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Journal of the Chinese Medical Association 76 (2013) 31−36

www.jcma-online.com

Original Article

Transarterial detachable coil embolization of direct carotid-cavernous fistula: Immediate and long-term outcomes

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Received February 15, 2012; accepted June 5, 2012

Abstract

Background: Transarterial embolization is a standard method for management of direct carotid-cavernous fistula (DCCF). The purpose of this study was to report our experiences, and immediate and long-term outcomes of endovascular embolization of DCCFs by using detachable coils (DCs).
Methods: Over 8 years, 24 patients with 25 DCCFs underwent endovascular DC embolization. There were 15 men and nine women; age ranged from 8 to 82 years (mean, 39 years). Immediate and long-term angiographic as well as clinical outcomes after endovascular DC embolization were retrospectively analyzed. The number and the length of DCs used to occlude the fistula were also evaluated.
Results: Eighteen DCCFs were successfully occluded by single-session endovascular embolization with preservation of the parent artery. Retreatments by transvenous ($n = 5$) and/ or transorbital routes ($n = 3$) had to be performed in seven patients because of residual fistula ($n = 4$) or recurrent fistula ($n = 4$) occurring within 3 weeks after embolization. The average numbers and length of coils to occlude the fistulas were 14 (range, 2−31) and 189 cm (range, 16−756 cm), respectively. Four patients had small residual fistulas with spontaneous thrombosis on follow-up angiography. Three patients had transient cranial nerve impairment of the third ($n = 1$) or sixth ($n = 2$) nerve. There was no significant procedure-related neurological complication. The follow-up period was 3−48 months (mean, 19 months)
Conclusion: Endovascular DC embolization of DCCFs was proved both efficacious and safe in managing high-flow fistulas with sustained angiographic and clinical effects, particularly in those DCCFs with small fistula track and/or cavernous sinus. However, retreatment via various routes may be necessary in some patients because of residual or recurrent fistulas.

Keywords: detachable coil; direct carotid-cavernous fistula; embolization; outcome

1. Introduction

Direct carotid-cavernous fistula (DCCF) is a high-flow arteriovenous fistula between the cavernous sinus (CS) and internal carotid artery (ICA). It commonly results from a traumatic tear or aneurysm rupture in the CS portion of the ICA. DCCFs usually present with ocular-orbital venous congestion and cephalic bruit. The goal of treatment is to occlude the fistula with preservation of the ICA flow. In the past, transarterial balloon embolization of DCCFs was the standard method and had promising results.[1−3] Due to lack of availability of detachable balloons, endovascular embolization using DC has become the mainstay for management of DCCFs. However, the immediate and long-term effect of DC for DCCFs has not been thoroughly evaluated.[4−7]

The purpose of this study was to report our experience of endovascular DC embolization in 24 patients with 25 DCCFs and to evaluate the immediate and long-term effects of DC in managing DCCFs.

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1726-4901/$ - see front matter
http://dx.doi.org/10.1016/j.jcma.2012.09.007

2. Methods

From October 2002 to September 2010, there were 24 patients with 25 DCCFs who were treated by endovascular DC embolization. This study was approved by Institutional Review board of Taipei Veterans General Hospital (IRB 201001003IA). The clinical data of the 24 patients are summarized in Table 1. These patients included 15 men and nine women, and their ages ranged from 8 to 82 years (mean 39 years). All patients had ocular−orbital venous congestive manifestations such as chemosis, bruit, and proptosis; three presented with headache, one experienced neurologic deficit because of intracerebral hemorrhage. Endovascular procedures of DCCFs were performed under general anesthesia using a femoral approach. Activated clotting time was maintained at a value of twice the baseline value by intravenous administration of heparin. A 6F or 7F guiding catheter was positioned in the cervical ICA, followed by navigation of microcatheter(s) to the CS. Occlusion of the DCCFs was initiated by selection of the proper DC; DCs were packed into the CS as densely as possible. The endpoint of the procedures was complete occlusion of the fistula flow ($n = 17$) or slow fistula flow with further coil embolization being impossible because of recoil of microcatheter into the parent artery ($n = 8$).

