Factors affecting prognosis in patients undergoing acute thrombectomy: single center experience

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ABSTRACT

Aims: Our hospital is the only stroke center in the province and serves as a stroke center that welcomes patients from many districts and even surrounding provinces. We aimed to compare the results of endovascular treatment (EVT) applications performed in our hospital with the literature.

Methods: The data of 93 patients who received EVT treatment in the radiology angiography unit between 01.01.2022 and 30.06.2023 were examined. Statistical analyzes were applied on the data obtained.

Results: While a significant positive effect of the first pass recanalization of EVT on National Institutes of Health Stroke Scale (NIHSS) and Modified Rankin Scale (mRS) was detected (p<0.001), the hemorrhagic transformation rate was also found to be significantly low (p<0.001). Exit NIHSS scores were significantly lower than entry NIHSS scores. A significant positive effect of short procedure time on exit NIHSS was detected. As the post-procedure complication rate increased, exit NIHSS and mRS values were also significantly higher. It was observed that the short procedure time significantly affected the exit NIHSS scores.

Conclusion: Although EVT is a treatment with proven effectiveness in acute stroke, conditions such as first pass recanalization, procedure complications and procedure duration affect the chance of success of the procedure. The success of EVT applied in our hospital gave similar results to the literature.

Keywords: Stroke, endovascular treatment, first pass recanalization, hemorrhage

INTRODUCTION

According to the World Health Organization definition, stroke is a clinical syndrome characterized by the rapid onset of signs and symptoms of focal cerebral function loss, without any apparent cause other than vascular causes. Stroke ranks first in both mortality and morbidity.[1] Approximately 80% of strokes are ischemic strokes.[2] In ischemic strokes, satisfactory results are obtained with early application and rapid intervention.[3] The effectiveness of intravenous tissue plasminogen activator (IVTPA) applied within the first 4.5 hours has been proven.[4] Endovascular treatment (EVT) also gives successful results when applied in the first 6 hours for anterior system strokes.[5] Various studies have demonstrated the success of EVT with appropriate patient selection in special cases such as strokes where thrombolytic treatment cannot be applied, wake-up strokes or strokes of unknown timing, and strokes presenting late.[6-9] Preliminary data from ongoing studies in this field also show that EVT is a successful treatment method even in strokes lasting up to 24 hours, when patients are selected with appropriate criteria.[7]

EVT success is also related to the duration of the stroke, procedure time, first pass recanalization, applied technique and procedure complications.[10] Previous publications have shown that the first pass recanalization significantly contributes to the risk of procedure success and morbidity. Additionally, it has been observed that the shortening of the processing time due to the first pass recanalization also has a positive effect.[11-12] It has been shown that the procedure has a positive contribution to long-term morbidity, as the combined technique used increases the first pass recanalization and shortens the procedure time. In addition, hemorrhagic transformation is lower in those with first pass recanalization.[12-13] It is expected that centers where EVT is applied will also meet these criteria in the long term.

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It is inevitable that EVT applications will become a more widely and effectively applied treatment in the future with developing materials and techniques, and the fact that the applied centers meet certain criteria will have medical and economic consequences in both the acute and chronic periods.

METHODS

The study was carried out with the permission of Ethics Committe of Antalya Training and Research Hospital (Date:11.07.2024, Decision No: 10/17 All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

The data of 93 patients who underwent EVT in the radiology angiography unit between 01.01.2022 and 30.06.2023 were examined. Since some patients had to be hospitalized in external intensive care units and non-hospital centers after the procedure, 3rd month mRS could not be obtained in all patients. Statistical analyzes were applied on the data obtained. Data on gender, age, laboratory data, involved artery area, TICI score, entry and exit NIHHS, 1st and 3rd month mRS, procedure duration, technique, and complications were collected.

Data were analyzed with IBM SPSS V23. Compliance with normal distribution was examined with Shapiro-Wilk and Kolmogorov-Smirnov tests. Chi-square test, Yates correction, Fisher's Exact test and Fisher-Freeman-Halton tests were used to compare categorical variables according to groups, and multiple comparisons of proportions were examined with the bonferroni-corrected Z test. One-way analysis of variance was used to compare normally distributed data according to three or more groups. The kruskal wallis test was used to compare non-normally distributed data according to three or more groups, and multiple comparisons were examined with the dunn test. Relationships between non-normally distributed quantitative data were examined with spearman's rho correlation coefficient. The relationships between continuous data and two-group categorical variables were examined with the Point-biserial correlation coefficient. Analysis results are mean±s for quantitative data. Categorical data were presented as deviation and median (minimum–maximum) and frequency (percentage). The significance level was taken as $p<0.050$.

