Original Article

Assessing symptoms of empty nose syndrome in patients following sinonasal and anterior skull base resection

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Background: Empty nose syndrome (ENS) is a rare condition characterised by paradoxical nasal obstruction following sinonasal surgery. For oncological purposes it is sometimes necessary to resect some or all of the structures within the nasal cavity.

Methods: We surveyed patients using the SNOT-25 questionnaire that had undergone large sinonasal or anterior skull base resection for symptoms of ENS.

Results: There were 17 patients from a single surgeon practice included in the study. None of the patients reported symptoms of ENS.

Conclusions: Patients undergoing anterior skull base surgery do not appear to develop ENS suggesting that the syndrome is more complex then anatomic alterations.

Keywords: Paranasal sinuses; intranasal surgery; turbinates; nasal disorders

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Introduction

Empty nose syndrome (ENS) refers to the crusting, dryness and paradoxical nasal obstruction that some patients suffer following sinonasal, particularly turbinate, surgery. Although the prevalence of ENS is unknown, it is rare and indeed not everybody that undergoes turbinate resection will suffer from ENS symptoms. The condition has also been described in patients that have normal turbinate volume. These details, combined with a lack of an objective method for diagnosis make ENS a difficult condition to identify and manage.

Endoscopic endonasal approaches to anterior skull base tumours have evolved in recent years and there is now literature supporting its use compared to traditional approaches in terms of gross tumour resection and complication rates (1,2). Approaches to the anterior skull base are tailored to the individual case but commonly include complete middle and/or inferior turbinate resection, septectomy as well as ethmoidectomy and sphenoidotomy. Mucosal flaps are also commonly used to cover defects. The aim of these oncological procedures is to remove all remnants of tumour, and the turbinates, if not involved, often need to be resected for access.

Quality of life (QOL) tools attempt to quantify a patients' personal assessment of their health status. The Sino-Nasal Outcome Test (SNOT-20) is a validated 20-item QOL survey that requires participants to rate sinonasal related symptoms such as sneezing, discharge and facial pain (3). In order to tailor this assessment for patients suffering ENS, Houser *et al.* (4) added an additional five domains to create the SNOT-25. This survey better evaluates the specific symptoms these patients suffer. These additional domains include dryness, difficulty nasal breathing, suffocation, nose too open and nasal crusting.

There have been studies that demonstrate improved

Figure 1 MRI following anterior skull base resection. The complete resection of the septum and turbinates result in a completely empty cavity.

Table 1 Summary of patient characteristics

Patient characteristics	Data
Total patients, n	17
Age (years), mean	52
Age (years), range	29–73
Male	13
Female	4
Follow up (months), median	32
Follow up (months), range	6–53

long-term QOL following anterior skull base resection (5,6) as well as after surgical intervention in ENS (7).

In this study we aim to assess whether patients undergoing resection for anterior skull base tumours develop ENS. As part of their oncological procedure these patients are often left with a true 'empty nose' with not only loss of turbinate volume and ethmoid/sphenoidotomy but also significant loss of nasal mucosa. An example of this is demonstrated in *Figure 1*

Methods

Patients from the tertiary practice of a single surgeon that had undergone anterior skull base or craniofacial resection for tumours between January 2009 and December 2014 were identified. The available patients were administered the SNOT-25 questionnaire by phone. The SNOT-25 can found at Houser *et al.* (4). Informed verbal consent was obtained for all patients. Additional information that was collected included patient demographics, treatment modalities and tumour characteristics.

Table 2 Summary of patient pathology

Pathology	Number of patients
Adenocarcinoma	4
Meningioma	2
Pituitary macroadenoma	2
Osteoma	2
Squamous cell carcinoma	1
Meningocele	1
Metastatic thyroid cancer	1
Rhabdomyoma	1
Glomangiopericytoma	1
SNUC	1
Hemangiopericytoma	1

SNUC, sinonasal undifferentiated carcinoma.

Results

A total of 34 patients were identified and of these 17 were contactable and amenable to completing the SNOT-25 questionnaire. Of the 17, 13 were male, the average age was 52 years and the median follow up time was 32 months (summarised in *Table 1*). There was a variety of pathologies, with the most common being adenocarcinoma (summarised in *Table 2*). The extent of the surgical resection for each patient is summarised in *Table 3*. Also included in this table are the details of whether septal, pericranial, turbinate or combinations of these were used as flaps to cover defects. Of the included patients, 9 of them received adjuvant radiotherapy prior to undertaking the survey.

The mean SNOT-20 score was 15.6/100 with the mean of the 5 ENS specific domains being 2.2/20 (*Table 4*). None of the patients described suffering the classic ENS symptoms. The most common ENS symptom identified by patients was nasal crusting with 5 of the patients scoring it as moderate or worse.

