Preliminary findings of selective endovascular repair for infra-renal abdominal aortic aneurysm at Viet Duc University Hospital

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ABSTRACT

Objectives: To evaluate the early result of EVAR in abdominal aorta aneurysm patients in Viet Duc university hospital from 01/01/2018 to 30/12/2021.

Methods: Descriptive and retrospective study with convenience sampling. Data was extracted from patient records.

Results: There were 37 patients (30 males and 7 females), the majority of which have hypertension and DeBakey sign. Average age was 72,96 ± 6,58 (61-86) years. The fusiform aortic aneurysm was presented in all patien[1,2]. The average diameter, neck diameter, and aneurysm neck angle are 52.57mm, 21.26mm, and 47.02°, respectively. Moreover, 97.3% of patients were given bifurcated stent grafts; internal iliac artery was occluded in 5(13.5%) patients; The early results of the study group included the following: hospital mortality was 2,7% (1); in complications: immediately endoleak was 8(21,6%); after 30 days was 3(8,1%); acute renal failure was in 1(2,7%); hematoma in goiter was in 1(2,7%). Hospital stay was 10±4 days.

Conclusion: The EVAR at Viet Duc University Hospital for selective abdominal aortic aneurysm is safe, effective with low risk of complication and mortality.

Keywords: *EVAR, Abdominal aorta aneurysm, Viet Duc university hospital.*

I. INTRODUCTION[1]

The abdominal aorta is a continuation of the thoracic aorta beginning at the level of the diaphragm, usually at the T12 vertebrae. The term "true arterial aneurysm" is defined as an increase to 1.5 times the normal arterial diameter, and the aneurysm wall consists of three layers (of arterial wall) that may be used to differentiate with pseudoaneurysm.[1,2] Abdominal aneurysms are classified with a diameter greater than 3 cm or more than 50% larger than a regular proximal segment measured in either ultrasound or CT scan.[3] Although aneurysms may occur along the length of the abdominal aorta, the infrarenal aorta is the most implicated location (85%) due to anatomy and physiology characteristics.[4,5] Elderly patients are the most vulnerable with risk factors such as atherosclerosis, smoking, hypertension, dyslipidemia, infection, or trauma. The risk of aneurysm rupture increases when the aneurysm diameter is larger than 5 cm and the larger the aneurysm diameter, the higher the risk of aneurysm rupture.6 Without adequate diagnosis and treatment, the aneurysm is at high risk of rupture, leading to life-threatening complications. Abdominal aneurysms were the source of 9,900 deaths in the United States in 2014.[3]

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Currently, we have three treatment methods for an abdominal aneurysm: open surgery to replace the aneurysm segment with an artificial vascular, endovascular repair, and a hybrid procedure that combines open surgery with endovascular repair.

Open repair is a classic treatment used for years in Viet Nam before endovascular repair and the hybrid advent. However, it's a high risk method with a low recovery, especially in elderly patients.

In 1986, endovascular aneurysm repair (EVAR) was used for the firstime by Ukrainian surgeon NiKolay Volodos for a thoracic aortic aneurysm patient. EVAR has many advantages which include: minimal invasiveness, shortened recovery time, and more positive outcomes for vulnerable populations such as the elderly and surgically contraindicated patients. In 1991, Parodi used EVAR for an abdominal aorta aneurysm patient which has been becoming more prevalent throughout the world.[3,7] However, due to its high cost and socioeconomics in Vietnam, EVAR has been rarely utilized.

Viet Duc university hospital receives hundreds of abdominal aneurysm patients per year and most were intervened via open repair due to high cost and technical difficulties in comparison to other procedures. Although, in recent years, EVAR has becoming more prevalent in Viet Nam: the number of patients able to afford the cost of EVAR and the number of centers can do EVAR are increasing.

Therefore, we propose this study to evaluate the early results of EVAR in abdominal aorta aneurysm patients in Viet Duc university hospital from 01/01/2018 to 30/12/2021.

II. SUBJECTS AND METHOD

Subjects: All infra-renal abdominal aorta aneurysm patients that underwent selective EVAR in cardiovascular and thoracic center of Viet Duc university hospital from 01/01/2018 to 30/12/2021.

Methods: Descriptive and retrospective study with convenience sampling. All information was extracted from patient records. Statistical analyses derived from SPSS 20.

III. RESULTS

50 patients: 37 patients with selective EVAR and 13 patients with emergency EVAR.

