NMC Case Report Journal 2020; 7: 67–70
DOI: 10.2176/nmccrj.cr.2019-0119

Case Report

Iatrogenic Pseudoaneurysm at the Deep Temporal Artery after Fronto-temporal Craniotomy Manifesting as Repeated Subcutaneous Hemorrhage -Case Report-

Masahito Katsuki,[1] Miki Fujimura,[1] Kenichi Sato,[2] Yasushi Matsumoto,[2] and Teiji Tominaga[3]

Iatrogenic pseudoaneurysm formation at the deep temporal artery (DTA) is a rare complication after neurosurgical intervention by craniotomy, and its management strategy has yet to be determined. We report a patient who developed iatrogenic pseudoaneurysm at the DTA after fronto-temporal craniotomy manifesting as repeated subcutaneous hemorrhage. A 44-year-old man underwent standard fronto-temporal craniotomy for the microsurgical clipping of a ruptured anterior communicating artery aneurysm in the acute stage. The initial postoperative course was uneventful, but he developed a massive subcutaneous hematoma that penetrated the surgical wound, leading to hypovolemic shock 23 days after the aneurysm surgery. Due to the continuous hemorrhage after temporary hemostasis by ligation of the superficial temporal artery, he underwent catheter angiography, which revealed a newly-formed pseudoaneurysm at the DTA that was 16 mm in diameter. Neuroendovascular obliteration of the pseudoaneurysm was successfully performed using liquid embolization material, *n*-butyl-2-cyanoacrylate, under local anesthesia. Pseudoaneurysm at the DTA is a rare but possible complication after fronto-temporal craniotomy, which can be fatal due to marked hemorrhage. Due to the anatomically deep location of the DTA under the temporal muscle, we recommend accurate diagnosis of the pseudoaneurysm by catheter angiography and prompt obliteration of the affected vessel by a neuroendovascular procedure under local anesthesia, especially when the hemodynamic status is unstable.

Keywords: pseudoaneurysm, deep temporal artery, NBCA, endovascular treatment, iatrogenic

Introduction

Iatrogenic pseudoaneurysm formation at the superficial temporal artery (STA) or occipital artery (OA) is a rare complication of neurosurgical intervention by craniotomy,[1,2] but that at the deep temporal artery (DTA) is even rarer and has not been reported previously. We report a patient who developed an iatrogenic pseudoaneurysm at the DTA after standard fronto-temporal craniotomy manifesting as repeated subcutaneous hemorrhage. Although there was marked hemorrhage from the pseudoaneurysm, the patient was successfully managed by neuroendovascular therapy following accurate diagnosis of the pseudoaneurysm by catheter angiography.

Case Report

A 44-year-old man presented with the sudden onset of loss of consciousness. His Japan Coma Scale score was III-200 and the Glasgow Coma Scale score was 8 (E1V2M5) on admission. Computed tomography (CT) demonstrated subarachnoid hemorrhage with intraventricular hemorrhage and bilateral frontal intracerebral hematomas (Fig. 1A). Digital subtraction angiography (DSA) confirmed a saccular aneurysm at the anterior communicating artery (ACoA) with a diameter of 8.3 mm (arrow in Fig. 1B). There were no abnormalities in the bilateral external carotid arteries, including aneurysmal dilatation, in DSA and preoperative magnetic resonance angiography. The patient underwent left fronto-temporal craniotomy and aneurysmal neck clipping in the acute stage. During standard craniotomy, the temporal muscle flap was tightly flipped toward the cranial base side by the hooked retractor (arrow in Fig. 1C) in order to sufficiently drill out the sphenoid ridge toward the cranial base. After the precise dissection of the left Sylvian fissure and interhemispheric fissure, the neck of the ruptured ACoA aneurysm was tightly occluded using a titanium clip. The initial postoperative course was uneventful, and the patient did not present neurological deterioration during the period of vasospasm. The staples for the surgical wounds were removed on the seventh day without dehiscence. The angiogram 16 days after surgery demonstrated complete disappearance of the aneurysm (Fig. 1D), and the patient continued rehabilitation.

