Clinical Case Report

Medicine®

OPEN

Gamma knife radiosurgery as an alternative treatment of Barrow type B carotid cavernous fistulas

A case report

Kang-Hoon Park, MD, Jung-Soo Park, MD, PhD*, Eun-Jeong Koh, MD, PhD, Jong-Myong Lee, MD

Abstract

Rationale: Barrow type B carotid-cavernous fistulas are dural shunts between the meningeal branches of the internal carotid artery and the cavernous sinus; these types of dural fistulas can produce specific patterns of symptoms based on the pattern of venous drainage.

Patient concerns and diagnoses: A 67-year-old man came to our hospital presenting with acute left orbital pain and double vision in the left eye. The diagnosis was carotid-cavernous fistula fed by the meningohypophyseal trunk and drained to the left superior ophthalmic vein.

Interventions and outcomes: We planned gamma knife radiosurgery for the left cavernous sinus including fistula point as an alternative treatment. The orbital pain disappeared in 2 weeks, and all signs and symptoms in the left eye completely improved within 2 months.

Lessons: Gamma knife radiosurgery may be an alternative treatment for carotid cavernous fistula. Furthermore, in patients with poor vascular access and no fatal presentation, this may be a reasonable first-line treatment option.

Abbreviations: CCF = carotid cavernous fistula, GKRS = gamma knife radiosurgery, IPS = inferior petrous sinus, MRI = magnetic resonance imaging, SOV = superior ophthalmic vein.

Keywords: Barrow classification, carotid-cavernous fistula, gamma knife radiosurgery

1. Introduction

Carotid cavernous fistulas (CCFs) are abnormal communications between the carotid artery and the cavernous sinus. Previously, Barrow et al[1] classified them as direct or indirect according to their angiographic features; type B CCFs are dural shunts between the meningeal branches of the internal carotid artery and the cavernous sinus. Because of the direct shunting of arterial blood into the cavernous sinus and subsequently into the superior ophthalmic vein (SOV), patients who have these fistulas often present with ocular bruit, blurred vision, headache, diplopia, ocular pain, proptosis, conjunctiva injection, seizure, and neurologic deficit.[1,2] Endovascular treatment with coils, stents, and liquid embolic agents through transarterial or transvenous routes remains the first-line treatment option for uncontrolled symptomatic or hemorrhagic CCFs.[3] However, endovascular approaches for CCFs are not always possible, safe, or effective because of poor vascular access, risk of retrograde flow of embolic materials, and partial embolization.[4,5] Recently, stereotactic radiosurgery has been attempted as an alternative treatment option for patients with CCFs who are at high risk of endovascular treatment.[4,6,7] Herein, we report a case of a patient with Barrow type B CCF who was successfully treated with gamma knife radiosurgery (GKRS).

2. Case report

A 67-year-old man with no past medical history visited our emergency room presenting with acute left orbital pain and double vision in the left eye on December 15, 2017. Ophthalmological examination showed chemosis, conjunctival injection, exophthalmos with mild ptosis, and an intraocular pressure of 23 mm Hg in the left eye (Fig. 1). Brain magnetic resonance imaging showed exophthalmos with dilated SOV in the left eye (Fig. 2). He was admitted to neurosurgery for interventional neuroradiology under suspicion of CCF.

On December 18, 2017, cerebral angiography was performed. Left internal carotid artery angiography showed

Editor: N/A.

Written Informed consent was obtained from the patient for publication of this case report and accompanying images.

The authors have no funding and conflicts of interest to disclose.

Department of Neurosurgery, Research Institute of Clinical Medicine of Chonbuk National University-Biomedical Research Institute of Chonbuk National University Hospital, Jeonju, Republic of Korea.

* Correspondence: Jung-Soo Park, Department of Neurosurgery, Chonbuk National University Medical School/Hospital, Geumam-dong, Deokjin-gu, Jeonju, 561-712, Korea (e-mail: rollingstone12@hanmail.net).

