

SYSTEMATIC REVIEW

Endovascular Repair (EVAR) Better Than Open Surgical Repair (OSR) in Abdominal Aortic Aneurysm: A Systematic Review

M. Iqbal Rifai Fauzi^{1*}, Karina Asyysifaa Alemina Ramadhani Ginting²

^{1,2}General Practioner, RSUDok Sanggul, Ferdinan Lumban Tobing Street No.1, Bonani Onan Sub-district, Dolok Sanggul District, Humbang Hasundutan Regency, North Sumatera, Indonesia

Corresponding email: rifaiqbal008@gmail.com

Abstract: Adult mortality from rupture of an abdominal aortic aneurysm (AAA) is significant. Patients are offered either open surgery surgery (OSR) or endovascular repair (EVAR). EVAR has been a choice for AAA treatment. However, EVAR has more post-procedural complications than OSR. This study examines current evidence contrasting the intricacy of EVAR and OSR as medical procedure choices for stomach aortic aneurysms (AAA). The published research article was searched in PubMed, Science Direct, BMJ, and Google Scholar databases with the keywords AAA, EVAR, OSR, and complication. This systematic review was written based on Prisma guidelines. The inclusion criteria for this study are as follows: research is conducted within the past five years, and the outcome should compare the complication of EVAR and OSR. The result of the selection found 9 articles that were included in the inclusion criteria. A total of 67.114 patients with all types of AAA and all types of ages were included in this study. OSR has a higher mortality rate than EVAR, however, OSR reintervention rate was lower. This study found the EVAR procedure (73%) more popular than OSR (27%). Many studies revealed EVAR had high rates of reinterventions mainly due to endograft-related complications. Our review was also in line with this statement. In conclusion, EVAR is better for AAA treatment, however, EVAR had a high reintervention rate.

Keywords: AAA, abdominal aortic aneurysm, re-intervention rate, EVAR, mortality rate, endo-vascular repair, OSR, open surgery repair

INTRODUCTION

Adult mortality from rupture of an abdominal aortic aneurysm (AAA) is significant. AAA depicts the impedance and expansion of the stomach aorta, by and large influencing the infrarenal part.¹

Over the past two decades, the AAA has increased.² AAA affects 7-8% of men over the age of 65.² AAA rupture is the most common complication, resulting in between 150.000 and 200.000 deaths annually worldwide.³ In 2017, the UK has

the highest mortality rate (7.5 per 100 000 for men and 3.7 per 100 000 for women).⁴ Portugal has the most reduced death rate for men (2.8 per 100 000) and Spain for ladies (1.0 per 100 000).⁴ From 2000 through 2016, 69,513 deaths were due to AAA in Brazil.⁵

Based on theory, the diameter of untreated AAA will grow larger.⁶ The risk of rupture is increased on large AAA.⁶ Sudden onset of abdominal or back pain and haemorrhagic shock commonly happen on ruptured AAA.⁶ Almost 100% mortality in rupture cases if not treated.⁶ With a high mortality rate for AAA rupture, open surgery or endovascular surgery is offered to the patient to treat AAA rupture.⁶ AAA rupture treatment depends on surgical repair.⁷ Endovascular aneurysm repair (EVAR) and open surgical repair (OSR) continue to be the mainstays of treatment.⁸ In recent decades, EVAR has been a choice for OSR for AAA treatment.⁹ EVAR decreases blood loss, does not need the aorta cross-clamping procedure, and has better recovery time than open surgery.⁹

EVAR procedure had post-operation complications that often need secondary re-intervention.⁹ The complication is estimated to range between 16% and 30%.⁹ In the long run, EVAR has a greater chance of rupture and secondary intervention than OSR.¹⁰

This research is the first study to compare EVAR and OSR based on mortality rate and post-operative re-intervention rate. This study also compares several journals published within the last five years.

This study aims to determine which method has a lower complication rate, especially in terms of mortality and reintervention rate after operation: EVAR or OSR.

METHODS

The preferred reporting items for systematic reviews and meta-analyses (PRISMA) criteria for reporting the events assessed by intervention and healthcare behaviours were used to write the systematic review.¹¹ The systematic review employed the following population, intervention, control, and outcome (PICO) questions:¹¹

P (population): AAA patient

I (intervention): EVAR procedure

C (comparison): OSR procedure

O (outcome): Complication

Eligibility Criteria

This study reviews data from any study with assesses the comparison complication of EVAR and OSR procedures on AAA patients. This review did not consider age, race, type of AAA, and follow-up duration.