Regarding the temporal profile of magnetic resonance images, T2-weighted image on admission showed no pseudoaneurysms at the DTA (Fig. 1E). T2-weighted image on the next day after clipping also did not show any pseudoaneurysms (Fig. 1F). Fluid-attenuated infusion recovery image 8 days after surgery showed an aneurysmal nodule in the left temporal muscle (arrow in Fig. 1G), which further enlarged 14 days after surgery as shown by T2-weighted image (arrow in Fig. 1H).

[1]Department of Neurosurgery, Kohnan Hospital, Sendai, Miyagi, Japan
[2]Department of Neuroendovascular Therapy, Kohnan Hospital, Sendai, Miyagi, Japan
[3]Department of Neurosurgery, Tohoku University Graduate School of Medicine, Sendai, Miyagi, Japan

Received: May 29, 2019; Accepted: October 17, 2019
Online March 24, 2020

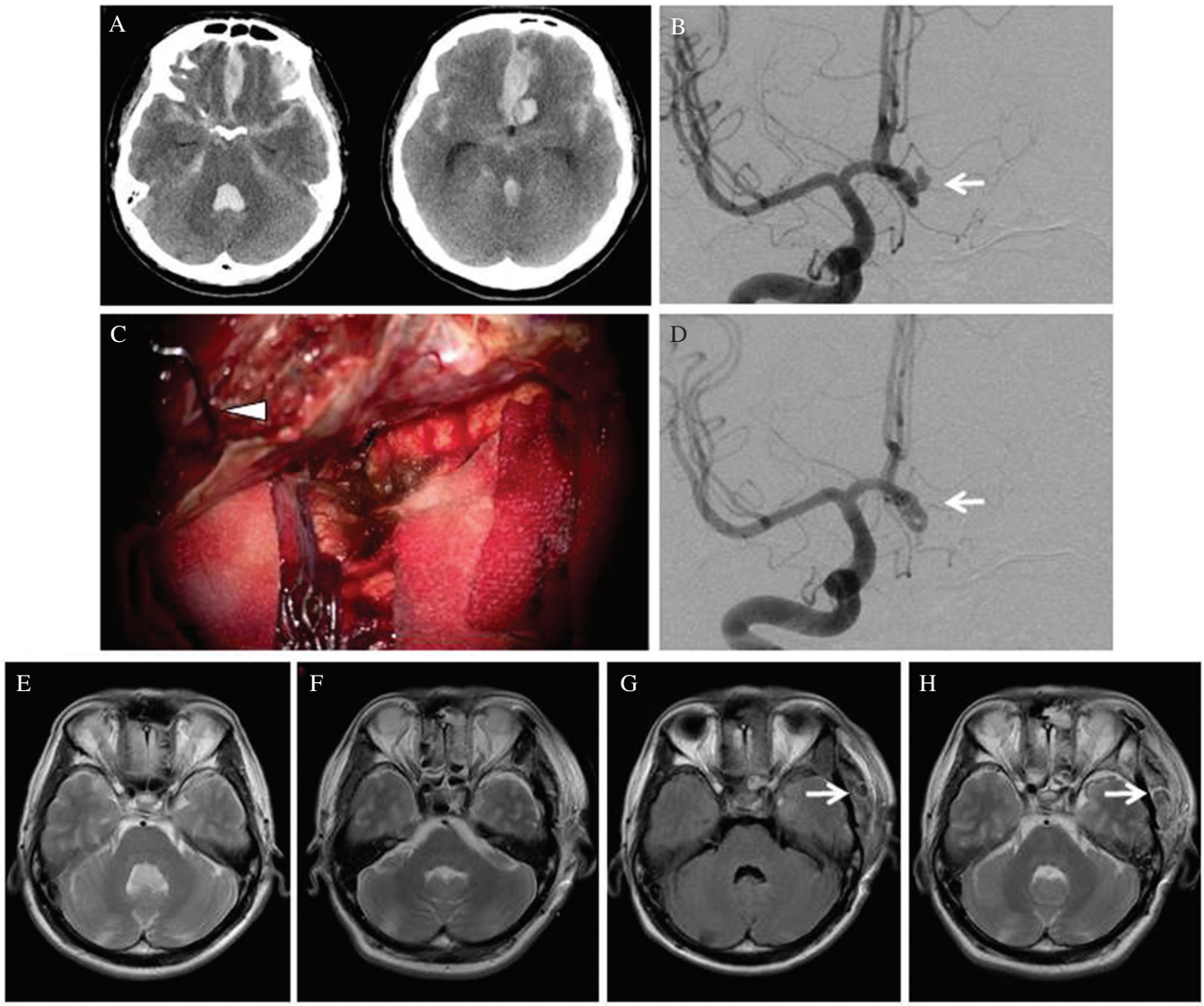

Fig. 1 (A) Initial computed tomography showing diffuse and thick subarachnoid hemorrhage predominantly in the interhemispheric cistern. (B) Preoperative angiography demonstrating a saccular aneurysm at the anterior communicating artery (ACoA) (arrow in B). (C) Intra-operative view of left fronto-temporal craniotomy. The temporal muscle flap was tightly flipped toward the cranial base side by the hooked retractor (arrowhead). (D) Post-operative angiography demonstrating complete disappearance of the ACoA aneurysm (arrow). (E) T2-weighted magnetic resonance image on admission showing no deep temporal artery (DTA) pseudoaneurysms. (F) T2-weighted image on the next day after clipping also showing no DTA pseudoaneurysms. (G) Fluid-attenuated infusion recovery image on the eighth postoperative day showing aneurysm in the temporal muscle (arrow in G). (H) T2-weighted image on the fourteenth postoperative day showing the growing aneurysm (arrow in H).

