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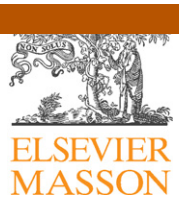

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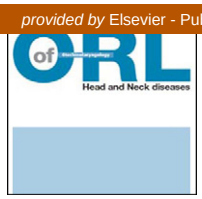

REVIEW

Empty nose syndrome

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KEYWORDS
Empty nose syndrome;
Turbinectomy;
Nasal obstruction;
Rhinitis

Summary Empty nose syndrome (ENS) is a clinical entity without consensual definition; it is a rare complication of nose or sinus surgery, and of inferior turbinectomy in particular. Physiopathology remains unclear, but probably involves disorder caused by excessive nasal permeability affecting neurosensitive receptors and inhaled air humidification and conditioning functions. Neuropsychological involvement is suspected. Symptomatology is variable and changeable, the most common sign being paradoxical nasal obstruction. Diagnosis is founded on: (1) a range of symptoms that need to be precisely collated; (2) broad post-surgical nasal permeability. Management is problematic, deploying the full range of simple nasal cavity hygiene and humidification techniques, with surgery reserved for the most severe cases; whatever the technique, surgery aims at partial filling of the nasal airway. Prevention is the most important strategy, and seeks (1) to check, before any surgery is envisaged, the reality of nasal dyspermeability resistant to medical treatment; and (2) to prefer the most conservative surgical techniques.

Introduction

First described in 1994 by Kern and Moore [1], empty nose syndrome (ENS) is a controversial clinical entity, the very reality of which is disputed by certain authors [2]. It has no consensual definition. It affects certain patients after nasal or sinus surgery, and particularly after inferior turbinectomy, but is rare even in these contexts. It associates the symptomatology of atrophic rhinitis with loss of normal endonasal anatomy, and in particular with the absence of one or more turbinates [3].

Definition — Incidence

ENS is a recognized complication, with onset at an interval of months or years after inferior and/or medial turbinate surgery [2]. It is to be distinguished from atrophic rhinitis (or ozena), which is a primitive pathology of sinonasal structures of unknown origin, showing similar symptomatology.

The most common symptom is so-called ''paradoxical'' nasal obstruction, reported by the patient despite objectively permeable cavities on clinical examination with no obstacle found on imaging or rhinomanometry and acoustic rhinometry [2,4].

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Houser distinguished several subtypes of ENS according to the resected turbinate: inferior, medial, both or, fourthly, a subtype in which turbinate structures paradoxically appear normal [4].

Incidence is unknown, as there have been no specific studies published. Chhabra and Houser, however, estimate a rate of 20% following inferior turbinate resection, which induces simple dry nose in many other patients [2,4,5].

Indeed, many series of turbinectomy or turbinoplasty (taking all techniques together) report almost no cases of ENS among complications. They do, however, mention varying rates of ''failure'': i.e., of patients suffering from postoperative nasal obstruction despite an apparently satisfactory anatomic result.

Physiopathology

The physiopathology of ENS remains poorly elucidated, but several complementary hypotheses are to be found in the literature. It may result from loss of physiological nasal functions (humidification, warming and cleansing of inhaled air) due to reduced mucosal area [6] inducing proportional loss of the sensory, tactile and thermal receptors [7] needed for inhaled air treatment. Shiethauer [8] demonstrated that ENS was associated with decreased humidification, increased warming and reduced nasal airflow resistance. These functional losses were estimated at around 23% following turbinectomy [6,9].

Several studies clearly demonstrated that significantly reduced inferior turbinate volume affects nasal cavity outflow regime, accelerating and increasing flow in the inferior at the expense of the superior part [3,4,10].

These changes underlie an alteration of pulmonary function. Nasal resistance plays a major role in opening peripheral bronchioles and optimizing alveolar ventilation. This in turn improves gas exchange, increases negative thoracic pressure and enhances cardiac and pulmonary venous return [4]. Thus, normal nasal resistance to expiration helps maintain pulmonary volume, indirectly determining arterial oxygenation [11].

The alterations induce the sensation of obstruction reported by patients, which may go as far as a feeling of suffocation.

The sensation of pharyngeal dryness sometimes reported is due to the flow of air insufficiently humidified by the nasal mucosa and drying the rhinopharyngeal mucosa [8].

Central involvement is currently under study. The paradox between subjective congestion and reduced nasal resistance could be due to alterations either in nasal permeability or in the valence of neural efferents from the nasal mucosa [6].

Role of turbinectomy in ENS onset

Atrophic rhinitis and ENS are late complications of turbinectomy. Large-scale resection (total or subtotal turbinectomy) incurs the greatest risk, but ENS has also been reported secondary to partial resection [12], mainly in partial inferior turbinectomy involving the anterior part or head of the turbinate which plays a major role in internal valve function.

