



Case report

Iatrogenic pseudoaneurysm of the superficial temporal artery following craniectomy from a scalp hook retractor penetrating injury: Case report and literature review

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ABSTRACT

Background: Iatrogenic pseudoaneurysms in scalp vessels are an uncommon complication after cranial surgery. This paper reports a case of scalp pseudoaneurysm in the superficial temporal artery (STA) after forceful hook retraction in craniectomy and reviews the relevant literature.

Case description: A 36-year-old man with history of hypertension and depression presented to the emergency department with head injury after using sedation medication. Brain computed tomography (CT) revealed a 2-cm-thick right parietal extradural hematoma (EDH) with parietal skull fracture, a bilateral lower frontotemporal contusional intracerebral hematoma, diffuse subarachnoid hemorrhage, and a right frontotemporoparietal subdural hematoma. To prevent EDH progression, frontotemporal emergency craniectomy to remove the EDH was performed. The next day, a firm, painful mass measuring $3 \times 3.5 \text{ cm}^2$ was discovered over the right frontal scalp. The mass was close to the site where the scalp hook retractor had been placed during surgery. Sonography revealed pulsatile blood flow with an arterial feeder inside the mass. CT angiography revealed a $1 \times 1.2 \times 0.7 \text{ cm}^3$ pseudoaneurysm in the right frontal scalp from the frontal branch of the STA. We scheduled a resection of the pseudoaneurysm and combined cranioplasty on the 29th postoperative day. The pseudoaneurysm was resected en bloc. The patient was discharged with clear consciousness and intact muscle power.

Conclusion: The complications of STA pseudoaneurysms caused by scalp hook retractors are rare and not yet well reported. Surgeons must avoid injuring the STA when using a scalp hook retractor.

1. Background

Iatrogenic pseudoaneurysms of scalp vessels are uncommon complications after cranial surgery [1]. Reported mechanisms of iatrogenic scalp pseudoaneurysm include penetrating injury by injection needles [2,3], the use of pin-type head holders [4,5], and placement of ventriculoperitoneal shunts [6] or intracranial pressure monitoring devices [7]. The current report describes scalp pseudoaneurysm of the superficial temporal artery (STA) following forceful hook retraction in craniectomy and reviews the relevant literature.

This case report has been reported in line with the SCARE 2020 criteria [8].

2. Case description

A 36-year-old man with history of hypertension and depression presented to the emergency department with head injury after using sedation medication. He was fully conscious and had intact muscle power in all four limbs. Brain computed tomography (CT) revealed a right parietal extradural hematoma (EDH) 2-cm thick with a parietal skull fracture, bilateral lower frontotemporal contusional intracerebral hematoma (ICH), diffuse subarachnoid hemorrhage, and a right frontotemporoparietal subdural hematoma (SDH). To prevent EDH progression, emergent craniectomy over the right frontal, temporal, and parietal regions to remove the EDH and SDH was performed uneventfully by experienced neurosurgeons. The next day, a firm, painful mass

Abbreviations: STA, superficial temporal artery; CT, computed tomography; EDH, extradural hematoma; ICH, intracerebral hematoma; SDH, subdural hematoma; GWT, Gardner-Wells tongs.

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measuring $3 \times 3.5 \text{ cm}^2$ was discovered over the right frontal scalp (Fig. 1). The mass was near the site where the scalp hook retractor had been placed during the operation. Sonography revealed pulsatile blood flow inside the mass with an arterial feeder (Fig. 2). CT angiography revealed a $1 \times 1.2 \times 0.7 \text{ cm}^3$ pseudoaneurysm in the right frontal scalp from the frontal branch of the STA (Fig. 3). The right parietal fracture line did not transverse the STA. Injury to the STA during fish hook retractor placement was suspected. The mass did not change in size in subsequent observation. We scheduled resection of the pseudoaneurysm combined with cranioplasty on the 29th postoperative day. Preoperative sonography revealed reduced blood flow in the pseudoaneurysm. For the craniectomy and pseudoaneurysm resection, the course of the STA was marked using a Doppler vascular detector, and we maintained distance from the STA when placing the fish hook retractor (Fig. 4). A blood clot formation was discovered inside the false lumen, and the feeding artery was ligated using a hemoclip (Fig. 5). The pseudoaneurysm was resected en bloc (Fig. 6). We confirmed that the site of the pseudoaneurysm was where the fish hook retractor had been anchored (Fig. 5). The patient was discharged with clear consciousness and intact muscle power without cosmetic defects. There was no recurrence of the pseudoaneurysm after 6 months follow-up.

