Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

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INTRODUCTION

Sinusitis is one of the most common health care complaints in the United States. (**1-9**) Approximately 1 in 8 people in the United States will have sinusitis at one time in their lives. The National Center for Disease Statistics reports that sinusitis is now the number one chronic illness for all age groups in the United States. The 1993 National Health Interview Survey found that sinusitis was the most commonly reported chronic disease, affecting approximately 14% of the United States population.(2) Sinus disease affects roughly 31 million people annually. Between 1990 and 1992, reports indicated that sinusitis sufferers had approximately 73 million days of restricted activity—a 50% increase from 4 years earlier. (**3**)

Sinusitis accounted for nearly 25 million physician office visits in the United States in 1993 and 1994. (3) (Of course, many more cases are unreported, and many patients suffer without seeing a physician, so the true incidence of sinusitis is unknown.) Although they are typically not serious and respond promptly to proper medical treatment, inflammatory diseases of the sinuses are a leading cause of loss of productivity both at work and at school. An estimated 32.3 million people in the United States have chronic sinusitis. (**3**) Furthermore, 10% of the population suffers from allergic sinus disease. (**3**) The cost of treating sinus disease runs into the billions of dollars, without taking into account loss of work. Given the trend toward rationedmedical care, physicians are increasingly working toward an effective means of both early diagnosis and followup in these patients. Until recently, sinusitis has been an undertreated disease. Its drastic negative effect on quality of life has been generally underappreciated and unrecognized.

Recent studies show that patients score the effects of chronic sinus disease in areas such as bodily pain and social functioning as more debilitating than diseases such as angina, congestive heart failure, emphysema, chronic bronchitis, and lower back pain, to name just a few. (**2-3**) It is estimated that 2.2 billion dollars is spent yearly on

prescription and nonprescription medication.(4) Overall health expenditures for sinusitis in 1996 were estimated at approximately 5.8 billion dollars, with 1.8 billion of that being spent on children 12 years and younger. (**5, 6, 7**) In the past, many patients were told they would just have to "live with it." Since the introduction of endoscopic techniques for diagnosis of sinus disease in the United States in 1985, increased attention has been directed to this problem. Medical therapy may be recommended in the face of nasal symptoms and mucosal disease. Typical medications used in the treatment of mucosal disease include oral antibiotics, steroids, mucolytics, nasal steroid spray, nasal saline spray, oral decongestants, and oral antihistamines. The selection of appropriate medications depends upon the determination of the diagnosis. For example, many times antibiotics are prescribed without first obtaining a sinus culture. Inadequate duration and breadth of treatment may result in persistent and recurrent symptoms, and also in the development of resistant bacteria.

A number of factors are felt to be important in the increasing incidence of sinusitis. Inhaled allergens and irritating air pollutants are detrimental to the sinuses and are on the rise. Global warming and the related increases in air pollution also affect the sinuses. Cigarette smoke is also detrimental to the sinuses, not only for the smokers, but also those exposed to secondhand smoke. While the incidence of sinusitis is on the rise, there have also been enormous improvements in the past 15 years in the ability to diagnose and treat these problems. This is largely because of technological advances in nasal endoscopy and X-ray imaging. Also, the development of newer, more powerful medications including new antibiotics, antihistamines, and others, and significant advances in surgical treatment have played a major role in improved patient care.

Sinusitis is the most common chronic health care condition in the United States, and its incidence is increasing. Fortunately, there have been significant advances in the diagnosis and treatment of this problem. This CME activity responds to the continuing need of practicing physicians to update their knowledge. This CME activity is designed to provide primary care physicians with the most up-to-date information about allergic and non-allergic sinusitis and its treatment.

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CHAPTER 1

SINUS ANATOMY AND PHYSIOLOGY WITH SINUSITIS OVERVIEW

DEFINITIONS

The sinuses are chambers in the bones of the face and skull that are normally lined with a thin mucus producing membrane (called mucosa). There are four paired paranasal sinuses—the maxillary, ethmoid, frontal, and sphenoid sinuses (Fig. 1). They communicate with the nasal cavity via narrow openings. Air and mucus enter and exit the sinus through these openings. Blockage of the small openings from swelling (caused by infection, allergy, and other causes) can result in sinusitis. (**1,2,3**)

SINUSITIS

Sinusitis literally means "inflammation of the sinus cavities." (**4-6**) This inflammation is what happens occurs when a patient's nose and sinuses are exposed to anything that might irritate the membranous linings. These irritants may include dust and pollution, cigarette smoke, and other irritants. Allergic reaction to mold, pollen, and so forth may also irritate the nasal linings. Furthermore, infection by a virus or bacteria may irritate the nasal linings. The swelling that occurs may cause the narrow openings in the nose and sinus cavities to narrow even further or even to shutclose entirely. Thick abnormal mucus secretions can also block the sinuses further.

Rhinitis refers to inflammation of the nasal mucosal linings only. Sinusitis refers to inflammation of the mucosal linings of the sinuses and is usually associated with and often preceded by rhinitis. Because the two go together, ear, nose, and throat specialists today often use the term rhinosinusitis. However, the words rhinitis, sinusitis and rhinosinusitis are often used interchangeably. In this article, we will use the term sinusitis to mean inflammation of the sinus and nasal passageways. Experts on sinusitis have tried to precisely define sinusitis. The Rhinosinusitis Task Force of the American Rhinologic Society has defined rhinosinusitis as a condition manifested by an inflammatory response involving the mucous membranes of the nasal cavity and paranasal sinuses, fluids within the cavities, and/or underlying bone. (**4-6**).

Symptoms associated with rhinosinusitis include nasal obstruction, nasal congestion and discharge, post-nasal drip, facial pressure and pain, cough, and others. (Table 1). A strong history consistent with chronic sinusitis includes the presence of two or more major factors or one major and two minor factors for greater than 12 weeks. (**4-6**).

TABLE 1: Factors Associated with the Diagnosis of Chronic Rhinosinusitis

Major factors	**Minor factors**
Facial pain/pressure*	Headache
Facial congestion/fullness	Fever
Nasal obstruction/blockage	Halitosis
Nasal discharge/purulence/discolored nasal drainage	Fatigue
Hyposmia/anosmia	Dental pain
Purulence in nasal cavity on examination	Cough
Ear pain/pressure/fullness	

*Facial pain/pressure alone does not constitute a suggestive history for chronic rhinosinusitis in the absence of another major nasal symptom or sign.

ANATOMY

Sinus development continues throughout childhood, and is usually complete by adolescence (Figure 1). (**1,2**) Most people have all eight sinuses present by this time, although in a minority of patients some of the sinuses do not fully form. These hypoplastic (incompletely formed) or aplastic sinuses (completely unformed) are often an incidental finding, usually not associated with any increased sinus problems, although in some instances they should be addressed. (**7-10**)

