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# Endovascular treatment in the posterior circulation stroke: A retrospective study

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### *Abstract*

*Background & Objective:* Posterior circulation stroke accounts for approximately 20% of all ischemic strokes and is a serious neurological event affecting a different areas of the brain. Although endovascular treatment is the gold standard for stroke in the anterior circulation system, there is no consensus on the best treatment in the posterior circulation system. We aimed to demonstrate the effectiveness and safety of the procedure in posterior circulation system stroke. *Methods:* Patients older than 18 years of age who had been diagnosed with a stroke in the posterior circulation system are included. Symptom duration, Alberta Stroke Program Early Computed Tomography scores in the posterior system, occlusion level, arrival Glascow Coma Scores (GCS), admission National Institute of Health Stroke Scale scores, 90-day mortality, modified treatment score for cerebral infarction and 3rd month modified Rankin Scores (mRS) were examined retrospectively. *Results:* The study population included 29 patients. Average procedure duration and average symptom duration was calculated as 61.72±49.09 and 235.90±153.13 minutes respectively. Average GCS score was found to be 8.86±4.27. Most of the occlusions were distal basilar (51.7%). Revascularization was achieved in 82.8% (n=24) of the cases. Favourable outcome (mRS ≤3 ) was achieved in 41.3% of the cases. Three cases of symptomatic haemorrhage occured after the treatment.
*Conclusion:* Although the success of the procedure in the posterior circulation system is relatively high, the desired good functional outcome rates still remain low. Ensuring rapid diagnosis of patients and shortening the duration of symptoms will positively affect the prognosis.

*Keywords:* Ischemic stroke, basilar artery, interventional neuroradiology

## INTRODUCTION

Among other reasons including the change in lifestyle witn increase in body-mass index, stroke has become one of the most common causes of death and disability in the world in recent years and is a public health problem causing serious economic burden.[1] Stroke occurs as a result of ischemia in the brain due to occlusion or decrease in blood flow in the anterior circulation systems perfused by the carotid arteries, or the posterior circulation systems perfused by the vertebrobasilar arteries. Posterior circulation stroke accounts for approximately 20% of all ischemic strokes and is a serious neurological event affecting the brainstem, thalamus, cerebellum and occipitotemporal lobes, resulting in high morbidity and mortality.[2] Although basilar artery is most commonly affected in the posterior circulation system stroke, vertebral arteries, posterior cerebral arteries, anteroinferior and posteroinferior cerebellar arteries may also be affected. Cardiac embolism and atherosclerosis of the posterior circulation arteries are the main etiology causes while dissection may also be an important cause especially in young patients.[3] Although endovascular treatment (EVT) in the posterior circulation system is a standard treatment for stroke, there is no clear consensus showing its superiority over intravenous thrombolysis (IVT).[4] In this study, we aimed to demonstrate the effectiveness and safety of the EVT in posterior circulation system stroke and to contribute to the literature.

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## METHODS

Between September 1st 2020 and September 1st 2023; patients older than 18 years of age who were admitted or referred to Bursa City Hospital Neurology emergency clinic, who had been diagnosed with a stroke in the posterior circulation system based on physical examination and Computed Tomography Angiography or Magnetic Resonance Imaging, and who had undergone EVT were included in the study. Patients receiving intravenous thrombolysis treatment or whose symptom duration exceeded 24 hours were excluded.

The initial procedure patients underwent was aspiration thrombectomy with Sofia aspiration catheter (Terumo Medical Corporation, Japan), and when that did not yield success, stent retriever thrombectomy with Trevo stentriever (Stryker Corporation, Michigan, USA) was resorted to, at most 3 times. Demographic characteristics of the patients, symptom duration (time from the onset of complaints to the femoral artery entrance on angiography), Alberta Stroke Program Early Computed Tomography scores (p-ASPECTS) in the posterior circulation system, occlusion level (proximal basilar, distal basilar, posterior cerebral artery, vertebral artery), arrival Glascow coma scores (GCS), admission National Institute of Health Stroke Scale (NIHSS) scores, 90-day mortality, modified treatment score for cerebral infarction (mTICI) and 3rd month modified Rankin score (mRS) were examined retrospectively.