Table 1. Clinical characteristics (N=37)

Characteristics		**Number of patients**	**Incidence (%)**
Average age		72,96 ± 6,58 (61-86)	
Sex	Male	30	81,1
	Female	7	18,9
Presenting complaint	Periodic heath examination	25	67,6
	Abdominal mass	3	8,1
	Abdominal pain	9	24,3

Medical background	Hypertension	31	83,8
	Diabetes	8	21.6%
	Smoking	10	27
	Dyslipidemia	7	18.9
DeBakey sign		35	94.6%

Table 2. Aneurysm characteristics from CT scans (N=37)

Shape			100 % Fusiform
Location	Infra-renal aorta		25 (67,5%)
	Iliac arteries aneurysm attach		12 (32.4%)
Max diameter (mm)			52,57 ± 1,68 (32,3-73)
Proximal neck diameter (mm)			21,26 ± 0,56 (16 – 32)
Aneurysm neck angle (angle)			47,02 ± 3,53 (0 - 96)
Thrombosis in neck			4 (10,8%)
Common iliac diameter (mm)		Right	18,36 ± 1,77 (7 – 58,3)
		Left	16,22 ± 1,13 (10 - 40,5)
Common femoral diameter (mm)		Right	9,34 ± 0,26 (6 – 13)
		Left	9,32 ± 0,24 (5,6 – 13)

Table 3. EVAR characteristics (N=37)

Femoral angioplasty		4 (10,8 %)
Stent graft Type	Aorto-uni-iliac graft	1 (2,7%)
	Bifurcated stentgraft	36 (97,3%)
Internal iliac artery occlusion	Right common iliac artery stenosis (Femorofemoral bypass include)	1 (2,7%)
	Stenosis and aneurysm of internal iliac artery	1 (2,7%)
	Unilateral or bilateral common iliac artery aneurysm	3 (8,1%)

Table 4. Early result of EVAR (N=37)

Endoleak during EVAR procedure	Type IA	1 (2,7%)	Additional bare stent
	Type IB	1 (2,7%)	Balloon dilation
	Type IV	6 (16,2 %)	Internal treatment
Preliminary findings (base on CT scan after EVAR)	Good	30 (81,08%)	
	Endoleak IA	1 (2.7%)	Internal treatment
	Endoleak IB	1 (2.7%)	Internal treatment
	Endoleak II	1 (2.7%)	Internal treatment
	Seroma	1 (2.7%)	Compression bandages
Acute renal failure		1 (2.7%)	Internal treatment
Mortality		1 (2.7%)	Serious gastrointestinal bleeding
Patient with Internal iliac artery occlusion		Good postoperation condition	
Hospital stay (day)		*10±4*	

IV. DISCUSSION

1. Clinial conditions

This study consisted of 37 patients undergoing selective EVAR, which is fewer the number of patients in Nguyen Van Quang's research in Cho Ray hospital from may 2012 to december 2015. This may be explained by the higher patient density of Ho Chi Minh city. However, both centers have similar proportions for age and biological sex: 73 years old and 81.1% male compare to 73 years old and 76.9% male.[7]

The most common presenting complaint is disease discovery during follow-up examinations (67.6%). Only 24.3% patients have abdominal pain and 8.1% patients have a papable abdominal mass. Most abdominal aortic aneurysm patients are symptomatic until the aneurysm becomes significantly enlarged or ruptures. However, some patients may complain of diffuse pain in their abdomen or a pulsatile abdominal mass, especially in thinner patients.[3] The DeBakey sign, which confirms that the aneurysm location is distal to the renal arteries, was found in 94.6% patients.

Of the Viet Duc patients, 83.8% presented with hypertesion. Kobeissi et al conducted a meta analysis through 18 institutions and concluded that hypertensive patients have a 66% higher risk of abdominal aortic aneurysm compared with the non-hypertensive group, and that the diastolic hypertensive group had a higher risk compared with the systolic hypertensive patients.[8] Moreover, Golledge et al concluded via meta analysis that blood pressure-lowering medications

do not limit growth or clinically associated events in those with abdominal aortic aneurysms.[9] Thus, not only hypertension increases risks for abdominal aortic aneurysms but also the aforementioned factors (atherosclerosis, dyslipidemia, elderly, etc.) participate in formation and risk of aneurysms. Interestingly, Palma et al proposes that the main risk factor for abdominal aortic aneurysms is atherosclerosis.