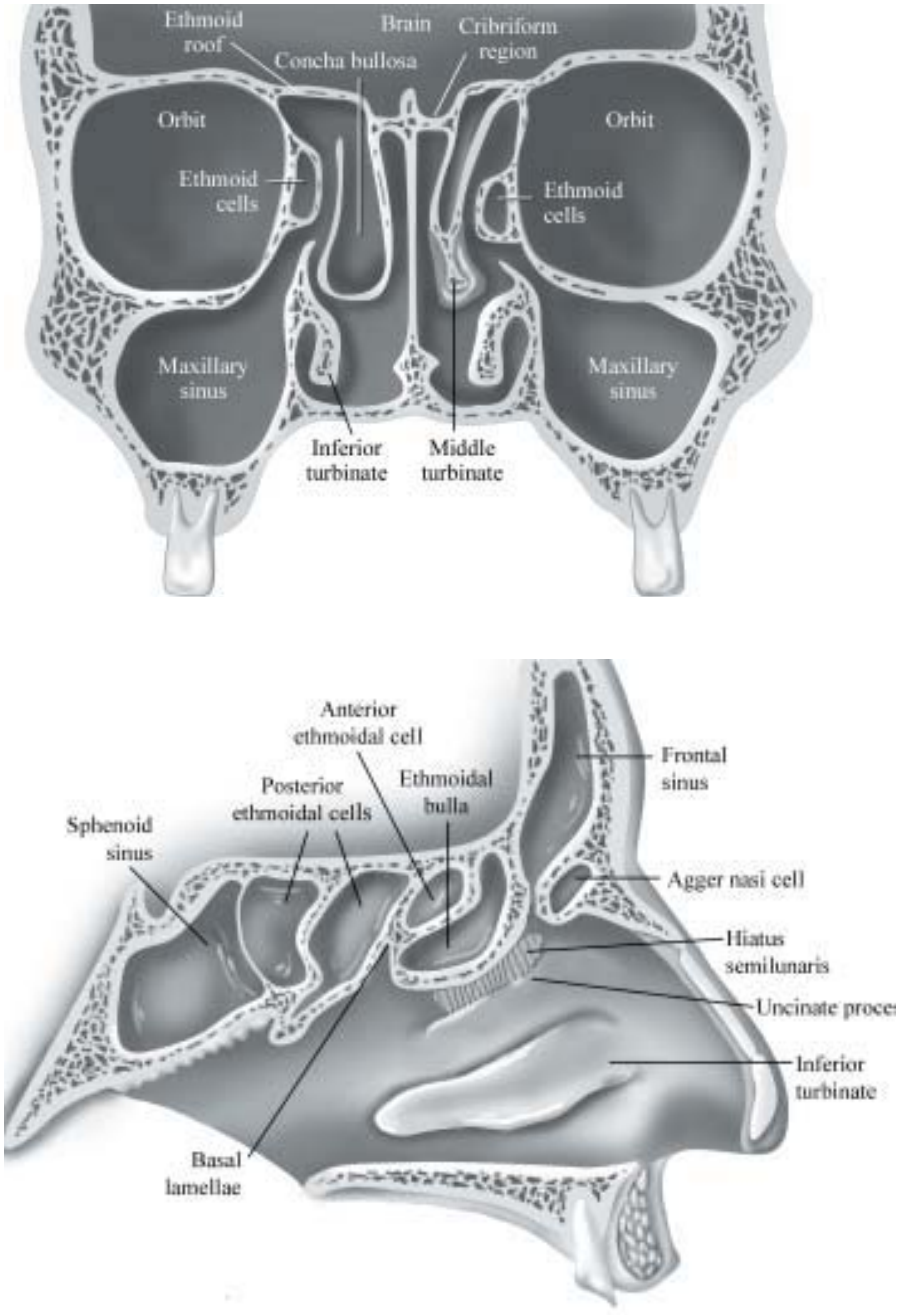

FIGURE 1 – Coronal (upper illustration) and sagittal (lower illustration) views into the paranasal sinuses.

The sinuses communicate with the nasal cavity via narrow openings called ostia. (**11**) Ostia drain into spaces within the nose called meati which are bordered by vertically oriented bones known as turbinates. The tear duct (naso-lacrimal duct) drains into the inferior meatus (which is bordered by the inferior turbinate bone). This is one reason why our nose drips when we cry. The maxillary, frontal, and ethmoid sinuses drain into the middle meatus, which is bordered by the middle turbinate bone (FIGURE 2). Some of the ethmoid sinuses also drain into the superior meatus, which is a space defined by superior turbinate bone. While the maxillary, frontal, and sphenoid sinuses are solitary, well-defined compartments, the ethmoid sinus is – in actuality – a collection of several small sinuses, structured like a beehive. It is for this reason that the ethmoid sinuses have varied drainage patterns. The sphenoid sinus drains into the spheno-ethmoidal recess, located between the superior turbinate bone and the nasal septum. (**3, 11, 12**)

Air and mucus enter and exit the sinus through the sinus ostia. The functions of the nose and sinuses include olfaction (sense of smell), respiration, and defense. (**3, 11, 12**) The nose and sinuses produce mucus to keep the nasal and upper respiratory passageways moist, and have an effect on vocal resonance. Among the important physiological roles of the sinuses are the humidification and warming of inspired air, and the removal of particulate matter from this air. Humidification and warming of inspired air are accomplished by the watery secretions of the serous glands, which can produce up to 1–2 liters of secretions per day.

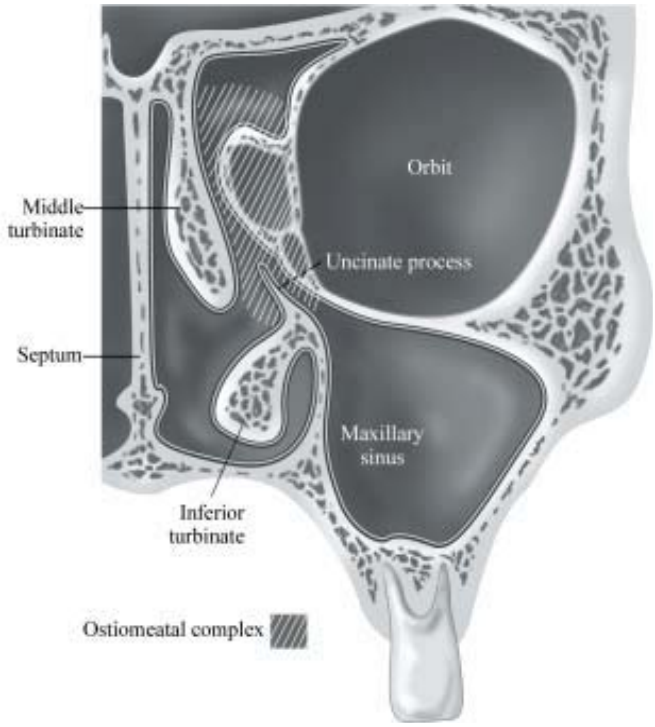

FIGURE 2 – The maxillary, frontal, and ethmoid sinuses drain into the middle meatus, which is bordered by the middle turbinate bone. The osteomeatal complex (OMC) is the Grand Central Station of the sinuses. Any process that causes swelling and blockage of this critical area contributes to the symptoms of sinusitis.

While the watery serous secretions play a role in humidification and warming, the secretions of the goblet cells and mucous glands facilitate the removal of particulate matter. This mucous is very effective, trapping up to 80% of particles larger than 3–5 microns. (3) This includes not only inorganic pathogens but also up to 75% of the bacteria entering the nose. (3) The mucous blanket of the nose is a very dynamic structure, continuously renewing itself every 10–20 minutes. (3) The mucous blanket also defends the body against infection. Besides trapping organic pathogens, the blanket constitutes a rich immunologic barrier within the mucosa. When exposed to the trapped antigens, it can further enhance the response by stimulating the immune system. The ciliated epithelium continually beats, propelling the mucus in a synchronized fashion toward the natural opening or ostium of each sinus. These ostia drain into the nasal cavity. The mucus is then propelled to the nasopharynx to be swallowed. At this point the acid secretions of the stomach can help destroy the inhaled pathogens. (**3, 11-13**)

