

3
3 1
, 1
1
3
가
6 2
가 1
1
6
가 1
가
3 4
3

(Fig. 1)

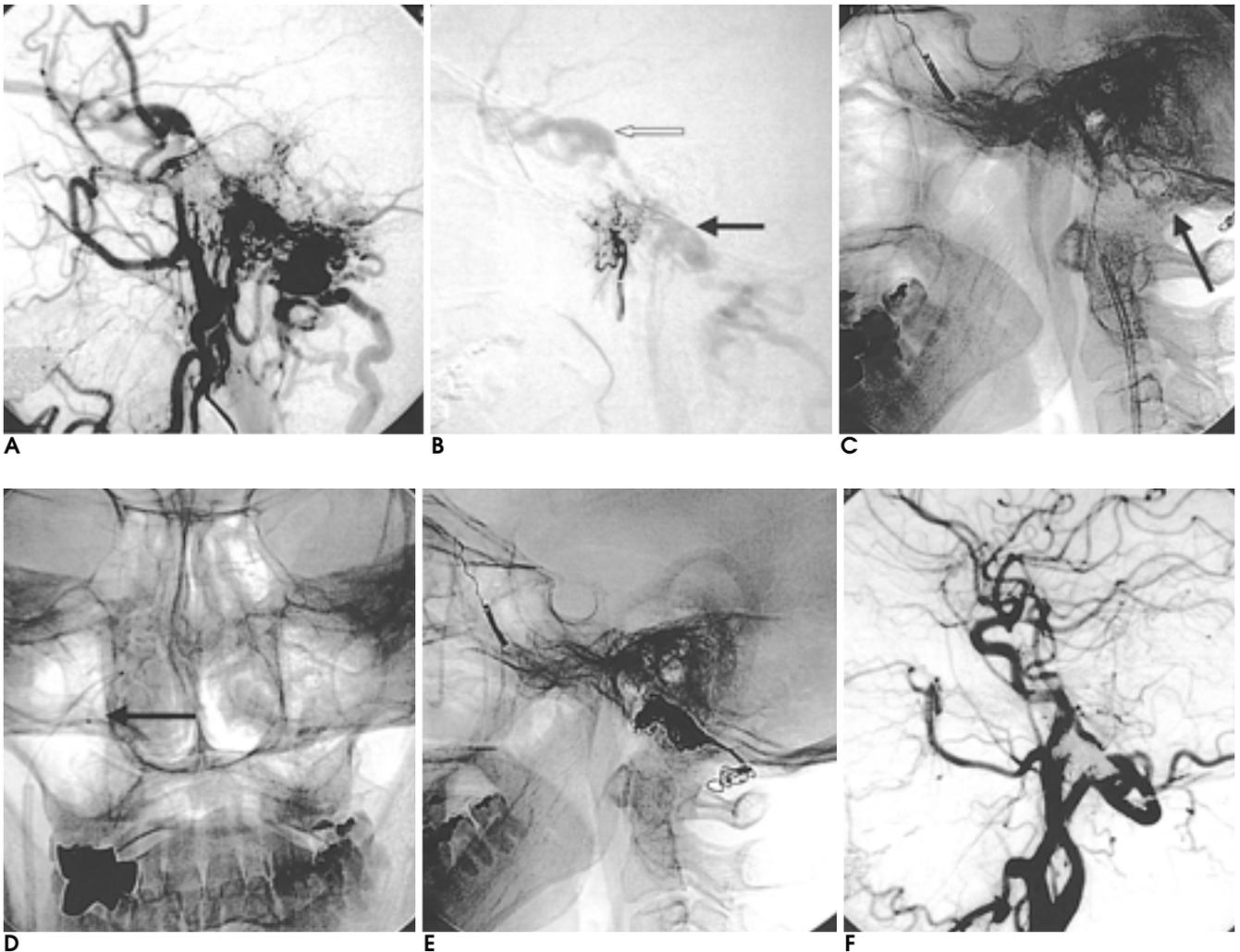


Fig. 1. DAVFs at marginal sinus with transvenous coil embolization through jugular vein.
A. Right ECA angiogram shows large amount of blood flow at fistula site around foramen magnum.
B. On selective angiogram of right ascending pharyngeal artery, venous flow from marginal sinus(arrow) is seen at internal jugular vein and paravertebral venous plexus with retrograde flow to cavernous sinus(open arrow), ophthalmic artery and cortical vein.
C, D. Superselected microcatheter is located at around foramen magnum(arrows), more medially and anteriorly than sigmoid or transverse sinus.
E. Tight coil packing is seen at marginal sinus.
F. Post embolic right CCA angiogram shows complete occlusion of marginal sinus DAVFs

(Fig. 2).
6 4

(1).
가

가
가 2
(Fig. 3).

