Clinical Neurology and Neurosurgery 142 (2016) 65–71

Contents lists available at ScienceDirect

Clinical Neurology and Neurosurgery

journal homepage: www.elsevier.com/locate/clineuro

Use of a harvested radial artery graft with preservation of the vena comitantes to reduce spasm risk and improve graft patency for extracranial to intracranial bypass: Technical note

Najib E. El Tecle[a], Samer G. Zammar[b], Youssef J. Hamade[c], Tarek Y. El Ahmadieh[d], Rami James N. Aoun[c], Allan D. Nanney[b], Hunt H. Batjer[d], Gregory A. Dumanian[e], Bernard R. Bendok[c,*]

[a] Department of Neurological Surgery, Saint Louis University, St. Louis, MO, United States
[b] Department of Neurological Surgery, Northwestern Memorial Hospital, Chicago, IL, United States
[c] Department of Neurological Surgery, Mayo Clinic, Phoenix, AZ, United States
[d] Department of Neurological Surgery, University of Texas Southwestern, Dallas, TX, United States
[e] Department of Plastic Surgery, Northwestern Memorial Hospital, Chicago, IL, United States

ARTICLE INFO

Article history:
Received 11 May 2015
Received in revised form
16 December 2015
Accepted 27 December 2015
Available online 31 December 2015

Keywords:
Radial artery graft
Venae comitantes
Vasospasm
EC–IC bypass
MCA aneurysm

ABSTRACT

Background and significance: The vessels of choice for cerebrovascular high-flow direct bypass procedures are the radial artery and the saphenous vein. Radial artery grafts have become favored over saphenous vein grafts because of higher patency rates and better size matching to appropriate recipient vessels. Radial grafts are prone to spasm however, and this may be seen in 4–10% of cases and can be associated with ischemic sequelae. The standard technique for radial artery harvest calls for complete separation of the artery from its adventitial attachments and associated venous network. There is reason to believe that this could contribute to spasm risk and possibly even thrombosis. Radial graft outcomes appear to be improved when the vena comitantes is preserved in cardiac and peripheral applications. We report the novel use of a harvested radial artery graft with preservation of its venae comitantes for extracranial to intracranial bypass.

Clinical presentation: The patient is a 59-year-old male who had a blunt head trauma with associated loss of consciousness and who was led to the incidental discovery of a large fusiform middle cerebral artery (MCA) aneurysm.

Conclusion: Preservation of the vena comitantes when harvesting a radial arterial graft for bypass, along with dual (arterial and venous) anastomoses, and concomitant use of intra-operative vaso-dilatory maneuvers to prevent spasm, may improve overall graft patency and patient outcome.

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* Corresponding author.
E-mail address: bendok.bernard@mayo.edu (B.R. Bendok).

http://dx.doi.org/10.1016/j.clineuro.2015.12.018
0303-8467/

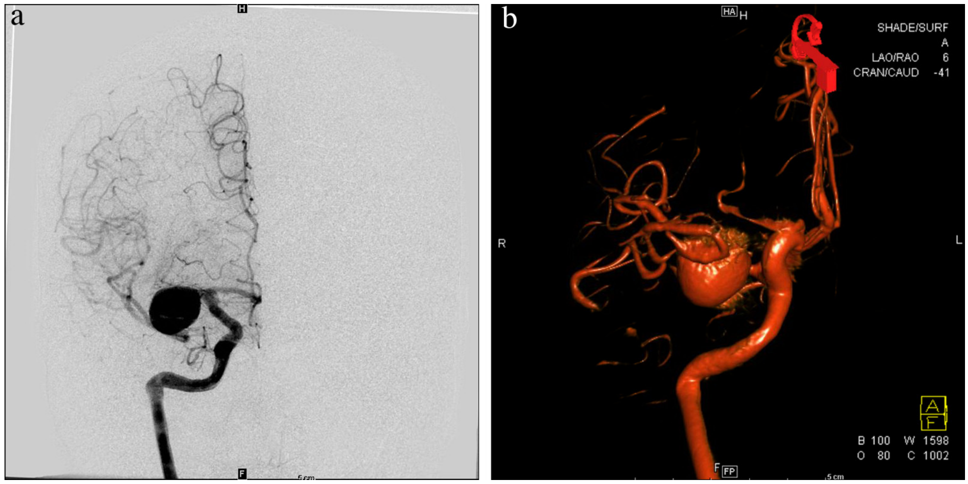

Fig. 1. Preoperative angiography. (a) Right ICA AP cranial angiogram showing the large M1 fusiform aneurysm with lenticulostriates arising from the superior dome. (b) 3D view showing both M2 segments arising from the aneurysm.