The normal function of the sinuses depends on three essential components: thin normal mucus secretions, normally functioning microscopic hairs (called cilia) that move the mucus out of the sinuses, and open sinus drainage openings (called sinus ostium). These components allow for the continuous clearance of secretions. Interference with any of these three components of the normal sinuses may predispose the patient to sinusitis. In other words, thick secretions malfunction of the microhairs, or blockage of the natural sinus openings may lead to symptoms of sinusitis. The microhairs move at a frequency of 10 strokes per second in a coordinated fashion. The action of these microhairs move any given mucus particle from the sinuses and out into the nose in about 10 minutes. Cilia function is most effective at a temperature above 18 °C and a relative humidity of about 50%. (3) This may be a factor with common colds, which occur in the winter months. For the mucociliary system to clear the secretions from the sinuses, the natural sinus openings must be patent. (**14**)

PHYSIOLOGY OF SINUSITIS

The grand central station of mucociliary clearance is the osteomeatal complex. (FIGURE 2). (**3-6, 15-17**) When a river is dammed, water flow is slowed or halted and water gathers behind the dam. The water level rises and a reservoir forms. Similarly, if the osteomeatal complex is blocked, a backup of mucus occurs. This can lead to a condition that leads to infection. Bacteria live in the nose and sinuses; however, in an infectious state some subset(s) of bacteria have reproduced out of proportion to others. This bacterial overgrowth is often present in sinusitis – particularly acute sinusitis. Any process that causes mucosal inflammation into the sensitive area of the osteomeatal complex (OMC) can occlude the other sinuses that drain into this crossroad zone. (**16-20**)

Blockage of the small openings from swelling (caused by infection, allergy, and other causes) can also result in sinusitis. When obstruction occurs, the mucus is retained in the sinus cavity. These stagnant secretions thicken and provide a medium for bacterial growth. Obstruction also impairs aeration and gas exchange within the sinus cavity. Absorption of trapped oxygen leads to hypoxia or decreased oxygen levels within the sinus, which exacerbates sinusitis. These changes lead to damage and dysfunction of the cilia and epithelium. The retained secretions and infection lead to further tissue inflammation, which in turn leads to further blockage. These changes

may be reversible with appropriate medical and - if needed - surgical management. On occasion, surgery is needed to allow restoration of normal mucosal lining. In these cases, surgery allows for restoration of normal sinus aeration and mucociliary clearance. (**21-23**)

An important goal of any treatment for sinusitis is to break the "vicious cyle." This phrase refers to the fact that once a patient develops sinusitis, it may persist and worsen in a downward spiraling cycle. . Swelling leads to more obstruction, which leads to more swelling, and so on. In other words, if swelling causes narrowing of a patient's sinus outflow tracts, then they can malfunction. The drainage of mucus is impaired, and the patient's mucus secretions can stagnate and thicken. The mucus in the nose and sinuses can also develop infection if it has difficulty draining from the nose and sinuses. Infection causes even more swelling, compounding the problem and causing the sinuses to spiral downward in the vicious cycle. It is for this reason that treatments should be targeted and focused – to break the "vicious cycle."

ANATOMICAL ABNORMALITIES AND SINUSITIS

As noted above, chronic sinusitis is – for the most part – a mucosal disease of the sinonasal lining. (**3,11,16,17,20-23)**

While non-anatomic irritants such as inhaled allergens, chemical irritants, and smoke may start this cycle of mucosal swelling, there are also anatomical abnormalities that may contribute to this process. These are discussed below.

The nasal septum divides the right and left nasal cavities. The septum is comprised of both bone and cartilage with a mucosal lining, and sits roughly in the midline of the nose. It is not uncommon for the nasal septum to be slightly deviated. In some instances, however, this septal deviation may be significant. Severe septal deviation will not only cause nasal obstruction by blocking the airflow into the affected side, but may also impact mucociliary clearance by "pushing" the middle turbinate and other structures towards the infundibulum leading to impairment of this sinus drainage outflow tract (FIGURE 3). (**3,11,12, 24-25**)

FIGURE 3A – Coronal CT scan of the sinuses demonstrating septal deviation towards the patient's right side. The ostiomeatal complex is swollen and blocked.

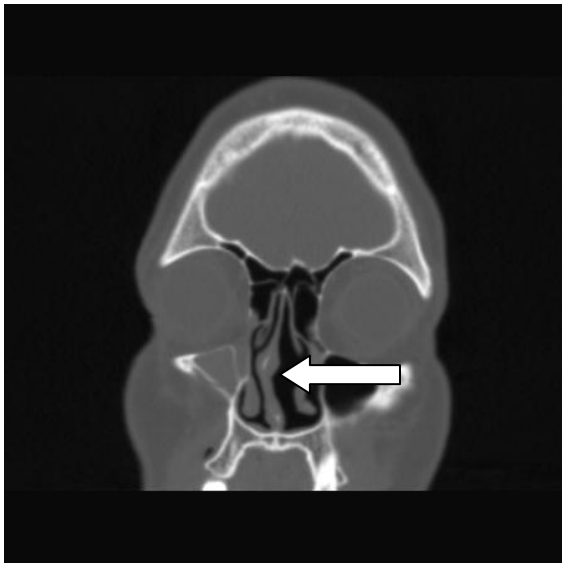

FIGURE 3B – This is a coronal CT scan of the sinuses of another patient demonstrating septal deviation toward the patient's right side. The ostiomeatal complex is swollen and blocked.

The middle turbinate is a normal structure that provides the medial boundary for the middle meatus – where the maxillary, ethmoid, and frontal sinuses drain. A paradoxically curved middle turbinate may push against the infundibulum blocking the sinus outflow pathway. A concha bullosa, or air filled middle turbinate, (FIGURE 4)

may impede drainage of the infundibulum on its own side of the nose or, in extreme circumstances, may push the septum to the opposite side of the nose and block drainage on that side. (**24-25**)

Sinonasal polyps are present in a small percentage of patients with sinus disease. By their sheer mass effect and location – often within the middle meatus – these polyps impede sinus drainage and mucociliary clearance, thereby contributing to the "vicious cycle." Of course the polyps are, themselves, products of inflammation so further sinus inflammation just leads to persistent polyps which are increased in size (FIGURE 5). **(25)**

OTHER CAUSATIVE FACTORS IN SINUSITIS

Causative factors in sinusitis can be considered by categories.

- Inflammatory factors include upper respiratory tract infections (example, the common cold), allergic rhinitis, vasomotor rhinitis, recent dental work, barotrauma, and swimming.
- Systemic factors include immunodeficiency, ciliary dyskinesia syndrome, cystic fibrosis, rhinitis of pregnancy, and hypothyroidism.
- Mechanical factors include choanal atresia, sinonasal polyps, deviated septum, foreign body, trauma, tumor, nasogastric tube, turbinate hypertrophy, concha bullosa, adenoid hypertrophy.
- Medicative causes include beta-blockers, birth control pills, antihypertensives, aspirin intolerance, rhinitis medicamentosa (overuse of topical decongestants), and cocaine abuse. Many of these causes will be discussed below. **(3,26-29)**

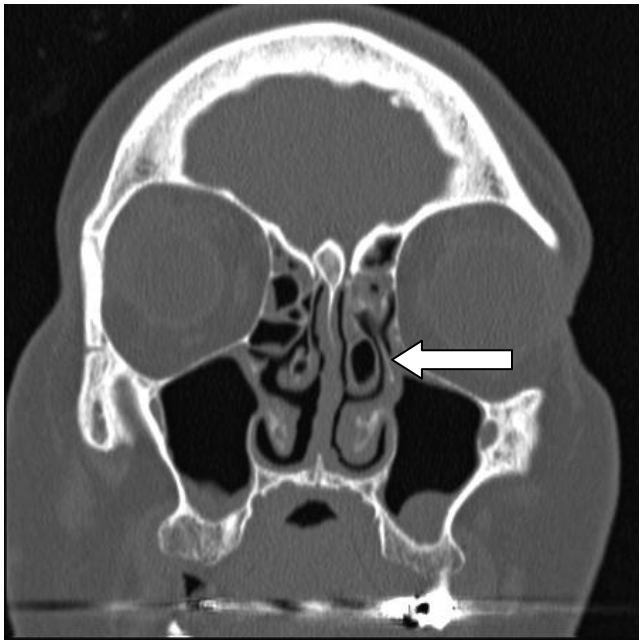

FIGURE 4 – An air-filled left-sided middle turbinate (concha bullosa) pushes against the patient's nasal sidewall and blocks the sinus drainage outflow pathway.

