Anosmia After Coiling of Ruptured Aneurysms
Prevalence, Prognosis, and Risk Factors

A. Stijntje E. Bor, MD; Sophie L. Niemansburg, MSc; Marieke J.H. Wermer, MD, PhD; Gabriel J.E. Rinkel, MD

Background and Purpose—Anosmia occurs frequently in patients with subarachnoid hemorrhage (SAH) from a ruptured aneurysm treated with clipping. We analyzed prevalence, prognosis, and potential risk factors for anosmia after coiling for SAH.

Methods—We interviewed all patients who resumed independent living after SAH treated with coiling between 1997 and 2007. We assessed by means of logistic regression analyses whether risk of anosmia was influenced by site of the ruptured aneurysm, neurological condition on admission, amount of extravasated blood, hydrocephalus, and treatment for hydrocephalus.

Results—Of 197 patients, 35 (18%; 95%CI:12 to 23) experienced anosmia. Anosmia had improved in 23 (66%) of them; in 20 the recovery had been complete after a median period of 6 weeks (SD ±6.5). Intraventricular hemorrhage was a risk factor for anosmia (OR 2.4; 95%CI:1.0 to 5.9). Anterior aneurysm location (OR 1.1; 95%CI:0.5 to 2.3) and high amount of extravasated blood (OR 0.9; 95%CI:0.4 to 2.1) were not related to anosmia.

Conclusions—Anosmia occurs after coiling in 1 of every 6 SAH patients, but has a good prognosis in most patients. The cause of anosmia after coiling for ruptured aneurysms remains elusive; severity of the initial hemorrhage or long lasting hydrocephalus may be contributing factors. (Stroke. 2009;40:00-00.)

Key Words: intracranial aneurysm ■ subarachnoid hemorrhage ■ olfaction disorders ■ cohort studies ■ risk factor

After aneurysmal subarachnoid hemorrhage (SAH) patients often experience loss of smell.1,2 It used to be regarded as a complication of clipping,2,3 but recently anosmia was found to occur after coiling.1 We studied the prevalence and prognosis of anosmia after aneurysmal SAH treated with coiling and assessed its cause by analyzing potential risk factors.

Materials and Methods

We included all patients admitted to the University Center Utrecht with SAH (confirmed by CT or lumbar puncture) from a ruptured aneurysm (confirmed by CT-angiography) between January 1997 and May 2007, who had been treated with clipping, and who resumed independent living. During the clipping procedure all patients were placed under general anesthesia. SAH had to be more than 6 months ago, to assess recovery of anosmia over time. All patients with preexistent anosmia or any intracranial surgery other than an aneurysm (confirmed by CT-angiography) between January 1997 and May 2007, who had been treated with clipping, and who resumed independent living. During the clipping procedure all patients were placed under general anesthesia. SAH had to be more than 6 months ago, to assess recovery of anosmia over time. All patients with preexistent anosmia or any intracranial surgery other than an uncomplicated intraventricular drain insertion were excluded.

From each patient we recorded gender, age, date of the SAH, neurological condition at admission (World Federation of Neurological Surgeons scale),4 site of the aneurysm, presence of hydrocephalus, and treatment modality for hydrocephalus. All CT scans performed within 72 hours of SAH were assessed for the amount of subarachnoid blood1 and the presence of hydrocephalus by means of the bicaudate index (BCI).5,6 BCI was recalculated into a relative bicaudate index (rBCI) by dividing the actual BCI by the upper limit of the BCI (95th percentile) for the age of the patient.6

Patients were interviewed with a self-developed semi-structured questionnaire performed in the outpatient clinic or by telephone.1 Impact of the loss of smell was assessed on a visual analog scale (VAS).

We performed univariate regression analysis for all possible risk factors and multivariate regression analysis with forward selection of variables with P<0.20 in the univariate analysis.