RESULTS

There was no difference in terms of demographic data of the patients (Table 1). The average age of the patients participating in the study is 69.72±11.79 years and the age distribution is between 35.00 and 90.00 years. Considering the gender distribution, 48.4% of the 93 patients participating in the study were male and 51.6% were female. According to the results of occlusion location analysis, 10.8% had occlusion in the basilar region, 41.9% in the ICA region, 43% in the MCA M1 region and 4.3% in the MCA M2 region. According to TICI score evaluation, 21.5% of the patients had TICI score 0, 8.6% had TICI score 1, 9.7% had TICI score 2A, 16.1% had TICI score 2B, 4.3% had TICI score 2B. 39.8% were treated with TICI score 2C and 39.8% with TICI score 3. In the

Table 1. Demographical data		
	Mean±s. deviation / Frequency (n)	Median (min. - max.) / percentage (%)
Age	69.72±11.79	70.00 (35.00 - 90.00)
Gender		
Male	45	48.4
Female	48	51.6
Location of the clot		
Basillary	10	10.8
ICA	39	41.9
MCA M1	40	43
MCA M2	4	4.3
TICI Score		
0.00	20	21.5
1.00	8	8.6
2A	9	9.7
2B	15	16.1
2C	4	4.3
3.00	37	39.8
TICI Result		
Good	56	60.2
Poor	37	39.8
Hemorrhagic transformation		
No	41	44.1
Yes	52	55.9
Hemorrhagic transformation scale		
HI1	27	51.9
HI2	8	15,4
PH1	13	25
PH2	4	7.7
Duration of the procedure (minute)	56.90±29.10	51.00 (16.00 - 151.00)
Type of the technique		
Aspiration	19	20.4
Combined	46	49.5
Stent	28	30.1
Number of EVT	1.62±1.22	2.00 (0.00 - 5.00)
First pass		
0	64	68.8
1	29	31.2
Complications related to the procedure		
No	80	86
Yes	13	14
Procedural complications		
CAS needed after EVT	2	15.4
CAS needed before EVT	2	15.4
Hemorrhage	1	7.7
Cateter problem	1	7.7
No access to the occlusion	3	23.1
Reocclusion	1	7.7
Vasospasm	3	23.1
Additional chronic diseases		
No	6	6.5
Yes	87	93.5
Hgb	12.31±2.23	12.60 (6.50 - 17.00)
Plt	228.60±72.70	212.00 (0.00 - 439.00)
Mpv	10.98±1.01	11.00 (9.30 - 13.70)
Wake-Up		
No	81	88
Yes	11	12
Duration of time from first symptom to the ER	4.48±3.97	3.00 (0.50 - 20.00)
IVTPA		
No	56	60.2
Yes	37	39.8
Initial NIHSS	14.50±5.05	15.00 (0.00 - 27.00)
Final NIHSS	11.56±6.55	11.00 (0.00 - 29.00)
The difference between NIHSS	3.19±5.95	3.00 (-14.00 - 20.00)
Postprocedural complications		
No	67	72
Yes	26	28
1.Month mRs	3.79±1.72	4.00 (0.00 - 6.00)
3.Month mRs	4.00±2.09	4.00 (0.00 - 6.00)

ICA: Internal carotid artery, MCA: Middle cerebral artery, TICI: The thrombolysis in cerebral infarction, HI: Hemorrhagic infarction, PH: Parenchymal hematoma, EVT: Endovascular treatment, Carotid artery stenting, Hgb: Hemoglobin, Plt: Platelet, Mpv: Mean platelet volüme ER: Emergency room, IVTPA: Intravenous tissue plasminogen activator, NIHSS: National institutes of health stroke scale, mRS: Modified rankin scale

outcome evaluation,60.2% of the patients had good results, while 39.8% had poor results. According to hemorrhagic

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transformation analysis, 44.1% of the patients did not experience hemorrhagic transformation, while 55.9% experienced hemorrhagic transformation. Looking at hemorrhagic transformation subgroups, 51.9% experienced HI1, 15.4% experienced HI2, 25% experienced PH1, and 7.7% experienced PH[2]. The average procedure time was 56.90±29.10 minutes and the range was 16.00 to 151.00 minutes.

