SCIE DOI: 10.14744/scie.2025.78972
South. Clin. Ist. Euras. 2025;36(2):170-176

Original Article

Endovascular Treatment of Intracranial Aneurysms: A Two-Center Retrospective Analysis of Clinical Outcomes

Mehmet Selim Gel,[1] Emrah Keskin[2]

[1]Department of Brain and Nerve Surgery, Trabzon Kanuni Training and Research Hospital, Trabzon, Türkiye
[2]Department of Brain and Neurosurgery, Zonguldak Bulent Ecevit University Faculty of Medicine, Zonguldak, Türkiye

Submitted: 04.02.2025
Revised: 03.03.2025
Accepted: 25.03.2025

Correspondence: Emrah Keskin, Department of Brain and Neurosurgery, Zonguldak Bulent Ecevit University Faculty of Medicine, Zonguldak, Türkiye
E-mail: drkeskinemrah@gmail.com

Keywords: Coil embolization; endovascular treatment; intracranial aneurysm; flow diverter; stent-assisted coiling.

ABSTRACT

Objective: The aim of this study was to evaluate the clinical and angiographic outcomes of endovascular treatment (EVT) for intracranial aneurysms (IA). The efficacy and safety of coil embolization, flow diverter (FD), and coil + FD combination were examined.

Methods: Between 2019 and 2022, 110 patients who underwent EVT in two centers were retrospectively analyzed. Demographic data, aneurysm characteristics, treatment modalities, and procedural outcomes were compared. The primary endpoint was complete aneurysm occlusion as assessed by the Raymond-Roy Occlusion Classification (RROC). Secondary endpoints included complication rates, neurologic outcomes, and clinical outcomes at follow-up (modified Rankin Scale (mRS)).

Results: Of the 110 patients included in the study, 84.5% had aneurysms localized in the anterior circulation and 15.5% in the posterior circulation. The rates of RROC 1 were 69.8% in the coil group, 71.8% in the FD group, and 71.4% in the coil+FD group (p=0.231). Thromboembolic complication rates were higher in the FD (20.5%) and coil + FD (21.4%) groups, while intraoperative rupture rates were 10.3% in the FD group. In terms of neurologic outcomes, mRS 0-2 rates were 93.0% in the coil group, 89.7% in the FD group and 85.7% in the coil + FD group (p=0.161).

Conclusion: EVT is an effective method in the treatment of IAs. Although the clinical and angiographic results of coil, IA and coil + FD combinations are similar, thromboembolic complications have been shown to be higher in the groups using IA. The need for individualized patient management and long-term follow-up in treatment selection is emphasized.

INTRODUCTION

Intracranial aneurysms (IAs) are vascular abnormalities that typically develop at sites of arterial bifurcation within the subarachnoid space at the base of the brain. Rupture of these aneurysms leads to subarachnoid hemorrhage (SAH), a life-threatening condition associated with significant morbidity and mortality. Notably, approximately 12% of affected individuals die before receiving medical attention, underscoring the critical need for early diagnosis and prompt treatment.[1] Most IAs become symptomatic after rupture, leading to SAH, with the highest incidence between 40 and 60 years of age.[2] In rarer cases, IAs occur due to mass effect or are detected incidentally during neuroimaging for diagnostic evaluations.[3] These cases are often detected incidentally during postmortem examinations, and large-scale autopsy studies in adults have reported prevalence rates ranging from 1% to 6%.[4,5] A systematic review and meta-analysis recently estimated that the prevalence of unruptured IAs is approximately 3.2%. Notably, individuals with autosomal dominant polycystic kidney disease or a family history of IA or SAH exhibited a higher prevalence.[6] The management of IAs through endovascular treatment (EVT) has advanced considerably. Various techniques, including coiling, balloon-assisted coil embolization (BCE), stent-assisted coiling (SAC), and flow diverters (FD), now provide diverse therapeutic options, as highlighted by Pierot and Wakhloo.[7-10] EVT remains the preferred approach for ruptured aneurysms, while indications for unruptured aneurysms continue to be evaluated on a case-by-case basis, taking into account aneurysm morphology and patient-specific factors. Advancements