FIGURE 5 – This coronal CT of a patient with polyps shows significant blockage of the nasal airway, as well as the sinuses. The patient also has a septal deviation.

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CHAPTER 1

QUESTIONS

1. Sinusitis - "inflammation of the sinus cavities" - may be due to all of the following EXCEPT:

    A. dust and pollution, and other irritants.
    B. Cigarette Smoke
    C. Allergic reaction to mold, pollen, and so forth.
    D. infection by a virus or bacteria.
    E. Structural Blockage such as a deviated septum

2. Systemic factors in sinusitis include all but the following EXCEPT:

    A. Ciliary dyskinesia syndrome
    B. Cystic fibrosis
    C. Rhinitis of Pregnancy
    D. Hypothyroidism
    E. Rhinitis Medicamentosa

3. Medicative Factors in sinusitis include all of the following EXCEPT:

    A. Beta Blockers
    B. Birth Control Pills
    C. Antihypertensives
    D. Aspirin
    E. Synthroid

4. The secretions of the goblet cells and mucous glands facilitate the removal of particulate matter. This mucous is very effective for,

    A. trapping up to 80% of particles larger than 3–5 microns.
    B. trapping up to 95% of particles larger than 1-3 microns
    C. trapping up to 60% of particles larger than 3-5 microns
    D. trapping up to 80% of particles larger than 1-3 microns
    E. trapping up to 85% of particles larger than 1-3 microns

5. Which of the following statements is TRUE regarding the mucous blanket of the nose

    A. It continuously renews itself every 10–20 minutes.
    B. It continuously renews itself every 30-60 minutes.
    C. It continuously renews itself every 6-8 hours.
    D. It continuously renews itself daily.
    E. It continously renews itself every 1-3 days

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CHAPTER 2

SIGNS AND SYMPTOMS OF SINUS DISEASE

Sinusitis is one of the most common health care complaints in the United States. (**1-8**) Approximately 1 in 8 people in the United States will have sinusitis at one time in their lives. The National Center for Disease Statistics reports that sinusitis is now the number one chronic illness for all age groups in the United States. The 1993 National Health Interview Survey found that sinusitis was the most commonly reported chronic disease, affecting approximately 14% of the United States population, and Anand reported a 16% incidence in his 2004 study. (**9**) A 2006 study by Koy and Coons on the incidence of chronic conditions reported that approximately three-fifths (62.5%) of the study sample reported at least one of 18 chronic medical conditions; sinusitis (24.8%) was the most commonly reported condition, followed by hypertension (23.5%) and arthritis (21.5%). (**10**)

Sinus disease affects roughly 31 million people annually. Furthermore, 10% of the population suffers from allergic sinus disease. Between 1990 and 1992, reports indicated that sinusitis sufferers had approximately 73 million days of restricted activity—a 50% increase from 4 years earlier. Sinusitis accounted for nearly 25 million physician office visits in the United States in 1993 and 1994. (Of course, many more cases are unreported, and many patients suffer without seeing a physician, so the true incidence of sinusitis is unknown.) Although they are typically not serious and respond promptly to proper medical treatment, inflammatory diseases of the sinuses are a leading cause of loss of productivity both at work and at school.

Rhinosinusitis poses an immense economic burden in the United States. (**9**) The cost of treating sinus disease runs into the billions of dollars, without taking into account loss of work. Overall health care expenditures attributable to sinusitis in 1996 were estimated at $5.8 billion, of which $1.8 billion (30.6%) was for children 12 years or younger. (5-7) A primary diagnosis of acute or chronic sinusitis accounted for 58.7% of all expenditures ($3.5 billion). (**5-7**) It is estimated that 2.2 billion dollars is spent yearly on prescription and nonprescription medication. (**5-7**) About 12% each of the costs for asthma and chronic otitis media and eustachian tube disorders were

attributed to diagnosis and treatment of comorbid sinusitis.(5-8) Nearly 90% of all expenditures ($5.1 billion) were associated with ambulatory or emergency department services. (**9, 11**)

Until recently, sinusitis has been an undertreated disease. Its drastic negative effect on quality of life has been generally underappreciated and unrecognized. Recent studies show that patients score the effects of chronic sinus disease in areas such as bodily pain and social functioning as more debilitating than diseases such as angina, congestive heart failure, emphysema, chronic bronchitis, and lower back pain, to name just a few. **(2-3)**

The symptoms of sinusitis include nasal blockage (the most common symptom), facial pressure or pain, snoring, postnasal drainage and bad breath, fatigue, recurrent infections, among others (**12-16**) (Table 1). In this chapter, we give detailed consideration to the signs and symptoms commonly associated with sinus problems.

TABLE 1: Factors Associated with the Diagnosis of Chronic Rhinosinusitis

Major factors	**Minor factors**
Facial pain/pressure*	Headache
Facial congestion/fullness	Fever
Nasal obstruction/blockage	Halitosis
Nasal discharge/purulence/discolored nasal drainage	Fatigue
Hyposmia/anosmia	Dental pain
Purulence in nasal cavity on examination	Cough
Ear pain/pressure/fullness	

*Facial pain/pressure alone does not constitute a suggestive history for chronic rhinosinusitis in the absence of another major nasal symptom or sign

NASAL BLOCKAGE

Nasal blockage has many causes. It is convenient to divide them into causes that are treated medically and causes that require surgical treatment. Medical causes include the common cold (viral infection—a temporary cause), bacterial sinusitis, allergy, sensitivity to dust, smoke, pollution, and other irritants. Surgical causes include anatomic abnormalities such as a deviated septum, nasal polyps, obstructed sinuses that do not improve with medication, over-enlarged turbinates, obstructing adenoids, and other causes. Sometimes scarring from trauma or

prior nasal surgery can cause nasal obstruction. (**7, 12-16**) Chronic nasal obstruction must be evaluated by an Ear Nose and Throat specialist.

SNORING

There are many causes of snoring, and one of them is nasal obstruction. Nasal obstruction causes a patient to breathe through the mouth, which causes greater vibration of the tissue in the back of the mouth and throat when sleeping and may lead to snoring or increased snoring. Patients who snore should check with a specialist to find out the cause. If it is because of nasal blockage, a nasal treatment may be indicated. Alternatively, snoring may be a sign of sleep apnea, especially when associated with witnessed apneic periods and daytime fatigue. (**7, 12-16**)

POSTNASAL DRAINAGE

Postnasal drainage is a symptom that may result from rhinitis or sinusitis. Abnormal swelling of the nasal and sinus membranes causes them to produce thick, abnormal mucus, which can contribute to nasal blockage, and also can drain into the back of the throat and cause cough, sore throat, and so forth. Treatment of postnasal drainage includes treating rhinitis and sinusitis.

