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Review

Nasal polyposis (or chronic olfactory rhinitis)

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ABSTRACT

The concept of chronic rhinosinusitis with or without polyps is founded on the structural and functional unicity of the pituitary mucosa and its united response to environmental aggression by allergens, viruses, bacteria, pollution, etc. The present review sets this concept against the evo-devo three-nose theory, in which nasal polyposis is distinguished as specific to the olfactory nose and in particular to the non-olfactory mucosa of the ethmoid, which is considered to be not a sinus but rather the skull-base bone harboring the olfactory mucosa. The evo-devo approach enables simple and precise positive diagnosis of nasal polyposis and its various clinical forms, improves differential diagnosis by distinguishing chronic diseases of the respiratory nose and those of the paranasal sinuses, hypothesizes an autoimmune origin specifically aimed at olfactory system auto-antigens, and supports the surgical concept of nasalization against that of functional sinus and ostiomeatal-complex surgery. The ventilation function of the sinuses seems minor compared to their production, storage and active release of nitric oxide (NO) serving to oxygenate arterial blood in the pulmonary alveoli. This respiratory function of the paranasal sinuses may indeed be their most important. NO trapped in the ethmoidal spaces also accounts for certain radiographic aspects associated with nasal polyposis.

1. Introduction

Nasal polyposis has a foggy and ambiguous past, which loses itself in the recent history of rhinology. Hippocrates gave the name "polyp" to any macroscopic tissue mass with a bell-clapper shape in the nasal cavity, by analogy with aquatic polyps. Nasal specula and Clar mirrors were long the only means of examining the nostrils, but from the early 20th century rhinologists were able to base their diagnoses on facial X-ray, with four views [1]. In the same period, nasal and facial sinus anatomy was masterfully described, with the ethmoid considered to be the hub of sinus pathology [2]. The advent of computed tomography (CT) in the late 20th century enabled fine-grained radiologic exploration of the sinuses, and in particular of the ethmoid, which had hitherto been poorly visualized on X-ray. At the same time, rigid and later flexible endoscopy was developed, becoming the gold-standard exploration of the nasal cavities and sinuses [3].

Clar mirrors and nasal specula revealed nasal polyps, which turned out histologically to be either tumoral or inflammatory. The very large number of polynuclear eosinophils found in inflammatory polyps, which tended to be bilateral, led to the definition of "nasal polyposis" as an entity in itself, suspected to be allergic in etiology. However, radiography revealed systematic sinus opacity in these patients, and the term "sinonasal polyposis" came to be preferred. In the same period, the otologic operative microscope was used to treat polyposis; in the 1980s, however, endoscopy proved better suited for intranasal surgery. High-resolution CT scans then drew attention to the ostiomeatal complex as the hub of ventilation and drainage of the anterior facial sinuses [4,5].

In 1994, a CT study of the common cold [6] found more or less extensive opacities in the sinuses even in the absence of any clinical symptoms of acute sinusitis, highlighting the apparently unitary response of the nasal and sinus mucosa to aggression; this unity was suggested in the 17th century by Schneider, for whom this mucosal membrane was named [7], and strengthened by Zuckerkandl's work in the 19th century [2]. In parallel to this CT study, the main international consensus statements agreed on the term "chronic rhinosinusitis" as designating this unity [8–10], clinically differentiating rhinosinusitis with and without nasal polyps (CRSwNP, CRSsNP), but maintaining the hypothesis of unitary causes and inflammatory pathology underlying both, rejecting the earlier position statement which distinguished nasal polyposis from other polyps [11].

The aim of the present review is to put forward an original description of nasal polyposis based on an evo-devo approach to nasal and sinus pathology, characterizing it as a chronic

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inflammatory disease specifically of the non-olfactory ethmoid mucosa, rather than as a form of chronic rhinosinusitis, which would be a non-specific inflammatory disease of the nasal and sinus mucosa as a whole.

2. Clinical presentation

Diagnosis of nasal polyposis is entirely based on an aspect of edematous polyps in both nasal cavities [8–11]. They appear to prolapse outward (middle meatuses) or inward (olfactory grooves) with respect to the middle turbinates [12].

Polyp volume in the two nasal cavities tends to be asymmetric, and is classically graded as stage 0 = no polyps, stage 1 = polyps only in the middle meatus, stage 2 = polyps projecting beyond the middle meatus without entirely obstructing the nose, and stage 3 = polyps entirely obstructing the nose [8]. We use this classification, with the following refinements: in stage 1, polyps do not go beyond the free edge of the middle turbinate, whether located in the middle meatus or in the olfactory groove; in stage 2, polyps touch the back of the inferior turbinate; in stage 3, polyps touch the floor of the nasal cavity; and in stage 4 polyps reach the nasal vestibule. Certain cases of polyposis developing more posteriorly and prolapsing into and obstructing the nasopharynx can also be classified as stage 4, distinguishing stage 4a (anterior or vestibular) and stage 4b (posterior or nasopharyngeal). Conversely, certain florid forms of unilateral polyposis may be associated with contralateral polypoid edema of the middle meatus or olfactory groove, and can be classified as stage 0a if the polypoid edema is visible only unilaterally or as stage 0b if it is visible on both sides of the middle turbinate.

