



## Case report

## Resolution of anosmia following treatment of traumatic ethmoidal dural arteriovenous fistula

Oszkar Szentirmai<sup>a</sup>, Brian Callahan<sup>a</sup>, Craig H. Rabb<sup>b,\*</sup><sup>a</sup> Department of Neurosurgery, University of Colorado at Denver and Health Sciences Center, Denver, CO, United States<sup>b</sup> Department of Neurosurgery, University of Oklahoma Health Sciences Center, 1000 N. Lincoln, Suite 400, Oklahoma City, OK 73104, United States

## ARTICLE INFO

## Article history:

Accepted 6 October 2009

### 1. Introduction

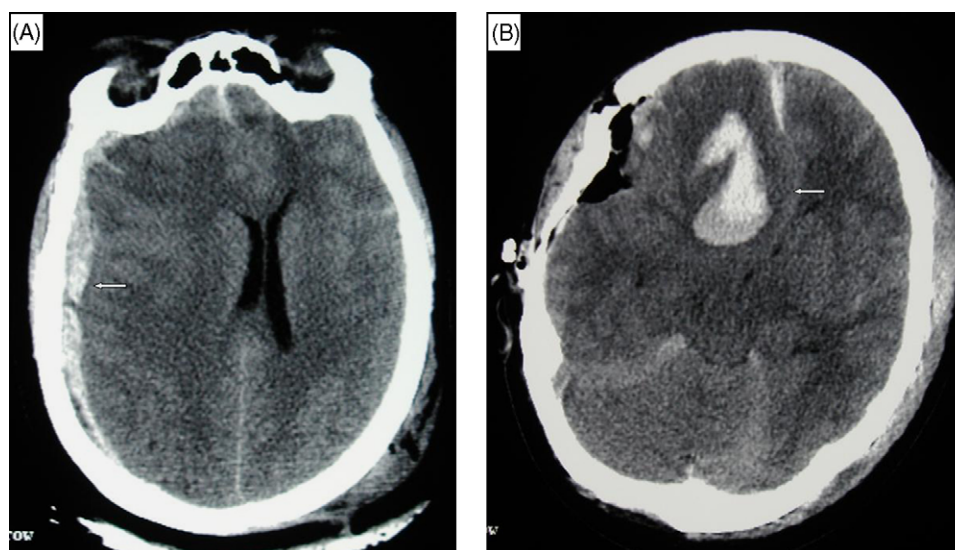
Anosmia is a well-recognised consequence of closed head injury.<sup>1,3</sup> Typically, this thought to result from blunt injury to the olfactory nerves along the cranial base, and is usually considered irreversible. Dural arteriovenous fistulas arising from the ethmoidal branches of the ophthalmic artery are also known to be the result of head trauma.<sup>6</sup> We present a case of post-traumatic anosmia that resolved 2 years following head trauma, following

surgical treatment of an ethmoidal dural arteriovenous fistula (DAVF). As a result, we recommend consideration of screening CT angiography in patients with post-traumatic anosmia.

### 2. Case report

#### 2.1. First hospitalisation

A 50-year-old woman was involved in a high-speed motor vehicle collision, when her car was struck by another car (T-bone mechanism). She arrived to the emergency room with bilaterally dilated and non-reactive pupils and a Glasgow Coma Score of 3. Head CT scan revealed an acute right fronto-temporal subdural haematoma (SDH) associated with midline shift and obliteration of the basal cisterns (Fig. 1a). An emergent right craniotomy was performed for evacuation of the SDH. Immediately following this



**Fig. 1.** (a) Non-contrast Head CT. Initial presentation with a right sided acute SDH. Pre-operative image. (b) Immediate post-SDH evacuation follow-up CT shows the development of a right frontal ICH with significant mass effect. The patient underwent a second craniotomy for evacuation.

\* Corresponding author. Tel.: +1 405 271 4912; fax: +1 405 271 3091.

E-mail address: [craig-rabb@ouhsc.edu](mailto:craig-rabb@ouhsc.edu) (C.H. Rabb).



**Fig. 2.** Coronal MRA, post-contrast. Two years following the evacuation of the SDH and ICH, a right frontal dural arteriovenous fistula is noted.



**Fig. 4.** CTA following a third craniotomy, shows obliteration of the draining vein.

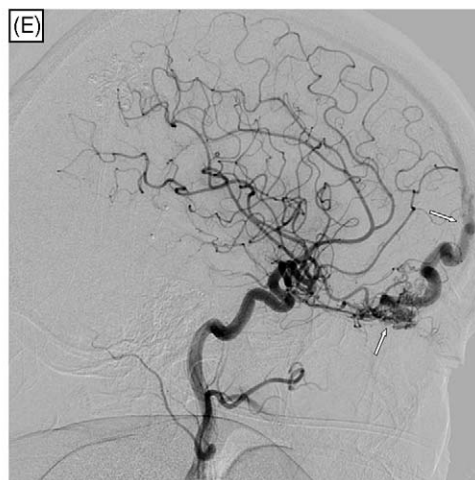
surgery, her intracranial pressure increased to the 40 mmHg, and a repeat CT scan showed a new, right frontal intracerebral haematoma (ICH) with mass effect (Fig. 1b). She was emergently taken back to the operating room for evacuation of the ICH. The patient subsequently underwent inpatient rehabilitation and was eventually able to return to independent daily activities (Glasgow Outcome Score 4–5). During her follow-up visits, she reported inability to smell.