2. Aneurysm characteristics

All patients presented with a fusiform aneurysm wherein the entire diameter of the artery is affected. In contrast, saccular aneurysms are more localized as just part of the circulatory circuit is affected. Most abdominal aortic aneurysms are fusiform, whereas the saccular form is often found in trauma-induced or infection-induced.[3]

The average aortic diameter in our study is 52.6 mm (32.3 – 73). The larger the aneurysm, the higher risk of rupture. Female patients presented with higher aneurysm risk.[10]

Table 5. Twelve-month risk of rupture based on abdominal aortic aneurysm diameter[3]

Diameter (mm)	Rupture risk (%)
30 -39	0.3
40 – 49	0.5 - 1.5
50 -59	1 - 11
60 - 69	11 - 22
> 70	> 30

Majority of patients in our study have fall within the normal aortic diameter and 75.7% patients do not present with abdominal pain. In reality, there are numerous indications for selective EVAR compared to emergency EVAR: Multiscan CT angiography is needed to measure and select for a suitable stent graft (type, size and implementation plan), many patients cannot afford the cost of procedure (200 - 300 milions dong), and shortages of endovascular surgeons able to perform the surgery.

Consequentially, patients with aortic ruptures or more likely rupture aneurysm, often have to replace the affected aortic segment via an artificial arteriole vessel to reduce risk of mortality. Patients that have a lower rupture risk and stable hemodynamics are ideal candidates for EVAR.

For our study, we found the average proximal aortic neck diameter to be 21.2 mm and average aorta aneurysm neck angle to be 47 degrees. We had 4 patients with aneurysm neck thrombi. Ideally, proximal neck diameter should be less than 32 mm, and aneurysm neck angle less than 60 degrees to be suitable for EVAR. Aortic aneurysm neck thrombi or calcification can be divide into 3 grades: Severe (> 50% of circumference), medium (25-50% of circumference) and mild (<25% of

circumference). Atherosclerotic plaques or thombi may embolize and cause peripheral artery thrombosis.[7,11] According to Chinsakchai et al, although aneurysm neck thrombus are not contraindications for EVAR, it seems to negatively influence outcomes via renal and peripheral embolization, which may be prevented with EVAR.[12] We have not had any cases of renal or peripheral arteries occlusion during or post-one month EVAR.

The average right and left common iliac artery diameter, right and left common femoral artery diameter are 18,36; 16,22; 9,34; 9,32 (mm), respectively. Stent grafts are delivered to abdominal aorta through the femoral and iliac artery. Thus, the artery size, tortuosity, calcification, and thrombosis strongly affect EVAR. In case of single iliac artery occlusion, a bifurcated stent graft is impossible – hence, the aorto-uni-iliac stent graft configuration with femoro-femoral bypass is commonly used.

Normally, the iliac artery diameter must be at least more than 7 mm. The common iliac artery diameter should be 2 mm smaller than the stent-graft limb diameter. Stenosis or occlusive arteries may be addressed with angioplasty or stent placement. A dilated iliac artery affects the distal seal zone, preventing successful fixation of the graft limb.

The common iliac artery is usually the placement site for a stent-graft. However, if there is a common iliac artery aneurysm or the common iliac artery is less than 1.5 cm, the distal limb is extended past the common iliac artery and may lead to the occlusion of the internal iliac artery. This may cause pelvic ischemia due to inadequate perfusion.[11] In our study, all patients have appropriate iliac ateries diameters for EVAR. The 4 patients with stenosis or occlusive femoral/iliac artery were treated via balllon angioplasty.

3. EVAR procedure

We used bifurcated stent grafts for 36 patients (97.3%); aorto-uni-iliac stent graft and femoro-femoral bypass for 1 patient (2.7%). There were 4 patients whose internal iliac arteries were intentionally occluded because of an iliac aneurysm or iliac stenosis. In this study, although there are only 12 patients (32.4%) that have an iliac artery aneurysm. Most patients had a bifurcated stent graft (36 - 97.3%). Nguyen Van Quang's findings were similar: 82.7% biurcated stent graft; 11.5% aorto-uni-iliac stent graft; 5.8% abdominal aorta stent graft. We did not utilize abdominal aorta stent grafting as no patient met the anatomical certerias for landing zone of stentgraft.

One patient had 75% stenosis of right iliac artery, thus a bifurcated stent graft was not suitable. We used a aorto - uni (left)- iliac stent graft; occluded right common iliac artery and left internal iliac artery; femoro-femoral bypass attach. No ischemia was detected in the 30 day follow-up. Femoro-femoral bypass makes EVAR possible despite unfavourable anatomy of the iliac/femoral artery, such as: stenosis or occlusion, tortuousness, calcification, thrombosis, and arterial dissection.

