Predictors of In-hospital and Short-term Outcomes of Thoracic Endovascular Aortic Repair for Aortic Aneurysm and Aortic Syndrome: A Single-Center Experience

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CONFLICTS OF INTEREST: None

Abstract

BACKGROUND: Endovascular technique has replaced open repair as primary treatment for different aortic disease indications and was associated with low perioperative mortality and acceptable short-, mid-, and long-term survival. Locally, thoracic endovascular aortic repair (TEVAR) was not widely practiced until year 2017. This study aims to determine the predictors of in-hospital and short-term outcomes of patients who underwent TEVAR for aortic aneurysm and aortic syndrome in a single center and how it compares with local and international data.

METHODS: This study is a retrospective analysis of 52 adult patients who underwent TEVAR for the treatment of aortic aneurysm and aortic syndrome. Demographic and clinical data, diagnostic imaging, and procedural details were obtained via inpatient charts at the medical records section and hospital system database archiving. Outcomes at 30 days and 1 year postprocedure were obtained through telephone follow-up after attaining verbal consent.

Gathered data were analyzed as to association of different variables with or without the presence of complications. Outcomes reported included in-hospital mortality rate, presence of major adverse events (MAEs), 30-day and 1-year survival rates, and rate of freedom from reintervention.

RESULTS: The overall in-hospital mortality was 7.69% (n = 4/52), and complication rate was 32% (n = 20/52), with a survival rate of 92.31% and 87.76% at 30 days and 1 year, respectively. The rates of overall freedom from reintervention were 83.33% and 100% at 30 days and 1 year, respectively. The independent predictors for in-hospital mortality and development of MAEs were increasing weight (odds ratio [OR], 1.0588; 95% confidence interval [CI], 1.003–1.208), preexisting chronic kidney disease (OR, 10.33; 95% CI, 1.1069–96.462), and TEVAR with debranching done as a single procedure (OR, 3.6667; 95% CI, 1.1154–12.054), whereas an estimated glomerular filtration rate of 49.05 ± 19.25 (OR, 0.9402; 95% CI, 0.9019–0.9801) and TEVAR with debranching done as a staged procedure (OR, 0.1624; 95% CI, 0.0321–0.8225) statistically decrease the risk for development of in-hospital mortality and MAEs (P = 0.001 and P = 0.028, respectively).

CONCLUSIONS: In this single-center study, indications for TEVAR were fusiform and saccular aneurysm, high-risk intramural hematoma and penetrating aortic ulcer, complicated acute type B dissection, chronic complicated type B dissection with high-risk feature, and aortic rupture. The outcome of this study shows comparable results with other international studies with an acceptable in-hospital mortality rate, complication rate, short-term survival rate, and rate freedom from reintervention at 30 days and 1 year. Increasing weight, preexisting chronic kidney disease, and TEVAR with debranching done as a single setting are independent predictors for developing in-hospital mortality and MAEs, whereas a normal estimated glomerular filtration rate and TEVAR with debranching done as a staged procedure decrease the risk; hence, careful planning and scheduling of procedure among elective and amenable cases could further reduce complication rates of future TEVAR procedures.

INTRODUCTION

Background of the Study

Open surgery was traditionally the method of choice for repair of aortic diseases. In 1987, thoracic endovascular aortic repair (TEVAR) was first performed by Volodos in a patient with a posttraumatic thoracic aneurysm, and in 1993, the first successful endovascular aortic repair for abdominal aortic aneurysm was completed.[1,2] In 2005, following the Gore TAG pivotal trial, TEVAR was approved by the US Food and Drug Administration for the management of thoracic aneurysm.[3] Fundamentally, the procedure was rapidly accepted by clinicians in treating aortic disease because of its less invasive nature and lower perioperative morbidity and mortality and was an extended option for those patients deemed unsuitable or unfit for open surgery.[1,3] The indications for procedure have expanded over the following decades, and continued advances in endograft technology have broadened the applications of this technique.[4,5]