NCSS (Number Cruncher Statistical System) 2020 Statistical Software (NCSS LLC, Kaysville, Utah, USA) program was used for statistical analysis of the data obtained. Quantitative variables were shown with mean, standard deviation, median, min and max values, while qualitative variables were shown with descriptive statistical methods such as frequency and percentage. ShapiroWilks test and Box Plot graphics were used to evaluate the suitability of the data for normal distribution. Mann Whitney-U test was used to evaluate variables that did not show normal distribution according to two groups. Spearman's correlation analysis was used to evaluate the relationships between variables. Fisher Exact test and Fisher's Freeman Halton test were used to compare qualitative data. The results were evaluated within the 95% confidence interval and the significance level was $p<0.05$.

## RESULTS

A total of 29 patients were included in the study, 34.5% (n=10) were female and 65.5% (n=19) were male. The ages of the patients ranged between 28 and 93, and the average age was 65.28±15.13 (Table 1). EVT procedure duration ranged between 15 to 180 minutes and the average procedure duration was 61.72±49.09 minutes. P-Aspects values of the cases ranged between 6 to 10 and the average P-Aspects value was 9.21±1.18. The symptom duration of the cases varied between 60 and 662 minutes, and the average symptom duration was 235.90±153.13 minutes. As for the occlusion level of the cases, 51.7% (n = 15) were in the distal basilar, 34.5% (n = 10) were in the proximal basilar, 6.9% (n = 2) were in the posterior cerebral artery P1 and 6.9% (n=2) were at the vertebral artery V1 level.

Revascularization was achieved after EVT treatment in 82.8% (n=24) of the cases. The admission NIHSS score of the cases varied between 3 and 42, and the average admission NIHSS was 15.79±10.59 points. The 3rd month mRS scores of the cases ranged between 0 and 6, and the average was found to be 3.97±2.37 points. It was observed that 41.3% (n=12) of the 3rd month mRS scores of the cases were mRS ≤3 and 58.7% (n=17) were mRS>3. In 31% (n=9) of the cases, post-operative hemorrhage was seen, 3 of whom were symptomatic hemorrhage. As for the 3rd month mortality of the cases, 58.6% (n = 17) are alive and 41.4% (n = 12) are deceased. GCS score of the cases ranged between 3 to 15, and the average GCS score was 8.86±4.27. Eight patients had a history of anticoagulant, antiaggregant or anticoagulant+antiaggregant drug use. Characteristics of the study population and treatment results are given in Table 1.

Gender (40% vs 42%) and age (65.76±15.48 vs 64.58±15.29) was not significantly different ($p>0.05$) in cases with mortality and alive. The procedure duration of mortality cases was found to be significantly higher than those of the living cases (88.75±54.74 vs 42.65±34.96 $p=0.018$; $p<0.05$). According to mortality, there was no statistically significant difference in P-Aspects (9.41±0.87 vs 8.92±1.51), symptom duration (273.29±171.52 vs 182.92±108.07), occlusion level, TICI (15 vs 9) and admission NIHSS (14.00±10.85 vs 18.33±10.11)($p>0.05$) between mortality and the alive cases. Post-operative hemorrhage (3 vs 6) also did not show a statistically significant difference according to mortality ($p>0.05$). The GCS score (10.18±4.17 vs 7.00±3.84) at admission of the exitus cases, was found to be significantly lower than the living cases ($p=0.045$; $p<0.05$). The relationship

**Table 1: Study population characteristics and treatment outcomes**

| | | |
|---|---|---|
| **Procedure time** | *Mean±Sd* | 61.72±49.09 |
| | *Median (Min-Max)* | 45 (15-180) |
| **P-Aspects** | *Mean±Sd* | 9.21±1.18 |
| | *Median (Min-Max)* | 10 (6-10) |
| **Sypmtom duration** | *Mean±Sd* | 235.9±153.13 |
| | *Median (Min-Max)* | 206 (60-662) |
| **Occlusion level** | Distal basilar | 15 (51.7%) |
| | Proximal basilar | 10 (34.5%) |
| | PCA P1 | 2 (6.9%) |
| | VA V1 | 2 (6.9%) |
| **mTICI score** | Treatment failure | 5 (17.2%) |
| | 2b/c-3 | 24 (82.8%) |
| **NIHSS on presentation** | *Mean±Sd* | 15.79±10.59 |
| | *Median (Min-Max)* | 13 (3-42) |
| **3. month mRS** | **mRS ≤3** | 12 (41.3%) |
| | **mRS >3** | 17 (58.7%) |
| **Hemorrhage after EVT** | No | 20 (69%) |
| | Yes | 9 (31%) |
| **GCS** | *Mean±Sd* | 8.86±4.27 |
| | *Median (Min-Max)* | 9 (3-15) |
| **Premorbid mRS** | 0 | 26 |
| | 1 | 3 |
| **Mortality (90. Day)** | Alive | 17 (58.6%) |
| | Dead | 12 (41.4%) |