Medicine (2019) 98:22(e15803)

Received: 18 January 2019 / Received in final form: 12 April 2019 / Accepted: 29 April 2019

http://dx.doi.org/10.1097/MD.0000000000015803

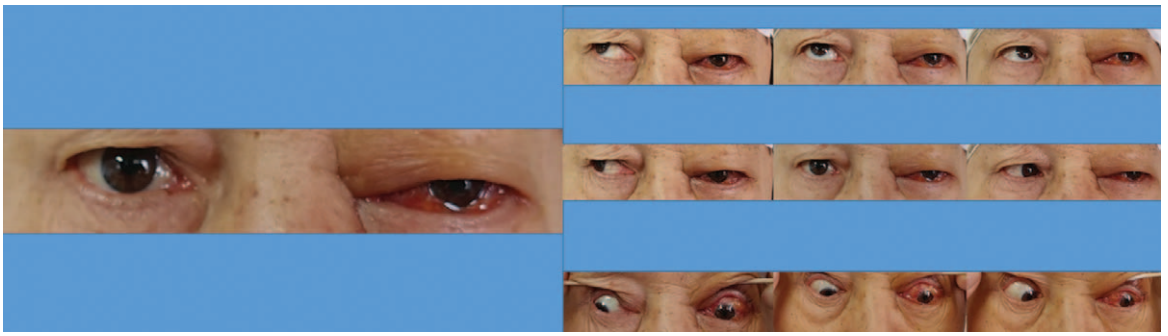

Figure 1. Note the chemosis, conjunctival injection, and mild ptosis in the left eye. Limited medial gaze in the left eye noted on images of the patient in 9 diagnostic positions of gaze at first visit.

a CCF (Barrow type B), which was fed by the meningohypophyseal trunk and drained to the left SOV (Fig. 3). Initially, we planned endovascular embolization, but the caliber of the meningohypophyseal trunk was very small, so we thought that a transarterial route was not possible. The transvenous approach via the inferior petrous sinus (IPS) also seemed to be difficult because we could not see the IPS even in the delayed venous phase. Because the patient's condition was not fatal, we thought that surgical exposure via SOV would be invasive considering the complaints. Therefore, we planned GKRS with Leksell Gamma Knife Perfexion (Elekta Instruments, AB, Stockholm, Sweden) for the left cavernous sinus including fistula point as an alternative treatment. The patients received GKRS at 18 Gy to the 50% isodose line based on the radiation dose applied to intracranial arteriovenous malformations on December 22, 2017 (Fig. 4). The orbital pain disappeared in 2 weeks, and all signs and symptoms in the left eye improved completely within 2 months (Fig. 5). On July 5, 2018, a follow-up angiography was performed that showed complete closure of the fistula with no visible engorged SOV (Fig. 6).

Figure 2. Time-of-flight magnetic resonance imaging of the patient showed mild exophthalmos and dilated superior ophthalmic vein (arrow) of left eye.

3. Discussion

Based on angiographic characteristics, CCFs were classified by Barrow et al[1] into type A, B, C, or D. Type A fistulas are abnormal direct communications between the carotid artery and the cavernous sinus. Type B, C, and D fistulas are indirect communication cavernous sinuses with dural feeders from the internal or external carotid artery.

Endovascular treatment through transarterial or transvenous routes remains the first treatment option for CCFs.[3,5] However, endovascular treatment is not always possible or safe. In patients with tortuous or atherosclerotic arteries, a transarterial approach may be challenging, or procedure-related complications such as distal emboli or vascular injury may result.[3,8] The IPS is the most commonly used route for transvenous approaches.[3,5] However, these routes are restricted when there are thromboses in the IPS or no communication between the IPS and the fistula site.[8,9] The SOV is another route for a transvenous approach, but this procedure requires an invasive upper eyelid cut-down and may not be possible if the SOV does not dilated or located deep in the orbit.[10]

Recently, because of the possible risks and complications with endovascular treatment of patients with CCF, alternative treatments such as flow diverter stents and stereotactic radiosurgery have been proposed with favorable outcomes.[4,6,7,11] There are some advantages of GKRS as an alternative treatment for CCF compared with endovascular embolization. First, it is possible even in cases of poor vascular access such as tortuous or atherosclerotic arteries, occluded IPS, or deep located SOV. Second, GKRS can minimize procedure-related complications; it does not entail directly manipulating blood vessels, and, it can reduce radiation to normal neuronal tissue adjacent to the cavernous sinus by detailed demarcation of the lesion area in the planning process. Third, if the patient's symptoms are tolerable, other adjuvant treatment option can be planned later.