Sometimes, the sensation of postnasal drainage may actually come from acid reflux. Acid from the stomach can travel in a retrograde direction – up the esophagus – and onto the voice box (larynx). The irritation to the larynx, and associated throat-clearing and feeling of "something stuck in my throat" can contribute to the feeling of postnasal drainage. An Ear, Nose and Throat doctor can quickly and easily evaluate for this Laryngopharyngeal Acid Reflux (see Chapter 7) with a quick clinical examination including flexible nasopharyngolaryngoscopy. In this case, as in most instances with the sinuses and the throat, effective treatment depends on proper diagnosis! (**7, 12-16**)

HALITOSIS

A common cause of halitosis (bad breath) is thick postnasal discharge. This thick mucus can be white, yellow, or even green. If a patient has sinusitis, the mucus is stagnant in the sinuses and becomes foul-smelling, it drips back into the throat to give bad breath. No mouthwash will take this bad breath away. The patient needs to see a sinus

specialist. As part of the evaluation of postnasal drainage and halitosis, the specialist will evaluate the nose and sinuses, as well as the throat. (**7, 12-16**)

CHRONIC COUGH AND SORE THROAT

Cough is a common presenting symptom of many patients seeing a primary care physician, and ultimately many are sent for evaluation by sinus specialists. For patients with chronic cough who are nonsmokers, have normal spirometry, and are not being treated with an ACE inhibitor, diagnosis usually focuses on differentiation between postnasal drip syndrome, asthma, gastroesophageal reflux disease, and nonasthmatic eosinophilic bronchitis, alone or in combination. Patients with severe COPD or GERD should be referred to appropriate specialists for those conditions. The management of conditions commonly treated by sinus specialists (e.g., allergic rhinitis, sinusitis) follows the recommendations of current guidelines and/or practice parameters. (**17**)

Two of the most common causes of cough are postnasal drip from rhinosinusitis and acid reflux (laryngopharyngeal reflux). Chronic productive cough in young adults is very often due to chronic rhinosinusitis (**18**). Nonetheless, patients with chronic cough, especially if they smoke, must have a specialist examine their larynx to evaluate the possibility of tumor or mass of the larynx. This only takes a few minutes and is done in the office under topical anesthesia with a small flexible endoscope. Patients with chronic cough should also have a chest X-ray and other evaluation by their primary care physician. Treatment of the cause of the cough often improves or resolves the patient's troublesome cough. However, sometimes a cough can persist even after the cause has been treated. Re-examination is important when a cough persists. However, this may be the "cough reflex." Often, this reflex must be broken by a cough suppressant.

An associated symptom may be a persistent sore throat. As with chronic cough, persistent sore throat should be evaluated by a specialist. If the cause is due to allergic or other irritation, treatment is often straightforward and effective. In other cases the presence of a mass needs to be excluded. This can often be done with a simple clinic laryngeal examination. (**7, 12-16**)

FATIGUE

Patients who experience fatigue should see their primary doctor to evaluate the many possible causes. However, chronic sinusitis—like any chronic illness— can take its toll on a patient. It can decrease energy levels and make the individual less productive. If a patient has sinusitis, this can be a contributing factor to fatigue. (**7, 12-16,19**)

Chester reported two cases of severe unexplained fatigue with mid-facial pain and rhinitis.(**19**) Sinus computerized tomography (CT) findings were minor, but both responded to functional endoscopic nasal surgery with resolution (Case 1) or near resolution (Case 2) of chronic fatigue. Possible mechanisms were suggested linking nasal disease and chronic fatigue, and include reflex etiology and sleep disturbance associated with abnormal nasal airflow. Chester pointed out that chronic sinusitis is typically not considered by the primary care physician in differential diagnosis of fatigue, and he suggested that it should be explored as a cause in unexplained cases. (**20**)

Chester and others report that fatigue and bodily pain is clinically and statistically improved by sinus surgery in patients who failed to respond to medical therapy. **(21-23**) Patients with severe fatigue showed a more pronounced improvement than patients less severely fatigued. (**22**) Significantly greater improvement occurs in patients with fibromyalgia and in patients who are more severely fatigued at presentation, compared to patients with mild fatigue. (**22**)

Soler et al (2008) report that nasal congestion, fatigue, decreased sense of smell , nasal drainage, and facial pain-pressure showed significant and sustainable postoperative improvement at 3, 6, 12, and 18 months after surgery. (**24**)

An important consideration regarding fatigue is medication use. Some antihistamines are sedating, and even non-sedating antihistamines have been associated with fatigue in some studies. (**25-26**) Bhattacharyya and Kepnes' prospective study found that higher fatigue symptom scores were associated with the use of non-sedating antihistamines, antibiotic use, but NOT with intranasal steroid use. The authors recommend that the long-term use of nonsedating antihistamines be scrutinized in patient reporting symptoms of fatigue. (**26**)

FACIAL PAIN AND HEADACHE

Facial pain and headache have many causes: tension headache, migraine headache, stress headache, cluster headaches, reflex sympathetic dystrophy, and more. Sinusitis does contribute to facial pressure and pain, and it can reduce resistance to other kinds of headaches—that is, sinusitis can lower the pain threshold or make the patient more disposed to get another type of headache. (**7, 12-16**)

The complete and thorough evaluation of headache includes evaluation by a neurologist and often an ENT specialist. If a patient's doctor feels that the individual's pain may be more sinus related, the doctor may want to start with a sinus specialist, who will examine the patient thoroughly and will search out all of the many causes of facial pain that can be treated.

If the specialist doesn't find anything definitive, there may still be hope of other effective treatment, and a neurologist may also suggest treatments.

In a rare patient, ENT and neurologic exam finds no cause for the headache. In these cases, a pain management specialist is enlisted into the team. The interventions of the pain management specialist may be effective in selected patients.

The relationship between sinus disease and headache is complicated. Phillips et al undertook a prospective study to examine the success of endoscopic sinus surgery for the alleviation of headache in a defined group of individuals. In particular they wished to discover whether the presence of asthma, nasal polyposis and purulent rhinosinusitis indicated that surgical intervention achieved any greater relief of symptoms compared to those without these conditions. Overall they found a significant improvement in headache symptoms after endoscopic sinus surgery, but subgroup analysis of patients with or without asthma, nasal polyposis and purulent rhinosinusitis showed no differences between the groups. (**27**)

RECURRENT SINUS INFECTIONS

Some patients have recurrent infections. The sinus specialist must find out why they get recurrent infections and treat this problem. Some causes are unavoidable—for instance, patients with small children in elementary

school who bring home cold after cold will have to wait until their children grow older. (Although, even in this situation the sinus specialist can often help with preventative medical treatment.) Patients with sinus blockage predisposing them to infections may find medical and/or surgical therapy to be helpful. The sinus specialist may need to check the function of the patient's immune status—while this is usually normal, occasionally a patient has low immune defenses that can be helped by directed treatment. (**7, 12-16**)

A relative indication for FESS is the presence of significant episodes of recurrent acute sinusitis. This refers to the situation in which a patient has repeated acute sinus infections but is relatively symptom-free between these infections. Relative indications for FESS exist in adults and in children over 12 who have recurrent acute sinusitis. While each patient's situation is unique, general guidelines do exist for surgery for recurrent acute sinusitis. These guidelines include (1) four or more episodes of infection during the past 12 months; (2) a trial of immunotherapy for allergic rhinosinusitis or absence of allergy; (3) presence of an anatomic variant, especially one causing OMC obstruction; and/or (4) prophylactic use of nasal steroids, mucolytics, and decongestants without benefit. (**15, 16**)

FACIAL PAIN AND PRESSURE WITH AIR TRAVEL

Nasal congestion secondary to sinusitis and other conditions is a relative contraindication to air travel. This means that patients prone to nasal congestive disorders should only travel by airplane if they have first consulted their physician. The physician may determine that it is not safe to fly or may feel that the patient can fly with proper pretreatment. The risks of flying with nasal congestion include severe facial pain, damage to the eardrums including bleeding, perforation, hearing loss, dizziness or vertigo, sinus bleeding. There is a small but real risk of even more serious conditions, such as neurological complications.

