



Use of Flow-Diverting Stents in Posterior Circulation Aneurysms

Zeki BOĞA¹, Ümit KARA²

¹ Clinic of Neurosurgery, University of Health Sciences Adana City Training and Research Hospital, Adana, Türkiye

² Clinic of Anesthesiology and Reanimation, University of Health Sciences Adana City Training and Research Hospital, Adana, Türkiye

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ABSTRACT

Objective: Flow-diverting stents are safely used for treating carotid artery aneurysms. Its use is limited in areas with dense branching, and more limited in posterior circulation arteries that have dense deep feeders. The aim of this study is to investigate the efficacy and safety of flow diverter stents in posterior circulation aneurysms.

Material and Methods: A total of 15 patients with subarachnoid hemorrhage and nine patients with incidental posterior circulation artery aneurysms, admitted to the clinic from 2019 to 2022, were included in the study. The procedure was performed on all patients under general anesthesia, with antiplatelet therapy being administered both before and after the procedure. Among these patients, 11 received a combination of flow-diverting stent and coiling, while 13 patients were treated solely with a flow-diverting stent. The Raymond-Roy classification and the modified Rankin Scale (mRS) score were employed to assess the occlusion rate and the outcome scores of the patients, respectively.

Results: In this group, 15 patients were discharged with an mRS score of 0, three patients with a score of 2, two patients with a score of 3, and one patient with a score of 4. Of the included patients, three patients died and three patients experienced thromboembolic events. Two patients developed dysphagia, which was resolved after six months. Two patients received second flow-diverting stent, as they had residual filling. Total occlusion was observed in 21 patients (6-18 months of follow-up).

Conclusion: Posterior circulation aneurysms are challenging to treat and carry elevated mortality and morbidity rates. Thanks to advancements in stent technology and the availability of new-generation antiplatelet medications, the risk of thromboembolism has been reduced. As a result, the utilization of flow-diverting stents in treating posterior circulation aneurysms has gained widespread acceptance for its safety and effectiveness.

Keywords: Posterior circulation aneurysms, flow-diverting stent, thromboembolism, optimal treatment

ÖZ

Posterior Sirkülasyon Anevrizmalarında Akım Yönlendirici Stent Kullanımı

Giriş: Akım yönlendirici stentler karotid arter anevrizmalarında güvenle kullanılmaktadır. Dallanmaların yoğun olduğu alanlarda kullanımı kısıtlıdır. Özellikle derin besleyicilerin yoğun olduğu posterior sirkülasyon arterlerinde kullanımı daha da kısıtlanmıştır. Bu yazıda, akım yönlendirici stent kullandığımız 24 hastayla ilgili bulgularımızı paylaşmak istedik.

Gereç ve Yöntemler: Kliniğimize 2019-2022 tarihlerinde başvuran 15 kanamış dokuz insidental saptanan posterior sirkülasyon arter anevrizması yazıya dahil edildi. Tüm hastalara genel anestezi altında işlem uygulandı. İşlem öncesi ve sonrası antiagregan tedavi verildi. Bunlardan 11 tanesine akım yönlendirici stent + koil uygulanırken 13 tanesine sadece akım yönlendirici stent uygulandı. Hastaların oklüzyon oranlarını belirlemek için Raymond-Roy skalası, çıkış skorları için modifiye Rankin Skalası kullanıldı.

Bulgular: Hastalardan 15 tanesi mRS 0, üç tanesi mRS 2, iki tanesi mRS 3, bir tanesi mRS 4 ile taburcu edilirken üç hasta eksitus oldu. Hastalardan üç tanesinde tromboembolik olay gelişti. İki hastada yutma güclüğü ortaya çıktı. Altı ay sonra düzeldi. İki hastada rezidü dolmuş olduğu için ikinci akım yönlendirici stent yerleştirildi. Altı-18 aylık kontrolleri yapılan 21 hastada tam oklüzyon olduğu görüldü.

Sonuç: Posterior sirkülasyon anevrizmalarının tedavisi zordur. Mortalite ve morbiditesi yüksektir. Stent teknolojisindeki gelişmeler ve yeni nesil antiagreganlar sayesinde tromboemboli riski her geçen gün azalmaktadır. Bu durum akım yönlendirici stentlerin posterior sirkülasyon anevrizmalarında daha sık ve güvenle kullanımını sağlamaktadır.

