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Technical Note

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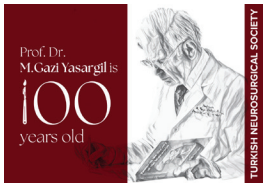

Basilar Artery Stenosis: Technical Tips to Prevent and Treat Hemorrhage during Angioplasty

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ABSTRACT

To describe the strategies and techniques to improve the outcomes in intracranial hemorrhage during endovascular procedures, a case of a 60-year-old male with symptomatic basilar artery stenosis who underwent balloon angioplasty procedure following an iatrogenic basilar artery hemorrhage, is presented. Hemorrhage control and vessel wall reconstruction were achieved with heparin reversal, intermittent balloon inflation, and telescoping stents. In addition, immediate external ventricular drainage was able to control the intracranial hypertension. In conclusion, the ruptured of intracranial vessels is usually challenging to treat. Intermittent balloon inflation with telescoping stents can help stop bleeding.

KEYWORDS: Balloon angioplasty, Basilar artery, Endovascular procedures, Intracranial arteriosclerosis, Intracranial hemorrhages, Intraoperative complications

ABBREVIATIONS: BMT: Best medical therapy, **CT:** Computed tomography, **EVD:** External ventricular drain, **ICAS:** Intracranial atherosclerosis, **PTA:** Percutaneous transluminal angioplasty

INTRODUCTION

Intracranial atherosclerosis (ICAS) is increasingly recognized as a cause of ischemic stroke. The involvement of posterior circulation and eloquent brain areas is associated with high morbidity and mortality (1). The best medical therapy (BMT) for initial treatment of symptomatic ICAS, recommended as the result of large randomized controlled trials, consists of statin therapy, dual antiplatelet agents (usually aspirin and clopidogrel), reduction of cardiovascular risk, and smoking cessation (1). In addition, an increased risk of stroke has been associated with percutaneous transluminal angioplasty (PTA) and stenting, mainly related to distal embolization, arterial dissection, or hemorrhage (1). This article describes a basilar rupture associated with PTA and discusses technical tips to increase treatment effectiveness, prevent complications, and treat the feared intraoperative hemorrhage.

ILLUSTRATIVE CASE

This study was conducted ethically in accordance with the World Medical Association Declaration of Helsinki**.** Ethics approval was not required from Institutional Review Board in accordance with local guidelines concerning single patient reports. Written informed consent for publication of data and images was provided and signed by the patient's guardian.

Clinical Presentation

A 60-year-old male with a history of vertigo and ataxia was diagnosed with vertebrobasilar insufficiency due to basilar artery stenosis, being treated with combined antiplatelet therapy (clopidogrel 75 mg and aspirin 100 mg). Despite one year of treatment followed by six months of anticoagulation therapy with warfarin, his condition progressed with recurrent episodes of syncope, leading to a referral for PTA and

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stenting. Digital subtraction angiography revealed a 90% basilar stenosis.

Surgical Technique

A Neuron 6F (Penumbra Inc., Alameda, CA, USA) catheter was positioned into the left vertebral artery. Suboptimal PTA using a 3.5mm×18mm PRO-Kinetic (Biotronik Berlin, Germany) coronary stent over 0.010-inch microguidewire (Silverspeed®, Medtronic, Minneapolis, MN, USA) was performed by inflating the balloon to a sub-nominal pressure of 7 atm (nominal pressure 8 atm). The postoperative angiogram revealed active contrast extravasation in the proximal basilar artery (Figure 1). Balloon was then immediately re-inflated for five minutes, and heparin was reversed with protamine. However, as the contrast leakage persisted after balloon deflation, a similar overlapping 3.0 mm×18 mm stent was rapidly deployed through the same microwire to provide a flow-diverter effect. The balloon was kept inflated for an additional five minutes and achieved bleeding control. An external ventricular drain (EVD) was placed in the angio-suite for intracranial pressure monitoring.

Postoperative Course

A CT scan confirmed posterior fossa subarachnoid hemorrhage. The patient was sedated for 48 hours, and the follow-up CT scan showed a left cerebellar ischemic stroke. The patient was discharged eight days later with mild ataxia and dysmetria and was able to walk assisted. He showed good functional recovery and could walk independently at a one-year follow-up.

DISCUSSION

The use of PTA and stenting for symptomatic ICAS refractory to BMT remains a matter of debate (2). It has been associated with higher stroke and death rates than BMT, but these risks have decreased with devices improvement and increased use of endovascular techniques (1). A recent meta-analysis involving 777 patients found that submaximal angioplasty for ICAS reduced the stroke and death rate, supporting its combination with BMT as a viable treatment option (7). Although decreasing the radial force reduces the risk of vessel rupture, the diseased vessel wall is still vulnerable to injury. In addition, the use of preoperative antiplatelets plus intraoperative anticoagulation can fatally exacerbate the hemorrhage. The role of endovascular therapy for iatrogenic vessel laceration or perforation injuries to intracranial vessels is not fully elucidated and usually involves vessel sacrifice (1).