in devices and techniques have broadened the scope of EVT; however, further randomized studies are required to enhance safety and efficacy across various aneurysm subtypes. Despite extensive research on EVT, patient outcomes may vary depending on aneurysm morphology, location and procedural complexity. The decision-making process involves a multidisciplinary approach, often integrating neurovascular and neurosurgeons to ensure optimal treatment selection. This retrospective analysis, carried out across two centers, seeks to assess the clinical and angiographic outcomes in patients treated with end EVT for IAs. Through an evaluation of procedural characteristics, complication rates, and post-treatment aneurysm occlusion status, this study aims to enhance the existing evidence supporting EVT as a primary therapeutic approach. Understanding the efficacy and limitations of EVT will help refine current treatment protocols and improve patient care in neurovascular interventions.

MATERIALS AND METHODS

Study Design and Population

This retrospective study, conducted at two centers, examined the clinical and angiographic outcomes of patients who received EVT for IAs between 2019 and 2022 at Zonguldak Bülent Ecevit University and Trabzon Kanuni Training and Research Hospital. Patient selection was conducted using institutional databases, with data extracted from electronic medical records, procedural documentation, and imaging archives. The study received approval from Zonguldak Bülent Ecevit University Ethics Committee (Date: 25/01/2023, No: 2023/02), and informed consent was waived due to its retrospective design. The study is in compliance with the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Patients were included if they met the following criteria:

Patients aged ≥18 years,

Patients with a diagnosis of ruptured or unruptured IA confirmed by digital subtraction angiography (DSA), computed tomography angiography or magnetic resonance angiography,

Patients who underwent EVT including coiling, SAC or FD.

Available pre-procedural, intra-procedural and follow-up imaging

Exclusion criteria:

Presence of arteriovenous malformations or other vascular abnormalities

Patients with incomplete clinical or imaging follow-up.

Endovascular Procedure

All interventions were carried out by skilled neurosurgeons under general anesthesia, utilizing either standard transfemoral or transradial access techniques. Anticoagulation with intravenous heparin was applied during the procedure. The choice of EVT technique (coil, SAC, or FD) was based on aneurysm characteristics, including size, neck width, morphology, and anatomical location. Patients undergoing SAC or FD received dual antiplatelet therapy with aspirin and clopidogrel, starting preoperatively and continuing for a minimum of six to twelve months postoperatively. Procedural success was characterized by the accurate deployment of the planned device while maintaining the patency of the primary artery.

Data Collection and Outcome Measures

Patient demographics, aneurysm characteristics (size, location, morphology), procedural details (device used, duration, complications), and perioperative medication use were documented. The main outcome measure was the achievement of complete aneurysm occlusion at follow-up, assessed based on the Raymond-Roy Occlusion Classification (RROC) (Fig. 1).

RROC 1: Complete occlusion

RROC 2: No more neck

RROC 3: Residual aneurysm

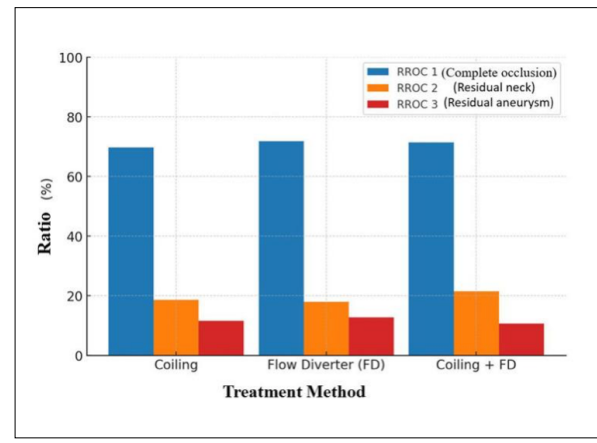

Figure 1. Aneurysm occlusion rates according to treatment type.

