

THE EFFICACY AND FEASIBILITY OF ENDOVASCULAR AORTIC PROGRAM AT DONG NAI GENERAL HOSPITAL

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ABSTRACT

Background: Endovascular aortic repair (EVAR) is a minimally invasive treatment for aortic pathologies, but implementing it in Vietnam's resource-constrained provincial hospitals faces challenges like limited expertise and infrastructure. This study evaluates the safety and feasibility of an EVAR program at Dong Nai General Hospital.

Methods: This retrospective cohort study analyzed 33 patients undergoing EVAR from April 2021 to April 2025. Data on demographics, risk factors, aortic regions, procedure types, and short-term outcomes were collected. Subgroup analyses by aortic region, debranching type, and hybrid approach used Fisher's exact test. Logistic regression assessed complication predictors.

Results: The cohort (81.8% male, mean age 71.2 years, 78.8% hypertensive, 60.6% dyslipidemic, 72.7% smokers) had a 3.0% mortality rate (1/33, arch-related) and 18.2% complication rate (6/33). Complications included type II endoleaks (9.1%, 3/33, conservatively managed), stroke (3.0%, 1/33), reoperation for bleeding (3.0%, 1/33), and prolonged ventilation (6.1%, 2/33). Thoracoabdominal (100%, 1/1) and visceral debranching (100%, 1/1) had the highest complication rates; infrarenal was lowest (7.7%, 1/13). Visceral debranching significantly predicted complications (OR = 3.5, 95% CI: 1.2 - 10.5; $p = 0.03$).

Conclusion: EVAR is safe and feasible in Vietnam's provincial hospitals, with manageable complications. Strategic training, volume increase, and infrastructure investment are crucial for sustainability.

Keywords: EVAR, aortic aneurysm.

I. INTRODUCTION

EVAR has become an established treatment modality for a wide range of aortic pathologies, offering significant advantages in terms of reduced perioperative morbidity and shorter recovery times compared to traditional open surgery. The evolution of endovascular techniques and devices has made it possible to manage complex thoracic and abdominal aortic diseases with increasing precision and safety. As a result, many centers around the world have adopted EVAR as the first-line therapy for suitable patients, particularly in elective settings where anatomical planning can optimize outcomes [1, 2].

The implementation of an EVAR program in a tertiary hospital setting requires careful planning, including the development of multidisciplinary teams, access to imaging and the ability to manage both standard and anatomically challenging cases. In provincial hospitals of Viet Nam, these factors pose unique challenges, making it essential to evaluate the feasibility and safety of such programs in local contexts [3].

Dong Nai General Hospital, as a provincial center, initiated its endovascular aortic program with the aim of expanding advanced vascular care in Dong Nai province. Understanding the short-term safety profile and procedural effectiveness in this

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setting is critical for validating the role of EVAR and guiding future resource allocation, training, and program development. Furthermore, assessing initial outcomes helps ensure alignment with international benchmarks and promotes sustainable practice growth [4].

II. MATERIALS AND METHODS

2.1. Study design and patient selection

This retrospective cohort study was conducted at Dong Nai General Hospital, a tertiary care center in southern Vietnam, and included all patients who EVAR between April 2021 and April 2025. A total of 33 consecutive patients were identified from institutional records and reviewed for demographic, clinical, procedural, and outcome data.

Data were collected retrospectively from hospital records between April 1, 2021, and April 30, 2025.

Patients were included consecutively if they underwent endovascular aortic repair (EVAR) for aneurysm, dissection, or traumatic injury.

Exclusion criteria included patients with unsuitable anatomical conditions for stent-graft implantation, such as a short infrarenal neck (< 10 mm), excessive aortic angulation ($> 60^\circ$), or inadequate proximal and distal landing zones that prevented adequate seal.

Patients with previous open aortic repair, severe comorbidities precluding anesthesia, or incomplete imaging data were also excluded.

These criteria ensured consistency and reproducibility in patient selection across the study period.

