Sinonasal Inflammation Manifestations and the Role of the Autonomic Nervous System

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Rhinosinusitis, ANS, Alternative treatment, Refractory rhinosinusitis, Pathophysiology

ABSTRACT

Introduction: Sinonasal inflammatory manifestations such as nasal congestion, discharge, and sneezing, along with sinusitis-related complaints, can be explained with respect to changes in the autonomic nervous system known since the time of the great Greek physician who served the Roman emperors. Scientific discussion began during the 1950s with one publication by Hilger titled autonomic dysfunction in otolaryngology. Despite recent advances in technology, our understanding of the exact mechanisms involved in changes in the autonomic nervous system during sinonasal inflammation due to exposure to inflammatory agents such as allergens, viral, infection, and exposure to physical inflammatory agents is limited.

Methods: The author performed a detailed online data search for publications on PubMed, Medline, Google Search, and Scopus platforms between 1950-2022. During the search, the author focused on sinonasal inflammation, common manifestations, and the relation of patient complaints to changes in the autonomic nervous system.

Result: Still, we are far from clearly knowing the reason behind refractory and chronic rhinitis; cases of sinusitis. The association of autonomic nervous system changes and manifestations of rhinosinusitis knowledge may help the treating physician plan a newer form of treatment for resistant cases.

Conclusions: A better understanding of the autonomic nervous system disturbance will help in planning better methods of treatment for chronic and resistant sinonasal inflammatory diseases, because they affect the individual and the community in all ways of life. This understanding can help to develop alternative methods to treat cases of refractory rhinosinusitis by using new treatment methods such as botulin toxin, mindfulness techniques, and cognitive behavioural therapy.

1. Introduction

Objective:

The purpose of the present narrative review was to revisit the role of the autonomic nervous system in the manifestation of sinonasal inflammation to improve the approach of clinicians to chronic and resistant sinonasal inflammation so that a way forward to a different treatment plan can be opened. This narrative review attempts to answer the clinical question “Can focus on the autonomic nervous system provide a better treatment strategy for sinonasal inflammation?”

Definition of the Autonomic Nervous System:

Every medical student during their first year of undergraduate medical course in nervous system chapters in both anatomy and physiology books, read about the autonomic nervous system. Since Roman physicians to many emperors, the mystic of antiquity, and the great Galen (129-216) knowledge on the autonomic nervous system according to Collins and Cambridge, as well as Oxford dictionary books, the Britannica Encyclopaedia also agrees that the autonomic nervous system is a part of the nervous system in vertebrate, and it has two components. The sympathetic and parasympathetic nervous system, which functions in coordination to maintain homeostasis in vertebrate living beings [1,2,3,4]:

1. Controls gland secretions, i.e., salivary glands, mucus-secreting glands, and even tear-producing lacrimal glands.
2. Muscles of internal organs such as blood vessels, gastrointestinal tract (pharyngeal wall, stomach, intestinal wall), heart, and lung. Controls vasodilatation or vasoconstriction.

Cambridge physiologist John Newport Langely (1852-1925) first coined the term autonomic nervous system in an article published in the journal of physiology in 1898[5].

2. Materials and Methods:

A search strategy was constructed to search for MEDLINE via PubMed, while key words were used to search Embase via Ovid and Google Scholar. The search strategy used for PubMed was as follows:

((("Rhinitis, Vasomotor"[Majr]) OR "Sinusitis"[Majr]) OR (rhinosinusitis)) AND ("Autonomic Nervous System"[Mesh]).

A total of 76 articles were recovered from the year 1950 to 2023. All types of study designs were included. After restricting the search to the English language, 47 articles were obtained as the final search result.

The keywords used for Ovid and Google Scholar were- Rhinitis, Vasomotor Rhinitis, Sinusitis, Rhinosinusitis and Autonomic nervous system.

After removal of duplicates and selection based on title, 38 articles were found relevant for the extraction of information for this narrative review. The author found only 3 articles out of 38 studies specific to finding changes in the autonomic nervous system during rhinosinusitis episodes in patients.

3. Results:

Surprisingly, not many articles are available that emphasize the importance of autonomic nervous system changes and manifestations of symptoms during sinonasal inflammation due to many etiologies, including allergy. First in itself, in an article published in the Annals of Allergy, Asthma & Immunology in February 2017 edition by author Minn Hee, Kim MM, and others with the title autonomic function in adults with allergic rhinitis and its association with disease severity and duration, confirmed increased vagal activity and, at the same time, hypo sympathetic activity in patients diagnosed with intermittent and mild allergic rhinitis. In the January 2018 edition of Rhinology Journal by W.C. Chen and others, the authors confirmed in a prospective study the positive association between chronic rhinosinusitis cases and the symptomatic burden in the autonomic nervous system.

4. Discussion:

Common symptoms of sinonasal disease and autonomic system disturbance as origin:

A. Nasal obstruction: Reasons for nasal obstruction during rhinitis [6,7,8].

   a) Mucosal oedema
   b) Polyps
   c) Hypertrophy of turbinates
   d) Sensory changes cause nasal congestion as symptoms even when there is no physical obstruction.

