CASE REPORT

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AIR VENT OF VEIN GRAFT IN EXTRACRANIAL-INTRACRANIAL BYPASS SURGERY

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ABSTRACT

Revascularization with a vein graft is a mandatory method for treatment of dissecting or pseudoaneurysms of the internal carotid artery. We report the necessity for an air vent from the vein graft and explain its use in our two cases. In Case 1, we searched for a great saphenous vein around its junction with a femoral vein during the harvest of vein graft. An accessory branch of that great saphenous vein was also found around the junctional region with a femoral vein, and was temporarily ligated. At first, anastomosis was completed on both the distal and proximal sides. After the proximal side of a vein graft was opened and the ligation of the branch was loosened, an air vent could be made through the branch of the vein graft. Multiple air bubbles and a large quantity of white microemboli were discharged through this branch. The postoperative course was uneventful. In Case 2, the air vent was omitted to shorten ischemia. During the opening of the vein graft, the migrated air was observed to move to the middle cerebral artery. A computed tomography scan demonstrated that brain infarction and dysarthria occurred postoperatively. The air vent of the vein graft is essential in extracranial-intracranial bypass surgery, because the air bubbles or microthrombi are easily trapped around the valve and cause cerebral infarction. An air vent can be easily made if the branch of a vein graft exists in the outflow pathway, because intraluminal air or thrombus can be washed out through the branch at the final stage of surgery.

Key Words: Air vent, Vein graft, EC-IC bypass, Saphenous vein, Accessory branch

INTRODUCTION

Revascularization with vein graft is a mandatory method for the treatment of dissecting or pseudoaneurysms of the internal carotid artery. Saphenous vein harvesting is a difficult technique because of the close relation with patency and complication. We report the necessity for an air vent from the vein graft, and explain its method of use in two cases of external carotid artery–middle cerebral artery bypass surgery.

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CLINICAL PRESENTATION

Case 1

A 45-year-old male presented with subarachnoid hemorrhage (Hunt and Kosnik Grade III). Angiographic studies demonstrated a non-branching aneurysm of the right internal carotid artery. An operation was performed the next day with a right pterional approach. The exploration disclosed a dissecting aneurysm of the right internal carotid artery with a red-colored vascular wall. Neck clipping was performed, but left hemiparesis followed because of a lacunar infarction in the right internal capsule. Two weeks later, the subarachnoid hemorrhage recurred, and angiographic studies demonstrated the regrowth of an aneurysm on the right internal carotid artery. The frontal and parietal branches of the superficial temporal artery were anastomosed to the right middle cerebral artery to prevent cerebral infarction after trapping the right internal carotid artery. However, blood flow through the right superficial temporal artery was relatively poor, and the right middle cerebral artery was spastic. Therefore, neck clipping was performed again instead of trapping the right internal carotid artery. Thirty-eight days after the onset, the aneurysm's recurrence was found by an angiographic study (Fig. 1A). Consequently, the right internal carotid artery was trapped after a high-flow bypass was made between the right external carotid artery and the M2 segment of the right middle cerebral artery, using a great saphenous vein.

During the harvest of the vein graft, a great saphenous vein was searched for around its junction with a femoral vein. The accessory branch of the great saphenous vein was also found around the junctional region with a femoral vein, and was temporarily ligated. During the anastomosis on both the distal and proximal sides, a distal temporary clip was applied on the vein graft just proximal to the branch. A proximal temporary clip was also applied just distal to the anastomosed site to an external carotid artery. After anastomosis was completed on both the distal and proximal sides, the distal temporary clip on the vein graft was repositioned to