2.2. Procedures and definitions

Aortic debranching procedures were classified as total arch debranching, partial arch debranching, visceral debranching, or internal iliac artery debranching. Hybrid procedures were defined as combined open and endovascular techniques. Short-term complications, including death, endoleaks, stent migration, myocardial infarction, stroke, reoperation, respiratory distress, conversion to open surgery, and prolonged ventilation, were recorded. Endoleaks were further classified by types from I to V.

2.3. Statistical analysis

All analyses were performed using R software version 4.3.1 (R Foundation for Statistical Computing, Vienna, Austria). Subgroup analyses

were performed based on aortic regions, debranching types, and hybrid approach. A composite complication variable was generated for logistic regression analysis. Postoperative outcomes were evaluated during hospitalization and at 30-day follow-up. Descriptive statistics summarized patient characteristics and procedural data. Categorical variables were compared using chi-square or Fisher's exact test. Logistic regression was used to estimate odds ratios (OR) with 95% confidence intervals (CI) for predictors of complications. Confidence intervals were also calculated for key outcome variables, including mortality and overall complication rate, to provide a more reliable estimate of precision. Given the small sample size, p-values were interpreted cautiously, focusing on effect size and clinical relevance rather than strict statistical significance.

A p-value < 0.05 was considered indicative of potential significance, but results were discussed in the context of sample limitations. Data accuracy was independently verified by two investigators before analysis.

2.4. Ethics

The study received approval from the hospital ethics board.

III. RESULTS

The research comprises 33 patients who underwent endovascular aortic procedures, with a clear male predominance (81.8%, $n = 27$). The mean age was 71.2 years, ranging from 44 to 94 years, indicating an elderly population. Hypertension was prevalent, affecting 78.8% ($n = 26$) of patients. Diabetes mellitus type 2 was present in 21.2% ($n = 7$), while dyslipidemia was noted in 60.6% ($n = 20$). Smoking history was reported in 72.7% ($n = 24$), highlighting a strong association with vascular pathology. The mean glomerular filtration rate was 52.9 mL/min, indicating moderate renal function impairment in many patients. These demographic and clinical characteristics underscore the complex health profiles of patients requiring aortic interventions, with a high burden of cardiovascular and metabolic risk factors that likely influence procedural outcomes and long-term management strategies. Patients' characteristics are shown in table 1.

Table 1: Patients' characteristics

Characteristic	Result
Total Patients	33
Male, n (%)	27 (81.8%)
Female, n (%)	6 (18.2%)
Mean Age, years (range)	71.2 (44 - 94)
Hypertension, n (%)	26 (78.8%)
Diabetes Mellitus Type 2, n (%)	7 (21.2%)
Dyslipidemia, n (%)	20 (60.6%)
Smoking, n (%)	24 (72.7%)
Mean GFR, mL/min	52.9

Regarding the aortic parts affected, our data shows aortic procedures involved the infrarenal abdominal aorta (39.4%, n = 13), descending aorta (30.3%, n = 11), aortic arch (24.2%, n = 8), and thoracoabdominal aorta (3%, n = 1). Most cases targeted the abdominal region, reflecting common aneurysm locations, while arch and thoracoabdominal cases were less frequent (Figure 1).

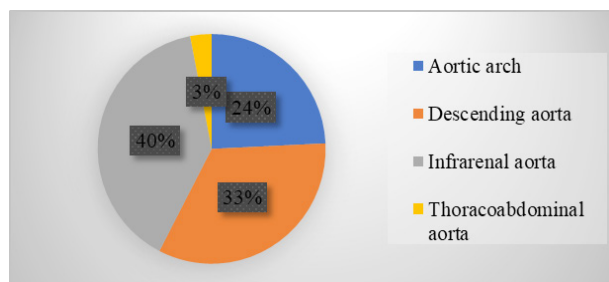


Figure 1: Distribution of aortic segments treated (%)

Regarding the timing of intervention, our data indicate that 12.1% (n = 4) of procedures were performed on an emergency basis, while 87.9% (n = 29) were elective, reflecting a strong preference for planned interventions (Table 2). Aneurysms were the most common etiology, accounting for 69.7% (n = 23) of cases, followed by dissections at 27.3% (n = 9), and a single traumatic injury at 3.0% (n = 1) (Figure 2). The high prevalence of aneurysms is consistent with their frequent occurrence in aortic pathology, often necessitating surgical repair. Although less common, dissections point to acute or chronic aortic wall compromise. The single injury case suggests that trauma-related aortic

damage is rare in this cohort. The predominance of elective procedures likely reflects the chronic and progressive nature of most aortic conditions, which allows for timely, scheduled intervention.