Changes in the autonomic nervous system during sinonasal inflammation are the reasons for the above-mentioned causes of nasal obstruction. These changes are due to the vasomodulating process that is carried out within the sinonasal environment to protect the lower airway by modifying the temperature and humidifying along with filtering the inhaled air [9,10].

B. Nasal discharge: There is an interplay of many pathophysiological changes during exposure of the nasal mucosa to inflammatory agents. Nasal discharge is a fine representation of autonomic nervous system disturbance with predominance of the parasympathetic side [12,13].

The following figures describe in short sinonasal inflammation and changes in the nasal environment [14,15,16,17].

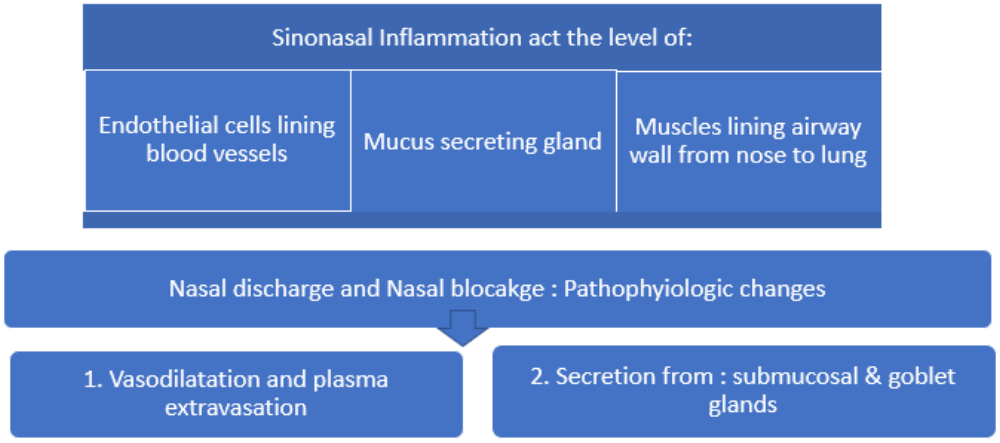

Figure1.

Studies on denervating the supply of the autonomic nerve to nasal cavity structures in animal models successfully decreased nasal secretion, and this has been proven by recording a decrease in the level of chemical mediators of inflammatory symptoms and signs [16,17] .Studies have shown that the above-mentioned relationship between inflammation and the response of the autonomic nervous system works in a bidirectional mode by up-regulation of the autonomic nervous system during chronic inflammation in a sinonasal environment.

C. Sneezing and related reflex changes during sinonasal inflammation [18,19,20,21,22,23,24].

It is well known that sneezing is a protective reflex mechanism. Sneezing reflexes involve coordinated activity of a) the respiratory system, b) the musculoskeletal system, and c) the parasympathetic nervous system to expel inflammatory agents.

i) Exposure to viral agents, ii) allergens, iii) physical agents like smoke, pollutants, iv) environmental irritant, i.e., cold air, dry air, dust particles, v) unusual causes: post-meal due to gustatory rhinitis (most probably), exposure to intense sunlight and rare like sexual orgasm.

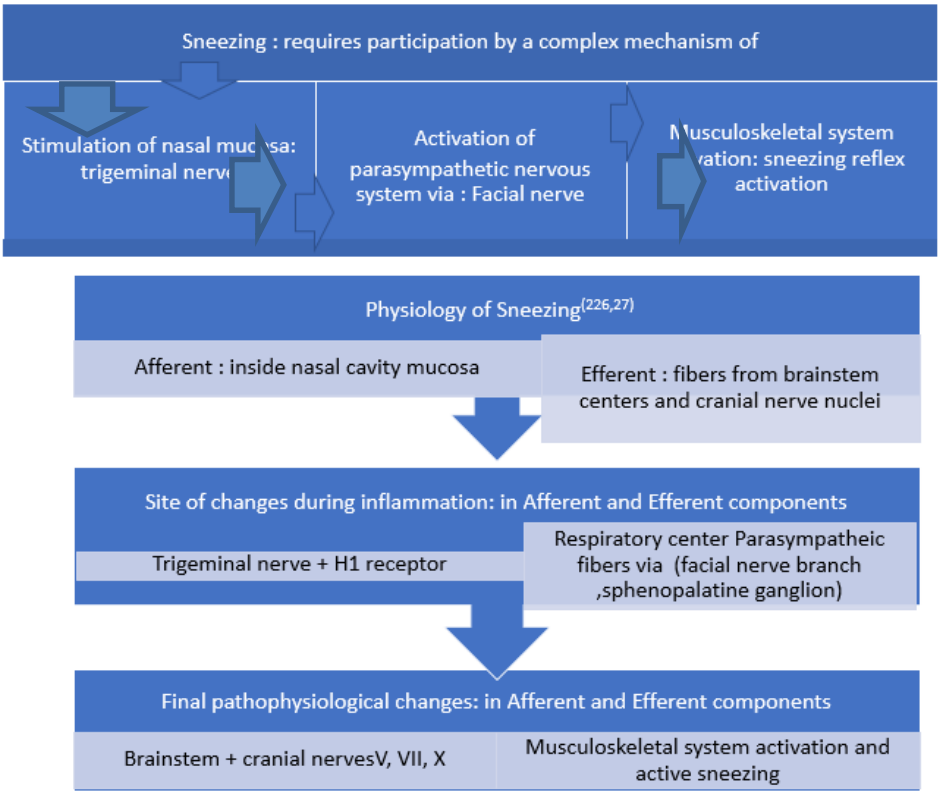

Figure 2.

