V-Possum Score as a Predictor of 30-Day Post-Mortality of Endovascular Aortic Aneurysm Repair - Thoracic Endovascular Aneurysm Repair Procedure in Cipto Mangunkusumo Hospital

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Introduction: This study aims to know the performance of the Vascular - Physiological and Operative Severity Score for Enumeration of Mortality and Morbidity (V-POSSUM) score as a predictor of 30-day mortality after the Endovascular Aortic Aneurysm Repair (EVAR) - Thoracic Endovascular Aortic Repair (TEVAR) procedure in Abdominal Aortic Aneurysms (AAA) and Thoracic Aortic Aneurysms (TAA) patients in Cipto Mangunkusumo Hospital.

Method: This was a retrospective cohort study using data from medical records. Data were taken according to the variables contained in the V-POSSUM scoring system in the patient who undergone EVAR – TEVAR procedure, on the period of 2013 to July 2018.

Results: The study involved 85 patients who met the study requirements. It was known that physiological scores, morbidity risk, and mortality risk could be used as a model to predict mortality outcomes because they had good accuracy and discrimination performance, while the severity of the operation score cannot. The result of the goodness of fit model's physiological score, morbidity risk, and mortality risk was significant ($p < 0.001$), while the severity score of the operation was 0.18 ($p > 0.05$). The Area Under the Curve (AUC) was 94%, 93%, 93%, with the cut points at 31, 68.8, and 10.6 for the physiological score, morbidity risk, and mortality risk, respectively.

Conclusion: The V-POSSUM score had good accuracy and discrimination for the physiological score, morbidity risk, and mortality risk.

Keywords: abdominal aortic aneurysm, thoracic aortic aneurysm, EVAR, TEVAR, V-POSSUM score, validation

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INTRODUCTION

Abdominal aortic aneurysms (AAA) and thoracic aortic aneurysms (TAA) are diseases with great challenges because they are related to high morbidity and mortality, difficult management, and often go undetected until the patients are in a critical condition.¹ Decision making in treating patients with AAA and AAT are complex. In the last two decades, there have been significant developments in the handling of AAA and AAT, with the development of endovascular techniques, as introduced by Parodi in 1991, known as endovascular aortic aneurysm repair or better known as EVAR. Now, the EVAR technique is preferred in the treatment of AAA because it has lower postoperative morbidity, especially in patients with a high risk of surgery.^{1,2} Short-term benefits of EVAR include shorter stays, less bleeding, shorter

duration of procedure compare to surgery, and lower postoperative morbidity and mortality.

In 1994, Dake et al. first reported the use of thoracic "stent-grafts" for the management of descending thoracic aortic aneurysms in patients at high risk for conventional open surgery. This action was then carried out in several hospitals and published. These authors show that the use of thoracic stents, otherwise known as thoracic endovascular aortic repair (TEVAR), has relatively low morbidity. However, long-term follow-up or observation will be needed as a more comprehensive assessment is needed.

One of the tools to predict the clinical outcome of those procedures is using Vascular - Physiological and Operative Severity Score for Enumeration of Mortality and Morbidity (V-POSSUM). Although the published scoring system can be used in predicting clinical outcomes, validity testing is still

needed in different populations because there are factors that can reduce the accuracy (calibration) and precision (discrimination) of the existing scoring system.³ This study aims to determine the performance of the V-POSSUM as a predictor of mortality 30 days after the EVAR TEVAR procedure at Cipto Mangunkusumo Hospital.

METHOD

This type of research was a retrospective cohort. Inclusion criteria included all AAA and TAA patients who were treated at the Cipto Mangunkusumo Hospital from 2013 - July 2018. Exclusion criteria included patients who were not included in the AAA and TAA diagnostic criteria, did not have research variable data and had no known outcomes after the postoperative period. The analysis was performed using the Stata 11 statistical program.

The Goodness of Fit Model test assessed the calibration performance of the V-POSSUM score. The area under the curve assessed the discriminatory performance. Apart from these two main points, the sensitivity and specificity of the V-POSSUM score were analyzed.

RESULTS

As much as 85 patients were recorded as patients who underwent EVAR or EVAR surgery and met the admission criteria for data recording and processing. Patients who underwent EVAR were 77 patients, while TEVAR were eight patients (table 1).