1. Introduction

Despite advances and innovations in both microsurgical and endovascular techniques, safe and effective treatment of giant intracranial fusiform aneurysms remains challenging. On the endovascular front, flow diversion has offered a potential solution for select cases but little is known regarding long-term outcomes and indications remain far from universal [9]. Open revascularization combined with a flow diversion or reversal strategy remains a viable alternative for select cases [15]. Efforts to reduce the morbidity of this approach may lead to better patient outcomes. Various bypass options exist with varying benefits and potential liabilities. The Superficial Temporal Artery is the preferred graft if low flow is needed. Radial and saphenous vein grafts can be used when higher flow rates are needed. Radial artery grafts have become favored over saphenous vein grafts because of higher patency rates and better size matching to appropriate recipient vessels. Radial grafts are prone to spasm however, and this may be seen in 4–10% of cases and can be associated with ischemic sequelae [2,6,18]. The standard technique for radial artery harvest calls for complete separation of the artery from its adventitial attachments and associated venous network. There is reason to be believe that this could contribute to spasm risk and possibly even thrombosis. Radial graft outcomes appear to be improved when the vena comitantes is preserved in cardiac and peripheral applications [10,12,13]. We report the novel use of a harvested radial artery graft with preservation of its venae comitantes for the treatment of a large fusiform middle cerebral artery (MCA) aneurysm. We hypothesize that preservation of the native venous drainage of the graft combined with intra-operative mechanical and pharmacologic dilation techniques may enhance graft patency, decrease spasm risk, and improve patient outcomes.

2. Case report

The patient is a 59-year-old male who had a blunt head trauma with associated loss of consciousness and who was led to the incidental discovery of a large right fusiform MCA aneurysm. The patient underwent digital subtraction angiography (DSA) that demonstrated a 2.1 cm fusiform aneurysm of the right M1 segment with associated fusiform dilation of the proximal superior and inferior MCA divisions as they exited the aneurysm. Additionally, multiple lateral lenticulostriate arteries arose from the aneurysmal M1 segment (Fig. 1a,b). We carefully contemplated the available therapeutic options including observation, use of a flow diverter, and Hunterian ligation of the intracranial Internal Carotid Artery (ICA) or proximal middle cerebral artery combined with a direct EC–IC bypass. After careful review, our team felt that flow diversion would not likely work given the fusiform dilation into both M2 branches. Also, a direct STA MCA bypass was thought to be insufficient view narrow STA branches. The significant perforators coming off the dome were also a concern. We discussed these options with the patient and the decision was made to treat with proximal occlusion and bypass.

3. Technical note

The patient was placed in the prone position with the head slightly extended and turned 30° to the left. The scalp, right neck, and right arm were prepped into the sterile field. A micro-Doppler was used to map and preserve the anterior division of the superior temporal artery (STA) prior to incision and during opening. Then, this arterial branch and its venous counterpart, the superficial temporal vein (STV), were carefully dissected and preserved. A standard right-sided pterional craniotomy was performed and the Sylvian fissure was opened. At this point, the distal MCA branches, the aneurysmal M1 segment, and the proximal arteries including the ICA and the Anterior Chroroidal Artery (AChA) were identified and exposed carefully. Next, our plastic surgery colleagues led by (G.D.) harvested the radial artery with preservation of one of its vena comitantes. The artery–vein graft complex was then soaked in a Papaverine solution and mechanically dilated using a radial artery dilator. After the intracranial carotid artery and A1 branch were identified, an M2 branch recipient was identified and temporary clips were placed proximally and distally to isolate a bypass graft landing zone. An arteriotomy of the M2 recipient was completed and one end of the radial artery donor was sutured to this site using interrupted 8–0 Prolene sutures. The plastic surgeons then anastomosed the free end of the radial graft to the intra-parotid STA using interrupted 8–0 Prolene sutures. The matching of the radial artery diameter and the proximal STA segment to which it was connected served to ensure maximal blood flow through the radial artery. The radial vena comitantes was then connected to the neighboring STV using a 2.0 mm coupling device, which provides and easy and fast way of performing the anastomosis. The coupling device consists of 2 metallic rings to which the donor and receiving veins are sutured respectively. The 2 rings are then locked together using a mechanical interlocking system. Following the vena comitantes to STV anastomosis, the temporary clips