ANGIOLOGIA E CIRURGIA VASCULAR
PUBLICAÇÃO OFICIAL SPACV

REVIEW ARTICLE

Behind the scar: a narrative review of risk factors for incisional hernia following open abdominal aortic aneurysm repair

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Submitted: April 23, 2025; **Reviewed:** June 14, 2025; **Accepted:** December 12, 2025
Presented at: Congresso 25 Anos Sociedade Portuguesa de Angiologia e Cirurgia Vascular, Maio 2025

ABSTRACT

OBJECTIVE: Incisional hernia (IH) is a well-documented complication after open abdominal aortic aneurysm (AAA) repair, with incidence rates that may be higher than historically reported. Understanding risk factors for IH development is important for optimizing perioperative strategies and long-term patient outcomes. This narrative review summarizes and discusses the main risk factors associated with IH after open AAA repair.

METHODS: A comprehensive narrative review was conducted using PubMed. Keywords included "incisional hernia", "abdominal aortic aneurysm", "open repair", and "risk factors". Original articles, cohort studies, and reviews were selected to provide an objective analysis of current knowledge on this topic.

RESULTS: This review included 10 studies comprising 10438 patients, including observational studies, randomized controlled trials, and systematic reviews. The reported incidence of IH ranged from 5.2% to 46.5%. Patient-related risk factors included obesity, smoking, chronic obstructive pulmonary disease, diabetes mellitus, and chronic kidney disease. Surgical risk factors, such as midline incisions, surgical site infection, and inadequate closure techniques, were also associated with increased IH risk. Prophylactic mesh at abdominal closure reduced hernia incidence in high-risk individuals.

CONCLUSION: Understanding the multifactorial etiology and potential specific risk factors for IH after open AAA repair is essential for guiding preventive strategies. We found that obesity, smoking, chronic obstructive pulmonary disease, diabetes mellitus, chronic kidney disease, and surgical factors such as midline incisions or inadequate closure techniques could negatively affect IH development after open AAA repair. Considering prophylactic mesh reinforcement in selected cases may help reduce this complication.

Keywords: Abdominal aortic aneurysm; Open repair; Incisional hernia; Risk factors.

INTRODUCTION

Over the past two decades, the management of abdominal aortic aneurysm (AAA) has changed significantly. Endovascular aneurysm repair (EVAR) is now considered the preferred treatment modality for most patients because of its minimally invasive nature and reduced perioperative morbidity.[1] Nonetheless, open surgical repair remains a crucial option, particularly for anatomically challenging cases or young patients, given its cost-effectiveness and long-term prognosis.[2]

Incisional hernia (IH) is a common and clinically significant complication after open AAA repair, with substantial

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implications for patient morbidity, quality of life, and healthcare costs.[3] Among patients undergoing open AAA repair, the incidence of IH is notably higher than in other laparotomy populations. This increased risk is believed to result from a combination of patient-specific, surgical, and disease-related factors, including systemic connective tissue alterations frequently associated with aneurysmal disease.[4]

Despite advances in surgical technique and perioperative care, IH remains a common postoperative complication, often requiring additional surgery. A thorough understanding of its multifactorial etiology is essential to improving outcomes and informing preventive strategies. This narrative review summarizes and critically appraises the current evidence on risk factors for IH after open AAA repair.

METHODS

We conducted a non-systematic literature search in PubMed to identify relevant articles published through May 2025 on risk factors for IH after open AAA repair. The search terms included: "incisional hernia," "abdominal aortic aneurysm," "open repair," and "risk factors." The search was restricted to articles published in English, Spanish, and Portuguese. Eligible studies included randomized controlled trials (RCTs), systematic reviews, and observational studies that specifically evaluated the incidence or predictors of IH after open AAA repair. Exclusion criteria were: 1) studies comparing endovascular versus open repair outcomes; 2) studies focusing exclusively on prophylactic mesh for IH prevention; and 3) studies reported only as abstracts or with incomplete data, letters, and nonclinical studies.