A postembolization angiogram was done immediately after the completion of the procedure to check for occlusion of the fistula. Of these 25 DCCFs, 18 had follow-up with conventional and/or magnetic resonance angiography to evaluate the occluded fistula. All patients were followed-up clinically for an average of 19 months (range, 3−48 months).

3. Results

Results and follow-up findings are listed in Table 1. The average number and length of coils used were 14 (2−31) and 189 cm (16−756 cm), respectively, and largely depended on the size of the fistula tract and CS. Complete fistula closures were documented on immediate postembolization angiograms in 17 DCCFs (Fig. 1), whereas small residual flow remained in the other eight and spontaneous thrombosis was confirmed in four DCCFs by follow-up angiograms within 7 days. Retreatment was necessary in four persistent residual (Fig. 2) and four recurrent DCCFs (Figs. 2 and 3) occurring on Days 1, 2, 11 and 17, respectively, after embolization. All these eight recurrent and/or residual fistulas were found in 16 larger CSs that needed longer coils (>100 cm) to pack the CS and fistula. Conversely, nine small fistulas with small CSs embolized by less coil length (<100 cm) all were treated in a single session with fistula total occlusion demonstrated by postembolization or follow-up angiograms (Table 1). Transarterial balloon-assisted *n*-butyl-2-cyanoacrylate (NBCA; Nycomed, Ingenor, Paris, France) embolization was performed in two; transvenous DC

Table 1
Demography and outcomes of endovascular detachable coil embolization in 24 patients with 25 direct carotid-cavernous fistulas.

Patient/sex/age (y)	DC number/length	Adjuvant embolic agent	Adjuvant access route(s)	Causes of adjuvant embolic agent and/or access route	Outcome	Follow-up (mo)
1/M/35	2/16 cm	Nil	Nil		Cure	20
2/F/24	13/234 cm	Nil	Nil		Cure	18
3/M/21	7/92 cm	Nil	Nil		Residual fistula with spontaneous cure	36
4/F/56	6/78 cm	Nil	Nil		Cure	23
5/F/39	9/88 cm 6/30 cm	Nil	Nil		Cure/residual fistula then spontaneous cure	18
6/F/82	3/48 cm	Nil	Nil		Cure	25
7/M/23	7/88 cm	Nil	Nil		Cure	36
8/M/35	16/283 cm	Nil	Nil		Residual fistula with spontaneous cure	28
9/M/67	8/96 cm	Nil	Nil		Cure	32
10/M/46	4/68 cm	Nil	Nil		Cure	19
11/F/24	11/134 cm	Nil	Nil		Cure	14
12/F/48	12/152 cm	NBCA	Nil	Residual fistula	Transient CN6 palsy	26
13/F/26	21/283 cm	NBCA	Transorbital	Recurrent fistula	Cure	25
14/M/8	19/225 cm	NBCA	Transorbital	Residual fistula	Transient CN6 palsy	16
15/M/51	9/128 cm	Nil	Nil		Cure	9
16/F/62	15/238 cm	Nil	Nil		Cure	19
17/M/27	25/250 cm	Nil	Nil		Cure	5
18/M/59	24/299 cm	Nil	Nil		Cure	18
19/F/46	28/345 cm	NBCA	Trans-FV, transorbital	Residual and recurrent fistulas	Transient CN3 palsy	17
20/M/24	31/756 cm	Nil	Trans-FV		Cure	7
21/M/31	21/205 cm	Nil	Trans-FV, trans-IPS	Recurrent fistula	Cure	16
22/M/34	15/189 cm	Nil	Trans-FV	Recurrent fistula	Cure	6
23/M/18	16/175 cm	NBCA	Nil	Residual fistula	Cure	4
24/M/57	14/235 cm	Nil	Nil		Residual fistula then spontaneous cure	3

CN = cranial nerve; FV = facial vein; IPS = inferior petrous sinus.