(17 - 19).
1970

4 45 가 14 2 (20, 21)

가
가

가

1

(22 - 24).

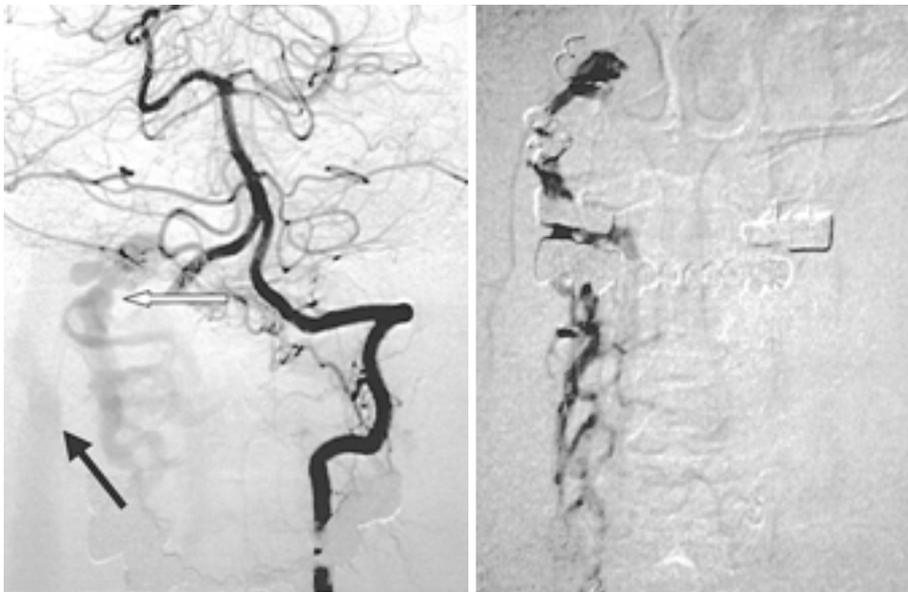
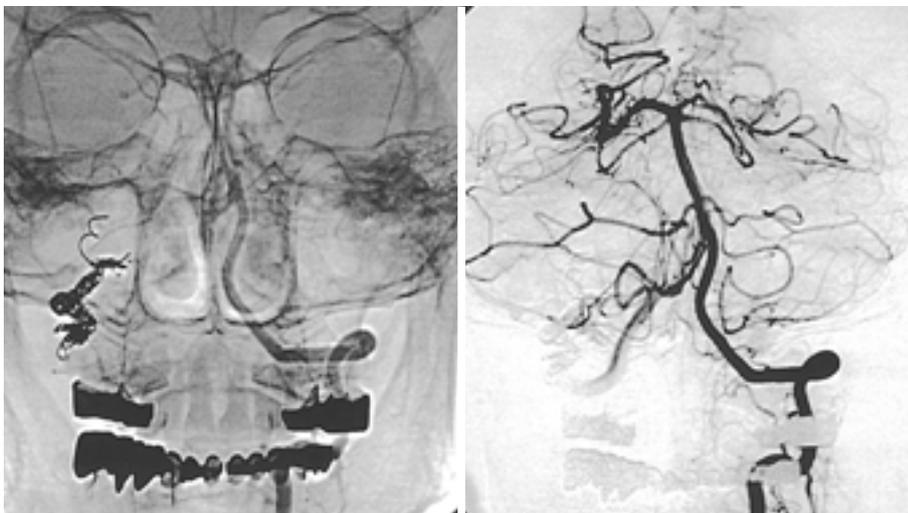


Fig. 2. Successful coil embolization through paravertebral venous plexus.

A. Left vertebral angiogram show DAVFs at right marginal sinus. Faint venous flow is seen at right internal jugular vein(arrow), but main flow is noted at paravertebral venous plexus(open arrow).