Anahtar Kelimeler: Posterior sirkülasyon anevrizmaları, akım yönlendirici stent, tromboemboli, optimal tedavi

Corresponding Address

Zeki BOĞA

Clinic of Neurosurgery, University of Health
Sciences Adana City Training and
Research Hospital,
ADANA-TÜRKİYE

e-mail: zekiboga2013@gmail.com

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INTRODUCTION

Posterior circulation aneurysms are challenging to treat and are associated with high mortality and morbidity rates due to their heterogeneous aneurysm configurations (including saccular, fusiform, dissecting, and partially thrombosed) and the critical role played by posterior circulation branches. These branches, rich in perforators, are essential for supplying important control centers. Flow-diverting (FD) stents work by directing the flow out of the aneurysm by using their high surface area and low porosity. Although this increases the risk of thrombus in perforators, FD stents have started a new trend in the treatment of intracranial aneurysms and are becoming increasingly popular worldwide (1,2). They have been effectively used for treating anterior circulation aneurysms. Nonetheless, initially, FD stents were not employed for posterior circulation arteries with a high volume of perforators due to the heightened risk of thrombus formation (3,4). They were mainly used for the treatment of dissecting fusiform aneurysms in this region. Other posterior circulation aneurysms have been treated using neck-modeling stents and coiling. However, posterior circulation aneurysms have a higher risk of rupture than anterior circulation aneurysms and have a worse clinical course when

ruptured (5). The inadequate closure of aneurysms using conventional stents and coils, along with the occurrence of recurrent bleeding from residual areas, combined with the heterogeneous configurations of aneurysms in this specific region, has prompted the investigation of novel endovascular treatment approaches for posterior circulation aneurysms. The use of FD stents in this field has increased with the advancements in stent technology and enhanced efficacy of new-generation antiplatelet drugs. In the present study, our aim was to share our clinical experience of treating 24 patients with posterior circulation artery aneurysms through the application of FD stents at our medical facility.

MATERIALS and METHODS

Between 2019 and 2022, 53 patients were diagnosed with posterior circulation aneurysm in our clinic. Of these patients, 12 underwent surgery and 41 received endovascular treatment. Of the 41 patients who received endovascular treatment, 24 patients with FD stents were included in this study. Among the included patients, 13 were exclusively treated with FD stents, whereas 11 underwent FD stenting and coiling (Figure 1-3). The demographic data, location and size of aneurysms, treatment methods, complications, occlusion rates, and outcome scores of the patients were recor-



Figure 1. Vertebral artery aneurysm treated with a flow diverter stent.

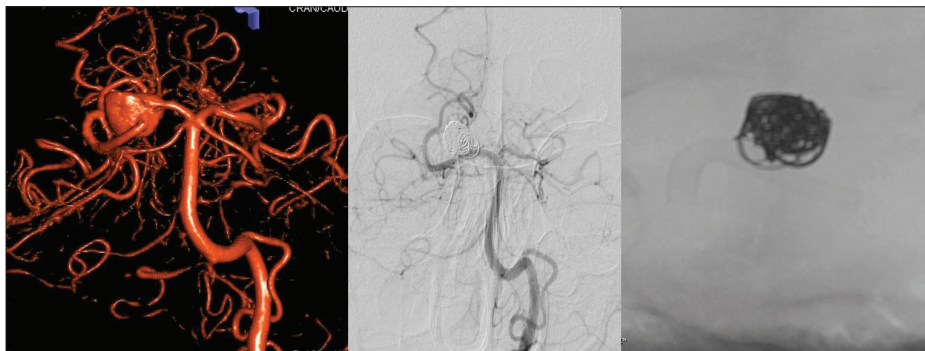


Figure 2. Right PCA aneurysm treated with a flow diverter stent and coiling.