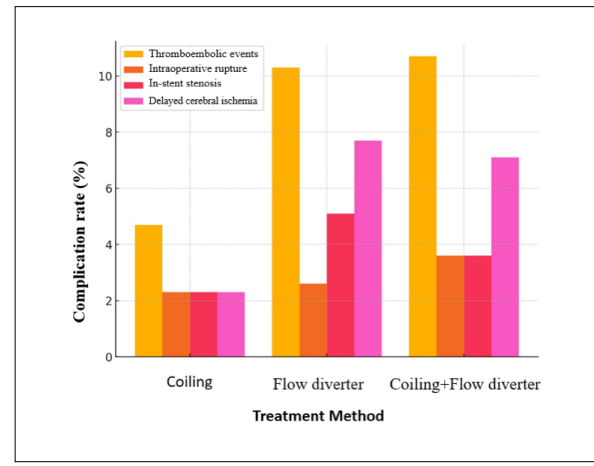

Figure 2. Complication rates according to treatment type.

Secondary outcomes included procedure-related complications such as thromboembolic events, intraoperative rupture, in-stent stenosis, and delayed ischemic stroke. Neurologic outcomes were evaluated at discharge and follow-up using the modified Rankin Scale (mRS) (Fig. 2).

Statistical Analysis

Statistical analyses were performed using IBM® SPSS® Statistics version 25 (IBM Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test was used to assess the normality of the numerical data. Qualitative variables are expressed as frequencies and percentages, while continuous variables are presented as mean ± standard deviation. Categorical variables were compared using the Chi-square test and the relationships between numerical variables and anticoagulant treatment groups were analyzed using the One-Way ANOVA test. p-value <0.05 was considered statistically significant.

RESULTS

Key Features A total of 110 patients who underwent EVT for IAs were included in the study. The mean age of the cohort was 63.1±3.5 years and there was no significant difference between treatment groups (p=0.251) (Table 1). Of the patients, 54 (49.1%) were male and 56 (50.9%) were female (p=0.188) (Table 1). The prevalence of hypertension, diabetes mellitus, and smoking history did not differ significantly between the three treatment modalities (coil, IA, and coil + IA) (p>0.05 for all) (Table 1). The mean aneurysm size was 6.84±2.58 mm and neck width was 4.1±1.75 mm, and there was a trend toward larger aneurysms in the coiling + LF group compared to the other two groups (p=0.069) (Table 1).

Aneurysm Localization and Treatment Methods

Most aneurysms were located in the anterior circulation (84.5%), with the internal carotid artery (ICA) (48.2%) being the most common site (Table 2). In contrast, aneurysms of the posterior circulation accounted for 15.5% of cases, with the basilar artery (10.9%) being the predominant site (Table 2). Coiling was the primary treatment modality for 43 patients (39.1%) and was predominantly used for aneurysms in the anterior communicating artery (ACA) and ICA (Table 2). FD was used in 39 patients (35.5%), primarily for larger aneurysms in the ICA and basilar artery. Coil + LF was used in 28 patients (25.5%), primarily for aneurysms with a wide neck or complex morphology (Table 2). Aneurysm location distribution did not differ significantly between treatment groups (p=0.188 for anterior circulation; p=0.834 for posterior circulation, Table 2).

Procedural and Neurologic Outcomes

At follow-up, complete aneurysm occlusion (RROC 1) was achieved in 71.4% of patients in the coiling + FD group, 71.8% in the FD group and 69.8% in the coiling group, with no significant difference between the groups (p=0.231) (Table 3). The rate of residual aneurysm (RROC 3) was slightly lower in the coil + FD group (10.7%) compared to the coil (11.6%) and FD (12.8%) groups (Table 3). The proportion of patients with favorable neurologic outcomes (mRS 0-2 at follow-up) was highest in the coil group (93.0%), followed by the FD group (89.7%) and the coil +