B. Superselective angiogram through paravertebral venous plexus.

C, D. Complete coil packing is noted with no residual flow at marginal sinus DAVFs.



C

D

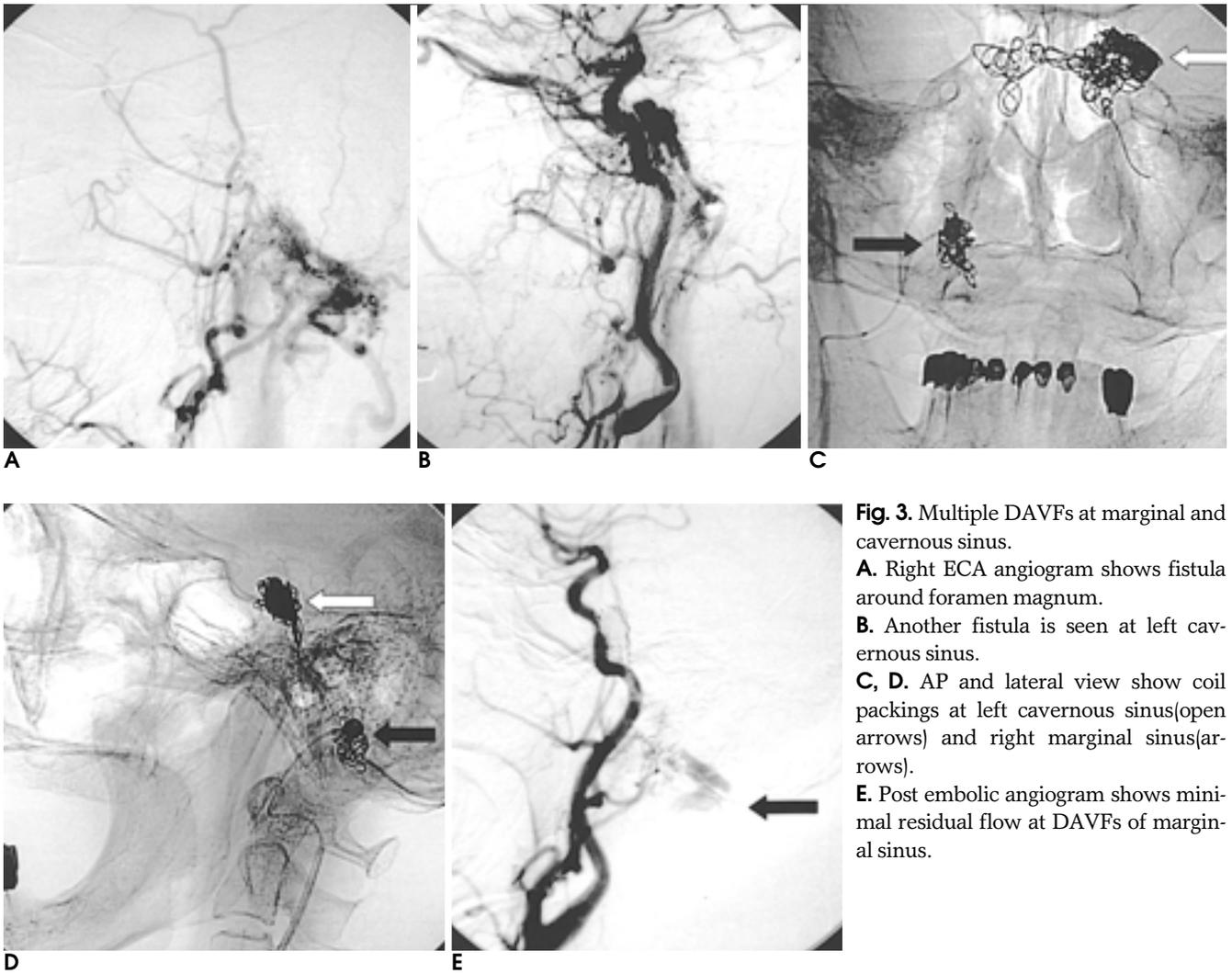


Fig. 3. Multiple DAVFs at marginal and cavernous sinus.
A. Right ECA angiogram shows fistula around foramen magnum.
B. Another fistula is seen at left cavernous sinus.
C, D. AP and lateral view show coil packings at left cavernous sinus(open arrows) and right marginal sinus(arrows).
E. Post embolic angiogram shows minimal residual flow at DAVFs of marginal sinus.