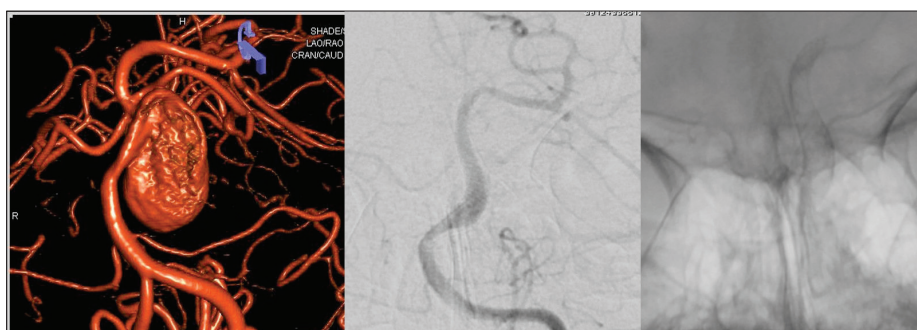


Figure 3. Basilar artery aneurysm treated with a flow diverter stent.

ded. Raymond-Roy classification was used to determine the occlusion rates of the patients, and modified Rankin Scale (mRS) scoring was used to determine their outcome scores. The mean follow-up period of the patients was 8.2 months (6-20 months).

Antiplatelet loading was administered on the morning of the operation for patients with bleeding aneurysms, and 3-5 days before the operation for non-bleeding patients (presurgel 10 mg or clopidogrel 75 mg, and aspirin 300 mg).

RESULTS

Among the included patients, 11 patients were male, and the mean age was 53.2 years (23-78 years). Although 15 patients presented with subarachnoid hemorrhage (SAH), nine patients were detected with posterior circulation artery aneurysms. Among them, four, two, three, three, one, three, and eight patients had basilar trunk artery, basilar apex (giant), vertebrobasilar junction (VBJ), posterior cerebral artery (PCA), superior cerebral artery, vertebral artery, and posterior inferior cerebellar artery aneurysms, respectively. Of these aneurysms, 21 were saccular. Among these cases, two aneurysms were fusiform in shape, while one presented as dolichoectatic dilatation, with the patients having a history of ischemic attacks in the posterior circulation. Of these patients, 11 were treated with FD stenting and coiling, and 13 were treated only with FD stents. At discharge, 15 patients had an mRS score of 0, three patients had a score of 2, two patients had a score of 3, and one patient had an mRS score of 4. Among the included patients, three died and three experienced thromboembolic events. One patient had permanent deficit due to thromboembolism. Two patients developed dysphagia, which was resolved after six months. Two patients received a second FD stent as they had residual filling at the time of their six-month follow-up visit. Complete occlusion was observed in the remaining 19 patients (Table 1).

DISCUSSION

Posterior circulation aneurysms are often complex due to their location, presence of several perforators, and their morphological structure. Surgical and endovascular treatment is more difficult in posterior circulation aneurysms than in anterior circulation aneurysms, and the complication rates are higher in the former. Previously, surgical treatments were associated with increased mortality and morbidity rates (6,7). Despite a partial decrease in this rate due to the advancement of microsurgical techniques and microscopes, mortality and morbidity rates associated with posterior circulation aneurysms remained higher than those associated with surgery for anterior circulation aneurysms. In the early days of endovascular treatment, there was optimism about achieving reduced mortality and morbidity rates. However, conventional stents and coils proved inadequate for effectively treating complex aneurysms located in this particular area (8,9). The advent of FD stents represents a new source of hope. FD stents have proven effective in treating anterior circulation aneurysms and, more recently, posterior circulation aneurysms. Although initially limited to the posterior circulation due to the presence of deep feeders, their application has broadened with advancements in stent technology and antiplatelet drugs.

In 2012, Philips TJ et al. assessed 32 patients who underwent FD stenting for posterior circulation aneurysms. The study revealed that 14% of patients experienced occlusion of perforating arteries, 9.4% developed lasting neurological impairment, and the rate of complete occlusion stood at 72% after one year (10). In our own study, we observed a total occlusion rate of 80% during the six-month follow-up period.