## 2.2. Second hospitalisation

During the course of her outpatient follow-up, an MRI was obtained to assess for any progressive hydrocephalus. This demonstrated a dilated vein in the anterior–inferior frontal region, raising the suspicion of a dural arteriovenous fistula (Fig. 2). As a result, the patient underwent formal angiography,

which confirmed the presence of a dural arteriovenous fistula with arterial supply emanating from the right ethmoidal branches of the ophthalmic artery, and venous drainage into the sagittal sinus via a dilated and elongated draining vein (Fig. 3a and b).

The patient eventually elected to undergo surgical treatment of the fistula. This was accomplished by re-opening her prior craniotomy and dissecting the draining vein via the encephalo-malacic brain. The small dural arterial feeders were extensively coagulated using bipolar coagulation, then two clips were placed on the draining vein, and the draining vein was divided. Post-operative CT angiography (CTA) demonstrated absence of flow through the fistula (Fig. 4). On a routine outpatient follow-up 2 months after surgery, the patient spontaneously reported recovery of her ability to smell. This was confirmed by standard physical exam.



**Fig. 3.** (a and b) Cerebral angiograms confirm the finding of a large DAVF with multiple ethmoidal feeders draining into the superior sagittal sinus via an elongated and dilated draining vein.

### 3. Discussion

Head trauma is responsible for approximately 10% of all olfactory disorders, and for about one fourth of those with anosmia. It has been estimated that approximately 5% of patients with head trauma exhibit total anosmia and 30% develop hyposmia. The prevalence of anosmia is directly proportional to the severity of the head trauma. Costanzo et al. demonstrated a 15.9%, 19.4% and 24.5% incidence of anosmia in 493 patients with Grade I, Grade II and Grade III head trauma, respectively.<sup>1,3,6</sup>

Cerebral dural arteriovenous fistulas (DAVFs) are known to form following head trauma.<sup>2,4</sup> Types II and III DAVFs are usually treated with either open surgical ligation or endovascular obliteration.<sup>2,4,5</sup> There have been occasional case reports of unilateral and bilateral ethmoidal DAVFs following head trauma.<sup>4,5</sup> 62–91% of these DAVFs present with haemorrhage prior to treatment.<sup>4</sup> Embolisation is also carried out with increasing frequency, but risks incomplete obliteration and need for definitive therapy with open surgery.<sup>2,5</sup> Surgical treatment is currently considered the gold standard therapy for ethmoidal DAVFs.<sup>4</sup>

Our patient not surprisingly reported anosmia once she recovered from her brain injuries, a finding that is common in patients sustaining traumatic brain injury. That she harbored a dural arteriovenous fistula was only discovered when she underwent an MRI scan to assess her ventricle size. This was confirmed by formal angiography. We suspect that a vascular injury caused the secondary intracerebral haemorrhage that eventually resulted in the development of a dural arteriovenous fistula. Her car was struck broadside by a drunk driver. As a result, we consider it highly unlikely that the DAVF was present prior to this motor vehicle crash or had any role in causing the crash.

anosmia in association with an ethmoidal DAVF, has previously been reported, although no response to surgical treatment was

described.<sup>6</sup> Presumably, anosmia may result from localised venous hypertension or from steal-effect via a high-flow DAVF. In this case long-standing complete anosmia fully reversed within a month following surgical treatment of an ethmoidal DAVF. This result, in addition to the worrisome tendency for fistulas in this location to bleed, raises the question, if patients with post-traumatic brain injury and anosmia should be screened within 1–2 years of their injury with CT angiography or MRI for the presence of an ethmoidal DAVF.

### 4. Conclusions

Further studies are needed in patients following TBI with anosmia to examine the incidence of anosmia associated with traumatic DAVFs. CT angiography or MRI might be indicated for post-injury screening of patients following traumatic brain injury to rule out the presence of a dural arteriovenous fistula. In addition to preventing haemorrhage, surgical treatment may potentially reverse even long-standing anosmia.

### References

1. Bramerson A, Nordin S, Bende M. Clinical experience with patients with olfactory complaints, and their quality of life. *Acta Otolaryngol* 2007;127:167–74.
2. Cognard C, Januel AC, Silva Jr NA, Tall P. Endovascular treatment of intracranial dural arteriovenous fistulas with cortical venous drainage: new management using Onyx. *AJNR Am J Neuroradiol* 2008;29:235–41.
3. Costanzo RM, Miwa T. Posttraumatic olfactory loss. *Adv Otorhinolaryngol* 2006;63:99–107.
4. Deshmukh VR, Chang S, Albuquerque FC, McDougall CG, Spetzler RF. Bilateral ethmoidal dural arteriovenous fistulae: a previously unreported entity: case report. *Neurosurgery* 2005;57:E809.
5. Katsaridis V, Papagiannaki C, Violaris C. Endovascular treatment of a bilateral ophthalmic-ethmoidal artery dural arteriovenous fistula. *J Neuroophthalmol* 2007;27:281–4.
6. Toone BK. Psychomotor seizures, arterio-venous malformation and the olfactory reference syndrome. A case report. *Acta Psychiatr Scand* 1978;58:61–6.