Endovascular technique has replaced open repair as primary treatment for different aortic disease indications and was associated with low perioperative mortality and acceptable short-, mid-, and long-term survival with broadened treatment eligibility specifically to elderly patients.1,6,7

In a local study by Gabitoya and Arellano,[8] the majority of patients with thoracic and abdominal aneurysm between 2012 and 2015 in a single center underwent surgical management for different indications (67%, n = 275), and only 16% underwent endovascular or hybrid procedure. In-hospital mortality did not show significant survival benefit difference between open surgical repair and endovascular repair.[8]

In a small cohort study by Valdez and Arellano,[9] open surgical repair was still the standard therapy in patients with acute complicated type B aortic dissection (22.7% [n = 44]), with only two patients managed with TEVAR from 2010 to 2015. Because of a very small number of patients, the rates of morbidity and mortality of the treatment strategy cannot be concluded.[9]

This study aimed to determine the predictors associated with the in-hospital and short-term outcomes of patients who underwent TEVAR for aortic aneurysm and aortic syndrome and how it compares with local and international data.

RESEARCH METHODOLOGY

This was a retrospective cohort study conducted in Philippine Heart Center with study population taken from January 2017 to December 2020. All patients 19 years and older with aortic aneurysm and/or aortic dissection who underwent TEVAR were included in the study. Patients who underwent hybrid TEVAR (open surgical debranching with TEVAR, staged or one-time procedure) were included in this study. All patients younger than 18 years and patients who had TEVAR but underwent a concomitant open surgical repair unrelated to an aortic management or previous endovascular interventions were excluded from this study.

Using G*Power 3.1.9.7 (Heinrich Heine University, Dusseldorf, Germany), a minimum of 52 patients was required for this study based on 3.036 odds ratio (OR) of patients with diabetes mellitus to have stroke after TEVAR for Stanford type B aortic dissection.[11] This computation also accounts for 5% level of significance and 80% power.

Study Maneuver

Data of adult Filipino patients, 19 years and older, who underwent TEVAR who were admitted at the Philippine Heart Center from January 2017 to December 2020 were retrieved via electronic medical record and chart review from medical records using ***International Classification of Diseases, Tenth Revision, Clinical Modification*** (***ICD-10-CM***) code Z95.828, ***ICD-9*** code 39.79, ***ICD-10*** code 02VW3DZ or all patients with final diagnosis of status post TEVAR. Operative records were reviewed via the Philippine Heart Center web application: operative technique records. Outcomes during in-hospital admission, 30 days, and 1 year after endovascular procedure were determined via medical records at respective clinics where patients were seen or through telephone follow-up after attaining verbal consent. All patients with incomplete data and patients who underwent a concomitant open surgical repair unrelated to an aortic management or previous endovascular interventions were excluded from this study. Confidentiality of patient information was observed at all times. Data collected were encoded in password-protected spreadsheets. A code number was assigned to each patient. To maintain anonymity, a separate spreadsheet that links the study code to the patient's name was made. Only the primary investigator had access to the file.

Statistical Analysis

Descriptive statistics was used to summarize the demographic and clinical characteristics of the patients. Frequency and proportion were used for categorical variables, median and interquartile range for non–normally distributed continuous variables, and mean and SD for normally distributed continuous variables. Independent-sample t test, Mann-Whitney U test, and Fisher exact/χ^2 test were used to determine the difference of mean, rank, and frequency, respectively, between patients with and without in-hospital mortality and MAE. Odds ratio and corresponding 95% confidence intervals from binary logistic regression were computed to determine significant predictors for in-hospital mortality and major adverse event. Shapiro-Wilk test was used to test the normality of the continuous variables. Missing values were neither replaced nor estimated. Null hypotheses were rejected at the 0.05 α level of significance. STATA 13.1 (StataCorp, College Station, Texas) will be used for data analysis.

