Chronic Rhino-Sinusitis and Asthma: Concept of Unified Airway Disease (UAD) and its Impact in Otolaryngology

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Abstract The aim of our study is to understand the concept of unified airway disease, to know the advantage of this concept in the diagnosis and treatment of allergic rhinitis, chronic rhino-sinusitis and asthma, to know its impact on practice of otolaryngologists, to motivate the otorhinolaryngologist to apply this concept in diagnosis and treatment. This article is based on our experience on (20 cases) chronic rhino-sinusitis and asthma, and observations and results from various literatures. Implement of the concept of unified airway disease and ability to translate its principles into successful diagnostic and treatment strategies can enhance the practice of otolaryngology. The end result is the potential for improved patient care. In our study 80% cases have reduced frequency of symptoms and all (100%) cases having improved night time symptoms thus the use of short-acting beta2 agonist to control the asthma symptoms decreases.

Keywords Unified airway disease (UAD) · Chronic rhino-sinusitis (CRS) · Immunoglobulin-E (IgE) · Para nasal sinuses (PNS) · Interleukin (IL) · Short-acting beta2 agonist- salbutamol

Introduction

Until recently, rhinitis and asthma have been evaluated and treated as separate disorders, but current opinion has moved toward the concept of unifying the management of these disorders. The unified airway disease (UAD) hypothesis purposes that upper and lower airway diseases are both are

infections of a single inflammatory process within the respiratory tract. Synonyms of UAD include allergic rhino bronchitis and combined allergic rhino-sinusitis and asthma. IgE mediated allergic responses to inhaled allergens cause symptom of asthma and rhino-sinusitis, but there is increasing evidence of a systemic link between the lower and upper airway.

Concept of Airway

Over the course of the past two decades, the concept of inflammation involving both the upper and lower airways has become increasingly recognized and studied. When examined, asthma, allergy, and rhino-sinusitis appear to behave similarly and in conjunction with one another in many cases, suggestive of an integration of the involved areas of the airway. This pattern of similarities has given rise to the concept of the unified airway model, which, simply stated, considers the entire respiratory system to represent a functional unit that consists of the nose, paranasal sinuses, larynx, trachea, and distal lung [1]. The broad number of inflammatory diseases that occur within this functional unit present to a variety of specialties, including otolaryngology, pulmonology, primary care, and allergy [11]. Similarly, literature related to this concept distributed among the literature of each of these specialties.

The model of unified airway provides conceptual framework for understanding and managing patients who have both upper and lower airway inflammatory disease. Through appreciating the relationships that exist among diseases such as otitis media, allergic rhinitis, acute and chronic rhino-sinusitis, and asthma, physicians can be more thorough in their diagnosis and treatment of patients who have airway disorders and can implement effective treatment strategies to decrease the burden and symptomatic expression of disease.

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Criteria in Support of a Unified Airway

Patients with upper airway diseases have a higher prevalence of lower respiratory disease such as asthma, the corollary, increased prevalence of upper respiratory diseases is also found among patients with lower respiratory disease.

Interrelated patho physiological mechanism between upper and lower airway diseases exist to explain the interaction of these two disease processes treatment of one portion of the unified airway improves the symptoms in a lower portion of the respiratory system.

Proposed pathophysiological links between the upper and lower airways:

- *Systemic interaction* (inflammatory crosstalk): The mechanism by which communication occurs between the upper and lower airways is suggested to be via systemic inflammatory response (IL-4, IL-5, IL-13, Eotaxin, etc.,) [1, 12].
- *Loss of conditioning by nose and PNS*: Allergic rhinitis has adverse effects on the lower airway by the promotion of breathing through the mouth. High nasal nitric oxide concentrations (up to 100 times greater than in orally exhaled air) are thought to have antiviral, bacteriostatic, and bronchodilator effects on the lower airway (conditioning of inspired air).
- *Nasobronchial reflex* has also been suggested (e.g., transient bronchoconstriction resulting from irritant stimulation of nasal mucosa).
- *Pharyngobronchial reflex*: Irritation of the hypopharynx with sinus secretions leads to bronchoconstriction and reduction in airflow rates.

Materials and Methods

This was prospective study of 20 cases (15–60 years age group) of asthma (diagnosed by physician) having chronic rhino-sinusitis (means nasal sign/symptoms of more than 12 weeks e.g., nasal discharge, blockage, post nasal drip,

hyposmia/anosmia with or without facial pain/pressure/fullness/headache). These patients were sent to ENT OPD to treat the nasal symptoms which were diagnosed as rhino-sinusitis with asthma. rhino-sinusitis was diagnosed by clinical features and radiological investigations (e.g., X-ray PNS waters view/CT scan if required).