Although it may not be appropriate in patients who need immediate symptom relief, GKRS may be an alternative treatment for selective CCF patients. Furthermore, in patients

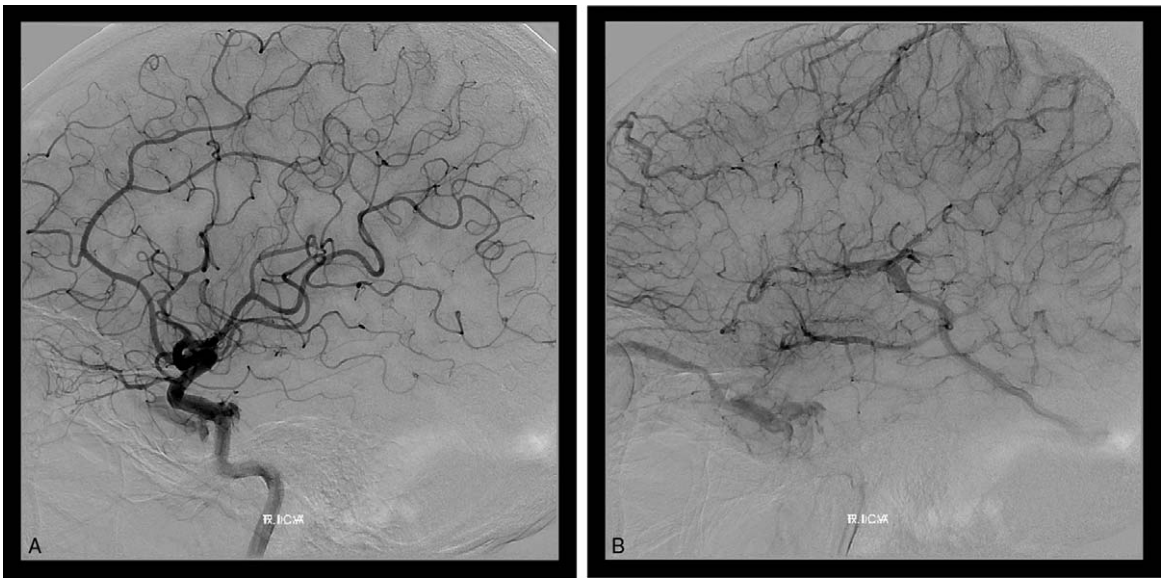

Figure 3. Lateral left internal carotid artery angiogram on December 18, 2017, demonstrates an indirect carotid cavernous fistula (type B) with drainage into the superior ophthalmic vein.