3. Discussion

Pseudoaneurysm of the STA is a rare vascular complication following trauma. The etiology of STA pseudoaneurysms includes blunt injury [9], penetrating injury [10], and iatrogenic injury [1]. The present case was pseudoaneurysm of the STA due to iatrogenic injury caused by a fish hook retractor during craniectomy.

A literature review of articles published up to March 31, 2021, was conducted using PubMed and Google Scholar to identify cases of STA pseudoaneurysms with an iatrogenic cause. We excluded duplicate studies, inaccessible articles, and articles not published in English. The published articles were reviewed by all authors to ensure that no potential cases were overlooked.

A total of 13 cases from 12 articles were identified from the literature



Fig. 1. Protruding and tender mass over the right frontal scalp measuring approximately $3 \times 3.5 \text{ cm}^2$.

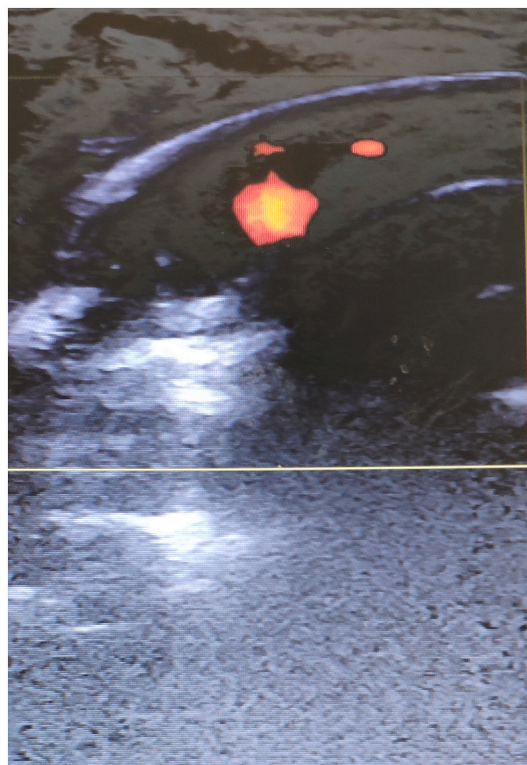


Fig. 2. Pulsatile blood flow inside the mass with an arterial feeder.

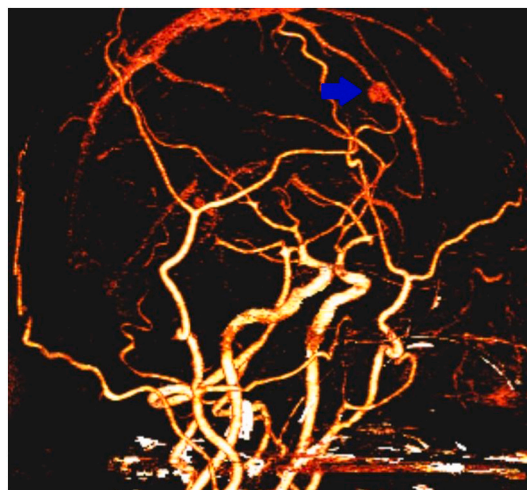


Fig. 3. Extravasation (blue arrow) of the frontal branch of the right STA.