Smit's study in 33 patients whom have a combination of aorto-uni-iliac stent graft and femoro-femoral bypass shows promising results wherein all participants avoided limb ischemia.[13]

In our cohort, we had no patient that showing pelvic organ ischemia post-operation of the 5 patients with occlusion of internal iliac

arteries. The internal iliac artery is the reason for endoleak type II when the distal limb of stent graft is extended past the common iliac artery.[7,11] The occlusion of internal iliac artery can be performed before or during EVAR procedure. However, if both internal iliac arteries are occluded, it should be conducted a week apart in order to avoid acute pelvic ischemia. Recent studies have shown that internal iliac arteries occlusion is safe.[7,14,15] More recently, internal iliac artery preservation is becoming popular in many cardiovascular centers globally, especially in the case of inferior mesenteric artery occlusion with aim to reduce risks of colon ischemia.

4. Early result

An endoleak is defined as persistent blood flow in the aneurysm sac following stent grafting. Endoleaks are categorized into five different types, which differ in etiology as well as treatment.[3]

Table 6. Classification of endoleaks[16]

Type	Explanation
I	Leakage at site of attachment (inadequate sealing) • IA: Proximal type • IB: Distal type • IC: In setting of aorto-mono-iliac graft and femoro-femoral bypass from contralateral non-grafted iliac artery
II	Leakage through collateral vessel (lumbar, inferior mesenteric or internal iliac arteries)
III	Leakage through defect in graft as fractures or holes (mechanical graft failure)
IV	Leakage with no origin (graft porosity)
V	Expansion of the aneurysm with no leakage (endotension)

In our study, during EVAR procedures: 1 patient that had a type IA endoleak and thus an an additional stent was placed; 1 patient had a type IB endoleak followed by balloon aingoplasty; 6 patients reported with a type IV endoleak showed positive recovery after treament.

Data from the 1 month post-op follow-up CT scan: 81.08% patients recovered without complications; 1 patient had a type IA endoleak, 1 patient had a type IB endoleak, and 1 patient had a type II endoleak. All patient with endoleaks were given internal treatment with close follow up. As a result, these patients underwent full recovery and no further intervention required. Importantly, Nguyen Van Quang's research shows only endoleak type II (17.6%). Meanwhile, Kassem's research show 10.8% endoleak type IA and 27% endoleak type II. Endoleak type IA may be addressed by balloon angioplasy and/or additional stent placement whereas endoleak type II can regress without any treatment.[16]

Additionally, we report that 1 patient had a seroma in the common femoral artery exposure site followed by treatment via compression bandages. Another patient presented with acute renal failure wherein they recovered without

dyalysis. To note, there are numerous factors that may lead to acute renal failure such as: occlusion of the renal artery due to thrombus or stent grafting, renal ischemia, and contrast agents.

Relative to open surgery, EVAR encapsulates approximately half the risk for acute kidney injury and one-third the risk for new hemodialysis requirement.[17]

Relatedly, we report one patient death due to severe gastrointestinal bleeding (2.7%). According to a meta-analysis of 26 studies with 354,500 patients, the 30-day all-cause mortality rate was 4.84 %.[18]

V. CONCLUSION

The EVAR procedure is safe, effective, and comes with low complication and mortality risk. From our outcomes at Viet Duc Hospital, we've found EVAR to be especially effective for elderly patients. Moreover, our early results of EVAR at Viet Duc University Hospital have been overwhelmingly positive, similar to reports from other domestic and international surgical centers. However, it's necessary to conduct further research to evaluate the mid and long-term effects of EVAR relative to open surgery, especially in long life expectancy patiens groups.