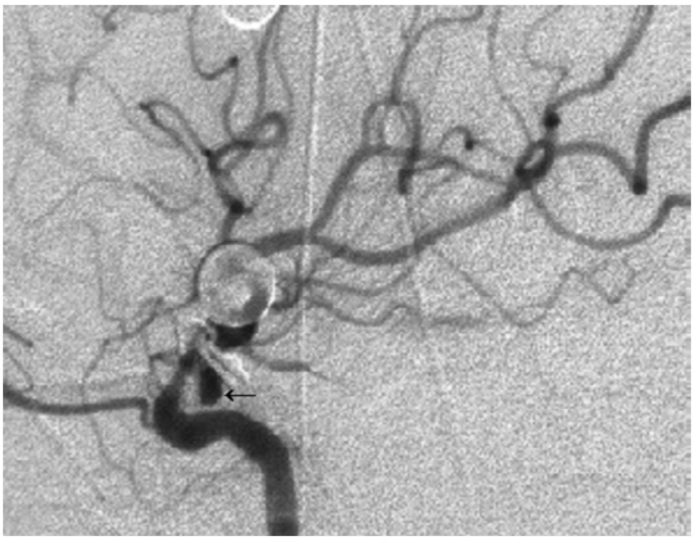

Fig. 1 Case 1
A: Right carotid angiography, lateral view. Angiographic study demonstrated recurrence of non-branching aneurysm (↑) in right internal carotid artery.

the distal portion of the branch (Fig. 1B). After the proximal side of the vein graft was opened and the ligation of the branch was loosened, an air vent could be made through the branch of the vein graft. Multiple air bubbles and a large quantity of white microemboli were discharged through this branch. After red blood passed through the branch, an aneurysmal clip was used to

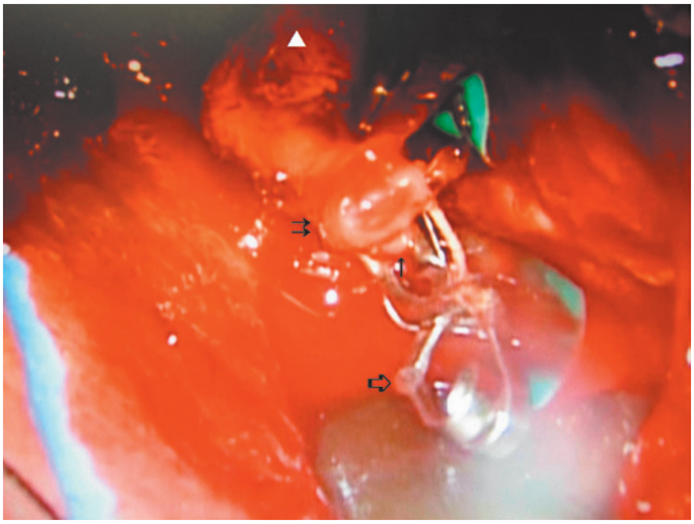

Fig. 1 Case 1
B: Intraoperative microscopic view. After anastomosis was completed in both distal and proximal sides, temporary clip (⇧) was applied to vein graft (▲) at distal portion (↑) of branch. After inflow pathway of vein graft was opened and ligation of branch was loosened, air vent could be done through the branch (↑↑) of vein graft. Multiple air bubbles and a large quantity of white microemboli were discharged through this branch. Thereafter, red blood passed through the branch.

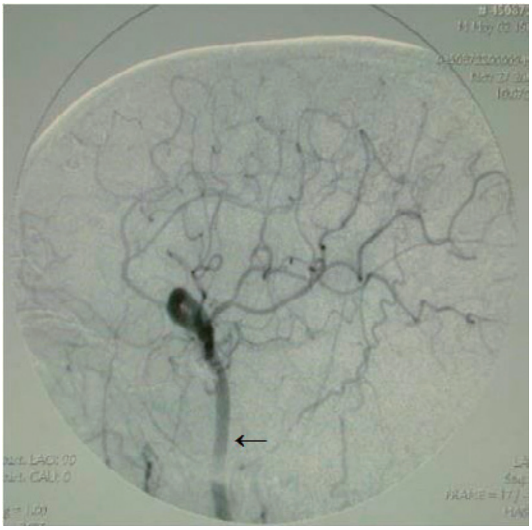

Fig. 1 Case 1
C: Postoperative right carotid angiography. Patency of vein graft (↑) was verified.

occlude it temporarily. Subsequently, an internal carotid artery was trapped and the vein graft was recanalized by opening its distal clip. Ultimately, the branch was occluded with a small titanium vascular clip. The postoperative course was uneventful, and the patency of the vein graft was also verified on angiography (Fig. 1C).