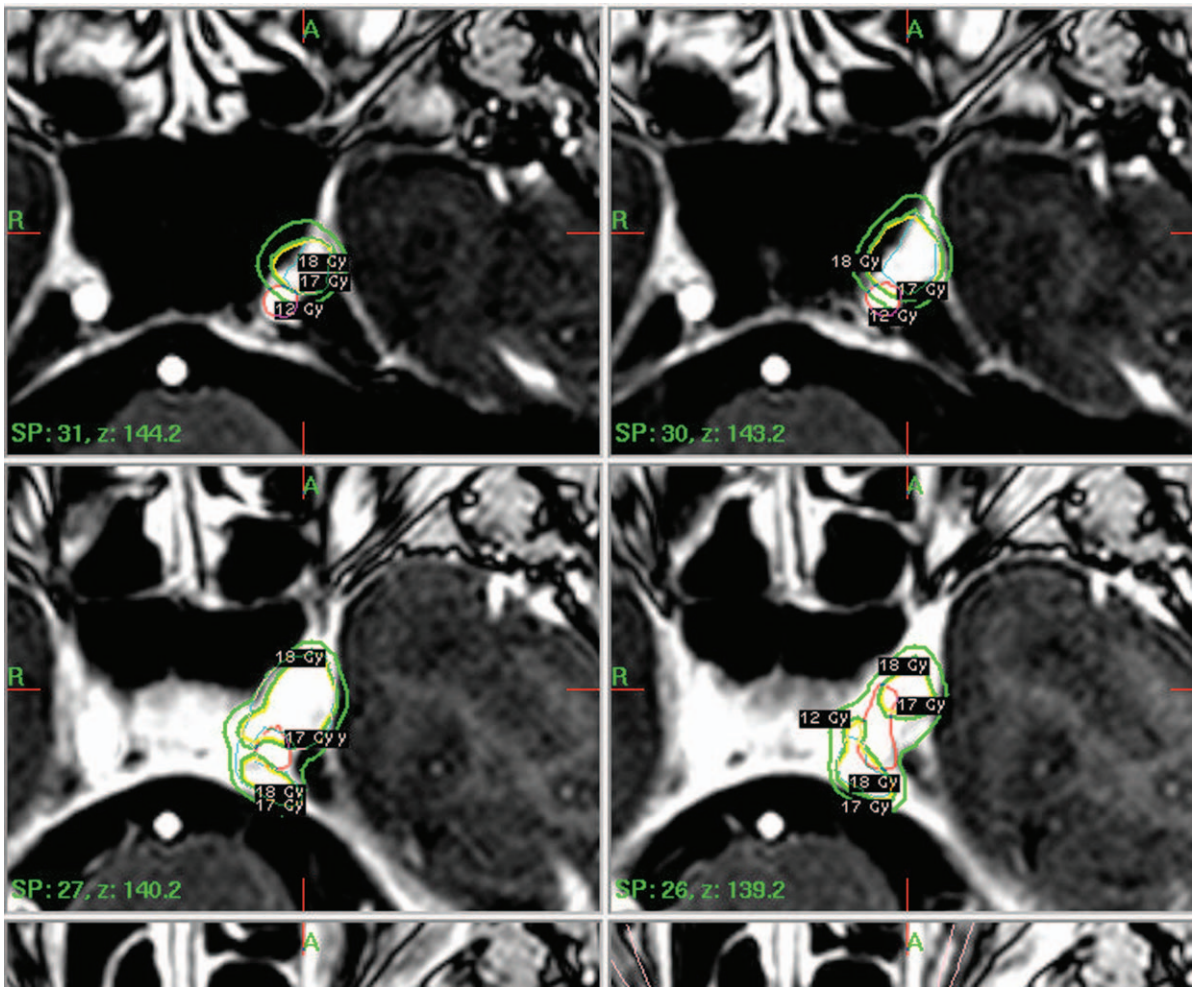

Figure 4. Axial treatment planning magnetic resonance imaging for gamma knife radiosurgery treatment showing the 50% prescription isodose line representing 18 Gy to the margin (yellow).

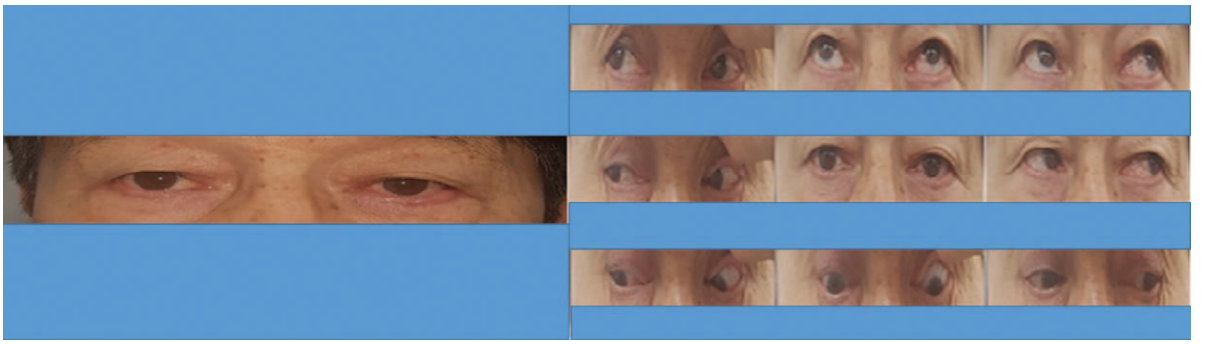

Figure 5. Nine diagnostic positions of gaze in 2 months of treatment. All signs and symptoms in the left eye completely improved.