In reporting polyposis stage, it is important to specify whether endoscopy was performed with or without vasoconstrictors.

The symptomatology of nasal polyposis is polymorphous, ranging from no functional trouble to various isolated symptoms such as nasal obstruction, anosmia, etc., to unbearable chronic or recurrent nasal dysfunction [13]. In case of olfactory fluctuation or loss, however, polyposis should be screened for when endoscopic diagnosis is difficult, especially in the early stages of the disease.

3. CT presentation

A search of PubMed for 1980–2017 with the search-terms "nasal polyposis" and "nasal polyps" found no studies of CT imaging of nasal polyposis as clinically defined. There are not even any sections focusing on imaging of "chronic rhinosinusitis withy polyps" in any of the international position papers [8–10].

Many articles, on the other hand, have studied and classified ethmoidal and sinus opacity in chronic rhinosinusitis without and without polyps: no correlations emerged between CT aspect and clinical presentation [14–17]. The various position papers advise against founding diagnosis of chronic rhinosinusitis on CT alone rather than on chronic symptomatology, with endoscopy to distinguish rhinosinusitis with and without polyps [8–10]. However, not all functional disorders of the nose are due to inflammation, and the term "chronic nasal dysfunction" seems more appropriate than "chronic rhinosinusitis" as an a-priori designation of nasal functional pathology as such [18] and to assess its specific impact on quality of life [19].

Nasal and sinus CT does, however, enable the concept of chronic rhinosinusitis to be reconsidered in the light of the new concepts of evo-devo theory [20] and sinusology [21].

Fig. 1, for example, shows CT imaging of a case of nasal polyposis comprising two coronal slices: one through the frontal sinuses, and one through the ostium (or more precisely, the maxillonasal canal) of the maxillary sinuses. How then does classic sinus ventilation/drainage theory explain the radiotransparency of the frontal and maxillary sinuses in the patient seen in Fig. 1, in whom the two ostiomeatal complexes containing the frontal and maxillary ostia seem opacified by the edematous ethmoidal pathology? And how to explain the gaseous aspect in the superior ethmoidal spaces (Fig. 1b)? The explanatory power of classical sinus ventilation theory should be compared to that of evo-devo theory.

The hypothesis of sinus ventilation renewing the "intrasinus air" derives from the late 19th century description of cavities developing from and dependent on the nasal cavities [22]. There are, however, few studies in healthy volunteers seeking to confirm this sinus ventilation in the strict sense of the term (i.e., renewal of intra-sinus air by nasal cavity air), and their conclusions have been unsure and unconvincing [23,24]. Probable ostial dysfunction due to eosinophil inflammation in polyposis further hinders understanding of frontal and maxillary sinus ventilation in Fig. 1 (the sphenoidal sinuses were also radiotransparent in this patient).

The evo-devo hypothesis regarding paranasal sinus formation offers a more rational explanation. The maxillary, frontal and sphenoidal sinuses (the ethmoid not being a sinus in evo-devo theory [20]) result from bone cavitation following red marrow degeneration. This "pneumatization" also concerns the vertebrae, sternum and avian wing bones, and is poorly understood biologically; at all events, it leaves a bone cavity covered by epithelium generating nitric oxide (NO) [25]. Thus, even in case of ostial dysfunction due to inflammation in nasal polyposis, NO production by the sinus

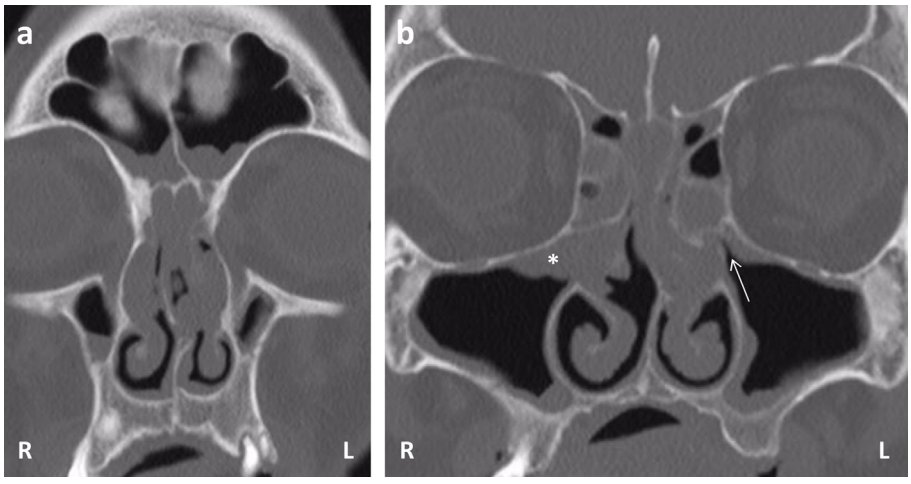

Fig. 1. CT, coronal slices: nasal polyposis: a: coronal slice through frontal sinuses; b: coronal slice through the maxillary sinus ostia (more precisely, through the maxillonasal canals). Arrow shows left maxillonasal canal; asterisk shows aspect of suspected prolapse of ethmoidal polyp in right maxillary sinus. R: right; L: left.

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