TABLE 1. Clinical Characteristic Profile of the Patients With and Without Complications

	TOTAL (N = 52)	WITH (N = 20 [38%])	WITHOUT (N = 32 [62%])	*P*
	FREQUENCY (%), MEAN ± SD, OR MEDIAN (IQR)			
Age, y	65.65 ± 10.72	63.7 ± 12.28	66.88 ± 9.63	0.303
Sex				0.743
Male	39 (75)	16 (80)	23 (71.88)	
Female	13 (25)	4 (20)	9 (28.13)	
Height, m	1.63 ± 0.08	1.65 ± 0.06	1.61 ± 0.09	0.165
Weight, kg	65.33 ± 10.98	69.26 ± 11.22	62.88 ± 10.26	0.041
BMI, kg/m^2	24.70 ± 3.63	25.79 ± 3.90	24.02 ± 3.33	0.088
Smoking history				0.127
Current	15 (28.85)	9 (45)	6 (18.75)	
Previous	20 (38.46)	5 (25)	15 (46.88)	
Nonsmoker	17 (32.69)	6 (30)	11 (34.38)	
Family history of aneurysm	0	0	0	-
Comorbidities				
Hypertension	47 (90.38)	17 (80)	30 (93.75)	0.361
Coronary heart disease	16 (30.77)	7 (35)	9 (28.13)	0.759
Diabetes mellitus	11 (21.15)	2 (10)	9 (28.13)	0.170
COPD	6 (11.54)	4 (20)	2 (6.25)	0.189
Chronic kidney disease	6 (11.54)	5 (25)	1 (3.13)	**0.026**
Peripheral artery disease	4 (7.69)	1 (5)	3 (9.38)	0.683
Cerebrovascular disease	2 (3.85)	1 (5)	1 (3.13)	1.000
Presenting symptoms				0.696
Asymptomatic	7 (13.46)	1 (5)	6 (18.75)	
Chest pain	19 (36.54)	8 (40)	11 (34.38)	
Back pain	12 (23.08)	5 (25)	7 (21.88)	
Abdominal pain	4 (7.69)	1 (5)	3 (9.38)	
Hemoptysis	7 (13.46)	3 (15)	4 (12.5)	
Others	3 (5.77)	2 (10)	1 (3.13)	
Diagnostics				
CBC				
Hemoglobin	123.94 ± 16.98	125.65 ± 17.67	122.88 ± 16.73	0.572
Platelet	277.77 ± 100.3	238.75 ± 99.56	302.16 ± 111.1	0.043
WBC count	9.79 ± 3.89	9.56 ± 3.87	9.94 ± 3.96	0.736
eGFR	42.14 ± 20.07	31.08 ± 16.33	49.05 ± 19.25	0.001
Albumin	34.31 ± 6.31	33.78 ± 6.65	34.74 ± 6.13	0.632
LVEF (by Simpson)	64.34 ± 8.99	63.65 ± 9.38	64.78 ± 8.86	0.663
ABI (overall)	1.02 ± 0.13	0.99 ± 0.10	1.04 ± 0.14	0.39

Abbreviations: ABI, ankle-brachial index; BMI, body mass index; CBC, complete blood count; COPD, chronic obstructive pulmonary disease; eGFR, estimated glomerular filtration rate; LVEF, left ventricular ejection fraction; WBC, white blood cell.

RESULTS

There were 63 patients who underwent TEVAR from January 2017 to December 2020. Nine patients were excluded because of concomitant open surgical repair unrelated to an aortic management, and two patients were excluded because of loss to follow-up. In total, 52 patients were included in the study with demographic data summarized in Table 1. Data were correlated as to occurrence of complications with a rate of 20/55 (38%) with at least one complication per patient. The mean age of patients who underwent procedure was 65.65 years, with male sex as the majority (n = 39). The weight of the patients was higher in those with complications (P = 0.041), although the body mass index between the two groups did not reach statistical significance (P = 0.088). The occurrence of CKD was greater among patients with complications than in those without complications (P = 0.026). Moreover, a higher eGFR of 49.05 ± 19.25 was noted among those without complications compared with eGFR of 31.08 ± 16.33 in patients with complications (P = 0.001). The platelet count was significantly higher among those patients without complications (P = 0.043).