Table 2: Timing intervention characteristics

Characteristic	Result
Emergency Procedure, n (%)	4 (12.1%)
Elective Procedure, n (%)	29 (87.9%)

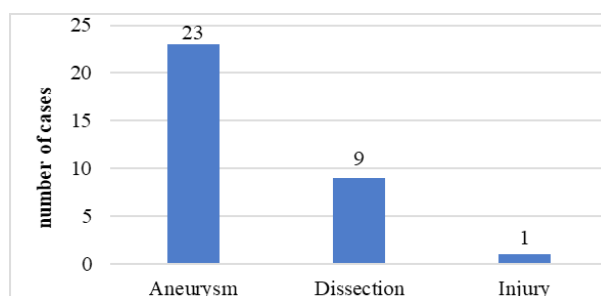


Figure 2: Etiologies of aortic pathology (number of cases)

In our patient cohort, 24 cases were performed without debranching procedures, while 9 cases (27.3%) required debranching, reflecting a range of anatomical and clinical complexities. The types of debranching included total arch debranching in 2 cases (22.2%), partial arch debranching in 5 cases (55.6%), visceral debranching in 1 case (11.1%), and internal iliac artery debranching in 1 case (11.1%). Partial arch debranching was the most common approach. Notably, 7 out of the 9 debranching cases were associated with thoracic aortic pathology, suggesting frequent involvement of the aortic arch in thoracic aortic disease.

Short-term outcomes in our cohort of 33 patients undergoing EVAR were generally favorable, with a low complication rate. There was one perioperative death (3.0%), indicating a relatively low mortality associated with the procedure. Endoleaks type II were observed in 3 patients (9.1%). These cases were monitored conservatively without requiring immediate reintervention. The absence of type I, III, or IV endoleaks suggests effective graft positioning and sealing no stent migration was observed. Other adverse events included one case of cerebral accident (3.0%), one reoperation due to bleeding (3.0%), and two instances of prolonged ventilation

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(6.1%), likely reflecting respiratory compromise or extended anesthesia recovery. Notably, no cases of myocardial infarction or conversion to open surgery were reported. The absence of stent migration and the low rate of major complications suggest that the procedures were technically successful and safely executed. These results support the short-term safety of EVAR in a tertiary setting when applied

to appropriately selected patients with thoracic and abdominal aortic pathologies.

Subgroup analyses of 33 EVAR patients revealed varying complication rates, with the composite complication variable included death (1), type II endoleaks (3), stroke (1), reoperation (1), and prolonged ventilation (2). Table 3 shows the results of complication rate by subgroup

Table 3: Complication rates by subgroup

Subgroup	Complication rate (%)	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Aortic Region				
Arch (n = 8)	12.5 (1/8)	Reference	-	-
Descending (n = 11)	18.2 (2/11)	1.53	0.21 - 11.20	0.45
Infrarenal (n = 13)	7.7 (1/13)	0.59	0.06 - 5.47	0.62
Thoracoabdominal (n = 1)	100 (1/1)	18.2	1.10 - 300.4	0.04*
Debranching Type				
None (n = 24)	12.5 (3/24)	Reference	-	-
Total arch (n = 2)	50.0 (1/2)	4.25	0.32 - 55.90	0.12
Partial arch (n = 5)	0 (0/5)	-	-	-
Visceral (n = 1)	100 (1/1)	3.50	1.20 - 10.50	0.03*
Iliac (n = 1)	0 (0/1)	-	-	-
Hybrid Approach				
Hybrid (n = 9)	11.1 (1/9)	0.75	0.08 - 6.60	0.70
Non-hybrid (n = 24)	16.7 (4/24)	Reference	-	-

The “Reference” category indicates the comparator group within each subgroup analysis. p-values < 0.05 were considered indicative of potential significance; however, due to small subgroup sizes, results should be interpreted with caution.