Twenty-three days after surgery, the patient exhibited hypovolemic shock in the patient room, with marked arterial bleeding from dehiscence of the surgical wound associated with a massive subcutaneous hematoma. Emergency CT after temporary hemostasis revealed a massive subcutaneous hematoma under the left temporal muscle, extending into the epidural space through the bone defect after craniotomy (Fig. 2A). Subcutaneous hemorrhage occurred on the following day, and further expansion of the hematoma was observed on CT (Fig. 2B). Although the left STA was ligated, the patient continued to hemorrhage from the surgical wound. Therefore, we performed catheter angiography 28 days after the aneurysm surgery to explore the bleeding source. Left external carotid artery injection delineated the newly-formed pseudoaneurysm at the anterior DTA, with a diameter of 16 mm (arrows in Figs. 2C and 2D), which was considered to be the bleeding point.

We then performed neuroendovascular obliteration of the pseudoaneurysm under local anesthesia. The left external carotid artery was catheterized with a 6-F guiding catheter (FUBUKI ST, ASAHI INTEC, Tokyo, Japan) and a microcatheter (DeFrictor, Medicos Hirata, Tokyo, Japan) was navigated into the left anterior DTA. The tip of the microcatheter was positioned at the proximal portion of the DTA away from the pseudoaneurysm. We injected 0.28 mL of 50% *n*-butyl-2-cyanoacrylate (NBCA, B. Braun, Melsungen, Germany) in 12 s and the NBCA cast was formed, leading to the feeder occlusion of the pseudoaneurysm (Fig. 2F).