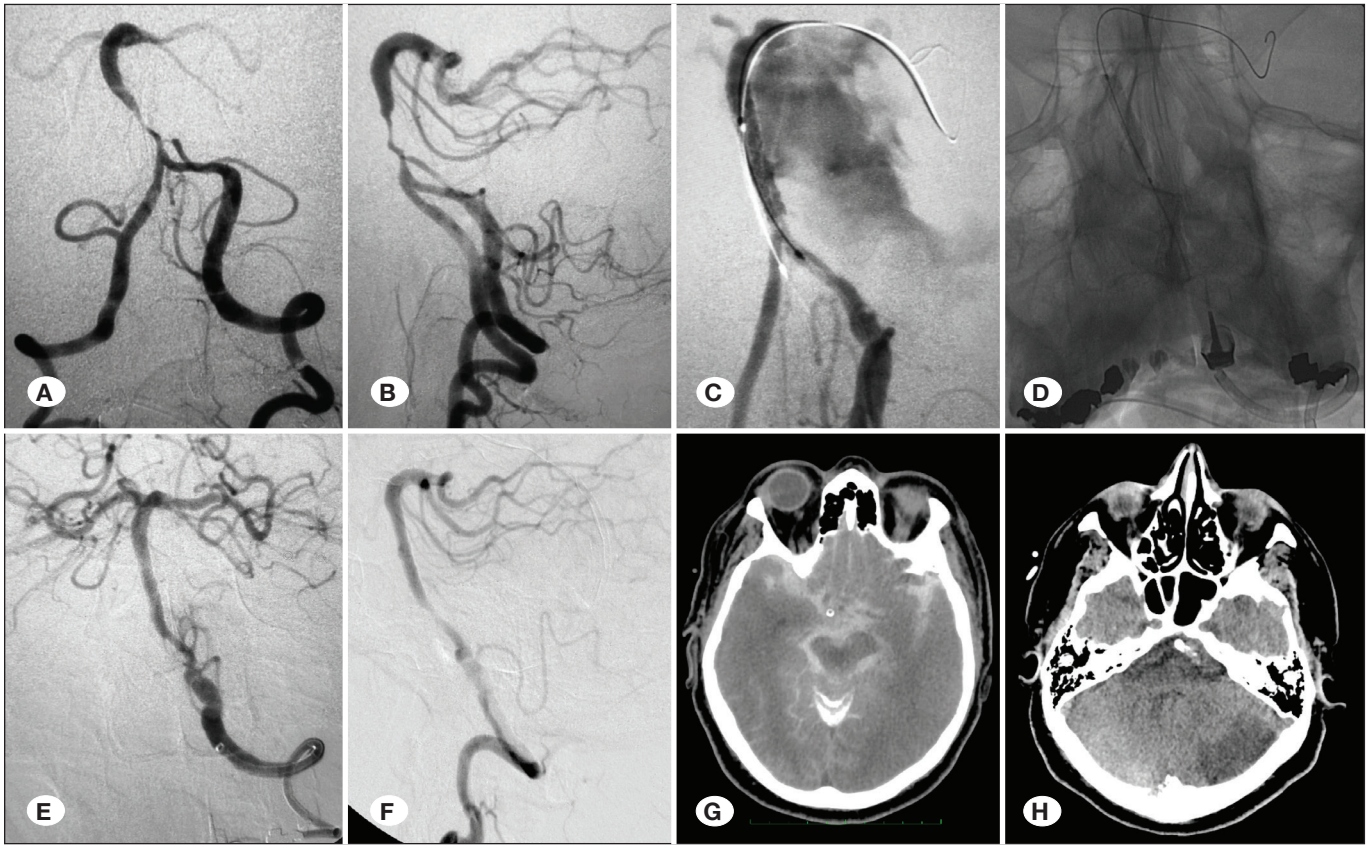

Figure 1: Left vertebral angiogram in frontal **(A)** and lateral view **(B)** shows subocclusive stenosis of the proximal basilar artery, with additional stenosis at the origin of the left anteroinferior cerebellar artery; after submaximal balloon angioplasty there is active contrast extravasation from the basilar artery **(C)**; the balloon is re-inflated **(D)**, the heparin is reversed and another stent is telescoped, ultimately being able to stop the bleeding **(E,F)**; the immediate postoperative CT-scan shows subarachnoid hemorrhage **(G)**, while late CT-scan shows cerebellar infarct **(H)**; the patient has good recovery.