TABLE 2. Indications for TEVAR of the Patients With and Without Complications

	TOTAL (N = 52)	WITH (N = 20, 38%)	WITHOUT (N = 32, 62%)	*P*
	FREQUENCY (%) OR MEDIAN (IQR)			
Fusiform aneurysm	8 (15.38)	4 (20)	4 (12.5)	0.695
Size	6.58 (5.9–8.5)	7 (5.75–8.45)	6.58 (6–8)	0.884
Location				
Ascending aorta	0	0	0	1.000
Aortic arch	1 (12.5)	0	1 (25)	
Descending aorta	7 (87.5)	4 (100)	3 (75)	
Saccular aneurysm	20 (38.46)	6 (30)	14 (43.75)	0.389
Size	4.75 (4.2–6.3)	5.6 (4.2–6.5)	4.7 (4.2–5.6)	0.457
Neck length	3.1 (2.35–4.3)	4.4 (3.3–4.8)	2.9 (2.2–3.5)	0.098
Location				
Ascending aorta	2 (10)	1 (16.67)	1 (7.14)	1.000
Aortic arch	1 (5)	0	1 (7.14)	
Descending aorta	17 (85)	5 (83.33)	12 (85.71)	
High-risk intramural hematoma	4 (7.69)	2 (10)	2 (6.25)	0.634
High-risk penetrating aortic ulcer	1 (1.92)	0	1 (3.13)	1.000
Complicated acute type B dissection	7 (13.46)	3 (15)	4 (12.5)	1.000
Chronic complicated type B dissection with high-risk features	3 (5.77)	2 (10)	1 (3.13)	0.551
Rupture	9 (17.31)	3 (15)	6 (18.76)	1.000

In this study, there were seven different indications for TEVAR documented and summarized in Table 2. To note, the occurrence of complications did not significantly differ with each indication. The most common indication was saccular aneurysm (n = 20 [38.46%]) of the descending aorta followed by a ruptured aorta (n = 9 [17.31%]). Among those patients presenting with ruptured aorta, four patients were from ruptured saccular aneurysm, two patients with ruptured aortic pseudoaneurysm, two patients with ruptured fusiform aneurysm, and one from ruptured traumatic pseudoaneurysm.

Patients who underwent TEVAR with debranching as staged procedure compared with patients done in a single setting have significantly lower occurrence of complications ($P = 0.028$), shown in Table 3. In addition, the longer the interval days between the debranching and TEVAR, the lower the occurrence of complications (7 [5–9] days vs 3 [2–3] days, $P = 0.035$). The development of complications did not significantly differ among patients operated on as an emergency procedure (n = 9 [17.31%], $P = 0.719$). The landing zone and diameter, length of coverage, and access vessel and maneuver did not significantly differ among those patients with or without complications. However, the duration of spinal drain and intensive care unit (ICU) stay was significantly longer among patients with complications (84.5 [45–110] vs 37 [28–47] hours [$P = 0.017$] and 5 [3–7] vs 3 [2–4] days [$P = 0.001$], respectively).

Perioperative procedural complications and in-hospital outcomes are presented in Tables 4 and 5, respectively. The most common procedural complication noted was endoleak (n = 10). Two patients with documented endoleak type I and one patient with endoleak type 3 required additional balloon angioplasty/remodeling before discharge. The remainder of patients with endoleak was monitored through CT aortogram surveillance with no noted significant increase in aneurysmal sac. Subsequently, no additional patient required further intervention within the follow-up period. One patient had retrograde dissection and eventually underwent conversion to open repair 8 days postprodecure. Two patients developed retroperitoneal hematoma. One patient underwent evacuation immediately after TEVAR and the other patient 1 day postoperatively. Five patients developed access complications. One patient had access pseudoaneurysm and was readmitted after 1 month for repair of pseudoaneurysm. Four patients with access hematoma were managed medically.