D. Pain and discomfort during sinonasal inflammation [28,29,31].

Various studies have abundant evidence linking trigeminal neuralgia syndromes to activation of the parasympathetic components of the autonomic nervous system leading to symptoms of nasal congestion, nasal discharge, and changes in smell perception, frequently observed during episodes of the above neuralgic pain syndromes.

The clinical manifestation of autonomic disturbance depends on the branch of the trigeminal nerve involved.

Sinonasal inflammation: Patient presentation depending on branch of trigeminal nerve involved[31]		
Ophthalmic branch (V1): Excessive tearing, Conjunctival redness, ptosis	Maxillary branch (V2): Facial swelling,Nasal symptoms	Mandibular branch (V3): Excessive salivation

Figure 3.

5. Conclusions

Surprisingly, during the search only a few studies were available to find changes in the autonomic nervous system during episodes of chronic rhinosinusitis cases. The importance of knowledge about changes in the autonomic nervous system during sinonasal inflammation episodes will help the clinician to understand the correct pathophysiological changes during episodes of inflammation that present with varying symptoms and unusual signs on examination. Better understanding of autonomic nervous system disturbance will help plan a new method of treatment for resistant and chronic sinonasal inflammatory diseases, because they affect the individual as well as the community in all aspects of life. The new treatment approaches being tried and are in the process of improvement are based on the correct understanding of the disease process such as the use of botulin toxin, a well-known immunomodulator, and the use of stress-relieving methods such as mindfulness, yoga, cognitive behavioural therapy in the treatment of chronic refractory rhinitis and allergic rhinitis.

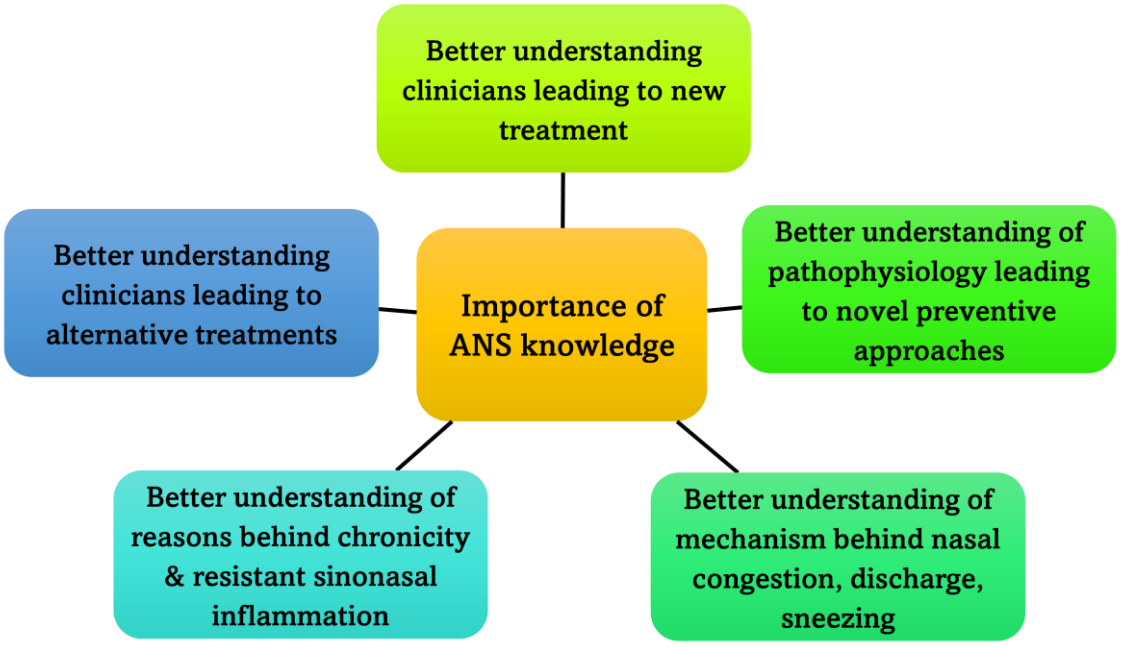

Figure 4.

Conflicts of Interests / Competing Interests:

The author has no conflict of interest.

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Authorship Contribution:

Dr. Kamlesh Kumar Dubey, Department of Otorhinolaryngology, MUCM, Melaka, is the main author of this article.

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