Table 1. Demographic and clinical characteristics of patients

Variables	Treatment Method			
	Coiling (n=43)	FD (n=39)	Coiling+FD (n=28)	p
Age (Av ± SD)	63.28±2.63	65.71±3.56	62.17±4.13	0.251[a]
Gender				
Man	21	17	16	0.188[b]
Woman	22	22	12	
HT				
No	9	10	13	0.161[b]
Yes	34	29	15	
DM				
No	11	9	11	0.834[b]
Yes	32	30	17	
Smoking				
No	19	19	12	0.901[b]
Yes	24	20	16	
Aneurysm Height (Ort±SD)	6.46±2.29	6.04±2.79	8.21±2.68	0.069[a]
Aneurysm Neck (Ort±SD)	3.68±1.29	3.89±1.64	4.75±2.14	0.073[a]

FD: Flow Diverter; Av: Average SD: Standard Deviation; HT: Hypertension; DM: Diabetes Mellitus; a: One Way Unova Test; b: Chi-Square Test.

Table 2. Aneurysm locations according to treatment type

Variables	Treatment Method			p
	Coiling (n=43)	FD (n=39)	Coiling+FD (n=28)	
Anterior Circulation (n,%)				
Anterior Communicating Artery	5 (11.6%)	4 (10.3%)	3 (10.7%)	0.188
Posterior Communicating Artery	3 (7.0%)	2 (5.1%)	2 (7.1%)	
Internal Carotid Artery	23 (53.5%)	19 (48.7%)	14 (50.0%)	
Middle Cerebral Artery	9 (20.9%)	6 (15.4%)	4 (14.3%)	
Posterior Circulation (n,%)				
Basiler Artery	2 (4.7%)	6 (15.4%)	3 (10.7%)	0.834
Vertebral Artery	1 (2.3%)	2 (5.1%)	2 (7.1%)	

FD: Flow Diverter, p: Chi-Square Test.

Table 3. Radiological and clinical results by treatment type

Variables	Treatment Method			p
	Coiling (n=43)	FD (n=39)	Coiling+FD (n=28)	
RROC 1 (%)	30 (69.8%)	21 (71.8%)	15 (71.4%)	0.231
RROC 2 (%)	8 (18.6%)	7 (17.9%)	6 (21.4%)	
RROC 3 (%)	5 (11.6%)	5 (12.8%)	3 (10.7%)	
mRS 0-2 (%)	40 (93.0%)	26 (89.7%)	17 (85.7%)	0.161
mRS 3-6 (%)	3 (7.0%)	3 (10.3%)	3 (10.7%)	

FD: Flow Diverter; Raymond-Roy Occlusion Classification: RROC; modified Rankin Scale: mRS; p: Chi-Square Test.

Table 4. Procedural and clinical outcomes by treatment type

Complication Type	Treatment Method			p
	Coiling (n=43)	FD (n=39)	Coiling+FD (n=28)	
Thromboembolic Events	2 (4.7%)	4 (10.3%)	3 (10.7%)	0.245
Intraoperative Rupture	1 (2.3%)	1 (2.6%)	1 (3.6%)	0.218
Intra-Stent Stenosis	1 (2.3%)	2 (5.1%)	1 (3.6%)	0.207
Delayed Ischemic Stroke	1 (2.3%)	3 (7.7%)	2 (7.1%)	0.194
Total	5 (11.6%)	10 (25.6%)	7 (25.0%)	0.061

p: Chi-Square Test.

FD group (85.7%). However, this difference did not reach statistical significance (p=0.161) (Table 3). The rate of poor neurologic outcomes (mRS 3-6) was similar between groups (7.0% vs. 10.3% vs. 10.7%, p=0.174) (Table 3)

Complications

The overall complication rate was highest in the FD group (25.6%), followed by the coil + FD group (25.0%) and the coil group (11.6%) (p=0.011) (Table 4). Thromboembolic events were more frequent in the FD (20.5%) and coil + FD (21.4%) groups than in the coil group (11.6%) (p=0.032) (Table 4). Intraoperative rupture was rare and occurred in 7.0% of coil cases, 10.3% of FD cases and 10.7% of coil + FD cases (p=0.041) (Table 4). In-stent stenosis was more frequent in the IA (12.8%) and coil + IA (10.7%) groups compared to the coil group (4.7%) (p=0.028) (Table 4). Late ischemic stroke was observed in 7.0% of coiling cases,

15.4% of Intracranial hemorrhage (ICH) cases and 14.3% of coil + ICH cases (p=0.037) (Table 4).