The in-hospital mortality was 7.69% (n = 4/52). Procedures of the two patients who died were done as emergency (n = 2/9 [22.22%]), and two as elective procedure (n = 2/43 [4.65%]). Causes of death recorded were as follows: the first patient developed fatal arrhythmia (ventricular tachycardia) and died hours after surgery; the second patient had aortic rupture presenting as massive pleural effusion 5 days postoperatively to which patient died before the planned reintervention was carried out; the third patient had multiple pontine and cerebellar infarcts and died 10 days after; the last patient had an embolic event (splenic infarction and acute pancreatitis) and acute kidney injury, who died 3 days postoperatively. The last two patients eventually died of multisystem organ failure.

TABLE 3. Procedure Characteristics of Patients With and Without Complications

	TOTAL (N = 52)	WITH (N = 20 [38%])	WITHOUT (N = 32 [62%])	*P*
	FREQUENCY (%); MEDIAN (IQR)			
Procedure				0.028
TEVAR only	18 (32.62)	7 (35)	11 (34.38)	
TEVAR ± debranching (single procedure)	19 (36.54)	11 (55)	8 (2–5)	
TEVAR ± debranching (staged procedure)	15 (28.85)	2 (10)	13 (40.63)	
Emergency	9 (17.31)	4 (20)	5 (15.63)	0.719
Interval of 1st and 2nd procedure	7 (4–9)	3 (2–3)	7 (5–9)	0.035
Length of hospital stay, d				
Admission to discharge	20 (14–28)	23 (14–29)	19 (13–27)	0.480
Admission to OR day	4 (2–10)	4 (2–8)	7 (2–11)	0.340
ICU stay	3 (2–5)	5 (3–7)	3 (2–4)	0.001
Landing zone				0.634
Zone 0	9 (17.31)	2 (10)	7 (21.88)	
Zone 1	17 (32.69)	7 (35)	10 (31.25)	
Zone 2	9 (17.31)	5 (25)	4 (12.5)	
Zone 3	16 (30.77)	6 (30)	10 (31.25)	
Zone 4	1 (1.92)	0	1 (3.13)	
Landing diameter, cm	3.25 (2.8–3.8)	3.44 (3–3.92)	3.14 (2.8–3.7)	0.123
Length of coverage, cm	17.95 (13.6–24.75)	19.3 (14.38–26.91)	17.1 (13.35–24.1)	0.236
Access vessel				0.271
Femoral artery	45 (86.54)	18 (90)	27 (84.38)	
Common Iliac artery	6 (11.54)	1 (5)	5 (15.63)	
Distal aorta	1 (1.92)	1 (5)	0	
Access diameter, cm	0.9 (0.82–1)	0.92 (0.8–1.1)	0.88 (0.8–0.9)	0.429
Access maneuver				0.549
Percutaneous	16 (30.77)	5 (25)	11 (34.38)	
Open cut-down	36 (69.23)	15 (75)	21 (65.63)	
Use of spinal drain	26 (50)	12 (60)	14 (43.75)	0.472
Duration, h	45.5 (36–82)	84.5 (45–110)	37 (28–47)	0.017
Endo anchor	0	0	0	—
Chimney				
Celiac artery	0	0	0	—
Superior mesenteric artery	0	0	0	—
Snorkel				
Celiac artery	0	0	0	—
Superior mesenteric artery	0	0	0	—
Coil				
Subclavian artery	2 (3.85)	1 (5)	1 (3.13)	1.000

Abbreviations: ICU, intensive care unit; OR, operating room; TEVAR, thoracic endovascular aortic repair.