P-Aspects: Posterior circulation Acute Stroke Prognosis Early Computed Tomography Score; m-TICI: Modified Treatment In Cerebral Infarction; NIHSS: National Institutes of Health Stroke Scale; mRS: Modified Rankin Score; EVT: Endovascular Treatment; GCS: Glascow Coma Scale

between variables and mortality is shown in Table 2.

## DISCUSSION

The most important factor determining the success of EVT treatment is whether revascularization can be achieved in the procedure.[5] Many factors can affect the revascularization rate, including the patient's aortic arch type, location of occlusion, content of the clot, experience of the team performing the procedure, and the device used for thrombectomy.[6] In the literature, the term mTICI score 2B-3 is used for patients with successful revascularization. In our study, the successful revascularization rate (82.2%) and good functional outcome rate (41.3%) were similar to the literature. In the MR Clean study, the success rate of the procedure was found to be 75% and good functional outcome was 46% in 264 patients with posterior system ischemia who underwent EVT.[7]

No significant difference in mortality was found between patients who underwent EVT and patients who received medical treatment. Due to longer symptom duration or poor collaterals, futile recanalisation can occur in posterior circulation stroke. Perfusion imaging and collateral scoring can be utilized in order to select patients who are suitable for EVT. More studies regarding patient selection is needed.

Although studies conducted until recent years in basilar artery occlusion have not shown significant benefits with the use of EVT, the ATTENTION (EndovAscularTreaTmENt for acute basilar artery occlusION) randomized prospective study showed that amongst basilar artery occlusion patients having symptom durations between 0-12 hours, of which good functional results were achieved at the 3rd month (mRS 0-3), were found to be significantly higher than the best medical treatment group (46% vs 22.8%).[8] Again, in the China-based BAOCHE (Basilar Artery Occlusion CHinese Endovasculartrial) randomized controlled study, the rate of good functional results in patients with

**Table 2: Effect of variables on mortality**

| | | Mortality (90 day) | | *p* |
|---|---|---|---|---|
| | | **Alive (n=17)** | **Ex (n=12)** | |
| **Sex** | **Female** | 6 (35.3) | 4 (33.3) | [a]***1.000*** |
| | **Male** | 11 (64,7) | 8 (66,7) | |
| **Age** | *Mean±Sd* | 65.76±15.48 | 64.58±15.29 | [b]***0.879*** |
| | *Median (Min-Max)* | 66 (28-93) | 65.5 (33-86) | |
| **Procedure duration** | *Mean±Sd* | 42.65±34.96 | 88.75±54.74 | [b]***0.018**** |
| | *Median (Min-Max)* | 30 (15-160) | 95 (15-180) | |
| **P-Aspects** | *Mean±Sd* | 9.41±0.87 | 8.92±1.51 | [b]***0.647*** |
| | *Median (Min-Max)* | 10 (7-10) | 10 (6-10) | |
| **Symptom duration** | *Mean±Sd* | 273.29±17.52 | 182.92±108.07 | [b]***0.180*** |
| | *Median (Min-Max)* | 270 (60-662) | 149 (75-420) | |
| **Occlusion level** | Distal basilar | 10 (58.8) | 5 (41.7) | [c]***0.859*** |
| | Proximal basilar | 5 (29.4) | 5 (41.7) | |
| | PCA P1 | 1 (5.9) | 1 (8.3) | |
| | VA V1 | 1 (5.9) | 1 (8.3) | |
| **mTICI score** | Treatment failure | 2 (11.8) | 3 (25.0) | [a]***0.622*** |
| | 2b/c-3 | 15 (88,2) | 9 (75,0) | |
| **NIHSS** | *Mean±Sd* | 14.00±10.85 | 18.33±10.11 | [b]***0.152*** |
| | *Median (Min-Max)* | 12 (3-42) | 19.5 (4-33) | |
| **Hemorrhage after EVT** | No | 14 (82.4) | 6 (50.0) | [a]***0.106*** |
| | Yes | 3 (17.6) | 6 (50.0) | |
| **GCS** | *Mean±Sd* | 10.18±4,17 | 7.00±3,84 | [b]***0.045**** |
| | *Median (Min-Max)* | 11 (3-15) | 5.5 (3-14) | |