(basilar venous plexus) ,
 S Pierot (27) 2
 6
 4 McDougall (28)
 (25 - 26). 14 3 가
 2
 2
 . Pierot (27) 6
 6 5 가
 . McDougall (28)
 2 1
 , Peirot (27)
 , 4 emissary vein 가 가
 3 가 .
 679

가

. Halbach (6)

11 9

가

17 10

가

가

McDogall (28) 14

가

11

6

4

2

road map

3

2

. 1

가

6

가 2

2

. 2

1

가

가

가

가

가

가

가 2

1. Newton TH, Cronqvist S. Involvement of the dural arteries in intracranial arteriovenous malformations. *Radiology* 1969;93:1071-1078
2. Newton TH, Weidner W, Greitz T. Dural arteriovenous malformations in the posterior fossa. *Radiology* 1968;90:27-35
3. Houser OW, Baker HL, Rhoton Jr. AL, Okazaki H. Intracranial dural arteriovenous malformations. *Radiology* 1972;105:55-64
4. , , . 1998;27:186-197
5. , , . 1999;40:835-844
6. Halbach VV, Higashida RT, Hieshima GB, Goko K, Norman D, Newton TH. Dural fistulas involving the transverse and sigmoid sinus: results of treatment in 28 patients. *Radiology* 1987;163:443-447
7. Halbach VV, Higashida RT, Hieshima GB, Reicher M, Norman D, Newton TH. Dural fistulas involving the cavernous sinus: results of treatment in 30 patients. *Radiology* 1987;163:437-442
8. Vinuela F, Fox AJ, Pelz DM, Drake CG. Unusual clinical manifestations of dural arteriovenous malformations. *J Neurosurg* 1986;64:554-558
9. Sundt TM, Plepgras DG. The surgical approach to arteriovenous malformations of the lateral and sigmoid dural sinuses. *J Neurosurg* 1983;59:32-39
10. Femand M, Reizine D, Melki JP, Riche MC, Merland JJ. Long term follow-up of 43 pure dural arteriovenous fistulae of the lateral sinus. *Neuroradiology* 1987;29:348-353
11. Vinuela F, Fox AJ, Debrun GM, Peerless SJ, Drake CG. Spontaneous carotid-cavernous fistulas: clinical, radiological, and therapeutic considerations. *J Neurosurg* 1984;60:976-984
12. Picard L, Bracard S, Islak C, et al. Dural fistulae of the tentorium cerebelli. *J Neuroradiol* 1990;17:161-181
13. Halbach VV, Higashida RT, Hieshima GB, Rosenblum M, Cahan L. Treatment of dural arteriovenous malformations involving the superior sagittal sinus. *AJNR Am J Neuroradiol* 1988;9:337-343
14. Halbach VV, Higashida RT, Hieshima GB, Hardin CW, Pribram H. Transvenous embolization of dural fistulas involving the cavernous sinus. *AJNR Am J Neuroradiol* 1989;10:377-383
15. Halbach VV, Higashida RT, Hieshima GB, Mehringer CM, Hardin CW. Transvenous embolization of dural fistulas involving the transverse and sigmoid sinuses. *AJNR Am J Neuroradiol* 1989;10:385-392
16. Barnwell SL, Halbach VV, Dowd CF, Higashida RT, Hieshima GB. Dural arteriovenous fistulas involving the inferior petrosal sinus: angiographic findings in six patients. *AJNR Am J Neuroradiol* 1990;11:511-516
17. Award IA, Little JR, Akrawi WP, et al. Intracranial dural arteriovenous malformations: factors predisposing to an aggressive neurologic course. *J Neurosurg* 1990;72:839-850
18. Brown RD Jr, Wiebers DO, Nichols DA. Intracranial dural arteriovenous fistulae: angiographic predictors of intracranial hemor-