It is recommended that patients with nasal congestion take systemic decongestant and also spray the nasal passages with a topical long-acting nasal decongestant before departure and before descent. Such patients should check with their doctors to make sure that they can take these medications – for instance, a patient with high blood pressure may need to avoid these medications. Patients with allergies may also take an antihistamine, under a doctor's supervision. In some cases, a doctor may wish to prescribe other medications, such as oral prednisone, a

few days prior to travel. Medical care should be available at the patient's destination in case sinusitis or other medical problems occur. (**7, 12-16**)

ACHING IN THE UPPER JAW AND TEETH

The maxillary (cheek) sinuses are located just above the teeth. In fact, the roof of the mouth, in the location of the dental roots) is the floor of the maxillary sinuses. While it is not uncommon for dental problems to lead to infection of the maxillary (cheek) sinuses, an infected maxillary sinus may also lead to dental pain. Once the maxillary sinuses are affected, infection can spread to adjacent sinuses. (**7, 12-16**)

RUNNY NOSE, NASAL DISCHARGE

Some patients complain of persistent runny nose or nasal discharge. This "rhinorrhea" may occur alone, or in association with sinusitis. The causes are varied. In allergic rhinitis, an inhalant allergen is the cause. Others suffer from infective rhinitis due to a bacteria or a virus, while some have gustatory rhinitis – triggered by eating. Some common medications may cause rhinitis ("drug-induced rhinitis"). Others have a runny nose triggered by a substance in their workplace. Still others are affected by cold weather or exercise ("Vasomotor Rhinitis"). Whatever the cause, precise diagnosis is the key to effective treatment. Fortunately, most patients with chronic runny nose will benefit from simple, targeted medical treatments. (**7, 12-16**)

SMELL AND TASTE DYSFUNCTION

Smell and taste sensation go hand in hand. Patients who lose their sense of smell probably also find that food is bland or tasteless. Although annoying, this can actually be a more serious problem because the patient cannot tell if food is spoiled or if there is a household emergency such as fire, which they would not be able to detect. The nerves for smell are located in a very small area high in the nasal cavity. Even a small amount of blockage in this location can cause loss of sense of smell (which is why patients lose sense of smell when they have a cold, for instance). Sinusitis is a common cause of loss of senses of smell and taste. However, there are a number of other

problems that can cause a loss of sense of smell, including tumors, and this must be evaluated by an ENT specialist.

(**7, 12-16**)

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 2

QUESTIONS

1. A 2006 study by Koy and Coons on the incidence of chronic conditions reported that approximately three-fifths (62.5%) of the study sample reported at least one of 18 chronic medical conditions. The most commonly reported condition was
    A. Hypertension
    B. Arthritis
    C. COPD
    D. Depression
    E. Sinusitis

2. Loss of sense of smell can be caused by all of the following EXCEPT:
    A. Tumor in nasal cavity
    B. Viral cold
    C. Trauma
    D. Sinusitis
    E. Aminoglycoside

3. Nasal congestion secondary to sinusitis and other conditions is a relative contraindication to air travel. The risks of flying with nasal congestion include all of the following EXCEPT:
    A. severe facial pain
    B. damage to the eardrums including bleeding and perforation
    C. hearing loss
    D. Dizziness or vertigo, sinus bleeding.
    E. visual scotomata

4. Bhattacharyya and Kepnes' prospective study, and other studies, have found that higher fatigue symptom scores were associated with all but which of the following:
    A. the use of non-sedating antihistamines,
    B. antibiotic use
    C. sedating antihistamines
    D. antihistamine nasal sprays
    E. intranasal steroid use

5. In studies by Chester and others, and by Soler et al, all but the following symptoms were clinically and statistically improved by sinus surgery in patients who failed to respond to medical therapy:
    A. fatigue
    B. bodily pain
    C. nasal congestion
    D. decreased sense of smell
    E. joint pain

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 3

DIAGNOSING SINUS DISEASE – AN OVERVIEW

MAKING THE DIAGNOSIS OF CHRONIC SINUSITIS

Rhinitis refers to inflammation of the nasal mucosal linings. Sinusitis refers to inflammation of the mucosal linings of the sinuses and is usually associated with and often preceded by rhinitis. (**1-8**) Together, Ear, Nose, and Throat specialists today often use the term rhinosinusitis.. However, the words rhinitis, sinusitis and rhinosinusitis are often used interchangeably. In this article, we will use the term sinusitis to mean inflammation of the sinus and nasal passageways.

Experts on sinusitis have tried to precisely define sinusitis. The Rhinosinusitis Task Force of the American Rhinologic Society has defined rhinosinusitis as a condition manifested by an inflammatory response involving the mucous membranes of the nasal cavity and paranasal sinuses, fluids within the cavities, and/or underlying bone. (**13**) Symptoms associated with rhinosinusitis include nasal obstruction, nasal congestion and discharge, post-nasal drip, facial pressure and pain, cough, and others (Table 1). (**14-15)**

TABLE 1: Factors Associated with the Diagnosis of Chronic Rhinosinusitis

Major factors	Minor factors
Facial pain/pressure*	Headache
Facial congestion/fullness	Fever
Nasal obstruction/blockage	Halitosis
Nasal discharge/purulence/discolored nasal drainage	Fatigue
Hyposmia/anosmia	Dental pain
Purulence in nasal cavity on examination	Cough
Ear pain/pressure/fullness	

*Facial pain/pressure alone does not constitute a suggestive history for chronic rhinosinusitis in the absence of another major nasal symptom or sign

MAKING THE DIAGNOSIS OF ACUTE SINUSITIS (1-9)

The diagnosis of acute bacterial sinusitis is made when the signs and symptoms persist longer than a typical viral upper respiratory tract infection, which is usually 7–10 days, or when the signs and symptoms become exacerbated after the initial 5 days. Acute bacterial sinusitis usually follows viral rhinosinusitis. Typically, acute bacterial sinusitis resolves with medical therapy, resulting in no permanent mucosal damage. However, recurrent acute episodes of sinusitis require further workup to uncover anatomic or systemic underlying factors.

MAKING THE DIAGNOSIS OF SUBACUTE SINUSITIS (1-8)

Acute sinusitis that is not resolved after 4 weeks is called subacute sinusitis. This is a relatively rarely used term but does represent sinusitis that lasts 4–12 weeks. This can represent acute sinusitis that has either been inappropriately treated or not treated at all. Generally, adequate medical treatment of subacute sinusitis should lead to complete resolution with no resultant mucosal damage.

MAKING THE DIAGNOSIS OF RECURRENT ACUTE SINUSITIS (**1-9**)

Acute sinusitis that responds to antimicrobial therapy but then repeatedly recurs is called Recurrent Acute Sinusitis. These patients often have unremarkable nasal endoscopic examinations and CT scans in between episodes of acute sinusitis. Because recurrent infections occur in these patients despite medical treatment, this subset of patients is more likely to undergo primary endoscopic sinus surgery.