[a]*Fisher Exact Test*
[b]*Mann-Whitney-U Test*
[c]*Fisher Freeman Halton Test*
**p<0,05*
***p<0,01*
P-Aspects: Posterior circulation Acute Stroke Prognosis Early Computed Tomography Score; m-TICI: Modified Treatment In Cerebral Infarction; NIHSS: National Institutes of Health Stroke Scale; EVT: Endovascular Treatment; GCS: Glascow Coma Scale

basilar occlusion with a symptom duration of 6-24 hours was found to be significantly superior to the best medical treatment (46.4% vs. 24.3%).[9] Randomized controlled studies are much needed in this field.

Since symptoms such as dizziness, headache and diplopia encountered in posterior circulation system stroke may be nonspecific and patients can present with very different symptomatology, the diagnosis may be made later than in anterior circulation system stroke.[10] Symptom duration, which is another factor affecting the success of the procedure and prognosis, was found to be 235.90±153.13 minutes on average in our study, which was found to be shorter compared to the literature. This may be due to the fact that our unit provides interventional services 24 hours a day, 7 days a week, and that our Emergency Department is well versed with the symptomatology of stroke. Raising public awareness about stroke through education and structuring health services for rapid intervention can further reduce this duration.[11]

On the side effects and safety of the procedure, intracranial hemorrhage stands out as the most important complication.[12] Factors affecting the frequency of bleeding after EVT include symptom duration, basal glucose level, antiplatelet use, basal blood pressure, and procedure duration.[13] Intracranial hemorrhages are divided into symptomatic and asymptomatic.[14] The frequency of hemorrhage after EVT is reported to be of a wide range in the literature. In our study, we found the symptomatic bleeding rate after EVT to be 8.7% (n=3). This rate was higher than the

average reported in the literature(5-6%). Although the patients did not receive IVT treatment in our study, the antiplatelet and anticoagulant medications used by the patients at the time of admission may have been a factor resulting in high intracranial hemorrhage rate.

Although in some studies the NIHSS score correlates with the functional outcome in posterior system strokes, it is used in selecting patients for EVT in the anterior circulation system and may underestimate the severity of posterior circulation system strokes.[15,16] In our study, admission NIHSS scores do not show a significant difference in terms of mortality. Different scoring methods are needed to determine the severity of stroke in the posterior circulation system. There are many studies showing that baseline infarct volume affects the response to EVT and functional results.[17] We used the posterior ASPECT score in our study to increase the safety of the procedure and to make optimal patient selection. In this score, one point is deducted out of 10 for the thalamus, cerebellum and PCA region, which become hypodense due to possible edema on non-contrast computed tomography, and 2 points for the more eloquent areas, the mesencephalon and pons. Since anterior circulation and posterior circulation strokes affect different parts of the brain, the standard ASPECT score may not give accurate results in posterior circulation stroke. It is important to use a posterior circulation stroke-specific scoring system in future studies for a more accurate reflection of the infarct volume.

The state of consciousness at the time of admission may be useful in predicting the clinical outcomes of stroke patients; for this purpose, studies on various coma scores have been utilized in the literature. In their study on 21 patients with posterior circulation system stroke, Tsao *et al*. found that an admission GCS score greater than 9 was associated with good clinical outcome.[18] The Japanese coma score, which prioritizes the eye response, has also been shown to be useful in predicting the clinical outcome in stroke patients with its simplicity and easy applicability. Since this score is a single-stage test, it can be applied more practically than the GCS score, which is a 3-stage test.[19] In our study, the mortality rates in patients presenting with a lower Glascow coma score were found to be statistically significant, indicating that this score may be useful in predicting prognosis in patients with posterior circulation system stroke. However, EVT treatment should not be excluded in patients presenting with a high GCS score.[20]

As a result, although the success of the EVT procedure in the posterior circulation system is relatively high, the desired good functional outcome rates still remain low. Ensuring rapid diagnosis of the stroke and shortening the duration of symptoms before the EVT will improve the prognosis.

## DISCLOSURE

Conflicts of interest: None

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