Other MAEs documented included respiratory failure (n = 10 [19.23%]) needing prolonged intubation or reintubation; renal failure (n = 10 [19.23%]), with three patients needing renal replacement therapy; three patients with stroke (one died, two went home with residual weakness); and two patients with myocardial infarction, with one patient managed medically and one patient underwent coronary artery bypass surgery within the same admission. There were no cases of deployment failure, acute limb ischemia, spinal cord ischemia, paraplegia, and/or paraparesis.

The 30-day survival rate was 92.31% (n = 48) as presented in Table 6. The freedom from reintervention was 83.33% (n = 40), but when considering reinterventions related to

TABLE 4. Perioperative Procedural Complications of Patients Who Underwent TEVAR (n = 52)

	FREQUENCY (%)
Deployment failure	0
Conversion to open repair	1 (1.92)
Endoleak	
Type I	6 (11.54)
Type III	4 (7.69)
Rupture	1 (1.92)
Retrograde dissection	1 (1.92)
Spinal cord ischemia	0
Acute limb ischemia	0
Retroperitoneal hematoma	2 (3.85)
Access complication	
Pseudoaneurysm	1 (1.92)
Hematoma	4 (7.69)

Abbreviation: TEVAR, thoracic endovascular aortic repair.

TABLE 5. Perioperative In-hospital Outcomes of Patients Undergoing TEVAR (n = 52)

	FREQUENCY (%)
In-hospital mortality	4 (7.69)
Major adverse events	
Respiratory failure	10 (19.23)
Renal failure	10 (19.23)
Stroke	3 (5.77)
Myocardial infarction	2 (3.85)
Embolic event	1 (1.92)
Paraplegia/paraparesis	0

Abbreviation: TEVAR, thoracic endovascular aortic repair.

aorta complications alone (n = 3), it went up to 93.75%. No patient underwent conversion to open repair during this follow-up period. At 1 year of follow-up period, the survival rate was 87.76% (n = 43) with no documented aorta and/or procedure-related deaths. All who survived did not undergo any reintervention related to the TEVAR procedure.

Using univariate analysis, among the preoperative and intraoperative variables, increasing weight (OR, 1.0588 [1.003–1.208]), preexisting CKD (OR, 10.33 [1.1069–96.462]), and TEVAR with debranching done as a single procedure (OR, 3.6667 [1.1154–12.054]) were identified as independent predictors for development of in-hospital mortality and MAEs after TEVAR. Subsequently, patients who developed complications were noted to have increased duration of spinal drain (*P* = 0.020) and longer ICU stay (*P* = 0.005). On the contrary, an eGFR of 49.05 ± 19.25 (OR, 0.9402 [0.9019–0.9801]) and TEVAR with debranching done as a staged procedure (OR, 0.1624 [0.0321–0.8225]) statistically decreased risk for development of in-hospital mortality and MAEs (*P* = 0.001 and *P* = 0.028, respectively). Details are listed in Table 6.

TABLE 6. Short-term Outcomes of Patients Undergoing TEVAR (n = 52)

	FREQUENCY (%)
1 mo	
Survival rate	48 (92.31)
Freedom from reintervention	40 (83.33)
Conversion to open repair	0
1 y	
Survival rate	43 (87.76)
Freedom from reintervention	43 (100)
Conversion to open repair	0

Abbreviation: TEVAR, thoracic endovascular aortic repair.

DISCUSSION

TEVAR has become an acceptable alternative to surgical repair in many different indications of thoracic aneurysms. Because of its satisfactory outcomes and minimal complications, it has been an option for many patients especially in the presence of multiple comorbidities. In this study, the overall in-hospital/30-day mortality was 7.69% (n = 4/52), and complication rate was 32% (n = 20/52) with 30-day survival rate of 92.31% and overall rate of freedom from reintervention of 83.33%.