RESULTS AND DISCUSSION

We included ten studies (summarized in Table 1) involving 10 438 participants. Of these, six studies (n=4293) were observational studies (only one prospective), two studies (n=950) were RCTs, and two were systematic reviews (n=5205).

Reported IH ranged from 5.2% to 46.5%. Multiple variables were assessed as potential risk factors, including patients' demographic characteristics, medical history, perioperative characteristics, surgical approach, and closure suture techniques.

Patient-Related Risk Factors

Age, although frequently cited in the literature, presents conflicting data. A systematic review found that older age (mean 69.6-70.7 years) was associated with a slightly higher incidence of IH (MD 1.39 years, 95% CI 1.12-1.66, p < 0.01)[6] However, other studies suggest that age above 65 years could have a protective effect[12], hypothesizing that younger patients may be more prone to severe connective tissue disorders and are more physically active. Findings from the OVER randomized trial support this hypothesis, reporting increased IH incidence in more physically active patients.[5]

Obesity is consistently reported as a risk factor. Increased abdominal wall tension and impaired tissue perfusion in obese individuals contribute to poor wound healing and fascial dehiscence. A body mass index (BMI) >25 kg/m2 has been associated with higher rates of hernia.[10,14]

Chronic obstructive pulmonary disease (COPD) has also been linked to IH. Basencenot et al. found that COPD may be a risk factor for IH, with a significant correlation in a multivariate Cox model (HR=2.35, p=0.018).[12] Chronic coughing and increased intra-abdominal pressure may compromise postoperative suture integrity. Moreover, COPD is often associated with systemic inflammation and more frequent use of inhaled corticosteroids.

Smoking and peripheral tissue hypoxia increase the risk of wound infection and dehiscence, presumably by reducing the oxidative killing mechanism of neutrophils, which constitute a critical defense against surgical pathogens.15 In addition, decreased collagen deposition in surgical test wounds has been observed in smokers.[16] While many studies failed to reach statistical significance, Barranquero et al. found that both current (HR: 4.578, CI: 1.386–15.127, p=0.013) and past smoking (HR: 4.868, 95% CI: 1.501–15.787, p=0.008) were independent risk factors.[7]

Diabetes mellitus, particularly when poorly controlled, is associated with delayed wound healing and an increased risk of infection.[17] Endo et al. found that diabetes mellitus was more frequently observed in the IH group.[9]

Chronic kidney disease (CKD) has emerged as a relevant risk factor among vascular surgery patients and has been identified as a risk factor for IH development after open AAA repair.[7] Uremia and associated metabolic disturbances impair wound healing. Additionally, patients with CKD often present with nutritional deficiencies, chronic inflammation, and reduced vascularization and cell proliferation, which may further compromise tissue repair mechanisms.[18]

Surgery-Related Risk Factors

Type and location of the incision are among the most significant surgical determinants of IH. Midline laparotomy, commonly used in open AAA repair, is associated with higher rates of IH than transverse incisions.[6,8,11] Deery et al. demonstrated that transabdominal open AAA repair is associated with a greater need for abdominal wall repair than the retroperitoneal approach (p<0.01).[19]

Wound infection is a well-established risk factor. A meta-analysis found that surgical site infection doubled IH development (RR 2.36, CI 1.31-4.24, p=0.004).[6] Surgical site infection impairs collagen deposition, delays healing, and increases the risk of fascial disruption.

Fascial closure technique has also been shown to influence hernia risk. Inadequate suture technique, excessive tension, use of rapidly absorbable sutures, or failure to adhere to the recommended suture-to-wound length ratio (usually 4:1) have all been linked to increased hernia rates.[8,13] However, secondary analysis of the OVER trial found no association between closure method and IH.[5] Some studies have suggested that the small-bite technique may reduce IH rates, although evidence remains limited in the context of open AAA repair.[20]

Prolonged operative time could increase the risk of tissue dehydration, contamination, and postoperative infection, but it did not show statistical significance across the studies.