Results

We included 197 patients (Table 1); for 161 a CT scan within 72 hours after SAH was available for assessment (Table 2). Of these 161 patients, 96 (60%) had intraventricular blood, and 43 (27%) a Hijdra score of ≥4 for intraventricular hemorrhage.5 The CT of 142 patients (89%) showed blood in the interhemispheric fissure, in 46 patients (29%) showing the highest possible score. A loss of smell was reported by 35 (18%, 95%CI 12% to 23%) patients; 20 reported an average impact of the anosmia on their daily life of 65 (standard deviation ±31) on the VAS, 15 (43%) were unable to express the impact. Smell had not improved in 9 patients (26%); complete recovery had occurred in 20 (57%). The median duration of their loss of smell was 6 weeks (SD ±6.5). Three patients (8.5%) reported partial improvement of the anosmia. The time of partial recovery was 8, 9, and 20 months. Three persons could not tell whether the anosmia had improved.
In univariate analyses we found intraventricular hemorrhage to be associated with anosmia (OR 2.4; 95% CI 1.0 to 5.9; Table 3). High age (OR 2.3; 95% CI 0.9 to 6.1) and intermittent lumbar puncture as treatment for clinical hydrocephalus (OR 2.1; 95% CI 0.7 to 6.6) were not statistically significant associated with anosmia, but had a probability value <0.20 and were therefore entered in the multivariate analysis. In multivariate analysis intraventricular hemorrhage was the only factor that remained statistically significant associated with anosmia (OR 2.4; 95% CI 1.0 to 6.8).

Discussion

Anosmia was found in 1 of 6 patients with aneurysmal SAH treated with clipping. Although anosmia was temporary in most patients, the VAS scores indicated a significant impact of the anosmia on daily living.

In patients with a ruptured aneurysm treated with clipping, anosmia occurs more often (1 of every 3 patients) is more often persistent (only 1 of 6 patients recovers) and takes more time to recover (median 6 months). The difference between clipped and coiled patients in the occurrence and persistence of anosmia is most likely attributable to a different cause of the anosmia.

Intraventricular hemorrhage was the only statistically significant risk factor for anosmia. It is unclear how intraventricular hemorrhage could be a direct cause of anosmia. A large amount of intraventricular blood may be a marker for a large impact of the initial hemorrhage, may result in fluctuating intracranial pressure from drainage and blocking of the drainage system, or may result in long lasting enlargement of the ventricles, because hematocoecephalus often is difficult to treat.

There are several limitations to this study. First, the prevalence of anosmia was determined with questionnaires and not with olfaction tests. It is known that patients may report normal olfactory function in spite of loss of olfaction. The prevalence could also be underestimated because patients were interviewed at least 6 months after SAH. Patients with transient anosmia might have had trouble to recall the experienced anosmia, in particular if they had been very ill during the first weeks after SAH. However, we compared the results from this study with the results of a study on anosmia in clipped patients that was carried out with the same limitations of interviewing patients 6 months after SAH, which makes it legitimate to compare the characteristics of anosmia after clipping with those after coiling. As we did not record the number of patients who were fed by nasogastric tubes and who may have developed sinusitis as a complication of this kind of feeding, we were unable to analyze a possible effect of nasogastric feeding on the prevalence of anosmia. Also, certain medications, such as...
ACE inhibitors and antibiotics, may influence taste. However, we never use ACE inhibitors during the clinical course of SAH. The antibiotics norfloxacine and ceftazidim can influence smell, but these are rarely used in patients with SAH in our hospital.

The cause of anosmia after coiling remains elusive. Initial impact of the hemorrhage and long lasting hydrocephalus might be contributing factors. Patients with anosmia should be informed that their symptoms are likely to improve.

**Disclosures**

None.

**References**


Anosmia After Coiling of Ruptured Aneurysms. Prevalence, Prognosis, and Risk Factors
A. Stijntje E. Bor, Sophie L. Niemansburg, Marieke J.H. Wermer and Gabriel J.E. Rinkel

*Stroke.* published online April 16, 2009;
*Stroke* is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2009 American Heart Association, Inc. All rights reserved.
Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/early/2009/04/16/STROKEAHA.108.539445.citation

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in *Stroke* can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to *Stroke* is online at:
http://stroke.ahajournals.org//subscriptions/