Table 1. Patient characteristics

Category	Number
Type of procedure	
EVAR	77 (91%)
TEVAR	8 (9%)
Gender	
Male	74 (87%)
Female	11 (13%)
Age (years old)	
< 61	16 (19%)
61 – 70	41 (48%)
>70	28 (33%)
Total of procedure (year)	
2013	6 (7%)
2014	23 (27.2%)
2015	15 (17.65%)
2016	15 (17.65%)
2017	20 (23.5%)
2018	6 (7%)
Comorbidity	
Heart disease	26 (30,6%)
Respiratory disease	21 (24,7%)
Abnormality of ECG	23 (27%)
Systolic hypo/hypertension	26 (30,6%)
Tachycardia/bradycardia	44 (51,8%)
Anemia	55 (64,7%)
Leukocytosis/leukopenia	19 (22,4%)

The score of V-POSSUM based on the distribution of mortality risk calculation showed that patients with 1-10% mortality risk were found in 67

patients, with 3 of them experiencing death (4%). In 16 patients with a mortality risk of 11-20%, nine patients died (56%). In 1 patient with a mortality risk of 21-30%, no patient died (0%). Last, in 1 patient with a mortality risk of 61-70%, the patient died (100%) [figure 1].

Figure 1. Mortality risk, number of patients, and mortality numbers in calculation of physiological scores and operational severity scores.

When the distribution of mortality risk calculated by V-POSSUM only includes physiological scores, it showed that the patients with a 1-10% risk of mortality were found in 38 patients, and none had died (0%). In 25 patients with an 11-20% mortality risk, two patients died (8%). In patients with mortality risk of 21-30% were experienced by 11 patients, 2 of whom experienced death (18%). Finally 11 patients with a mortality risk of 31-80%, nine patients experienced death (81%) [figure 2].

The goodness of fit models was analyzed to assess physiological scores (PS), operating scores (OS), morbidity risk, and mortality risk as methods that can be used to predict mortality. The three models had good accuracy to be applied to AAA and TAA patients in Cipto Mangunkusumo Hospital. (table 2-5).

Figure 2. Mortality risk, number of patients, and mortality numbers in calculation of physiological scores.

The ROC area score of PS was 94% (95% CI 88-99%), which showed that the method could distinguish between death and not well. The cut-off point for PS scores that distinguished between mortality and not was 31 with a sensitivity of 85% and a specificity of 85% (tables 6 and 7).

The ROC area score of morbidity was 93% (95% CI 86-99%), indicated that the method could distinguish between death and not well. The cut-off point for morbidity that distinguished between

Table 2. Model of death based on PS score.

Death	Coefficient	p (Z)	Observation	p (Chi square)	Pseudo R Square
Score of PS	0.51	0.00	85	0.001	0.49
Constant value	-0.16	0.00			

Table 3. Models of death based on OS scores

Death	Coefficient	p (Z)	Observation	p (Chi square)	Pseudo R Square
Score of OS	-0.51	0.21	85	0.18	0.02
Constant value	3.02	0.42			

Table 4. Death models based on morbidity risk

Death	Coefficient	p (Z)	Observation	p (Chi square)	Pseudo R Square
Morbidity risk	0.15	0.00	85	0.00	0.45
Constant value	-11.49	0.00			

Table 5. Model of death based on mortality risk

Death	Coefficient	p (Z)	Observation	p (Chi square)	Pseudo R Square
Mortality risk	0.32	0.00	85	0.00	0.43
Constant value	-5.06	0.00			

mortality and not was 68.8, with a sensitivity of 85% and a specificity of 85% (tables 8 and 9).

Table 6. Cut-off for score of PS.

Cut-off	Sensitivity	Specificity	LR +	LR -
≥30	0.92	0.79	4.43	0.09
≥31	0.85	0.85	5.54	0.18
≥32	0.77	0.92	9.23	0.25

Table 7. ROC area for score of PS.

Observation	ROC area	95% CI
85	0.94	0.88 0.99

Table 8. Cut-off for morbidity risk.

Cut-off	Sensitivity	Specificity	LR +	LR -
≥68.1	0.92	0.79	4.43	0.09
≥68.8	0.85	0.85	5.54	0.18
≥70.1	0.77	0.88	6.15	0.26

Table 9. ROC area for morbidity score.

Observation	ROC area	95% CI
85	0.93	0.86 0.99

The ROC area score of mortality was 93% (95% CI 88-99%) showed that the method could distinguish between death and not well. The cut-off point in mortality score that distinguished between mortality and not was 10.6 with a sensitivity of 85% and specificity of 83% (tables 10 and 11).

Table 10. Cut-off for mortality risk.