Search Strategy

In December 2022, we conducted a comprehensive search using keywords related to AAA, EVAR, OSR, and English-language complications in PubMed, ScienceDirect, BMJ, and Google Scholar. The accompanying watchwords were utilized in searches of all data sets referenced previously: “AAA” AND “EVAR OR Endovascular

Aortic Repair” AND “Open surgical repair OR OSR” AND “Complication”.

Selection of Studies

Before the searches, the inclusion and exclusion standards were chosen. The studies that compare EVAR and OSR complications in all AAA instances are all taken into account by the reviewers. Then, studies containing pertinent keywords are gathered and sorted. Studies that were discovered across many databases were eliminated. Then, full-paper manuscripts were examined; manuscripts not pertinent to them were omitted. A comprehensive review comprised ten studies. From four databases from which we searched for studies published within the past 5 years, there are 623 articles (10 articles from PubMed, 495 articles from Science Direct, 2 articles from BMJ, and 116 articles from Google Scholar), 595 articles were excluded from the title or abstract due to irrelevant titles, and four articles were removed due to duplicate titles. Another 15 articles were excluded for several reasons, 4 articles were excluded because not in the English language, and 11 articles with a main outcome not comparing EVAR and OSR procedure were excluded too. After a second review of the articles' titles and abstracts, only nine studies were selected for analysis.

Data Extraction

The relevant information has been extracted from selected studies after further investigation. Significant data incorporates the number of patients with

AAA medical procedures, the quantity of EVAR and OSR methodologies, and the principal result looking at the intricacies of EVAR and OSR techniques.

RESULTS

The diagram flow of the selection of articles was shown in Figure 1 with a total of 9 articles chosen from the initial 623 articles. All of the selected studies have been conducted in the last 5 years and are from the USA (5), Germany (1), Thailand (1), Netherlands (1), and Canada (1). A total of 67.114 patients with all types of AAA and all types of age were from 9 studies. All of these patients are divided into two groups: one underwent EVAR 73% (n=49243) procedure and the other underwent an OSR procedure 27% (n=17749). Many studies only discuss death and reintervention as complications of EVAR and OSR procedures. Only 3 studies address other complications such as colonic ischemia, myocardial ischemia, stroke, respiratory complication, acute kidney injury, mesenteric ischemia, and lower extremity ischemia.