Case 2

A 60-year-old man had presented with an acute hemorrhage from his right external auditory meatus, after puncturing it with an ear pick. The patient developed repeated hemorrhages several times thereafter. He showed sudden onset of massive right aural bleeding and was admitted to the Department of Otology. He had deafness of the right ear on admission. Bone window computed tomography showed a destroyed petrous bone around the right internal carotid artery. A massive hematoma also accumulated in the middle ear. Enhanced computed tomography scan showed that the internal carotid artery was exposed to the right middle ear with a pseudoaneurysm. Investigation by right carotid angiography revealed that a pseudoaneurysm arose from the internal carotid artery, coursing through the middle ear (Fig. 2A). During the angiography, dissection occurred in the origin of the right vertebral artery, and right cerebellar and occipital infarctions followed. The patient showed ataxia in his right extremities, but he recovered enough to be able to do his daily work without assistance. This pseudoaneurysm at the petrous portion of the right internal carotid artery was supposed to be infectious following the chronic otitis media.

Two weeks after the onset, the right internal carotid artery was trapped with an external carotid artery–middle cerebral artery bypass surgery using a vein graft. At first, the distal end of the vein graft was anastomosed to the right middle cerebral artery, and its proximal end was anastomosed

Fig. 2 Case 2
A: Right carotid angiography, AP view. Right carotid angiography revealed pseudoaneurysm (↑) arising from internal carotid artery coursing through middle ear.

to the right external carotid artery later on. Next, coil embolization of a distal internal carotid

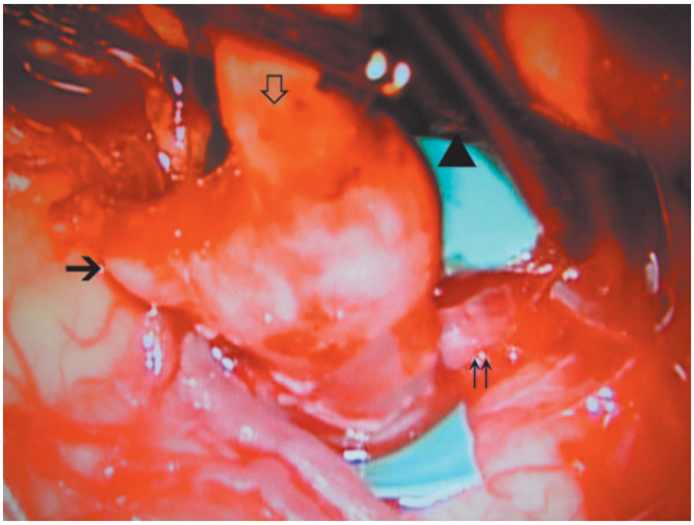

Fig. 2 Case 2
B: Intraoperative microscopic view. Distal end of saphenous vein graft (⇧), anastomosed to the right middle cerebral artery (↑↑), is shown. Although the branch (↑) existed around the distal end of vein graft, air vent was omitted to shorten ischemia. An temporary clip on vein graft proximal to branch (▲) is also shown.

Fig. 2 Case 2
C: Postoperative computed tomography. Computed tomography scan demonstrated brain infarction (↑) which occurred during revascularization.

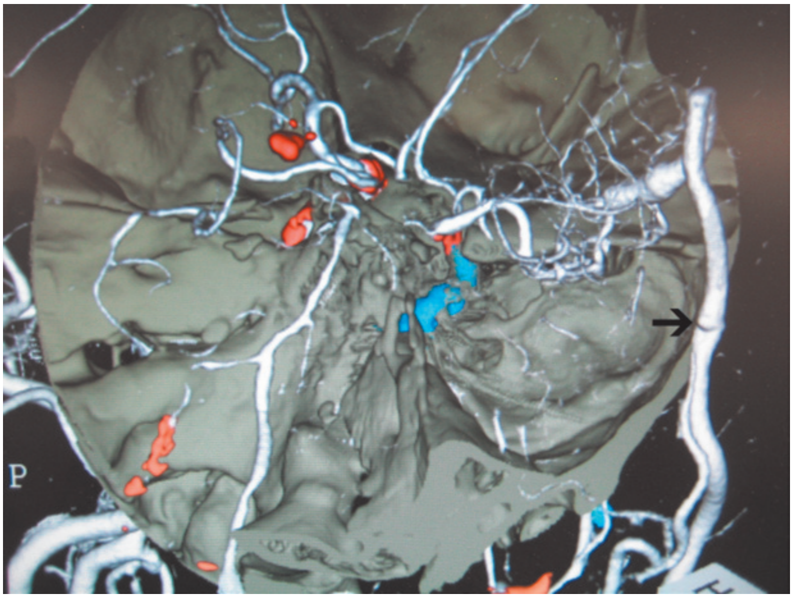

Fig. 2 Case 2
D: Postoperative three-dimensional computed tomography angiography confirming the patent vein graft (↑).