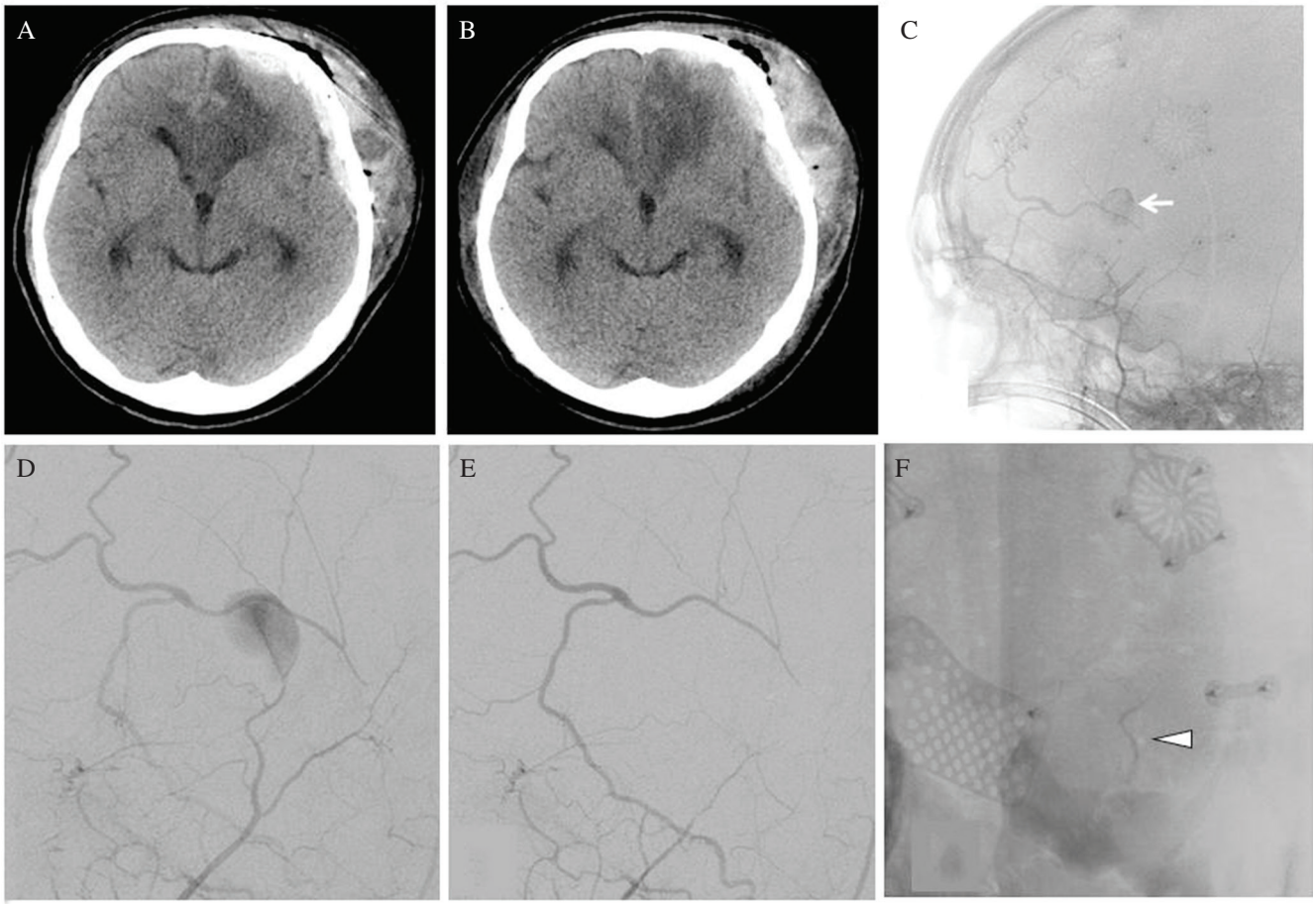

Fig. 2 (A and B) Emergency computed tomography after marked arterial bleeding from the surgical wound revealing a continuous subcutaneous hematoma under the left temporal muscle extending into the epidural space through the bone defect after craniotomy (A), which expanded further on the next day (B). (C and D) Catheter angiography (left external carotid injection) 28 days after aneurysm surgery indicating the newly-formed pseudoaneurysm at the anterior deep temporal artery (DTA), with a diameter of 16 mm (arrow in C). (E) Left external carotid angiography after endovascular obliteration of the affected DTA demonstrating complete disappearance of the pseudoaneurysm. (F) The *n*-butyl-2-cyanoacrylate cast was formed along the DTA (arrowhead).

After removing the microcatheter, left external carotid angiography confirmed complete disappearance of the pseudoaneurysm (Fig. 2E). No further bleeding occurred during or after the procedure. Thirty-nine days after the aneurysm surgery, the patient was transferred to the rehabilitation hospital.