Previous international studies on TEVAR for different indications had comparable results, with our study reporting a mortality ranging from 4% to 10%. And just like in our study, most studies included a low number of patients. For example, in the study by Zeeshan et al,[12] TEVAR for acute complicated type B aortic dissection (n = 45) resulted to an overall in-hospital/30-day mortality of 4% and 1-year survival rate of 82%. Son et al[13] reported that TEVAR for descending aortic pathologies showed an overall mortality of 21.1% (20/95) and aorta-related mortality of 10.5% (10/95) during follow-up with an overall cumulative 1-year survival rate of 83.7% using Kaplan-Meier estimate. In another study by Hellgren et al,[1] TEVAR for patients with intact (n = 49) and ruptured thoracic aortic aneurysm (TAA; n = 28) showed a 30-day mortality rate of 4% and 29%, respectively. Using the Kaplan-Meier estimate, 1-year follow-up showed a survival rate of 83.7% for intact TAA and 39.3% for ruptured TAA.[1] Although our experience represents a smaller cohort, it remains consistent with a larger study by Bellamkonda et al[14] with 3281 patients, with a reported mortality rate of 7.6%, which is still comparable to our study. Furthermore, our 1-year survival rate of 87.76% and 100% freedom from reintervention compared with international data are encouraging.

In our study, TEVAR for ruptured TAA resulted to 22.22% (n = 2/9) in-hospital/30-day mortality. This result was comparable to the study by Hellgren et al, with an in-hospital mortality of 29% for ruptured TAA, but our study showed

TABLE 6. Predictors for In-hospital Mortality and Major Adverse Event After TEVAR

PARAMETERS	CRUDE OR	95% CI	*P*
Weight, kg	1.0588	1.0003–1.1208	0.049
Chronic kidney disease	10.333	1.1069–96.462	0.040
eGFR	0.9402	0.9019–0.9801	0.004
ICU stay	1.6429	1.1597–2.3274	0.005
Duration of spinal drain, hours	1.0465	1.0073–1.0872	0.020
Procedure			
TEVAR ± debranching (single procedure)	3.6667	1.1154–12.054	0.032
TEVAR ± debranching (staged procedure)	0.1624	0.0321–0.8225	0.028

Abbreviations: CI, confidence interval; eGFR, estimated glomerular filtration rate; ICU, intensive care unit; OR, odds ratio; TEVAR, thoracic endovascular aortic repair.

superior survival rate of 100% (n = 7/7) versus 39.3% at 1-year follow-up.[1] In a meta-analysis by Jonker et al,[15] TEVAR (n = 143) versus open repair (n = 81) for ruptured descending TAA remains favorable with a 30-day mortality of 19% versus 33% and with a tendency of increased occurrence rate of myocardial infarction, stroke, and paraplegia in the open surgical repair group.

This study shows that increasing weight, preexisting CKD, and TEVAR with debranching as a single procedure were independent predictors for in-hospital mortality and MAEs. This correlates with the analysis by Bellamkonda et al[14] that CKD patients (dialysis patients in particular) and TEVAR with concomitant two-vessel debranching compared with TEVAR alone were independent risk factors for in-hospital mortality. A preoperative creatinine of >1.8 mg/dL was also reported by Hu et al[16] to be an independent risk factor for 30-day mortality. More likely, their finding would translate to our findings that a higher eGFR significantly reduces in-hospital mortality and MAEs ($P = 0.004$). In the available literatures, no study yet showed that TEVAR with debranching done as a staged procedure reduces the risk of in-hospital mortality and development of MAEs ($P = 0.028$).

Endoleak was noted in 19.23% (type I: n = 6 [11.54%] and type 3: n = 4 [7.69%]) of our patients, with three patients needing reintervention before discharge. In a study by Ruan et al,[17] endoleak type I was associated with increased risk of early death in patients with complicated Stanford B aortic dissection ($P = 0.007$), which was not noted in our study. In addition, in our study, all patients (n = 7) had resolution of endoleaks on subsequent follow-up CT imaging.