A relative indication for FESS is the presence of significant episodes of recurrent acute sinusitis. Relative indications for FESS exist in adults and in children over 12 who have recurrent acute sinusitis (2-7). While each patient's situation is unique, general guidelines do exist for surgery for recurrent acute sinusitis. These guidelines include (1) four or more episodes of infection during the past 12 months; (2) a trial of immunotherapy for allergic rhinosinusitis or absence of allergy; (**3**) presence of an anatomic variant, especially one causing OMC obstruction; and/or (**4**) prophylactic use of nasal steroids, mucolytics, and decongestants without benefit. (**2-7**)

While data regarding the outcomes of care for these patients is extremely limited, one study evaluated objective and patient-based measures in patients diagnosed with recurrent acute sinusitis before and after surgical

intervention, in comparison to patients with chronic rhinosinusitis requiring surgery.(9) Patients with recurrent acute rhinosinusitis were less likely to have asthma or previous sinus surgery. Patients with chronic rhinosinusitis underwent more extensive surgery. Both groups showed statistically significant improvements in total postoperative Quality of Life (QOL) scores. Patients with recurrent acute rhinosinusitis used significantly fewer sinus medications after endoscopic sinus surgery. Patients with recurrent acute rhinosinusitis were more often primary surgical patients and underwent less extensive surgery than their chronic rhinosinusitis counterparts. Both groups reported improved quality of life after surgery. (**9**)

MAKING THE DIAGNOSIS OF CHRONIC SINUSITIS

A strong history consistent with chronic sinusitis includes the presence of two or more major factors or one major and two minor factors for greater than 12 weeks. See Table 1. (**7, 8, 10**)

The diagnosis of chronic sinusitis is made on the basis of signs, symptoms, and physical findings. The signs and symptoms of chronic sinusitis have been detailed in the previous chapter. They include major and minor symptoms, which vary slightly depending on the source. [13] Major criteria generally include facial pain and pressure, facial congestion and fullness, nasal congestion and obstruction, nasal discharge, purulence and discolored nasal drainage, hyposmia or anosmia, and fever (for acute sinusitis). Minor criteria include headache, fever, halitosis, fatigue, dental pain, cough, and ear pain, pressure, or fullness. There are some criteria more specific to children, and these include cough and irritability.

A strong history consistent with a diagnosis of sinusitis is indicated by the presence of either two major criteria or one major and two minor criteria. A suggestive history is indicated by the presence of one major or two minor criteria (Table 1).

Chronic sinusitis is most commonly defined as persistent signs and symptoms for more than 3 months, with or without a constant need for antibiotics. Chronic sinusitis may be punctuated with acute exacerbations. This condition requires evaluation by an otolaryngologist, possibly by an allergist, and possibly by an infectious disease specialist to identify causative factors.

To make the diagnosis of sinusitis, the doctor will take a thorough history, asking about the duration and nature of the symptoms and other related factors, other factors relating to functional nasal problems, including environmental allergy, medications including inappropriate use of over-the-counter nasal decongestant sprays, nasal trauma, and prior nasal surgery. Next the doctor will perform a careful examination, including nasal endoscopy (Fig. 4).

THE PHYSICAL EXAMINATION

Thorough physical examination includes the external and internal nose; intranasal examination is undertaken both before and after topical vasoconstriction. An assessment is made of mucosal appearance; size, shape, and angulation of the turbinate; obstruction secondary to a deviated septum; and cross-sectional airway competence at the external and internal nasal valve. Hyperemia, edema, crusting, polyps, and purulence in the nasal cavity are also noted and may be indicative of chronic sinusitis. Rigid nasal endoscopy in the office after appropriate topicalization by a skilled endoscopist may be helpful in identifying these physical findings (**11, 12**). The patient's history can reveal underlying factors predisposing to an episode of acute sinusitis. Factors that lead to nasal obstruction, and more specifically to obstruction of the narrow sinus drainage pathways, are identified. These include viral upper respiratory tract infection, allergic rhinitis, vasomotor rhinitis, barotrauma, and mucosal hypertrophy. Furthermore, mechanical obstruction can be caused by nasal polyps, deviated nasal septum, foreign body, trauma, choanal atresia, and tumors. Gastroesophageal reflux disease (GERD) may be a contributing factor in chronic sinusitis. Recent dental work or infections can introduce bacteria into the maxillary sinus. Instrumentation of the nose in the hospital, such as a nasogastric tube, can be a contributing factor. Immunocompromised patients with connective tissue disease or immunodeficiency, including HIV, are also at risk. All these factors should be kept in mind.

DIFFERENTIATING VIRAL URI, ACUTE SINUSITIS AND CHRONIC SINUSITIS

Primary care physicians often diagnose and treat patients with acute bacterial sinusitis. Typically, the patient has a previous upper respiratory viral infection whose symptoms have failed to clear after numerous over-the-

counter and home remedies. Many patients will not allow these symptoms to persist longer than 2–3 weeks before seeking professional advice; others wait 1–2 months.

Community-acquired bacterial sinusitis is relatively common as a complication of a viral upper respiratory infection. Patients with acute bacterial sinusitis complain of facial pain aggravated by bending over, a yellowish/ greenish nasal discharge, nasal obstruction, unpleasant breath and taste, increased postnasal mucus (especially in the upright position) headache, and cough. Some patients may also have chills and fever. Because purulent nasal discharge and pain are the most common clinical findings of acute bacterial sinus infections, the location of the facial pain may suggest which sinuses are involved. Pain in the cheeks suggests maxillary sinusitis, whereas pain in the forehead or medial orbit suggest frontal sinusitis. Pain between the eyes suggests ethmoid sinus and pain behind the eyes and also occipital pain is associated with sphenoid sinusitis.

It is not at all surprising that there is confusion about differentiating the common cold from sinusitis, because the symptoms are very similar in the first week. However, patients who develop bacterial sinusitis typically seek help because of fever, headache, facial pain, or nasal obstruction that interferes with sleep. Symptoms of bacterial sinusitis are generally not relieved with over-the-counter preparations.

Chronic sinusitis is present when there are persistent signs and symptoms of sinusitis for 12 weeks or more. There is a more scientific definition of chronic sinusitis: chronic sinusitis is a disease in which the mucosal damage is no longer reversible despite appropriate medical therapy (**4-6**). In these cases, a definitive cure will most likely require surgery that addresses the “main” sinus drainage pathways. All patients with the diagnosis of chronic sinusitis or recurrent acute sinusitis should be evaluated by an ENTdoctor.

NASAL ENDOSCOPY, AND NASOPHARYNGOLARYNGOSCOPY

Nasal endoscopy allows for more detailed examination of the nasal cavities and can be performed with a flexible fiberoptic or rigid endoscope. Endoscopic examination enables the doctor to identify specific areas of blockage, to detect the presence of polyps, and to obtain cultures at specific drainage sites (Fig.4). (**5,11,12**) Findings on nasal endoscopy may include deviated septum, perforation of the septum, retained secretions, small surgical

ostium caused by postoperative stenosis, recirculation of mucus, hyperplastic nasal disease, synechiae, recurrent disease in previously unaffected sinuses, empty nose syndrome, frontal sinus disease, and many other entities. (**5, 11-13**)

FIGURE 4 – Nasal endoscopy allows for more detailed examination of the nasal cavities and can be performed with a flexible fiberoptic (shown here) or a rigid endoscope. Endoscopic examination enables the doctor to identify specific areas of blockage, to detect the presence of polyps, and to obtain cultures at specific drainage sites.

The flexible fiberoptic endoscope is useful in certain circumstances because its flexibility allows examination of difficult-to-examine structures. Examination of the ear, nose, and throat all the way down to the vocal cords can be undertaken with a flexible scope. The rigid endoscopes are advocated for diagnostic purposes by most otolaryngologists. The rigid endoscopes provide greater definition than do the flexible ones. The rigid scopes commonly come with 0°, 30°,

45°, or 70° fixed-angle lenses. Other angled lenses are available.