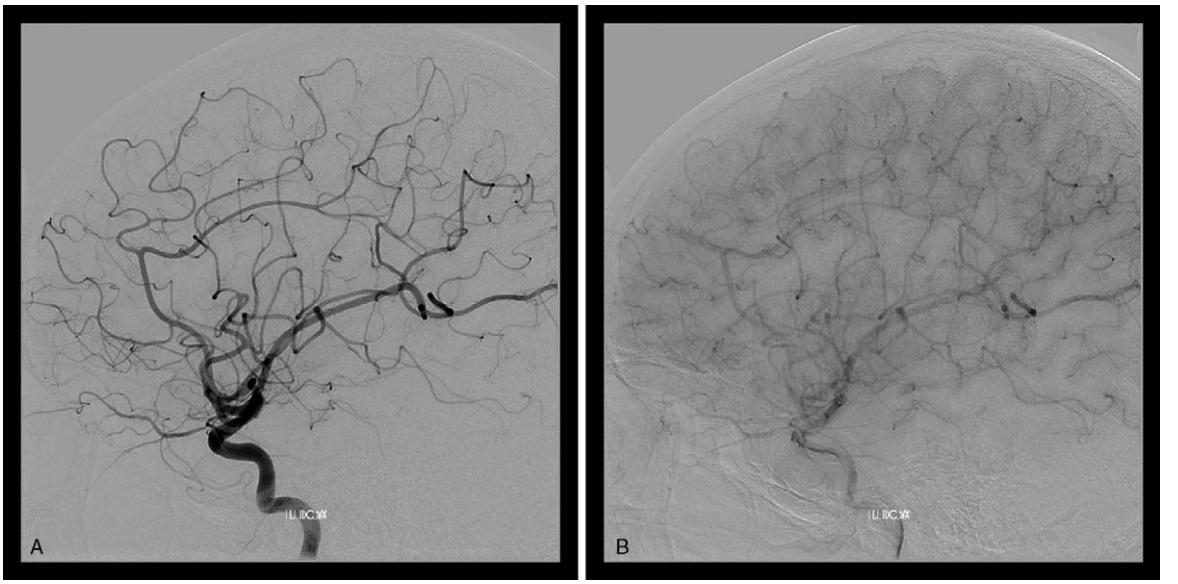

Figure 6. Follow-up left internal carotid artery angiogram on July 5, 2018, showing complete resolution of the carotid cavernous fistula and no visible engorged superior ophthalmic vein.

with poor vascular access and no fatal presentation, this may be a reasonable first-line treatment option.

Author contributions

Conceptualization: Eun-Jeong Koh.
Formal analysis: Kang Hoon Park.
Methodology: Jung Soo Park.
Writing – original draft: Kang Hoon Park, Jung Soo Park.
Writing – review & editing: Jung Soo Park, Eun-Jeong Koh, Jong-Myong Lee.

References

[1] Barrow DL, Spector RH, Braun IF, et al. Classification and treatment of spontaneous carotid-cavernous sinus fistulas. J Neurosurg 1985;62:248–56.
[2] Chaudhry IA, Elkhamry SM, Al-Rashed W, et al. Carotid cavernous fistula: ophthalmological implications. Middle East Afr J Ophthalmol 2009;16:57–63.
[3] Gemmete JJ, Ansari SA, Gandhi DM. Endovascular techniques for treatment of carotid-cavernous fistula. J Neuroophthalmol 2009;29: 62–71.
[4] Park SH, Park KS, Kang DH, et al. Stereotactic radiosurgery for dural carotid cavernous sinus fistulas. World Neurosurg 2017;106:836–43.
[5] Yoshida K, Melake M, Oishi H, et al. Transvenous embolization of dural carotid cavernous fistulas: a series of 44 consecutive patients. AJNR Am J Neuroradiol 2010;31:651–5.
[6] Barcia-Salorio JL, Soler F, Barcia JA, et al. Stereotactic radiosurgery for the treatment of low-flow carotid-cavernous fistulae: results in a series of 25 cases. Stereotact Funct Neurosurg 1994;63:266–70.
[7] Pollock BE, Nichols DA, Garrity JA, et al. Stereotactic radiosurgery and particulate embolization for cavernous sinus dural arteriovenous fistulae. Neurosurgery 1999;45:459–66. discussion 466-7.
[8] Elhammady MS, Peterson EC, Aziz-Sultan MA. Onyx embolization of a carotid cavernous fistula via direct transorbital puncture. J Neurosurg 2011;114:129–32.
[9] Lekkhong E, Pongpech S, Ter Brugge K, et al. Transvenous embolization of intracranial dural arteriovenous shunts through occluded venous segments: experience in 51 patients. AJNR Am J Neuroradiol 2011;32:1738–44.
[10] Reis CV, Gonzalez FL, Zabramski JM, et al. Anatomy of the superior ophthalmic vein approach for direct endovascular access to vascular lesions of the orbit and cavernous sinus. Neurosurgery 2009;64:318–23. discussion 323.
[11] Castano C, Remollo S, Garcia-Sort R, et al. Treatment of Barrow type 'B' carotid cavernous fistulas with flow diverter stent (Pipeline). Neuroradiol J 2017;30:607–14.