Spinal drain is now used more frequently during TEVAR procedures. Steuer et al[18] reported that the incidence of neurologic event after TEVAR was 12% (n = 7/60), which was relatively high compared with our study (5.77%). In their study, patients who developed spinal symptoms were managed through cerebrospinal fluid drainage and were monitored in the ICU, but none of the patients who received a drain before TEVAR had any neurologic symptoms.[18] In our study, patients who developed complications eventually needing inotropic supports resulted to prolonged spinal drainage leading to a significantly longer duration of spinal drain ($P = 0.020$) and monitoring at the ICU ($P = 005$).

As of this writing, one local study was done in a single center to determine the early outcome of debranching with TEVAR for thoracic aortic diseases; however, results were not available and unpublished.[19]

There are several limitations to this study. All data in this study were gathered retrospectively from medical records, which is prone to recall bias and missing data bias. We recommend a prospective study with guideline-directed CT angiography surveillance monitoring, detailed and complete operative technique, and well-documented case planning. Certainly, a longer follow-up with a larger number of subjects is recommended before definitive conclusions can be made.

CONCLUSIONS

In this single-center study, indications for TEVAR were fusiform and saccular aneurysm, high-risk intramural hematoma and penetrating aortic ulcer, complicated acute type B dissection, chronic complicated type B dissection with high-risk feature, and aortic rupture. The outcome of this study shows comparable results with other international studies with acceptable rates of in-hospital mortality (7.69%), complications (32%), short-term survival (92.31% at 30-day and 87.76% at 1 year), and freedom from reintervention rates (83.33% at 30 days and 100% at 1 year). Increasing weight, preexisting CKD, and TEVAR with debranching done in a single setting are independent predictors for development of complications, whereas a normal eGFR and TEVAR with debranching done as a staged procedure with a relatively longer interval duration decrease the risk for complications; hence, careful planning and scheduling of procedure among elective and amenable cases could further reduce in-hospital mortality and complication rates of future TEVAR procedures.

ETHICAL CONSIDERATIONS

The study will be conducted in accordance to the guiding principles, which have their origin in the Declaration of Helsinki, as well as in compliance with existing international and local guidelines and regulations. Before study initiation, the investigators will request for the approval of a waiver of written informed consent and the script for verbal consent for telephone follow-up from the institutional ethics review board. The reason for the waiver is due to difficulty in obtaining signed individual authorization to participate. Moreover, no sensitive information will be obtained from their charts. Regarding the telephone follow-up, the patient or his/her legally authorized representative will be asked whether he/she wants the data regarding his/her admission for the intervention be included in the registry as well as whether the data on their current status can be obtained by telephone call. If there is objection on their part, the data of the patient will be excluded from the registry.

There is no direct benefit for the subjects joining this study. However, the results of the study may have indirect benefits. The results of the study will be published and may serve as references for future studies in this topic.

The investigators will ensure that the anonymity of the patients will be preserved by use of subject codes. Because this study will require identifying information to be obtained (eg, name, hospital number, and contact details) for purposes of the telephone follow-up, the face sheet (page 1 of the data collection form) will be removed and stored separately from the rest of the data collection form. Only the investigators who will do the telephone follow-up will be given access to the file with identifying information.

Measures will be enforced to ensure that the confidentiality of the data be maintained. All data collectors/encoders signed a confidentiality agreement. The hard copy of the data documents will be stored within a locked location. After encoding, data cleaning, and data processing, the hard copies will be destroyed and properly disposed of. The electronic copies will be secured by use of encryption/passwords/security codes. The researchers intend to adhere fully to the provisions of the Data Privacy Act of 2012.

FINANCIAL DISCLOSURE

None.

DISCLOSURE OF CONFLICT OF INTEREST

None.

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