Table 1. Summary of Key Outcomes and Predictors after BKA

Author/ year of publication	Study type	n	Study purpose	Results
Jeniann A Yi, et al., 2024.[5]	Randomized control trial	881	Determine risk factors associated with IH development following AAA repair.	Patients with increased activity experienced a higher incidence of hernia.
Nandita N Mahajan., et al. 2024.[6]	Systematic review and meta-analysis	1806	Review all the risk factors for IH after an open AAA repair.	Age, midline vertical incision, intraoperative blood loss, and surgical site infection are risk factors for IH after open AAA repair.
Alberto G Barraquero, et al., 2020.[7]	Retrospective observational study	157	Quantify the IH incidence after open AAA surgery and identify the risk factors associated with the IH development.	Previous abdominal surgery, chronic kidney disease, and smoking habit were independent factors for the IH development.
Chalotte W Nicolajsen, et al., 2020.[8]	Systematic review and meta-analysis	3399	Perform a systematic review and meta-analysis of AAA laparotomy and closure technique and the risk of IH development.	A suture to wound ratio of more than 4:1 is used reduces the risk of IH.
Takashi Endo, et al., 2023.[9]	Retrospective observational study	131	Evaluated the risk factors of IH after open AAA repair, including surgical factors.	Diabetes mellitus was significantly more common in the IH group.
Nadia A Henriksen, et al., 2013.[10]	Retrospective observational study	2597	Evaluate risk factors for IH repair after open elective aortic reconstructive surgery for aortoiliac occlusive disease and AAA.	High body mass index was an independent risk factors for a subsequent IH surgery.
N Fassiadis, et al., 2005.[11]	Randomized control trial	69	Evaluate the incidence of IH after transverse or vertical incisions for open AAA repair.	The incidence of IH was high after AAA repair but was lower in patients who had a transverse incision.
Auréliien Besancenot, et al., 2022.[12]	Retrospective observational study	223	Characterize the long-term risk factors for IH after open surgery for AAA.	Chronic obstructive pulmonary disease was independent risk factor for the occurrence of IH.
Mario Gruppo, et al., 2012.[13]	Prospective observational study	1065	Evaluate rate of formation of midline abdominal wall IH after elective open repair of AAA and revascularization of aortoiliac occlusive disease.	A suture length-to-wound length ratio of <4:1 was the only independent predictor of IH in AAA.
Volkan Sayur, et al., 2021.[14]	Retrospective observational study	110	Investigate IIH incidence and risk factors after AAA and aortic occlusive disease surgery.	High body mass index is a risk factor for IH in patients undergoing aortic reconstructive surgery.

Factors such as previous abdominal surgery (HR: 1.653; CI: 1.014–2.695, p = 0.044) and increased intraoperative blood loss (MD 429.8 ml, CI 234.8–624.8, p < 0.01) have also been linked to higher IH risk.[6,7]

Preventive measures

The use of prophylactic mesh during abdominal wall closure has been investigated as a strategy to prevent IH, particularly in high-risk patients. According to the 2019 European Society for Vascular Surgery (ESVS) guidelines on the management of AAA, prophylactic mesh placement in patients undergoing open AAA repair may be considered for selected high-risk individuals (Class IIb recommendation, Level of Evidence B).[1] A recent systematic review of 493 patients supports prophylactic mesh augmentation as an effective strategy to reduce IH and suggests it could be considered standard of care.[1]

CONCLUSION

IH remains a common and clinically significant complication after open AAA repair. Obesity, smoking, and wound infection are among the most consistently identified risk factors for IH after open AAA repair. Surgical factors, including midline incision and suboptimal closure, also play

a significant role. In selected high-risk patients, prophylactic mesh placement may be considered to reduce hernia incidence. A better understanding and stratification of risk factors will be essential to guide individualized preventive strategies and reduce the incidence of IH in this population.

Acknowledgements: None
Conflicts of interest: None
Funding: None
Data availability: By request to authors
Ethics Approval: Not applicable
Informed Consent: Not applicable
Declaration of Generative AI and AI-Assisted Technologies in the Writing Process: No generative AI or AI-assisted technologies were used in the writing process.

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