REFERENCE

1. Thompson MM, Bell PRF. Arterial aneurysms. *BMJ*. 2000;320(7243):1193-1196.

2. Kaufman JA. CHAPTER 9 - Thoracic Aorta. In: Kaufman JA, Lee MJ, eds. *Vascular and Interventional Radiology*. The Requisites. W.B. Saunders; 2004:219-245. doi:10.1016/B978-0-8151-4369-7.50017-2

3. Sidawy AN, Perler BA, eds. *Rutherford's Vascular Surgery and Endovascular Therapy*. Ninth edition. Elsevier; 2019.

4. Dương Ngọc Thắng, Bùi Minh Tứ, Phùng Duy Hồng Sơn. Kết quả sớm điều trị phồng động mạch chủ bụng dưới thận bằng phẫu thuật có kế hoạch tại Bệnh viện hữu nghị Việt Đức giai đoạn 2018 - 2020. *Tạp Chí Học Việt Nam*. 2022;515(2). doi:10.51298/vmj.v515i2.2800

5. Kim HO, Yim NY, Kim JK, Kang YJ, Lee BC. Endovascular Aneurysm Repair for Abdominal Aortic Aneurysm: A Comprehensive Review. *Korean J Radiol*. 2019;20(8):1247. doi:10.3348/kjr.2018.0927

6. Đỗ Kim Quế, Chung Giang Đông, Nguyễn Anh Trung, Đào Hồng Quân. Đánh giá kết quả điều trị phình động mạch chủ bụng bằng can thiệp nội mạch. Tạp chí Y học Thành phố Hồ Chí Minh. 2017; 21(3): 282 - 286.

7. Nguyễn Văn Quảng, Phạm Minh Ánh, Trần Quyết Tiến. Kết quả điều trị 52 trường hợp phình động mạch chủ bụng dưới thận bằng can thiệp nội mạch tại Bệnh viện chợ rẫy. Tạp chí Y học Thành phố Hồ Chí Minh. 2017;21(2): 187-194

8. Kobeissi E, Hibino M, Pan H, Aune D. Blood pressure, hypertension and the risk of abdominal aortic aneurysms: a systematic review and meta-analysis of cohort studies. *Eur J Epidemiol*. 2019;34(6):547-555. doi:10.1007/s10654-019-00510-9

9. Golledge J, Singh TP. Effect of blood pressure lowering drugs and antibiotics on abdominal aortic aneurysm growth: a systematic review and meta-analysis. *Heart*. 2021;107(18):1465-1471. doi:10.1136/heartjnl-2020-318192

10. Mortality results for randomised controlled trial of early elective surgery or ultrasonographic surveillance for small abdominal aortic aneurysms. *The Lancet*. 1998;352(9141):1649-1655. doi:10.1016/S0140-6736(98)10137-X

11. Bryce Y, Rogoff P, Romanelli D, Reichle R. Endovascular Repair of Abdominal Aortic Aneurysms: Vascular Anatomy, Device Selection, Procedure, and Procedure-specific Complications. *RadioGraphics*. 2015;35(2):593-615. doi:10.1148/rg.352140045

12. Chinsakchai K, Hongku K, Hahtapornsawan S, et al. Outcomes of abdominal aortic aneurysm with aortic neck thrombus after endovascular abdominal aortic aneurysm repair. *J Med Assoc Thail Chotmaihet Thangphaet*. 2014;97(5):518-524.

13. Smit JGM, van Marle J. Repair of abdominal aortic aneurysms with aorto-uni-iliac stentgraft and femoro-femoral bypass. *South Afr J Surg Suid-Afr Tydskr Vir Chir*. 2012;50(2):33-36.

14. Dierks A, Sauer A, Wolfschmidt F, et al. Proximal occlusion of unaffected internal iliac artery versus distal occlusion of aneurysmatic internal iliac artery prior to EVAR: a comparative evaluation of efficacy and clinical outcome. *Br J Radiol*. 90(1072):20160527. doi:10.1259/bjr.20160527

15. Rhodes K, Didomenico P, Vatakencherry G. Bilateral internal iliac artery occlusion for EVAR. *Vasc Dis Manag*. 2011;8:E1-E5.

16. Kassem TW. Follow up CT angiography post EVAR: Endoleaks detection, classification and management planning. *Egypt J Radiol Nucl Med*. 2017;48(3):621-626. doi:10.1016/j.ejrnm.2017.03.025

17. Zarkowsky DS, Hicks CW, Bostock IC, Stone DH, Eslami M, Goodney PP. Renal dysfunction and the associated decrease in survival after elective endovascular aneurysm repair. *J Vasc Surg*. 2016;64(5):1278-1285.e1. doi:10.1016/j.jvs.2016.04.009

18. Tzani A, Doulamis IP, Katsaros I, Martinou E, Schizas D, Economopoulos KP. Mortality after endovascular treatment of infrarenal abdominal aortic aneurysms - the newer the better? *VASA Z Gefasskrankheiten*. 2018;47(3):187-196. doi:10.1024/0301-1526/a000685.