Table 1. Demographic data and results of patients		
Age		
Age range		(23-78)
Mean age		53.2
Sex		
Male		11
Female		13
Symptoms		
SAH		15
Incidental (Headache, vomiting...)		9
Aneurysm morphology (Including additional ICA aneurysms on the same side)		
Saccular		21
Fusiform		2
Dolichoectasia		1
Aneurysm size		
Small (0-5 mm)		6
Medium (5-10 mm)		15
Large (10-25 mm)		2
Giant (>25 mm)		1
Aneurysm localization		
Basilar body		4
Basilar apex		2
VBJ		3
PCA		3
SCA		1
Vertebral artery		3
PICA		8
Endovascular treatment		
FD stent		13
FD stent and coil		11
Complication		
Thromboembolism		3
Swallowing weakness		2
Outcome score		
mRS 0		15
mRS 2		3
mRS 3		2
mRS 4		1
mRS 6 (Exitus)		3
Occlusion rates in the first six months		
RR Class 1 (Total occlusion)		19
RR Class 2		1
RR Class 3		1
SAH: Subarachnoid hemorrhage, ICA: Internal carotid artery, VBJ: Vertebrobasilar Junction, PCA: Posterior cerebral artery, SCA: Superior cerebellar artery, PICA: Posterior inferior cerebellar artery, FD: Flow diverter, mRS: Modified Rankin Score, RR: Raymond-Roy.		

A meta-analysis conducted by Cheng-Bin Wang et al. in 2016 analyzed patients with posterior circulation aneurysms who were treated using FD stent. A total of 220 posterior circulation aneurysm patients were included in 14 studies. The study revealed a total mortality rate of 15%, and it was reported that the rate was higher in cases with giant aneurysms. At six-month follow-up, complete occlusion rate was 84%, and incidence rates of ischemic stroke, perforator occlusion, postoperative SAH, and intraparenchymal hemorrhage were 11%, 7%, 3%, and 4%, respectively. The authors emphasized that although the use of FD stents in posterior circulation aneurysms yields high occlusion rates, they should be performed in a carefully selected set of patients in advanced medical centers due to high mortality and morbidity rates associated with the procedure (11). In our study, the rate of ischemic events was 12%.

In their meta-analysis, Alwakeal et al. examined 301 patients who underwent treatment with FD stents. The analysis revealed that 22% of the patients experienced significant complications, 65% achieved total occlusion, and 67% were discharged with an mRS of 0 to 2. This study underscored the significance of FD stents as a crucial tool in the treatment of posterior circulation aneurysms. Additionally, patient age, aneurysm size, prior treatment history, and the quantity of FD stents employed were found to be correlated with complications and treatment outcomes (12).

Recently, FD stents have been applied in treating aneurysms located within the primary vascular structures of the posterior circulation, as well as the perforating arteries stemming from these structures. These applications have yielded successful outcomes.

A multicenter study led by Samer et al. evaluated 18 patients who had undergone treatment with FD stents for aneurysms originating from basilar artery perforators. The study found that the total mortality rate was 2%, but 81% patients had a favorable outcome score (mRS 0-2) and the total occlusion rate was 100% (13). In our study, 75% of patients were discharged with mRS 0-2.

Da Ros et al. used FD stents for the treatment of seven hemorrhagic aneurysms of the posterior circulation perforating artery and achieved complete occlusion in 85% patients. Six patients were discharged with an mRS of 0 and one with an mRS of 4. It was concluded that FD stent treatment can be an effective and safe treatment method even in perforating artery aneurysms (14).

The utilization of FD stents in posterior circulation aneurysms has become prevalent thanks to advancements in stent technology. The declining complication and mortality rates contribute to its increasing utilization each year.

CONCLUSION

The use of FD stent in treating posterior circulation artery aneurysms has gained popularity in recent years. Although its initial application was limited by the dense localization of deep feeder arteries in this area, its utilization is now expanding even for aneurysms arising from deep feeder arteries. FD stenting proves to be an effective and safe method for treating posterior circulation aneurysms.

Ethics Committee Approval: This study was approved by the Adana City Training and Research Hospital Clinical Research Ethics Committee (Decision Number: 2260, Date: 17.11.2022).

Author Contributions: Concept/Design: ZB; Analysis/Interpretation: ZB; Data Acquisition: ÜK; Writing: ZB, ÜK; Critical Revision: ZB; Final Approval: ÜK.

Conflict of Interest: All authors declare that they have no conflict of interest.

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