Cut-off	Sensitivity	Specificity	LR +	LR -
≥10.3	0.92	0.8	4.74	0.09
≥10.6	0.85	0.83	5.08	0.18
≥11.8	0.77	0.89	6.92	0.26

Table 11. ROC area for mortality risk

Observation	ROC area	95% CI
85	0.93	0.88 0.99

DISCUSSION

This study aims to determine the performance of the V-POSSUM as a predictor of mortality 30 days after the EVAR TEVAR procedure at Cipto Mangunkusumo Hospital. From the characteristics data, more male patients were identified (74 people, 87%) compared to female 13% (11 people, 13%). This result follows the demographic distribution of the sexes of patients with AAA and TAA in general, in which men were four times more affected than women. Women more often experienced aneurysms associated with arteritis than degenerative aneurysms.⁴

The age of patients based on the criteria for the distribution of V-POSSUM scores was mostly in the range of 61-70 years, as many as 41 patients (48%). The second most prevalence was in the age of >70 years, as many as 28 patients (33%). Lastly, patients with age <61 years were 16 patients (19%). The interesting thing was there is a wide range for the prevalence of the age. The youngest was 19 years old, while the oldest was 89 years old. Young patients with AAA are generally associated with certain genetic disorders, trauma, or systemic immune system disorders.

Comorbid diseases experienced by patients were quite diverse. The most comorbidities were anemia. Both tachycardia and bradycardia ranked second, followed later by heart disease, blood pressure impairment, and respiratory disease. The number of patients experiencing comorbidities was quite large, ranging from 22.4% to 64.7%. In some studies, the comorbid influences on clinical outcomes after the EVAR TEVAR procedure were mostly related to old age. Anemia, decreased kidney function, heart problems, and respiratory system disorders were the dominant comorbid factors most often mentioned in previous studies. In this study of the 13 patients who died, as many as eight patients experienced anemia (61.5%), ten patients with heart problems (77%), and six patients had respiratory problems (46%). Whereas for the combination of patients who had experienced both heart and respiratory disease as many as five patients (38.5%), both heart disease and anemia five patients (38.5%), and both respiratory disease and anemia of 2 patients (15%).

The physiological score results obtained a range of 15 to 48. On the results of the calculation of the operation, the score ranged from 9 to 13. It appeared that the variation in the results of the physiological score was higher than the operation score. The physiological score variable had a large variation. This combined score will then lead to morbidity and mortality risk predictors. The risk of morbidity ranges from 18.5% to 84.8%; the risk of mortality ranges from 1.1% to 62.3%.

After the prediction score appeared, it was different compared to the real event of the patients. Patients with a score of 1-10% mortality risk were found in 67 patients, with 3 of them experiencing death. In 16 patients with a mortality risk score of 11-20%, nine patients died. Patients with a mortality risk score of 21-30%, experienced by one patient, and did not experience death. Lastly, one patient with a mortality risk of 61-70% experienced death. This means that the real death rate was far higher than predicted, although overall statistical calculations were still acceptable. This can occur

because the value of operation score was not varied, so patients were considered good or optimal when undergoing the procedure.

Further analysis was performed by calculation without including the operation score. As a result, the resulting mortality risk score showed a shift to a more significant number, with real mortality rates were increasingly acceptable. This calculation provided a mortality risk rate that ranges from 3.2% to 79.4%. Patients with a 1-10% mortality risk score were present in 38 patients, and none had died (0%). In 25 patients with an 11-20% mortality risk score, two patients died (8%). Eleven patients have a mortality risk score of 21-30%, two of whom experienced death (18%). Finally, 11 patients with a mortality risk of 31-80%, nine patients experienced death (81%).

Further analysis showed a physiological score of AUC values of 94%; morbidity scores 93%; mortality scores 93%. The three scores above were concluded to had a very good discrimination performance. Based on sensitivity-specificity and ROC, it was shown that PS scores, mortality risk, and morbidity risk could be used to predict mortality with each cut-off point of 31, 68.8, and 10.6, respectively.

Good calibration performance (accuracy) and discrimination performance (precision) in this

study indicated that the V-POSSUM score could be used as a prognostic score for AAA and TAA patients treated with EVAR-TEVAR performed at Cipto Mangunkusumo Hospital.

CONCLUSION

The V-POSSUM score had a good performance in predicting the mortality of AAA and TAA patients who were treated by EVAR TEVAR at the Cipto Mangunkusumo Hospital. The V-POSSUM score had good accuracy and discrimination for a physiological score, morbidity risk, and mortality risk.

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