More recently, flow-diverter stents have been successfully deployed to reconstruct the vessel wall and achieved hemorrhage control (1). In this case of iatrogenic injury to the basilar artery, telescoping stents were enough to cover the rupture point and stop bleeding. Telescoping stents achieved similar flow reduction compared with flow diverters; thus, they may be a viable treatment alternative when flow diverters are not a possibility (5). Additionally, coronary stents are usually more available and cheaper than flow diverters, and the attached balloon provides temporary flow occlusion, providing an interesting alternative as a rescue treatment. The tortuosity of the posterior cerebral circulation can present a challenge for endovascular therapy (3). Associated vertebral stenosis below 70% may also affect asymmetric flow, contributing to basilar artery tortuosity (6). Using shorter balloons and paying attention to arterial curves can avoid straightening the basilar artery, causing eventual detachment of perforators. Paying attention to the insufflated balloon period for damage control is another important matter of concern because it may cause brainstem ischemia with catastrophic outcomes. Therefore, fast covering with another stent and transient occlusion may be better tolerated than prolonged balloon inflation. Although an ischemic cerebellar injury occurred in this case, it was probably related to anteroinferior cerebellar artery occlusion, as evidenced by Wang et al. (8); the risk of postoperative ischemic stroke is higher for PTA patients with perforator artery involvement than those with distal hypoperfusion or embolic symptomatology.

CONCLUSION

PTA and stenting for symptomatic ICAS may be safe and effective in properly selected cases (3,4). Although it is extremely difficult to successfully manage periprocedural bleeding, fast intervention with intermittent balloon inflation, heparin reversal, telescoping stents, and immediate EVD can be lifesaving option. Further experience is necessary to define the optimal management of these patients and improve their outcomes.

Declarations

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Availability of data and materials: All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Disclosure: The authors declare no competing interests.

AUTHORSHIP CONTRIBUTION

Study conception and design: ZDJ, RFB
Data collection: ZDJ, RFB
Analysis and interpretation of results: ZDJ, ACD
Draft manuscript preparation: ZDJ, RFB
Critical revision of the article: RFB, ACD
Other (study supervision, fundings, materials, etc...): ZDJ, RFB, ACD
All authors (ZDJ, RFB, ACD) reviewed the results and approved the final version of the manuscript.

REFERENCES

1. Johnson RM, Young M, Guglielmi GN, Farhat H: Proximal basilar artery hemorrhage after submaximal angioplasty for intracranial atherosclerotic disease presenting as a large vessel occlusion treated with pipeline embolization device. J Cerebrovasc Endovasc Neurosurg 23:145-151, 2021. https://doi.org/10.7461/jcen.2021.E2020.11.005
2. Machado M, Borges de Almeida G, Sequeira M, Pedro F, Fior A, Carvalho R, Fragata I, Reis J, Nunes AP: Percutaneous transluminal angioplasty and stenting in acute stroke caused by basilar artery steno-occlusive disease: The experience of a single stroke centre. Interv Neuroradiol 28:547-555, 2022. https://doi.org/10.1177/15910199211051830
3. Palmisciano P, Hoz SS, Algburi HA, Ventre G, Street S, Agyeman N, Robinson MW, Smith MS, Shirani P, Grossman AW, Prestigiacomo CJ: Percutaneous transluminal angioplasty and/or stenting for the treatment of basilar artery stenosis: A systematic review and meta-analysis. Neuroradiology 65: 985-1000, 2023. https://doi.org/10.1007/s00234-023-03124-x
4. Piano M, Milonia L, Cervo A, Modello B, Macera A, Pero G, Quilici L, Boccardi E, Valvassori L: Endovascular treatment of symptomatic intracranial vertebrobasilar stenosis: A 10-year single centre experience using balloon-expandable coronary artery stents. J Stroke Cerebrovasc Dis 30:105431, 2021. https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.105431
5. Roszelle BN, Gonzalez LF, Babiker MH, Ryan J, Albuquerque FC, Frakes DH: Flow diverter effect on cerebral aneurysm hemodynamics: An in vitro comparison of telescoping stents and the Pipeline. Neuroradiol 55:751-758, 2013. https://doi.org/10.1007/s00234-013-1169-2
6. Sahin H, Gokce M: The effect of the vertebral artery stenosis on the basilar artery tortuosity. Turk Neurosurg 33:156-161, 2023. https://doi.org/10.5137/1019-5149.JTN.40980-22.2
7. Seyedsaadat SM, Yolcu YU, Neuhaus A, Rizvi A, Alzuabi M, Murad MH, Brinjikji W, Bydon M, Kallmes DF: Submaximal angioplasty in the treatment of patients with symptomatic ICAD: A systematic review and meta-analysis. J Neurointerv Surg 12:380-385, 2020. https://doi.org/10.1136/neurintsurg-2019-015451
8. Wang G, Cheng T, Niu H, Ma J, Wang J, Li W: Risk prediction of CISS classification in endovascular treatment of basilar artery stenosis. Heliyon 10:e23747, 2023. https://doi.org/10.1016/j.heliyon.2023.e23747