literature, there is a limited number of studies comparing the groups in terms of incisional hernia development between AAA and AOD, and it has been reported that the incisional hernia rate is often higher in the AAA group.^[2,4] A large multi-center study by Henriksen et al.^[2] evaluated 2,597 patients, including 838 and 1,759 who underwent open elective surgery for an AOD and AAA, respectively. According to this study, high BMI and AAA repair were independent risk factors for incisional hernia development in patients undergoing aortic reconstructive surgery. The ASA scores, sex, age, and surgical site infection were also investigated; however, none of them were found to be statistically significant. In this study, the median time from primary surgery to the incisional hernia repair was 14.8 months in AOD patients and 16.1 months in AAA patients ($p=0.355$). In our study, the median time from primary surgery to the incisional hernia development was 22.7 ± 9.1 months in the AOD group and 20.8 ± 10.0 months in the AAA group ($p=0.713$), consistent with the literature data.

In previous studies, the incisional hernia development rate ranged from 11 to 42% in the AAA group and 2 to 12% in the AOD group.^[9,10] This rate was 16.7% in patients with AAA and 9.9% in the AOD group in subsequent studies.^[2,4,11] In our study, the cumulative incidence of total incisional hernia was 16.4%. It was 17.6% in the AAA group and 14.3% in the AOD group ($p=0.643$). The incisional hernia was more common in the AAA group than the AOD group. However, there was no statistically significant difference between the two groups ($p=0.643$). A few studies reported similar results to ours.^[4,5] A similar incisional hernia incidence was reported in both groups in a study of 1,065 patients by Gruppo et al.^[4] (412 with AAA and 653 with AOD) ($p=0.061$). This study emphasized that the abdominal closure technique, suture length-to-wound length ratio (SL:WL) was an independent risk factor for the

development of incisional hernia, suggesting that an SL:WL ratio of at least 4:1 should be used.

Several studies have shown that morbid obesity is directly related to incisional hernia.^[12,13] In addition, the size and type of incisional hernia are different in these patient groups, and the risk of recurrence is higher after repair.^[13] The incision type is also associated with the incisional hernia incidence in patients undergoing abdominal open vascular surgery.^[14] However, some studies have reported no significant difference between the incision type and hernia.^[6,15] According to a recent systematic review, five studies compared transverse with midline incisions in a total of 3,399 patients (2,098 with transverse and 1,301 midline incisions).^[6] There was a trend toward a benefit of transverse incisions, but the results were not significant ($p=0.08$). This variable could not be compared in our study, since all patients were operated with a midline incision.

Furthermore, patients operated for an AAA are usually older than patients operated for other aortoiliac vascular diseases.^[4,6,9] In our study, the mean age was 70.1 ± 10.1 in the AOD group and 68.7 ± 9.6 in the AAA group, indicating no statistically significant difference. Some authors have noted a risk factor for male sex incisional hernia.^[16,17] However, in the following period, male sex was not found to be a risk factor.^[2,6,7] In our study, there was no significant difference in the incisional hernia development rates between two sexes. Most of the patients operated for AAA and AOD are active smokers or those with a high smoking history. In some studies, smoking was reported as a risk factor.^[16,17] In other studies, smoking was not a statistically significant risk factor.^[2,7] In our study, smoking was not a risk factor, either ($p=0.414$). Also, the ASA score was not a risk factor ($p=0.519$).

The fascia closure technique has been reported as a significant risk factor for incisional hernia development. Two studies compared the rates of hernia development according to the SL:WL of less or more than 4:1.^[4,18] A total of 483 patients were included (217 with a ratio less than, and 266 with a ratio greater than 4:1). According to these studies, the SL:WL strongly affected incisional hernia development. There was a significant difference in the hernia risk ratio between the two groups ($p<0.01$).^[4,18] Our study does not compare these closure techniques, which can be deemed as a limitation.

In a study of 17,594 patients (9,314 with AAA and 8,280 with AOD) by Altieri *et al.*,^[19] after controlling for all other factors, patients undergoing

AAA repair were more likely to undergo ventral hernia repair (7.93% with AAA and 5.8% with AOD). The authors concluded that prophylactic use of mesh might be considered in this patient population for future procedures due to their significant comorbidity. Prophylactic mesh reinforcement may be considered for patients in some high-risk groups including patients undergoing bariatric surgery, a stoma, or high-risk gastrointestinal surgery. In a recent meta-analysis performed by Indrakusuma *et al.*,^[20] four studies were included. According to this meta-analysis, mesh augmentation significantly reduced the risk of developing incisional hernia.

Collagen tissue defect, common gene mutation, or clear biological indicator have not yet been fully elucidated in the formation of AAA and abdominal wall hernias. In recent studies, the aortic aneurysm pathogen is not based on collagen defect as previously thought; more recent experimental studies have focused on inflammation as the main cause of aortic wall weakening during the process of aneurysm development.^[21,22] It is well known that repairs with endovascular methods (i.e., endovascular aneurysm repair and thoracic endovascular aortic repair) are used more frequently in recent years. Patients treated with these methods were not included in our study. In addition, endovascular techniques are performed for particularly high-risk patients.

This study has some limitations. First, this study has a single-center, retrospective, non-randomized design with a relatively small sample size. Further prospective, randomized studies would provide more accurate results on this subject. In addition, the suture type, suturing method, and length of incision were not evaluated. Furthermore, the rate of postoperative wound dehiscence was unknown. Finally, the presence of connective tissue disorders and immunosuppressive medicine could help to evaluate possible risk factors for incisional hernia repair.

In conclusion, high body mass index is a risk factor for incisional hernia development in patients undergoing elective aortic reconstruction surgery. In our study, although the incisional hernia incidence was higher in the AAA group, it did not reach statistical significance between the AAA and AOD groups. Based on these findings, there is a trend toward a tendency of AAA for incisional hernia development in patients undergoing open elective aortic reconstructive surgery; however, further clinical studies are required to evaluate incisional hernia risk and reduce the incidence.

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