Conservative surgery (turbinoplasty, radiofrequency surgery, etc.) is thus recommended after formal indication (nasal obstruction resistant to well-conducted medical treatment in patients with turbinal hypertrophy).

The amount of mucosa resected is not necessarily implicated, and the risk of ENS cannot presently be predicted.

ENS subtypes distinguish ENS secondary to inferior turbinectomy (ENS-IT), to medial turbinectomy (ENS-MT) and to the association of both (ENS-both) [12].

ENS-IT is the most frequent. The basic complaint is paradoxical nasal obstruction and very dry mucosa. One hypothesis for such frequent obstruction following inferior turbinectomy would concern its role in modulating nasal airflow.

ENS-MT is rarer. As well as the typical nasal obstruction, it involves pain on respiration, possibly due to lack of mucosa protecting the pterygopalatine ganglion [12].

ENS and atrophic rhinitis

ENS was long assimilated to a iatrogenic form of atrophic rhinitis. Certain authors, however, detailed a distinction between the two [2,12]. The paradoxical sensation of obstruction, dryness and crusts found in both led to their being confused.

The risk of atrophic rhinitis following surgery including mucosal resection is due not only to the amount of mucosa removed but also to undetermined individual and environmental factors [13], with estimates in the literature ranging from 2 to 20% according to the type of turbinal surgery.

Other associated factors

ENS affects only a few patients who have undergone one or several endonasal procedures, which explains the present controversy as to whether any such organic pathology exists. The underlying factors are only partially understood. One point of contention concerns the frequent association with psychiatric disorder and possibly psychosomatic pathologies (fibromyalgia, functional colopathy, etc.) [3,6,9,14,15]. A possible role of psychological stress in certain patients, as suggested in tinnitus, has been raised [3]. A neurological component might also contribute to onset in the particular case of neuropathic patients [16].

Diagnosis

ENS is made more difficult to diagnose by the lack of consensual clinical definition, the variety of symptoms and the associated psychological and sometimes social distress.

Diagnosis is clinical, founded on subjectively reported symptomatology and clinical examination based on nasal cavity endoscopy performed during consultation.

Clinical diagnosis

Subjective symptomatology

The characteristic-presenting symptom is a sensation of nasal obstruction [2—4,6,12], sometimes associated with sensations of suffocation, breathlessness or difficult

breathing. Other symptoms such as pain, a sensation of empty nose or rhinopharyngeal dryness are also often reported. Symptom intensity varies, and may restrict everyday activity [2]. Patients with ENS symptomatology may suffer loss of concentration (nasal aprosexia), fatigue, anxiety, irritability or depression.

Other frequently reported symptoms are [2,4,17,18]:

- sensation of excessive airflow;
- lack of sensation of nasal airflow;
- hypersensitivity to cold air;
- dyspnea (also paradoxical), breathlessness, hyperventilation;
- nasal pain of variable, sometimes pseudoneuralgic, types;
- headache;
- nasal and pharyngeal dryness;
- difficulty falling asleep, general fatigue.

The SNOT-20 [19] or modified SNOT-25 [3] standardized questionnaires (Sino-Nasal Outcome Test — Appendix A), with 25 questions scored 0 to 5, are useful in diagnosing ENS and assessing subsequent treatment. The most frequent symptoms are sensation of nasal obstruction, dyspnea, nasal and pharyngeal dryness, hyposmia and depression.

Physical examination

Physical examination finds permeable nasal cavities enlarged by previous surgery, with turbinal structures missing or greatly reduced. The mucosa is generally pale and dry [3]. There may be crusts. Dryness, which is an almost constant subjective complaint, is easily confirmed on examination.

Diagnostic test

One simple pre-therapeutic or diagnostic test is the cotton test [2,4]. A piece of moist cotton is placed in the nasal cavity, where an implant would be positioned, for 20 to 30 minutes. Alleviation of symptoms confirms diagnosis and indicates repair surgery.

Paraclinical examinations

Imaging

Diagnosis is clinical, but variable non-pathognomic signs may still be found on imaging.

Sinus CT shows rhinosinus mucosal thickening and maxillary opacity in more than 50% of cases [13,18,20].

Rhinomanometry

Rhinomanometry is not useful for diagnosis [6], but generally confirms the absence of any obstacle, demonstrating normal or weak nasal resistance [4].

Perspectives

Freund's functional MRI study [6,21] demonstrated specific activation patterns in temporal and cerebellar regions and the amygdala in ENS patients.

Bronchopulmonary functional exploration is certainly useful in case of lower respiratory tract symptoms.

Bacteriology is also recommended in case of crusts and suppuration; it enables adapted antibiotherapy.

The roles of cytologic or anatomopathologic analysis of turbinal mucosa and mucociliary functional exploration remain to be determined.