Asthma was diagnosed by following clinical features:

1. Shortness of breath
2. Wheezing
3. Coughing in cold and night
4. Chest tightness

All 20 cases were categorized in four groups ((1) intermittent, (2) mild persistent, (3) moderate persistent, (4) severe persistent), depending on frequency of asthma symptoms/night time symptoms/use of beta2 agonist for control of symptoms. Than rhino-sinusitis was treated medically (in 18 cases) and both medically and surgically (FESS in 2 cases). After 6 months of rhino-sinusitis treatment we compared the asthma symptoms and need of asthma medication before and after treatment of rhino-sinusitis and conclusion was made.

Observations and Results

Table 1 showing that all 20 cases were grouped in four groups depending upon severity of symptoms and requirement of short-acting beta2 agonist for symptom control. All patients in an individual group having equal severity of symptoms (depending upon frequency of symptoms and night time symptoms) so required the same amount of beta2 agonist for control of symptoms.

All the four tables (Tables 2–5) representing the different four groups of patients after medical and surgical (required in 2 cases) treatment of rhino-sinusitis. Tables 2, 3, 4, 5 showing that frequency of symptoms decreases in 80% (in 16 out of 20 cases) and night time symptoms improved in all 20 cases (100%) thus use of beta2 agonist also decreases in all groups.

Table 1 Before treatment of rhino-sinusitis the symptoms severity of asthma and requirement of short-acting beta2 agonist

Severity in patients (no. of patients)	Symptom frequency	Night time symptoms	Use of short-acting beta2 agonist for symptom control
Intermittent (5)	≤2 per week	≤2 per month	≤2 days per week
Mild persistent (7)	>2 per week but not daily	3–4 per month	>2 days/week but not daily
Moderate persistent (6)	Daily	>1 per week but not nightly	Daily
Severe persistent (2)	Throughout the day	Frequent (often 7 × /week)	Several times per day

Table 2 Intermittent asthma (five cases) after treatment of rhino-sinusitis

No. of patients (5)	Symptom frequency	Night time symptoms	Use of short-acting beta2 agonist for symptom control
1	<Once/week	<Once/month	<2 days/week
2	<Once/week	<Once/month	<2 days/week
3	Once/week	Once/month	<2 days/week
4	Once/week	Once/month	<2 days/week
5	Twice/week	Once/month	≤2 days/week

The table shows that only in one case symptom frequency not improved

Table 3 Mild persistent asthma (seven cases) after treatment of rhino-sinusitis

No. of patients (7)	Symptoms frequency	Night time symptoms	Use of short-acting beta2 agonist for symptom control
1	Once/week	<Once/month	<2 days/week
2	Once/week	<Once/month	<2 days/week
3	Once/week	<Once/month	<2 days/week
4	Twice/week	Once/month	≤2 days/week
5	Twice/week	Once/month	≤2 days/week
6	>Twice/week	<Twice/month	>2 days/week but not daily
7	>Twice/week	<Twice/month	>2 days/week but not daily

The table shows that in two cases symptom frequency not improved

Table 4 Moderate persistent asthma (six cases) after treatment of rhino-sinusitis

No. of patients (6)	Symptoms frequency	Night time symptoms	Use of short-acting beta2 agonist for symptom control
1	Once/week	<Twice/month	<2 days/week
2	Once/week	<Twice/month	<2 days/week
3	Once/week	3–4/month	<2 days/week
4	>Twice/week	3–4/month	>2 days/week but not daily
5	>Twice/week	3–4/month	>2 days/week but not daily
6	Daily	3–4/month	Daily

The above table show that only in one case symptom frequency did not improved

Discussion

Correlation Between Asthma and CRS

Our experience with 20 cases (15–60 years age group) is that when rhino-sinusitis is appropriately treated (medically 18 cases or surgically FESS were done in 2 cases) there was significant improvement in frequency and

Table 5 Severe persistent asthma (two cases) after medical and surgical treatment of rhino-sinusitis

No. of patients (2)	Symptoms frequency	Night time symptoms	Use of short-acting beta2 agonist for symptom control
1	>Twice/week	3–4/month	>2 days/week but not daily
2	>Twice/week	3–4/month	>2 days/week but not daily

severity of asthma symptoms (e.g., (1) Shortness of breath, (2) Wheezing, (3) Coughing in cold and night, and (4) Chest tightness) and there was decrease need of asthma medication in all cases when rhino-sinusitis has been controlled.

In other recent study, 100% of subjects with severe asthma (requiring steroid treatment) had abnormal sinus computed tomography scans versus 77% of subjects with mild to moderate asthma. Initial associations among these diseases were noted due to the concurrence of these disease processes and were later more objectively established by way of epidemiologic studies. The simple coexistence of rhinitis and asthma, as an example, was demonstrated by Corren [2], who noted that nasal symptoms were suffered by approximately 78% of a large group of patients with asthma. In another classic paper, the Finnish twin cohort study [3], more than 11,000 patients were followed longitudinally to assess whether the presence of allergic rhinitis was associated with the development of other respiratory diseases over time. Questionnaires were administered in 1975, 1981, and 1990 and revealed a fourfold increase in asthma reporting at the end of the study in subjects with hay fever over normal control subjects. In 2002, Guerra et al. [4] corroborated these findings after following 1,655 patients with allergic rhinitis and 2,177 normal controls over a 20-year period. As in the previous study, sufferers of allergic rhinitis were approximately three times more likely to develop asthma than were the controls.