The average number of mechanical thrombectomies was 1.62±1.22, with a range of 0.00 to 5.00. Of the patients who experienced complications during the procedure, 68.8% were treated in the first pass, while 31.2% were treated in the second pass. When procedure-related complications were examined, 86% experienced no complications, while 14% experienced various complications. While 6.5% of patients do not have additional chronic diseases, 93.5% have one or more chronic diseases. The average hemoglobin (Hbg) value is 12.31±2.23 g/dl and the range is between 6.50 and 17.00 g/dl. The average platelet (Plt) value is 228.60±72.70 /µl and the range is between 0.00 and 439.00/µl. Mean platelet volume (MPV) was 10.98±1.01 fl with a range of 9.30 to 13.70 fl. The mean entry NIHSS score was 14.50±5.05, the mean exit NIHSS score was 11.56±6.55, and the mean post-procedure NIHSS score difference mean was 3.19±5.95. Of the patients who experienced complications after the procedure, 72% did not experience complications, and 28% experienced various complications. According to the first month results, the average mRs (modified rankin score) value of the patients is 3.79±1.72 and the range is 0.00 to 6.00. According to the third month results, the average mRs value of the patients is 4.00±2.09 and the range is 0.00 to 6.00. Additionally, 88% of the patients did not experience a wake-up stroke, while 12% experienced a wake-up stroke. Lytic application was not applied in 60.2% of the patients and was applied in 39.8%. The average arrival time is 4.48±3.97 days and the range is between 0.50 and 20.00 days.

There is a difference between initial and final NIHSS medians (p<0.001) (Table 2). While the entry median was 15.00, the exit NIHSS median was 11.00. There is no difference between the distributions of TICI score according to IVTPA application (p=0.320). TICI results do not differ according to IVTPA application (p=0.924). Good results were obtained in 58.9% of the untreated group and 62.2% of the applied ones. The presence of hemorrhagic transformation and hemorrhagic transformations do not differ according to lytic application (p values 0.612, 0.816, respectively). Hemorrhagic transformation was observed in 58.9% of those who were not applied and 51.4% of those who were applied.

Table 2. The Comparison of the NIHSS				
	Mean±s. deviation	Median (min. - max.)	Test statistic	p
Initial NIHSS	14.50±5.05	15.00 (0.00 - 27.00)	-4.958	<0.001
Final NIHSS	11.56±6.55	11.00 (0.00 - 29.00)		
Difference between NIHSS	s3.19±5.95	3.00 (-14.00 - 20.00)		
*Wilcoxon test NIHSS: National institutes of health stroke scale, Min:Minumum; Max: Maksimum				

A statistically significant, weakly positive relationship was obtained between Procedure Time (Minutes) and final NIHSS (r=0.274; p=0.008). No significant relationship was obtained

between procedure time and initial NIHSS (p=0.275) (Table 3). No significant relationship was obtained between arrival time and initial and final NIHSS (p values 0.500, 0.227, respectively).

Table 3. Examining the relationship between processing time and arrival time and initial and final NIHSS values				
	Duration of procedure (minute)		Application time	
	r	p	r	p
Initial NIHSS	0.116	0.275	0.073	0.500
Final NIHSS	0.274	0.008	0.129	0.227
r: Spearman's rho correlation coefficient NIHSS: National institutes of health stroke scale				

It shows that post-procedure complications have a significant relationship with the final NIHSS (National institutes of health stroke scale) score and the modified rankin score (mRs) at the end of the 1st month and 3rd month. The correlation coefficient (r) between the final NIHSS score and post-procedure complications was found to be 0.274, and the positive relationship between them was significant (p=0.008). It shows that a high final NIHSS score increases the risk of complications after the procedure. The correlation coefficient between post-procedure complications and mRs at the first month was calculated as 0.411, and there is a moderately significant relationship between them (p<0.001). A high 1-month mRs score may increase the risk of post-procedure complications. Finally, the relationship between mRs at 3 months and post-procedure complications is quite high. The correlation coefficient was calculated as 0.609 and this relationship is significant (p<0.001). This finding suggests that postprocedural complications can significantly affect long-term functional outcomes (Table 4). The connection between Wake-Up and TICI result was not statistically significant (p=0.518). Good results were obtained in 59.3% of those who did not wake up and in 72.7% of those who did.