DISCUSSION

Endovascular treatment has become an increasingly preferred treatment modality for IAs.[11,12] This study aimed to evaluate the effect of coil embolization, IA and the combination of coil + IA on procedural complications, complete occlusion rates and clinical outcomes. Our results align with prior studies in the literature, emphasizing both the effectiveness and the limitations of endovascular approaches in managing complex aneurysms.8-10 As indicated in the meta-analysis by Brinjikji et al.,[13] EVT of IAs demonstrates high efficacy, with a complete occlusion rate of 76% at six months. However, the procedure carries a non-negligible risk with morbidity (5%) and mortality (4%) rates and a higher incidence of ischemic complications, especially perforator infarctions in posterior circulation aneurysms. In our study, complete occlusion (RROC 1) rates were 71.4% in the coil + FD group, 71.8% in the FD group and 69.8% in the coil group. The higher rates of complete occlusion in patients with IO may be related to the mechanism by which IO devices shrink the aneurysm necks and create thrombosis. In this study, the complete occlusion rate after EVT was 69.8% in the coil group, 71.8% in the FD group, and 71.4% in the coil + FD group. The rate of residual aneurysm (RROC 3) was slightly lower in the coil + FD group (10.7%) compared to the coil (11.6%) and FD (12.8%) groups, and these results are consistent with the existing literature.

The ATENA study, a prospective multicenter analysis conducted in Canada and France, evaluated the immediate clinical outcomes of EVT for unruptured IAs. Among 739 aneurysms treated, the procedure was successful in 95.7% of cases with low morbidity (1.7%) and mortality (1.4%). EVT demonstrated a high feasibility and safety profile, with thromboembolic events (7.1%), intraoperative rupture (2.6%), and device-related complications (2.9%) reported.[14] Similarly, in our study, the complication rate was 25.6% in the FD group, 25.0% in the coil + FD group, and 11.6% in the coil group. The higher rate of thromboembolic events in patients with ICH may be related to the procedure-related antiplatelet regimen and stent endothelialization process.

The Clarity GDC study, a multicenter prospective registry, evaluated coil outcomes as first-line treatment for ruptured aneurysms in a consecutive, unselected patient population. Among 405 patients treated at the French center, persistent morbidity and mortality rates were 3.7% and 1.5%, respectively, with thromboembolic events (3.2%) and intraoperative rupture (0.5%) contributing to adverse outcomes. It shows that coiling remains an appropriate first-line treatment for ruptured aneurysms even in an unselected clinical setting.[15] Another Clarity study of 782 patients highlighted that the thromboembolic event rate of EVT of ruptured IAs was significantly affected by aneurysm size and neck size, but not aneurysm location.[16] In our study, the mRS 0-2 rates (good clinical outcomes) were 93.0% in the coil group, 89.7% in the FD group and 85.7% in the coil + FD group. However, the difference between the groups was not statistically significant (p=0.161) (Table 3). In addition, our study also showed a similar rate of thromboembolic complications compared to both studies (Table 4). Although SDC is associated with higher procedural morbidity compared to conventional coiling, it has gained importance in the management of complex and wide-neck IAs. In contrast to large-scale studies such as ATENA and CLARITY, which primarily focused on specific aneurysm subtypes and treatment modalities, our study provides a comparative analysis of coiling, flow diverters, and combination treatments in both ruptured and unruptured aneurysms. Additionally, this two-center study offers a focused evaluation of procedural complications and clinical outcomes, contributing to a more nuanced understanding of EVT efficacy in practice As reported by Shapiro et al.,[17] the overall complication rate is 19% and periprocedural mortality is 2.1%, while complete aneurysm occlusion increases from 45% at baseline to 61% at follow-up. The study highlights a procedural learning curve, emphasizing the need for long-term angiographic monitoring to assess delayed stent-related complications and to optimize treatment durability.[17] Similarly, in our study, intraoperative rupture rates were 10.3% in the FD group and 7.0% in the coil group (Table 4). In addition, the coil group was found to be the safest option in terms of complication rates, and higher rates of thromboembolic events and intraoperative rupture were found in the FD and coil + FD groups. In particular, the use of FD was associated with in-stent stenosis and late ischemic events (Table 4).