Discussion

Pseudoaneurysms at the STA or OA present as a painless, pulsatile and expanding mass in the temporo-occipital area.[1–3] In 1985, Rousseaux et al.[4] reported the first case of iatrogenic STA pseudoaneurysm, and more than 22 cases have been reported. Since 2007, when Tambasco[5] described the first case of iatrogenic OA pseudoaneurysm, three case reports have been published. To the best of our knowledge, however, pseudoaneurysm formation at the DTA after standard fronto-temporal craniotomy has not been reported previously. Therefore, this is the first report of a patient who underwent endovascular embolization for a ruptured pseudoaneurysm at the DTA under local anesthesia.

Previous reports suggested that iatrogenic pseudoaneurysms at the STA or OA result in poor outcomes due to marked hemorrhage.[6–8] Therefore, pseudoaneurysms on the scalp should be managed promptly.[6–8] As they are located on the superficial region of the scalp, they can be diagnosed by ultrasonography[9,10] or surgical resection under local anesthesia as diagnostic treatment.[2] On the other hand, pseudoaneurysms at the DTA are located in an anatomically deeper layer, and standard ultrasonography and/or direct surgical exploration may fail to detect them. Indeed, our patient was finally diagnosed with a DTA pseudoaneurysm from the bleeding point according to catheter angiography. Based on the definitive diagnosis by DSA, we successfully managed the pseudoaneurysm at the DTA by neuroendovascular therapy using NBCA.

The exact mechanism underlying the formation of the pseudoaneurysm at the DTA in the present case is undetermined, but the following events may have played a role in this rare complication after standard fronto-temporal craniotomy: considering the anatomical location of the DTA ascending between the temporal muscle and the pericranium on the deep surface of the temporal muscle,[11] it is conceivable that microtrauma, either direct or indirect, to the intima

of the DTA caused by exfoliation of the pericranium and temporal muscle from the cranium, and tight retraction of the temporal muscle flap by sharp hooked retractors, collectively led to the formation of the DTA pseudoaneurysm. Direct injury of the affected artery during skin incision is less likely to participate in this rare complication, because the DTA pseudoaneurysm in our case was located apart from the site of the skin incision. While considering the gradual enlargement of the DTA pseudoaneurysm as shown by time sequential magnetic resonance images (Figs. 1E–1H), it is concervable that more indirect mechanical impact such as tight retraction of the temporal muscle and/or exfoliation of the pericranium and temporal muscle from the cranium could mainly initiate the pseudoaneurysm formation. In fact, pseudoaneurysms of the OA, STA, and internal maxillary artery could occur more commonly in delayed fashion after indirect impacts including blunt head injuries rather than iatrogenesis.[12–15] Therefore, it could be important to peel off the periosteum from the cranium gently not to affect the temporal muscle layer directly while flipping the skin flap. We also recommend thorough coagulation of the arterial bleeding and the use of hooked retractor with blunt tip during craniotomy.

Regarding the management of the pseudoaneurysm at the DTA, general anesthesia is required for direct surgical resection because of its deep location, but our choice of neuroendovascular obliteration of the affected DTA enabled immediate patient management after the diagnostic angiography under local anesthesia. Due to the continuous hemorrhage from the DTA pseudoaneurysm and unstable systemic hemodynamics, we considered emergency neuroendovascular therapy under local anesthesia to be the best management choice to treat this deleterious complication. The post-procedural hemodynamics were stable and no further bleeding occurred after neuroendovascular obliteration of the pseudoaneurysm in the present case.

Conclusion

Pseudoaneurysms at the DTA are a rare complication after fronto-temporal craniotomy, which may be fatal due to marked hemorrhage leading to hemorrhagic shock. Considering the anatomically deep location of the DTA under the temporal muscle, we recommend accurate diagnosis of the pseudoaneurysm by catheter angiography and prompt obliteration of the affected vessel by a neuroendovascular procedure under local anesthesia, especially when the hemodynamic status is unstable.