Table 4. Examining the relationship between post-procedural complications final NIHSS and mRs scores		
	Postprocedural complications	
	r	p
Final NIHSS	0.274	0.008
1. month mRs	0.411	<0.001
3. month mRs	0.609	<0.001
*Point-biserial correlation coefficient mRS: Modified rankin scale		

The correlation coefficient (r) between procedure time and hemorrhagic transformation was calculated as 0.171 and this relationship is not significant (p=0.102). On the other hand, when the relationship between transaction time and first pass recanalization is examined, the correlation coefficient is calculated as -0.352 and this relationship is statistically significant (p=0.001) (Table 5). It shows that as the transaction time decreases, the number of people opened with the first pass recanalization increases slightly.

Table 5. Examining the relationship between procedure time and Hemorrhagic transformation and first pass recanalization		
	Duration of procedure (minute)	
	r	p
Hemorrhagic transformation	0.171	0.102
First pass effect	-0.352	0.001
*Point-biserial correlation coefficient		

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The presence of hemorrhagic transformation varies depending on the technique type (p=0.010). Hemorrhagic transformation occurred in 42.1% of the aspiration technique, 71.7% of the combined technique and 39.3% of the stent technique. This difference is between combination and stent. Hemorrhagic transformations differ depending on the technique type (p=0.040). Hemorrhagic transformation HI1 is present in 75% of the aspiration technique, 36.4% of the combined and 81.8% of the stent. This difference is between combination and stent. It varies between those opened with the first pass recanalization depending on the technique type (p=0.027). There are first pass recanalization in 52.6% of the aspiration technique, 19.6% of the combined technique and 35.7% of the stent technique. This difference is between combination and aspiration (Table 6). There are not any other significant findings for the other parameters.

DISCUSSION

Stroke is still one of the leading causes of mortality and morbidity in the world. Recently published data also supports this.[1] In studies based on AHA (American Heart Association) criteria, it was possible to draw a framework for the effectiveness, reliability and principles of thrombectomy treatments applied in acute stroke.[2] In ischemic stroke, many factors such as hospital admission time, risk factors leading to stroke, mRS, TOAST, and gender distribution contribute to the prognosis of the treatment.[3] Data supporting prehospital and emergency stroke care were reviewed, including the use of emergency medical service protocols to identify patients with stroke, intravenous thrombolysis in acute ischemic stroke, updates to recommended patient eligibility criteria and treatment time windows, and advanced imaging.[4] In fact, it is predicted that early intervention will increase with the widespread use of mobile stroke units.[5] The criteria for thrombectomy applications in acute stroke have expanded over time in terms of application time, and the number of patients who have been intervened and benefited from imaging techniques that enable the demonstration of salvageable penumbra tissue, apart from symptom time and admission time, has increased.[6,7]

Hemorrhagic complications related to thrombolytic treatments applied in acute stroke have been described in many studies and possible aggravating factors have been tried to be determined.[8] However, because the treatment range is narrow and its effectiveness in large vessel occlusions is controversial, compilations and analyzes have shown that thrombectomy alone gives similar results.[9]

Hemorrhagic complications could also cause late problems such as epilepsy after ischemic stroke. So it is also important to have less hemorrhagic complications.[10] Studies have shown that both the first pass recanalization and the success of the technique applied according to occlusion are important.[11-14] In our study, similar to the literature, it was concluded that patients with first pass recanalization had a better prognosis. Despite hemorrhagic transformation and recanalization, poor prognosis has been shown to be associated with high NIHSS, low ASPECT score and late presentation time.[13] In our study, it was observed that shorter procedure time in cases opened with first pass recanalization reduce complications and has a positive effect on mRS.

CONCLUSION

Increasing the number of stroke centers serving in the light of current literature and information will not only reduce mortality and morbidity, but will also benefit society socioeconomically.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of Ethics Committe of Antalya Training and Research Hospital (Date:11.07.2024, Decision No: 10/17).

Informed Consent

Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

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Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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