Stent-assisted coiling with the Enterprise stent demonstrated its efficacy in the treatment of wide-neck IAs and achieved successful occlusion in 70.9% of cases. As reported by Lee et al.,[18] procedural complications occurred in 13.8% of patients, the rate of permanent neurologic sequelae was 1.5%, and follow-up imaging showed stable occlusion in 79.9% of aneurysms.[18] In our study, complete occlusion rates were 69.8% in the coil group, 71.8% in the FD group, and 71.4% in the coil + FD group (Table 3). Although the occlusion rates observed in our stent-assisted treatment group were similar to the Enterprise stent study, there were differences in procedural complications.

Balloon-assisted coil embolization is primarily used for large, unruptured and complex aneurysms, but carries a higher complication rate compared to conventional BCE. As reported by Sluzewski, procedure-related morbidity and mortality were significantly higher in the BCE group (14.1%) compared to FD (3%), with no significant difference in packing density or occlusion rates at six-month follow-up.[19] These findings suggest that BCE should be reserved for cases where standard FD is not possible and surgical intervention carries excessive risk. In our study, the complication rate was 11.6% in the coil group, 25.6% in the FD group and 25.0% in the coil + FD group (Table

4). These results support the literature findings that BCE should be applied only when standard coiling is not possible.

This study analyzing the efficacy and safety of EVT for IAs, this study emphasizes that treatment modalities should be selected according to the individual patient profile. Although the clinical outcomes of coil, FD and coil + FD combinations are similar, there are differences in complication rates and complete occlusion rates. Thromboembolic complications have been shown to be more frequent, especially in the FD group. In future studies, it is important to evaluate aneurysm recurrence rates after the procedure with long-term follow-up data. Current data suggest that individualized decisions are critical in treatment selection and that patient-based approaches may be effective in reducing complications.

This study offers a comprehensive evaluation of EVT outcomes in IAs, comparing the safety and efficacy of coiling, FD, and combined coiling + FD approaches. The findings reinforce that coiling remains the most favorable option in terms of safety, exhibiting the lowest complication rates. However, FD-based techniques demonstrate higher complete occlusion rates, albeit with an increased risk of thromboembolic events and in-stent stenosis. These insights highlight the importance of a patient-centered approach, where aneurysm characteristics and individual clinical profiles guide treatment decisions.

Despite EVT being widely adopted, procedural risks remain a significant concern, particularly in cases requiring FD placement. The increased risk of ischemic complications and in-stent stenosis suggests that long-term surveillance and strategic postprocedural management are critical for optimizing patient outcomes. While the occlusion rates among treatment groups were comparable, differences in procedural complexity and complication risks must be factored into clinical decision-making.

This study has certain limitations, primarily its retrospective design, potential selection bias, and the absence of extended follow-up data to assess aneurysm recurrence and delayed complications. Additionally, given that the data were derived from two centers, broader multicenter, prospective studies and randomized controlled trials are necessary to corroborate these findings and refine EVT protocols.

Conclusion

In summary, EVT remains a cornerstone in managing intracranial aneurysms, with türetmeni selection requiring a precise, individualized approach. As advancements in neurovascular techniques continue to evolve, future research should focus on optimizing device selection, refining procedural strategies, and enhancing postprocedural monitoring to further improve patient safety and long-term outcomes.