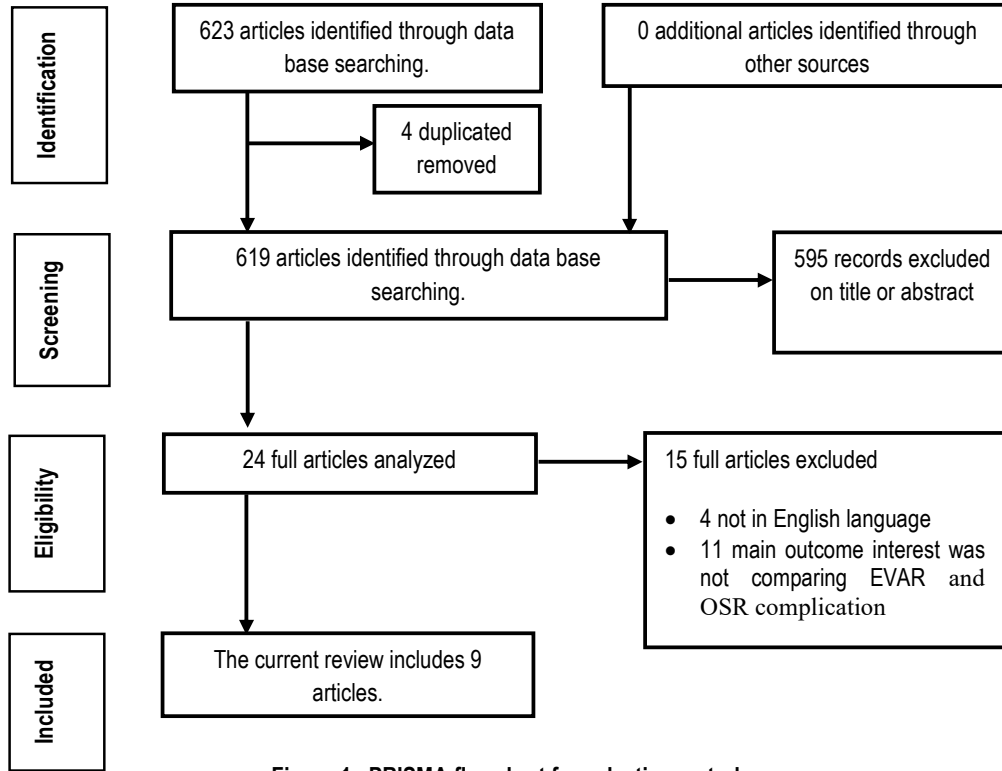


Figure 1. PRISMA flowchart for selecting a study

Table 1. Description of the Included Studies Data Summary of EVAR and OSR

Study	Publication year	Origin	Number of AAA patient	EVAR procedure	OSR Procedure	EVAR Complication	OSR Complication
Atlee et al. ¹²	2017	USA	43105	34177 (79.3%)	8928 (20.7%)	402 deaths (0.9%)	339 deaths (0.7%)
Christopher et al. ¹³	2021	USA	2106	1149 (54.5%)	957 (45.5%)	43 deaths (2.04%)	65 deaths (3.08%)
Nathan et al. ¹⁴	2018	USA	2641	1928 (73%)	713 (27%)	27 reinterventions (1.2%)	35 reinterventions (1.32%)
Mario et al. ¹⁵	2020	USA	4257	2389 (56.1%)	1868 (43.9%)	OSR has higher hospital mortality and higher reintervention	
Christian et al. ¹⁶	2018	Germany	9145	6496 (71%)	2649 (29%)	38 colonic ischemia (0.4%)	98 colonic ischemia (1.07%)

Study	Publication year	Origin	Number of AAA patient	EVAR procedure	OSR Procedure	EVAR Complication	OSR Complication
Boonying et al. ¹⁷	2021	Thailand	162	62 (38.2%)	100 (61.8%)	2 deaths (1.23%)	-
Gerdine et al. ¹⁸	2021	Netherland	455	197 (43.2%)	258 (56.8%)	65 patients with complications (14.2%) 16 patients with reintervention (3.51%)	127 patients with complications (27.9%) 34 patients with reintervention (7.47%)
Linda et al. ¹⁹	2020	USA	4929	2749 (55.77%)	2180 (44.23%)	10% myocardial ischemic, major adverse events 37%, 30-day death 21%	15% myocardial ischemic, major adverse events 67%, 30-day death 34%
Oonagh et al. ²⁰	2018	Canada	314	218 (69.42%)	96 (30.58%)	126 deaths (40.12%) 39 reintervention (12.4%)	58 deaths (18.47%) 2 reintervention (0.6%)

DISCUSSION

An abdominal Aortic Aneurysm (AAA) is generally defined as an abdominal aorta with a diameter greater than 3 centimetres.²¹ AAA is a vascular pathology that causes a lot of problems and death.²¹ This disease is commonly asymptomatic, 80% of cases are ruptured because of the vascular dilation progressively.²² Aortic mural inflammation, oxidative stress, vascular smooth muscle cell apoptosis, depletion of elastin, and degradation of the extracellular matrix are some of the biological processes involved in the pathogenesis of AAA.²³

Untreated AAA can lead to death because of rupture.²⁴ Large AAA are typically treated with endovascular aneurysm repair (EVAR) or open surgical repair (OSR).²⁴ EVAR procedure is now commonly used, especially in high-risk and

elderly patients with AAA.²⁵ This is because of improved perioperative outcomes and less invasive repair than the OSR.²⁶

This review found the EVAR procedure (73%) more popular than OSR (27%). Only Boonying et al. and Gerdine et al. studies had a different opinion, in these studies, OSR had more attempts than EVAR.^{17,18}

It has been demonstrated that EVAR, a minimally invasive procedure, reduces early mortality and morbidity more effectively than conventional open surgery.²⁷ This statement directly supports Atlee et al., Christopher et al., Mario et al., Linda et al., and Oonagh et al., who mention OSR had more mortality rate than EVAR.^{12,13,15,19,20} Although the EVAR procedures mortality rate is low, the reintervention rate is not low.²⁸

Randomized controlled trials (RCT) and large population-based observational studies of elective treatment have reported early benefits of EVAR compared to open surgical repair.²⁹⁻³² However, many studies also revealed relatively high rates of reinterventions mainly due to endograft-related complications.^{9,33} Our review was also in line with this statement. Only Nathan et al. had a different opinion.¹⁴

EVAR and OSR had many other complications, not only dead or reintervention. Additionally, these procedures were associated with postoperative bleeding, infection (non-surgical), cardiac complications, pulmonary complications, renal complications, neurologic complications, wound complications, and reconstruction/prosthesis-related complications.^{18,19}

CONCLUSION

In conclusion, based on current evidence, EVAR is the preferable option for AAA treatment over OSR. This is evident from its higher utilization in treating AAA cases based on patient condition. Moreover, EVAR is a minimally invasive procedure, leading to faster patient recovery and a lower mortality rate. However, to address the issue of high EVAR reintervention rates, further research is needed.

CONFLICT OF INTEREST

The authors stated that they do not have any vested interests.

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