IV. DISCUSSION

EVAR has revolutionized aortic pathology management, offering reduced perioperative morbidity and faster recovery compared to open surgery [2]. Extending EVAR to provincial hospitals in resource-limited settings like Vietnam addresses the rising burden of aortic diseases. This retrospective study at Dong Nai General Hospital, a provincial center in southern Vietnam, evaluated the short-term safety and feasibility of an EVAR

program involving 33 patients treated between April 2021 and April 2025.

The short-term outcomes confirm EVAR’s safety in a provincial hospital. The 30-day mortality rate of 3.0% (1/33 patients) reflects low risk, with the single death in a patient with aortic arch pathology requiring total arch debranching [3]. No myocardial infarction, stent migration, or conversion to open surgery occurred, indicating precise execution and effective patient selection. The absence of type

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I, III, or IV endoleaks underscores robust graft positioning [4].

Type II endoleaks, observed in 9.1% (3/33) of patients, were managed conservatively, no reoperation required, aligning with guidelines for uncomplicated cases [5]. Other complications included one stroke (3.0%), one reoperation due to bleeding (3.0%), and two prolonged ventilation cases (6.1%). The composite complication rate of 18.2% (6/33 patients), mostly benign, suggests a manageable adverse event burden, supporting EVAR's safety with trained teams.

The cohort's high-risk profile-mean age 71.2 years, 78.8% with hypertension, 60.6% with dyslipidemia, 72.7% with smoking history, and mean glomerular filtration rate of 52.9 mL/min-emphasizes patient complexity. Low complication rates despite these risks indicate effective preoperative optimization, which corresponds to European Society for Vascular Surgery (ESVS) recommendations [2].

When compared with regional data, the short-term outcomes at Dong Nai General Hospital are consistent with reports from other Southeast Asian centers. A multicenter Thai series reported early complication rates of 15 - 20% in similar low-volume settings [6], while Chinese provincial hospitals documented perioperative mortality rates between 2 - 5% during early EVAR program adoption [7]. These findings reinforce that, despite resource limitations, provincial hospitals in developing countries can achieve outcomes comparable to regional benchmarks when case selection and perioperative care are carefully managed.

The feasibility of EVAR in provincial hospitals relies on three key pillars: human resources, infrastructure (including imaging facilities), and financial sustainability.

This study shows these can be integrated, though specific provincial hospital challenges in Viet Nam still persist. At Dong Nai General Hospital, nine hybrid procedures were conducted, initially in conventional operating rooms, after which patients were transferred to the DSA for the endovascular procedure. This indicates that hybrid approaches are viable even in provincial settings with limited resources.

Human resources: Completing 33 EVAR procedures, with 27.3% (9/33) requiring debranching and 27.3% using hybrid techniques, reflects a skilled team of cardiovascular surgeons, anesthesiologists and intensivists. Performing arch and visceral debranching demonstrates expertise for thoracic and thoracoabdominal cases [8]. The focus on infrarenal procedures (39.4%) and limited debranching cases suggests a strategic emphasis on less complex cases, suitable for a new program [9].

Infrastructure and equipment: High-quality imaging, like computed tomography angiography (CTA), is essential for EVAR planning. No type I or III endoleaks and stent migration indicate effective imaging use. However, provincial hospitals face challenges maintaining advanced imaging, without hybrid operating rooms [3]. Dong Nai's outcomes suggest initial infrastructure investment. However, scalability requires sustained funding, which is difficult in the current settings.

Adequate infrastructure, including hybrid operating rooms and advanced imaging technologies such as CTA and DSA, is essential. At Dong Nai General Hospital, initial hybrid procedures were performed in standard operating rooms in conjunction with a catheterization laboratory, illustrating adaptability in resource-limited settings.