Conflicts of Interest Disclosure

The authors report no conflicts of interest concerning the materials or methods used in this study, or the findings presented in this paper. No sources of financial or material support were received. This article and content of this study were not published or presented previously. This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

References

1) Srinivasan VM, Karas PJ, Sen AN, Fridley JS, Chen SR, Gopinath SP: Occipital artery pseudoaneurysm after posterior fossa craniotomy. *World Neurosurg* 98: 868.e1–868.e4, 2017
2) Elgamal ME, Elgamal EA, Ahmad A, et al.: Iatrogenic (traumatic) occipital artery pseudoaneurysm - rare complication of ventriculoperitoneal shunt in an infant: case report and review of the literature. *Asian J Neurosurg* 13: 914–917, 2018
3) Conner WC, Rohrich RJ, Pollock RA: Traumatic aneurysms of the face and temple: a patient report and literature review, 1644 to 1998. *Ann Plast Surg* 41: 321–326, 1998
4) Rousseaux M, Lesoin F, Barbastre, Jomin M: Postoperative aneurysm of the superficial temporal artery. *Neurochirurgie* 31: 461–463, 1985 (French)
5) Tambasco N, Hamam M, Castrioto C, Calabresi P, Rossi A: Occipital pseudoaneurysm as a complication of extension channel placement for DBS in Parkinson's disease. *Mov Disord* 22: 1834–1836, 2007
6) Madhusudan HV, Krishnamoorthy N, Suresh PK, Subramaniam V: Superficial temporal artery pseudoaneurysm presenting as extradural hematoma: a case report and review of literature. *Asian J Neurosurg* 10: 63–65, 2015
7) Fujiwara Y, Miyazaki T, Yoshikane T, et al.: A case of traumatic occipital artery pseudoaneurysm followed by hemorrhagic shock. *No Shinkei Geka* 46: 61–65, 2018 (Japanese)
8) Honda M, Anda T, Ishihara T: Ruptured pseudoaneurysm of the superficial temporal artery after craniotomy. *Neurol India* 61: 698–699, 2013
9) Bobinski L, Boström S, Hillman J, Theodorsson A: Postoperative pseudoaneurysm of the superficial temporal artery (S.T.A.) treated with Thrombostat (thrombin glue) injection. *Acta Neurochir (Wien)* 146: 1039–1041, 2004
10) Wright CH, Wright J, Badjatiya A, Manjila S, Reed S, Geertman R: Ultrasound guided local endovascular coiling of an iatrogenic superficial temporal artery pseudoaneurysm. *J Cerebrovasc Endovasc Neurosurg* 17: 313–317, 2015
11) Nakajima H, Imanishi N, Minabe T: The arterial anatomy of the temporal region and the vascular basis of various temporal flaps. *Br J Plast Surg* 48: 439–450, 1995
12) Patel M, Tchelepi H, Rice DH: Traumatic pseudoaneurysm of the occipital artery: case report and review of the literature. *Ear Nose Throat J* 87: E7–E12, 2008
13) Cross WR, Nishikawa H: Traumatic pseudoaneurysm of the superficial temporal artery. *J Accid Emerg Med* 16: 73, 1999
14) Rubio-Palau J, Ferrer-Fuertes A, García-Díez E, Garcia-Linares J, Martí-Pagès C, Sieira-Gil R: Traumatic pseudoaneurysm of the superficial temporal artery: case report and review of the literature. *Oral Surg Oral Med Oral Pathol Oral Radiol* 117: e112–e114, 2014
15) Chakrabarty S, Majumdar SK, Ghatak A, Bansal A: Management of pseudoaneurysm of internal maxillary artery resulting from trauma. *J Maxillofac Oral Surg* 14: 203–208, 2015

Corresponding author:
Miki Fujimura, MD, PhD, Department of Neurosurgery, Kohnan Hospital, 4-20-1, Nagamachi-minami, Taihaku-ku, Sendai, Miyagi 982-0012, Japan.
✉ fujimur417@kohnan-sendai.or.jp