review. Patient age ranged from 3 weeks to 78 years. Table 1 lists the several iatrogenic etiologies of the 13 cases, 3 of which resulted from craniotomy for intracranial aneurysm [5,11,12]. Two cases were caused by penetrating injury from an injection needle [2,3]. Gardner–Wells tongs (GWT) are an instrument used to facilitate the reduction of cervical spine dislocation, and pin-type head holders are widely used in cranial surgery. GWTs and pin-type head holders can directly apply pressure to the scalp because of their pin-type structure. Two cases, one caused by GWT⁴ and one caused by a pin-type head holder [5], were identified. Face lift surgery caused 2 of 13 cases [13], and other iatrogenic etiologies included Mohs surgery for basal cell carcinoma of the lateral forehead [14], bifrontal craniotomy and frontal sinus cranialization for meningioma [15], corrective surgery for craniosynostosis [1], frontal scalp laceration debridement [16], and placement of an



Fig. 4. Course of the frontal branch of the STA preoperatively marked on the scalp.



Fig. 6. Thrombus formation in the pseudoaneurysm was removed en bloc.

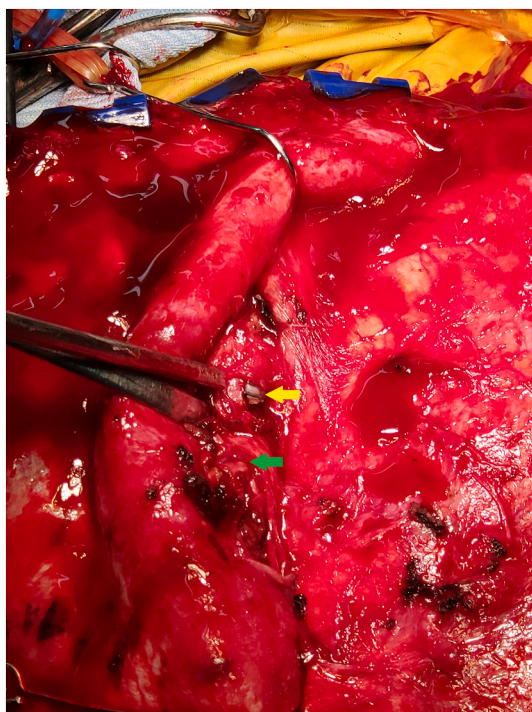


Fig. 5. Pseudoaneurysm (green arrow) and its feeding artery (yellow arrow). The site of the pseudoaneurysm was confirmed to be where the fish hook retractor had been placed in the previous craniectomy.

intracranial pressure monitoring device [7]. Most cases of STA injury were attributed to direct injury to the vessel by needle penetration, thread penetration, pin-type device penetration, or skin incision.

The STA is a branch of the external carotid artery, and it separates into frontal and parietal branches. The frontal branch of the STA is prone to injury because it lacks protection from muscles when crossing from the temporalis muscle to the frontalis muscle [16]. This corresponds with our result that 10 of the 13 cases were caused by frontal branch injury, whereas the remaining 2 cases were caused by parietal branch injury. The two cases of STA injury in the parietal branch were related to pin-type retractor instruments [4,5]. This result may be explained by the sites of pin attachment and pressure applied to the scalp.

We have presented a rare complication of craniectomy caused by a scalp hook retractor. A scalp hook retractor is a surgical device with a

sharp tip that is widely used in brain surgery for scalp retraction (Fig. 7). It is usually applied at the scalp reflection with pressure applied at its tip by using a rubber band. Penetrating injury can occur if the vessel below the scalp is damaged by the retractor's sharp tip. When the tip contacts the STA, the pressure exerted by the retractor tip can cause vascular wall damage. We suspected that the pseudoaneurysm was caused by a penetrating injury from the hook retractor, and we confirmed this hypothesis in the second surgery. We took precautions to protect the STA by using a Doppler vascular detector, and no recurrence of the pseudoaneurysm was noted after surgery.