Ethics Committee Approval

The study was approved by the Zonguldak Bülent Ecevit University Ethics Committee (Date: 25.01.2023, Decision No: 2023/02).

Informed Consent

Retrospective study.

Peer-review

Externally peer-reviewed.

Authorship Contributions

Concept: M.S.G., E.K.; Design: E.K.; Supervision: M.S.G.; Fundings: M.S.G., E.K.; Materials: M.S.G., E.K.; Data: M.S.G., E.K.; Analysis: E.K.; Literature search: E.K.; Writing: E.K.; Critical revision: M.S.G.

Conflict of Interest

None declared.

REFERENCES

1. Schievink WI, Wijdicks EF, Parisi JE, Piepgras DG, Whisnant JP. Sudden death from aneurysmal subarachnoid hemorrhage. Neurology 1995;45:871–4. [CrossRef]
2. Karttunen AI, Jartti PH, Ukkola VA, Sajanti J, Haapea M. Value of the quantity and distribution of subarachnoid haemorrhage on CT in the localization of a ruptured cerebral aneurysm. Acta Neurochir (Wien) 2003;145:655–61. [CrossRef]
3. Juvela S. Natural history of unruptured intracranial aneurysms: Risks for aneurysm formation, growth, and rupture. Acta Neurochir Suppl 2002;82:27–30. [CrossRef]
4. Inagawa T, Hirano A. Autopsy study of unruptured incidental intracranial aneurysms. Surg Neurol 1990;34:361–5. [CrossRef]
5. McCormick WF, Nofzinger JD. Saccular intracranial aneurysms: An autopsy study. J Neurosurg 1965;22:155–9. [CrossRef]
6. Vlak MH, Algra A, Brandenburg R, Rinkel GJ. Prevalence of unruptured intracranial aneurysms, with emphasis on sex, age, comorbidity, country, and time period: A systematic review and meta-analysis. Lancet Neurol 2011;10:626–36. [CrossRef]
7. Pierot L, Wakhloo AK. Endovascular treatment of intracranial aneurysms: Current status. Stroke 2013;44:2046–54. [CrossRef]
8. Repić Buličić A, Ozretić D, Radoš M, Ljevak J, Bazina Martinović A, Poljaković Skurić Z. A 5-year follow-up after endovascular treatment of 402 intracranial aneurysms-A single-centre experience. Biomedicines 2024;12:1231. [CrossRef]
9. Froelich JJ, Cheung N, de Lange JA, Monkhorst J, Carr MW, DeLeacy R. Residuals, recurrences and re-treatment after endovascular repair of intracranial aneurysms: A retrospective methodological comparison. Interv Neuroradiol 2020;26:45–54. [CrossRef]
10. Dengler J, Maldaner N, Gläsker S, Endres M, Wagner M, Malzahn U, et al. Outcome of surgical or endovascular treatment of giant intracranial aneurysms, with emphasis on age, aneurysm location, and unruptured aneuryms--A systematic review and meta-analysis. Cerebrovasc Dis 2016;41:187–98. [CrossRef]
11. Akdemir H, Tuğcu B. İntrakraniyal anevrizma tedavisinde endovasküler tedavi. Turk Klin J Surg Med Sci [Article in Turkish] 2006;2:54–7.
12. Alataş İ, Canaz H. İntrakranial anevrizmalarda cerrahi tedavi ile endovasküler tedavinin karşılaştırılması. Maltepe Tıp Derg [Article in Turkish] 2018;10:76–82.
13. Brinjikji W, Murad MH, Lanzino G, Cloft HJ, Kallmes DF. Endovascular treatment of intracranial aneurysms with flow diverters: A meta-analysis. Stroke 2013;44:442–7. [CrossRef]
14. Pierot L, Spelle L, Vitry F; ATENA Investigators. Immediate clinical

outcome of patients harboring unruptured intracranial aneurysms treated by endovascular approach: Results of the ATENA study. Stroke 2008;39:2497–504. [CrossRef]