Table 3 Summary of structures resected, details of intra operative flap used and adjuvant radiotherapy

Patient	Procedure/structures resected	Flap	Radiotherapy
1	E, S, L, Sept, IT	Pericranial + IT mucosa	N
2	A, E, Sept, L	Septal	Y
3	A, E, S, L, MT	Septal	Y
4	A, E, S, L, MT	Septal	Y
5	L	–	N
6	S, Sept	Septal	N
7	L	Pericranial	N
8	S, Sept	Septal	N
9	A, E, S, Sept, MT	Septal + pericranial	Y
10	MM, E, S, Sept, L	Pericranial	Y
11	E, S, Sept	Septal	N
12	A, E, S, Sept, MT	Septal	N
13	A, E, Sept, L	Pericranial	Y
14	A, E, S, F	Pericranial	Y
15	A, E, S, Sept, L	Septal	Y
16	A, E, S, MT	–	N
17	MM, Sept, L	IT mucosa	Y

A, antrostomy; MM, medial maxillectomy; E, ethmoid; S, sphenoid; F, frontal; L, Lothrop; Sept, septectomy; IT, inferior turbinate; MT, middle turbinate; N, no; Y, yes.

Table 4 Mean scores by domain on the SNOT-25 questionnaire

Domains	Mean score
SNOT 20 domains	
Need to blow nose	1.4
Sneezing	1.4
Runny nose	1.1
Cough	0.7
Postnasal discharge	0.9
Thick nasal discharge	0.9
Ear fullness	0.5
Dizziness	1
Ear pain	0.1
Facial pain/pressure	1.1
Difficult falling asleep	0.2
Waking up at a night	0.4
Lack of good night's sleep	0.4
Waking up tired	0.7
Fatigue	1.4
Reduced productivity	0.9
Reduced concentration	0.9
Frustration/restlessness/irritability	0.2
Sadness	0.0
Embarrassment	0.2
ENS domains	
Dryness	0.5
Difficulty with nasal breathing	0.3
Suffocation	0.2
Nose is too open	0.0
Nasal crusting	1.2

SNOT, Sino-Nasal Outcome Test; ENS, empty nose syndrome.

Discussion

ENS is a rare, nebulous condition that presents in patients following sinonasal/turbinate surgery. Its pathophysiology is not well understood but is thought to be due to a combination of reduction in turbinate volume, alterations in air flow and neural damage (8). There is evidence that reducing the surface area within the nasal cavity impairs mucosal cooling, which is required for the sensation of nasal patency (9).

It has been demonstrated that anterior skull base surgery does not have an effect on subjective sinonasal function (10) and that although sinonasal surgery alters nasal anatomy this does not correlate with a change in function (11). In their systematic review, Choby *et al.* (12) concluded that in the appropriately selected patients, middle turbinate resection did not have a detrimental outcome.

Other turbinate reducing procedures such as Denker's operation (medial maxillotomy and inferior turbinectomy) have been shown to improve patient symptoms (13) and QOL (14).

The patients included in this study have had large resections. None of them had postoperative symptoms consistent with ENS. The main complaint was crusting, of

which 5 patients suffered. Of these 5, 2 had radiotherapy as well which can contribute to crusting. Overall it does not appear that radiotherapy had a significant impact on the sinonasal function of the patients in this study.

The lack of ENS symptoms in patients that undergo anterior skull base resections suggests that anatomic alterations alone cannot explain why some patients suffer the sensation of obstruction after surgery. It is important to note that these patients are undergoing operations for oncological reasons not necessarily for sinonasal symptoms. It is possible that some patients that complain of obstruction already have underlying neural/psychological issues and when this subgroup undergo surgery, their persisting symptoms are then attributed to the operation.

There are a number of studies that have demonstrated that surgical interventions, mostly implants to replace turbinate bulk, have improved ENS symptoms (15,16) with there also being reports of improvement in SNOT-25 scores (7). In his systematic review of surgical interventions, Leong (17) concluded that although surgery appears to have benefit for some patients, there are some patients that have no or minimal improvement. Although only a case report, Lemogne *et al.* (18) reported treating a patient with ENS as a somatic symptom disorder with management consisting of cognitive behaviour therapy and psychotropic medication with significant improvement in the patients' QOL, highlighting a potential psychological component to ENS.

Given that anatomical variation, in the form of turbinate reduction, is a core part of ENS it is a logical assumption that patients undergoing massive oncological sinonasal and anterior skull base resection would as a consequence be more likely to develop the condition. In assessing sinonasal function following anterior skull base surgery we have demonstrated that this is not the case and in doing so support the notion that turbinate reduction alone does not account for ENS.

Limitations of our study include not having preoperative SNOT-25 scores to compare to, or serial scores at set intervals post operatively (i.e., before and after adjuvant radiotherapy treatment). Bias could be reduced by the patients completing the surveys independently rather than answering questions over the phone.

Conclusions

In this study we administered the SNOT-25 questionnaire and were able to demonstrate that patients undergoing significant sinonasal resection in approaching anterior skull base lesions do not subsequently develop ENS. This confirms that anatomic alterations cannot completely explain ENS.

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Footnote

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at http://dx.doi.org/10.21037/ajo.2018.01.02). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). Informed verbal consent was obtained for all patients.

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