Management of STA pseudoaneurysms is diverse and includes complete excision, coil embolization, and manual compression. The optimal treatment modality for STA pseudoaneurysm should be considered case by case. The size of our patient's pseudoaneurysm was measured each day, and no enlargement or rupture was noted. Therefore, rather than excising the pseudoaneurysm immediately upon discovery, we arranged its resection in combination with cranioplasty.

4. Conclusions

Complications of STA pseudoaneurysms caused by scalp hook retractors are rare and have not yet been reported. A scalp pseudoaneurysm should be suspected when a postoperative mass is noted along the STA after scalp hook retractor use. Preoperative use of a Doppler vascular detector can help surgeons mark the course of the STA and its branches. Surgeons must avoid injury to the STA when using a scalp hook retractor.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Informed consent

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-chief of this journal on request.

Ethical approval

Not requires.

Table 1
Summary of reported cases of STA pseudoaneurysm.

Reference	Year	Patient gender	Patient age	Iatrogenic etiology	Possible etiology of pseudoaneurysm formation	Management for pseudoaneurysm	Branch of STA
Fernández-Portales et al. [5]	1999	Male	51	Left pterional craniotomy for the ruptured anterior communicating artery aneurysm	Puncture of STA branch by pin-type head holder	Surgical ligation and resection	Parietal branch
Lin et al. [2]	2004	Female	51	Short-scar face lifting surgery	Needle penetration during local anesthesia	Surgical ligation and resection	N/M
Lee et al. [4]	2010	Male	54	Gardner-Wells retraction for C5/C6 fracture and dislocation with spinal cord injury	N/M	Surgical ligation and resection	Parietal branch
Wang et al. [11]	2011	Male	28	Right pterion craniotomy for intracranial false aneurysm	STA was near the initial surgical incision	Surgical ligation and resection	Frontal branch
Terterov et al. [12]	2012	Male	31	Left fronto-orbital craniotomy for the anterior communicating artery aneurysm	Prolonged periods of induced hypertension and hyperperfusion in antivasospasm therapy	Coil embolization	Frontal branch
Skaf et al. [3]	2012	Female	60	Botox injection above the eyebrows and within the left lateral periorbital area	Needle injection trauma	Coil embolization	Frontal branch
Dunbar et al. [14]	2014	Male	50	Mohs surgery for a basal cell carcinoma of the lateral forehead	Vessel injury during cutaneous surgery	Surgical ligation and resection	Frontal branch
Wright et al. [15]	2015	Male	78	Bifrontal craniotomy and frontal sinus cranialization for resection of a right sphenoid wing meningioma and right frontal parasagittal meningioma.	N/M	Coil embolization	Frontal branch
Corvino et al. [13]	2016	Female	45	Facial lifting surgery	Antiptosis lifting thread injury	Not mentioned	Frontal branch
Corvino et al. [13]	2016	Female	55	Facial filler silicon oil injection	Injection trauma	Not mentioned	Frontal branch
Anania et al. [1]	2018	Not mentioned	Three-week-old	Corrective surgery for craniosynostosis	Surgical dissection trauma to STA	Surgical ligation and resection	Frontal branch
Xu et al. [16]	2019	Male	20	Surgical debridement of a right frontal scalp laceration	Scalp laceration over the course of the STA	Surgical ligation and resection	Frontal branch
Pan et al. [7]	2020	Male	30	Right frontal intracranial pressure monitoring device placement	N/M	Surgical ligation and resection	Frontal branch
Current study	2020	Male	36	Right craniectomy for epidural hematoma and ICH	Fish hook retractor penetrating injury	Surgical ligation and resection	Frontal branch

N/M: not mentioned.



Fig. 7. Fish hook retractor used for scalp traction in cranial surgery.

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Hong Xiang Zheng, Yao Lin Lee and Yi-Chieh Hung: perform the surgery
Hong Xiang Zheng, Yao Lin Lee and Yi-Chieh Hung: writing the paper
Guan-Yu Chen: collect the references.

Declaration of competing interest

None declared.

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