Similar relationships have been identified among other allergic and non-allergic respiratory diseases. Anecdotal associations between asthma and rhino-sinusitis have been reported for more than 70 years [5]. The prevalence of asthma, for instance, in patients with chronic rhino-sinusitis (approximately 20%) is consistently noted to be much greater than that observed in the general population (5–8%) [6], and in those patients who undergo endoscopic sinus surgery the prevalence climbs even higher, to approximately 42% [7]. This same association exists between chronic rhinitis and allergic rhinitis, as shown by a cohort of patients with the diagnosis of recurrent acute or chronic rhino-sinusitis who were followed within a major health care system. In this study, patients diagnosed with chronic rhino-sinusitis demonstrated a 57% prevalence of positive in vitro or allergy skin testing [8]. The overlap and interrelationship of these respiratory diseases become less

surprising as definitions of disease and underlying pathophysiologies come into better focus. The concept of asthma as a chronic inflammatory disease emerged in 1991 as a result of a report by the National Institute of Health and the National Heart, Lung, and Blood Institute [9]. With this report, the pathophysiological focus of asthma shifted from bronchospasm to one of inflammation that is mediated at the cellular level. The implications of this report were monumental and resulted in a major shift in treatment strategy for the disease. It was not until later that similar observations resulted in refinements in the definition of chronic rhino-sinusitis. In 2003, a definition of chronic rhino-sinusitis was introduced that emphasized the pathogenic role of inflammation in the disease [10].

Treatment Approaches can be Divided into

Environmental Controls of Allergy

Environmental controls of allergy remain a cornerstone in the management of the patients who have allergic rhinitis. Reduction of antigen quantity is, however only an indirect measure of where an environmental control strategy actually reduces allergic symptoms. Strategies for reduction of indoor inhalants allergens (dust, mite cockroach, molds), as well as techniques for reducing exposure to outdoor inhalant allergens should be encouraged.

Treatment with Drugs

Antihistaminic

They control rhinorrhoea, sneezing, and pruritus

Sympathomimetic Drugs (oral or topical)

Alpha adrenergic drugs constricts of blood vessels and reduce nasal congestion and edema.

Corticosteroids

Limited to acute episodes which have not been controlled by other measures. They have several systemic side effects. Topical steroids are used as aerosols and are very effective in control of symptoms.

Sodium Chromoglycate

It stabilizes the mast cells and prevents them from degranulation despite the formation of IgE complex.

Immunotherapy

Immunotherapy or hyposensitisation is used when drug treatment fails to control the symptoms or produce intolerable side effects. Allergen is given in increasing doses till the maintenance dose is reached. Immunotherapy reduces the formation of IgE. It also raises the titer of IgE antibody. Immunotherapy has to be given for a year or so before a significant improvement of symptoms can be noticed.

Surgery

Functional endoscopic sinus surgery done from CRS management has demonstrated to result in the decreased need for asthma medications, improved pulmonary function, and fewer asthma exacerbations.

Treatment Effects in the Unified Airway

Several papers have shown that treating allergic rhinitis with intra nasal corticoid sprays can improve both asthma symptoms and objective indices of pulmonary functions [13, 14]. Both oral antihistaminic and oral leukotriene receptor antagonist have shown similar effects. In addition these treatment effects can be translated into direct social impact, in that patient with concurrent allergic rhinitis and asthma who have treatment for their nasal disease demonstrate decreased incidence of hospitalization and emergency department visits for asthma when compared with patients not receiving or not adherent to rhinitis treatment.

Successful management of chronic sinus disease has been demonstrated to result in decreased need for asthma medications, improved pulmonary functions, and fewer asthma exacerbations.

Evidence of concurrent benefit to both the upper and lower airways with immunotherapy further strengthens the observations that system wide airway effects can be noted with proper therapeutic interventions.

The impact of these various treatment studies supports the hypothesis that the treatment of airway inflammation can have benefit in the management of the unified airway as a systemic whole.

Conclusion

1. Otorhinolaryngologist frequently treat individuals who have upper airway disease such as allergic rhinitis and acute and chronic rhino-sinusitis and therefore are positioned uniquely to identify, monitor, and manage patients currently symptomatic from or at risk of developing concurrent asthma.

2. Thus an understanding of the concept of the unified airway and ability to translate its principles into successful diagnostic and treatment strategies can enhance the practice of otolaryngology.
3. Management with this concept can lead to improved patient outcomes and quality of life.

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