- rhage and clinical outcome in nonsurgical patients. *J Neurosurg* 1984;81:531-538
19. Halbach VV, Hieshima GB, Higashida RT, Reicher M. Carotid cavernous fistulae: indications for urgent treatment. *AJR Am J Roentgenol* 1987;143:587-593
20. Newton T, Greitz T. Arteriovenous communication between the occipital artery and the transverse sinus. *Radiology* 1966;87:824-828
21. Takekawa S, Holman C. Roentgenologic diagnosis of anomalous communications between the external carotid artery and intracranial veins. *AJR Am J Roentgenol* 1965;95:822-825
22. Graeh D, Dolman C. Radiological and pathological aspects of dural arteriovenous fistulas. *J Neurosurg* 1986;64:962-967
23. Cognard C, Gobin Y, Pierot L, et al. Neurological symptoms of intracranial dural arteriovenous fistulas : clinical and angiographic correlation in 205 cases. A revised classification of the venous drainage. *Radiology* 1994;194:671-680
24. Lasjaunias P, Berenstein A. *Surgical Neuroangiography, Vol 2: Endovascular treatment of craniofacial lesions*. New York: Springer-Verlag, 1987
25. de Oliveira E, Rhoton AL, Peace D. Microsurgical anatomy of the lesion of the foramen magnum. *Surg Neurol* 1985;24:293-352
26. Okudera T, Huang YP, Ohta T, et al. Development of posterior fossa dural sinuses, emissary veins, and jugular bulb: morphological and radiologic study. *AJNR Am J Neuroradiol* 1994;15:1871-1883
27. Pierot L, Chiras J, Meder JF, Rose M, Rivierez M, Marsault C. Dural arteriovenous fistulas of the posterior fossa draining into subarachnoid veins. *AJNR Am J Neuroradiol* 1992;13:315-323
28. McDougall CG, Halbach VV, Dowd CF, Higashida RT, Larsen DW, Hieshima GB. Dural arteriovenous fistulas of the marginal sinus. *AJNR Am J Neuroradiol* 1997;18:1565-1572

Dural Arteriovenous Fistula at Marginal Sinus: Angiographic Findings and Treatment with Transvenous Coil Embolization¹

Yoon Joon Hawang, M.D., Dong Ik Kim, M.D.², Pyeongho Yoon, M.D.²

¹Department of Radiology, College of Medicine, Inje University, Ilsan Paik Hospital

²Department of Radiology, College of Medicine, Yonsei University

Purpose: The purpose of this study was to evaluate the angiographic findings of dural arteriovenous fistulas (dAVFs) at the site of a marginal sinus and to assess the efficacy of transvenous embolizations.

Materials and Methods: Six patients in whom an angiographically confirmed dural arteriovenous fistula was present at the site of a marginal sinus were involved in this study. Arterial feeders and the venous drainage of dAVFs were evaluated, and we describe the location of other combined dAVFs. Transvenous, with or without arterial, embolization was performed in all patients, and the angiographic findings and clinical outcomes were evaluated.

Results: Ascending pharyngeal and occipital arteries were the main arterial feeders, and dAVFs were also supplied from the meningohypophyseal trunk, posterior auricular artery, middle meningeal arteries, and the accessory meningeal, internal maxillary, and meningeal branch of the vertebral artery. In five of six cases, the supply originated not only from the ipsilateral arterial system, but also from the contralateral system. Posterior venous drainage occurred via the internal jugular vein and the paravertebral venous plexus, and superiorly, via the and cavernous sinus. All six patients underwent transvenous coil embolization. Except in one case, in which drainage involved the paravertebral venous plexus, the venous route of embolization was the internal jugular vein. In four of six patients, angiography revealed complete occlusion of the fistula, and the clinical symptoms showed complete resolution. In the other two cases there was minimal residual flow, but the clinical symptoms showed improvement. In both, a further fistula was seen at a site other than the marginal sinus.

Conclusion: In all patients, the angiographic findings were evaluated and subsequent endovascular treatment was successful. Transvenous embolization involving dAVFs at the site of a marginal sinus were effective; clinical outcomes depended on successful endovascular treatment and the extent of dAVFs.

Index words : Arteriovenous malformations, dural
Angiography
Veins, therapeutic embolization

Address reprint requests to : Dong Ik Kim, M.D., Department of Diagnostic Radiology, Severance Hospital
134 Shinchondong, Seodaemunku, Seoul 120-752, Korea.
Tel. 82-2-361-5837 Fax. 82-2-393-3035 E-mail: dikim@yumc.yonsei.ac.kr