artery was performed using intraoperative angiography, followed by ligation of a proximal internal carotid artery. The vein graft was opened immediately after the right internal carotid artery was occluded. Air vent was omitted to shorten the ischemia (Fig. 2B). While opening the vein graft, the migrated air in the vein graft was observed moving to the middle cerebral artery. Computed tomography scan demonstrated brain infarction, and dysarthria occurred postoperatively, although it recovered several weeks after the incident (Fig. 2C). Three-dimensional computed tomography angiography confirmed the placement of the patent vein graft (Fig. 2D).

DISCUSSION

Air vent of a graft is essential in extracranial-intracranial bypass surgery, because air bubbles or microthrombi can easily cause cerebral infarction. In the vein graft, air bubbles or microthrombi are easily trapped around the valve.[1] The valve has the complex figure to trap air bubbles and complicated characteristic features to generate microthrombi. It was reported that the valves opened and closed in each cardiac cycle at reduced flow (30 to 10 ml/min), and that the flow was stagnant for a considerable portion of the cardiac cycle.[2,3] The trapped air bubbles and microthrombi generated in the vein graft can only be washed out antegradely, because the valve does not allow a retrograde flow through the graft.

In Case 2, the air vent was omitted to shorten ischemia after the coil embolization of the distal internal carotid artery and ligation of the proximal internal carotid artery, although the branch existed in the outflow pathway of the vein graft. Soon after flow was established in the vein graft, the migrated air bubbles there were observed to move to the middle cerebral artery. The cerebral infarction and dysarthria occurred postoperatively. On the contrary, there was no ischemic event in Case 1 after an adequate air vent was made. An air vent is easy to make if a branch of the vein graft exists in the outflow pathway, because intraluminal air or thrombus can be washed out through the branch at the final stage of surgery. This technique was mentioned only in one report insofar as we know; therefore we consider that it should be stressed further in the future.[4)]

Accessory branches usually join the great saphenous vein at the sapheno-femoral junction.[5)] 53.5% of them have a lateral accessory branch of the great saphenous vein, and 16.5% have a medial accessory branch, but no major branches were detected in 30%.[5)] If there is no vein graft branch in the outflow pathway, an air vent must be made in a different way. Needle puncture with a low-caliber cannula might be another method. This method leaves only a small hole in the vein graft, and stenosis can be prevented by suturing the hole in a longitudinal direction of vein graft.

Theoretically, other modalities are possible for air vent. Anastomosis is performed in the external carotid artery at first, and the air vent is made during the second anastomosis in the middle cerebral artery. However, occlusion of the middle cerebral artery tends to take longer in that case, because many steps must be continuously performed as follows: Loosening of temporary clips in two sites of vein graft, air vent, re-clipping of vein graft, tightening of suture in vein graft-middle cerebral artery anastomosis, and loosening of two clips of the middle cerebral artery. Occlusion of the middle cerebral artery, on the other hand, is necessary only during the vein graft-middle cerebral artery anastomosis if the anastomosis is performed in the middle cerebral artery at first, and the air vent can be made through a branch of the vein graft later. Another ischemia just happens later for a short duration between the ligation of an internal carotid artery, and the loosening of a clip on the outflow pathway of the vein graft. Therefore, an air vent through the branch of vein graft is a useful technique for shortening the occlusion of middle cerebral arteries.

Another technique to simplify the air vent is to use a radial arterial graft. This graft has no valve, so air bubbles or microthrombi tend to be trapped in the graft less frequently than with a vein graft. Furthermore, an air vent can be easily arranged in retrograde fashion through the site of anastomosis in the arterial graft-external carotid artery. However, we selected the saphenous vein graft for fear of causing an inadequate blood flow to the forearm in the two current cases.

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