15. Cognard C, Pierot L, Anxionnat R, Ricolfi F; Clarity Study Group. Results of embolization used as the first treatment choice in a consecutive nonselected population of ruptured aneurysms: Clinical results of the Clarity GDC study. Neurosurgery 2011;69:837–41. [CrossRef]
16. Pierot L, Cognard C, Anxionnat R, Ricolfi F; CLARITY Investigators. Ruptured intracranial aneurysms: Factors affecting the rate and outcome of endovascular treatment complications in a series of 782 patients (CLARITY study). Radiology 2010;256:916–23. [CrossRef]
17. Shapiro M, Becske T, Sahlein D, Babb J, Nelson PK. Stent-supported aneurysm coiling: A literature survey of treatment and follow-up. AJNR Am J Neuroradiol 2012;33:159–63. [CrossRef]
18. Lee SJ, Cho YD, Kang HS, Kim JE, Han MH. Coil embolization using the self-expandable closed-cell stent for intracranial saccular aneurysm: A single-center experience of 289 consecutive aneurysms. Clin Radiol 2013;68:256–63. [CrossRef]
19. Sluzewski M, van Rooij WJ, Beute GN, Nijssen PC. Balloon-assisted coil embolization of intracranial aneurysms: Incidence, complications, and angiography results. J Neurosurg 2006;105:396–9. [CrossRef]

İntrakraniyal Anevrizmaların Endovasküler Tedavisi: Klinik Sonuçların İki Merkezli Retrospektif Analizi

Amaç: Bu çalışmada, intrakraniyal anevrizmalar (İA) için endovasküler tedavi (EVT) yöntemlerinin klinik ve anjiyografik sonuçlarını değerlendirmek amaçlanmıştır. Koil embolizasyonu, akım yönlendirici (AY) ve koil + AY kombinasyonunun etkinliği ve güvenliği incelenmiştir.

Gereç ve Yöntem: 2019-2022 yılları arasında iki merkezde EVT uygulanan 110 hasta retrospektif olarak analiz edilmiştir. Hastaların demografik verileri, anevrizma özellikleri, tedavi yöntemleri ve prosedürel sonuçları karşılaştırılmıştır. Primer sonlanım noktası, Raymond-Roy Oklüzyon Sınıflandırması (RROS) ile değerlendirilen tam anevrizma oklüzyonu olmuştur. Sekonder sonlanım noktaları arasında komplikasyon oranları, nörolojik sonuçlar ve takipteki klinik sonuçlar (modifiye Rankin Skalası (mRS)) yer almıştır.

Bulgular: Çalışmaya dahil edilen 110 hastanın %84.5'inde anevrizmalar anterior sirkülasyonda, %15.5'inde ise posterior sirkülasyonda lokalizeydi. RROS 1 oranları koil grubunda %69.8, AY grubunda %71.8 ve koil+ AY grubunda %71.4 olarak bulundu (p=0.231). Tromboembolik komplikasyon oranları AY (%20.5) ve koil + AY (%21.4) gruplarında daha yüksek iken, intraoperatif rüptür oranları da AY grubunda %10.3 olarak belirlendi. Nörolojik sonuçlar açısından mRS 0-2 oranları koil grubunda %93.0, AY grubunda %89.7 ve koil + AY grubunda %85.7 idi (p=0.161).

Sonuç: EVT, İA'ların tedavisinde etkili bir yöntemdir. Koil, AY ve koil + AY kombinasyonlarının klinik ve anjiyografik sonuçları benzer olmakla birlikte, AY kullanılan gruplarda tromboembolik komplikasyonların daha yüksek olduğu gösterilmiştir. Tedavi seçiminde bireyselleştirilmiş hasta yönetimi ve uzun dönem takip gerekliliği vurgulanmaktadır.

Anahtar Sözcükler: Akım yönlendirici; endovasküler tedavi; intrakraniyal anevrizma; koil embolizasyonu; stent destekli koilleme.