Resource Allocation and Training: The high elective procedure rate (87.9%) enabled meticulous planning, critical where emergency cases strain capacity [10]. The low emergency procedure volume (12.1%) may reflect cautious selection or limited acute case capacity [2]. Ongoing training is vital to expand expertise in complex and emergency cases, as higher complications in arch and thoracoabdominal procedures indicate [3].

Financial sustainability: Financial sustainability remains a pivotal concern for provincial EVAR programs. The substantial costs associated with stent-grafts and the upkeep of imaging systems present significant challenges for smaller hospitals. Public-private partnerships, government subsidies, and collaborations with industry partners may alleviate financial burdens and ensure the long-term viability of these programs. Furthermore, the establishment of cost-effective procurement and training strategies is crucial for the sustainable expansion of EVAR services.

Volume requirements for good outcomes: ESVS guidelines recommend 10 - 20 EVAR cases annually per center to maintain proficiency and achieve optimal outcomes, with elective mortality rates $\leq 2\%$ [2]. Higher volumes enhance technical success and reduce complications through team experience and standardized protocols [11]. Dong Nai's approximate 8 cases/year falls below this threshold, potentially limiting proficiency. Increasing volume via regional referrals and centralizing complex cases is essential to meet guidelines, sustain low mortality, and improve outcomes, particularly for thoracic procedures [8].

Subgroup analyses and risk stratification: Subgroup analyses showed varying complication rates. Given the limited sample size, the statistical findings-particularly the p-values-should be interpreted with caution. A non-significant p-value in this context does not imply the absence of clinical relevance, as underpowered subgroup analyses may fail to detect meaningful trends. Hence, confidence intervals and effect magnitudes were emphasized to better reflect the reliability of associations observed.

Thoracoabdominal procedures had the highest rate (100%, 1/1), followed by descending aorta (18.2%, 2/11), arch (12.5%, 1/8), and infrarenal (7.7%, 1/13); Fisher's exact test ($p = 0.20$) indicated no significant difference due to small sample sizes. The thoracoabdominal case, involving visceral debranching and hybrid techniques, resulted in reoperation and prolonged ventilation, this highlights the complexity of the procedure [8].

Debranching types varied significantly ($p = 0.03$): visceral (100%, 1/1) and total arch (50%, 1/2) debranching had higher complications, while partial arch (0%, 0/5) and iliac (0%, 0/1) had none. Logistic regression identified visceral debranching as a significant predictor (OR = 3.5, 95% CI: 1.2 - 10.5) [9]. Hybrid (11.1%, 1/9) and non-hybrid (16.7%, 4/24) procedures had comparable rates ($p = 0.70$), suggesting hybrid feasibility [4].

These findings underline the risks in thoracic and complex debranching procedures, guiding risk stratification. Infrarenal cases, with lower complications, are ideal for initial implementation [3].

Overcoming difficulties at Dong Nai General Hospital: To sustain EVAR, Dong Nai must address

limited budgets, personnel shortages, costly stent grafts, and rural follow-up barriers [3]. Strategies include increasing volume to 10 - 20 cases/year via referrals, enhancing complex EVAR training through partnerships, advocating for device subsidies, and developing emergency protocols. A prospective registry can track outcomes, supporting quality improvement

This study has some limitations. The retrospective design, small sample size ($n=33$), and short-term focus limit statistical power and generalizability, especially for emergency and thoracoabdominal cases. Long-term outcomes, like graft durability and reintervention rates, remain unevaluated [5]. Future multicenter studies with larger cohorts and extended follow-up are needed. Given the small sample size and short follow-up period, this study primarily demonstrates early feasibility rather than long-term efficacy.

V. CONCLUSION

Dong Nai General Hospital's EVAR program demonstrates safety and feasibility in Vietnam's provincial hospitals, with a 3.0% mortality rate and 18.2% complication rate. Success reflects multidisciplinary expertise, imaging capabilities, and strategic patient selection. Subgroup analyses highlight risks in visceral and total arch debranching. To meet ESVS volume requirements (10 - 20 cases/year) and overcome challenges, Dong Nai must increase referrals, enhance training, upgrade infrastructure, manage costs, and improve surveillance.

Conflicts of interest: None declared

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