Treatment

Prevention of ENS

Turbinate conservation during endonasal and sinus surgery and rhinoplasty is fundamental in minimizing risk of ENS [1]. Inferior turbinectomy is a common procedure for nasal obstruction in case of turbinal hypertrophy resistant to medical management [22]. Surgery used to aim at maximal resection to maximize gain in nasal cavity volume; with improvements in knowledge of the complications of total and subtotal turbinectomy, including ENS, present attitudes favor conservative surgery.

The techniques currently recommended [23] are:

- laser surgery [24] and electrical cauterization;
- partial turbinectomy, conserving at least 50% of turbinate volume;
- submucosal turbinoplasty, to manage nasal obstruction by reducing turbinate volume without resecting the mucosa needed for nasal function, and consisting in resecting turbinal bone without involving the associated mucosa;
- submucosal resection by micro-debrider, which also conserves the mucosal surface;
- radiofrequency surgery [25], which avoids ENS-type complications.

Indications for any turbinate surgery should be carefully considered, and functional exploration should be generalized.

Surgical treatment

The objectives of endonasal repair surgery are: to reduce nasal cavity volume so as to increase resistance to airflow, to reduce airflow so as to increase air humidity, and to deviate airflow from the surgical site toward a healthy or non-operated area [12].

The principle consists in positioning an implant on the septum, floor or lateral wall [2,18,26].

Endonasal microplasty

Creating a neo-turbinate is one of the surgical solutions available in ENS. Techniques vary from team to team, but results have been very encouraging [17,18]. The material used should combine minimal risk of extrusion, rejection and infection with sufficient and well-tolerated restoration of volume in the nasal cavity. This has been achieved by submucosal implantation of a turbinal or septal cartilage graft to restore inferior turbinate volume [18]. The aim is to restore a mucosal area sufficient to ensure the physiological functions of warming, filtering and humidification of inhaled air. Exogenic materials (hydroxyapatite [26], goretex [17,27], teflon, plastipore) have also given satisfactory results in the small series that have been published; they do not seem to induce rejection, and enable lasting increase in turbinate

volume [2,4]. Hyaluronic acid gel, an injectable composite, also seemed to improve symptoms without increasing complications [17].

The amount of volume restored by surgery and the durability of its efficacy remain under discussion [4,18].

Houser [4] described a technique of submucosal acellular dermis graft filling. The dermis showed integration within 3 to 6 months, and the resultant volume proved durably effective.

These results are interesting but difficult to assess given the small numbers involved in the various series.

Indications should in all cases be carefully considered; we recommend neuropsychological counseling ahead of any decision to operate, given the possible psychological impact of surgical failure.

These techniques are only possible if there is some residual turbinate. Otherwise, the problem confronting surgery is more complex. Medialization or volume augmentation of the intersinonasal wall has been recommended; medialization seems to provide mediocre results, with a risk of lacrimal duct obstruction [25].

Medical treatment

Although non-codified, medical treatment is obviously indispensable and is the first-line attitude in all cases.

It can associate nasal lavage (physiological saline, sulfur derivatives), nasal hydration ointment, directed antibiotherapy, aerosols and local corticosteroids, although such treatments seem to be less effective in ENS than in atrophic rhinitis [18].

Adding menthol to the classical local treatments may provide benefit in terms of the nasal obstruction sensation [6].

Associated treatments

Follow-up should include psychological support for patients showing signs of depression, and algotherapy in case of serious pain.

Conclusion

ENS seems to us to be an entity that is not to be overlooked, especially as it can severely affect certain patients whose only presenting complaint was nasal obstruction. It might be suspected that this nasal obstruction was initially disproportionate in its psycho-affective and social impact compared to the objective and clinical observations, predisposing to ENS following turbinate surgery. Diagnosis and management remain to be codified, but the best attitude is preventive, preferring medical treatment and the least invasive surgery possible to deal with a nasal obstruction.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

Appendix A. SNOT-20 and SNOT-25 quality-of-life questionnaires adapted for empty-nose syndrome.

SNOT-20 and SNOT-25 assessment for ENS.

	Scoring Range (0—5)					
SNOT-20 and SNOT-25 Nasal Symptoms	0 No symptoms	1	2	3	4	5 Severe symptoms
1. Need to blow nose						
2. Sneezing						
3. Runny nose						
4. Cough						
5. Postnasal discharge						
6. Thick nasal discharge						
7. Ear fullness						
8. Dizziness						
9. Ear pain						
10. Facial pain/pressure						
11. Difficulty falling asleep						
12. Waking up at night						
13. Lack of good night's sleep						
14. Waking up tired						
15. Fatigue						
16. Reduced productivity						
17. Reduced concentration						
18. Frustration/restlessness/irritability						
19. Sadness						
20. Embarrassment						
Houser Modification adds:						
21. Dryness						
22. Difficulty with nasal breathing						
23. Suffocation						
24. Nose is too open						
25. Nasal crusting						

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