A topical decongestant and topical anesthesia are first applied. Spraying the nose with 1% phenylephrine and 2% tetracaine (pontocaine) often is sufficient to make the patient comfortable for a complete office exam with nasal endoscopy. If necessary, additional comfort can be effectively achieved by placing a cotton pledget with 4% topical anesthetic agent into the nasal cavity for 5 minutes. After appropriate decongestion and topical anesthesia, the 4-mm nasal endoscope with a 0° or 30° lens is passed into the nasal cavity. Examination of the entire nose and nasopharynx is undertaken. Proper diagnosis of intranasal and sinus disease can only be maximally achieved with this type of endoscopic examination (**5, 11-13**).

LABORATORY EXAMINATION

Several laboratory tests may be considered in the workup of patients with refractory chronic or recurrent acute sinusitis. These include complete blood count (CBC) with differential, and serum immunoglobulin tests,. Also, sweat chloride testing may be performed to rule out cystic fibrosis, especially in children with nasal polyps or chronic or recurrent sinusitis.

RADIOLOGY

When an X-ray must be done, the imaging procedure of choice is the computerized tomography (CT) scan, which is recommended primarily in evaluating the extent and severity of disease in chronic sinusitis and in complicated sinusitis (Figs. 5–6). Sinus CT scans and MRI scans have allowed doctors to directly visualize the pathology within the sinuses and depict normal and abnormal anatomy. These tools are an immense improvement over plain film sinus depiction and can give reliable reproducible information. (**14-24**)

The CT scan is now the gold standard and has replaced plain X-rays as the imaging study of choice in chronic sinusitis. CT scans, especially the coronal images, are useful in imaging the underlying sinus anatomy in detail. The combination of nasal endoscopy and CT scans in the evaluation of chronic sinus disease allows for precise diagnosis and treatment.

CT scan is an invaluable tool in the evaluation of the sinuses. One of the primary strengths of sinus CT imaging is improved contrast resolution: that is to say, the ability to depict bone/air and bone/soft tissue interfaces. Another primary strength of CT scans is improved spatial resolution: that is, the ability to depict very small structures. The surgeon and the radiologist, working together, hope to obtain numerous specific pieces of information from CT scans of patients with sinus disease. This information includes the status of the bony walls, the nature of material within the sinuses, and the status of the adjacent normal structures such as the eye, brain, and midface. The status of the bony walls of the sinuses is important both in benign sinus disease and also in sinus tumors. It takes newer-generation scanners only minutes to provide high-resolution images of tissue slabs that are

only a few millimeters thick. CT scans in the coronal plane provide the endoscopic sinus surgeon a road map for performing sinus surgery to improve efficacy and safety.

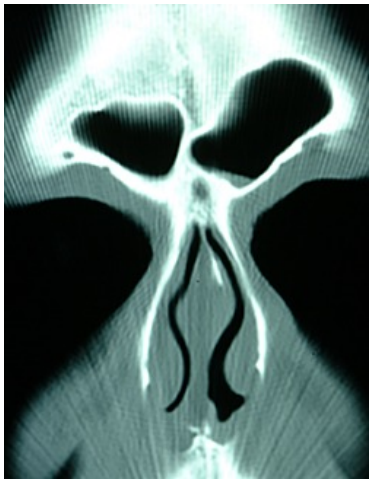

FIGURE 5A – Anatomy of the frontal sinuses. The imaging procedure of choice is the computerized tomography (CT) scan, which is recommended primarily in evaluating the extent and severity of disease in chronic sinusitis and in complicated sinusitis. CT scans, especially the coronal images, are useful in imaging the underlying sinus anatomy in detail.

It is critical that the patient's history at the time of the CT scan be known. Doctors should be aware that positive CT findings do not always correspond to acute bacterial infection. Up to 40% of asymptomatic patients have some degree of sinus opacification. (14-17) Also, recent studies have reported that a large percentage of patients with common cold symptoms show abnormal CT scan findings, nearly 80% of which resolved in 2 weeks without antibiotic therapy. (**14-17**) Moreover, patients with sinus and nasal polyps may show sinus opacification without evidence of actual infection. In patients with chronic sinusitis, medical treatment is preferred before CT scan imaging to maximize the anatomic detail we need to obtain. Patients undergo medical therapy to address acute infections, shrink inflamed mucosal membranes, and reduce hyperplastic mucosa. The CT scan can typically be obtained with modern scanners in under 5 minutes. No IV contrast is needed. The scan technique results in relatively low radiation exposures and generates image contrast that is diagnostic for definition of anatomic structures. These images are adequate for evaluation of various densities within the sinus contents, which can indicate fungal sinus disease or concretions in the sinuses. Although some clinicians advocate additional windowing to increase sensitivity for extra

sinus pathology, this has not routine. If there is concern for orbital pathology, intracranial pathology or other sinus complications, the specialist will add axial images, administer IV contrast, or request MRI. It is notable that plain films of the sinuses in children can be especially misleading. Using CT as the gold standard, plain films have had a false negative rate of 45% and a false positive rate of 35% in infants andchildren. (14-17) With these discouraging numbers, it is clear that the choice of plain films is fraught with error.

FIGURE 5B – Maxillary and ethmoid sinuses

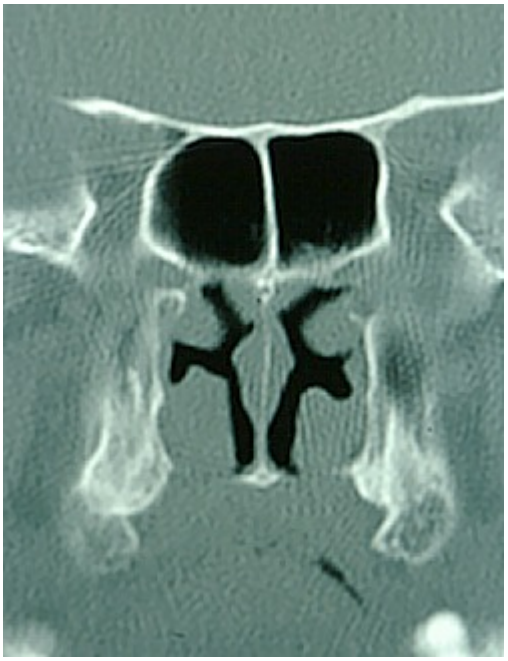

Figure 5C – Sphenoid sinuses

FIGURE 6 – A case of severe sinusitis with pansinus opacifi cation. The combination of nasal endoscopy and CT scans in the evaluation of chronic sinus disease allows for precise diagnosis and treatment.

In children, computer tomography will offer an improved sensitivity and specificity, but it has its drawbacks, namely higher cost, somewhat increased radiation exposure, and the frequent necessity of sedation to perform these exams in children. A "plain X-ray" may be helpful in evaluating the pediatric patient suspected of having acute sinusitis. Beyond that, these plain X-rays have limited value for evaluation of sinusitis.

Whenever taking X-rays, there is a concern about radiation exposure. Much improvement has been made in this area in recent years. The finely collimated beams used in thin section CT and the increased sensitivity of radiation detectors have allowed the radiologist to significantly refine the technique necessary to provide high-quality images and subsequently reduce the radiation exposure to the patient. However, even reduced radiation with modern CT scans entails greater radiation exposure than that in "traditional" radiography. With regard to radiation exposure, the lens of the eye and the thyroid gland are primary organs of concern. It remains prudent to use X-ray or CT exam only if the results will alter clinical management.

CAUSATIVE FACTORS IN SINUSITIS

In many patients with sinusitis, the lining of the nose and sinuses is overly sensitive to a variety of factors. This is a problem to which a patient may be genetically predisposed. Factors to which the nose may react include environmental pollution and allergies, temperature changes, and possibly stress and certain foods (**2-6**).

In patients with hypersensitive sinus and nasal lining, these factors may cause more marked irritation and swelling, secondary sinus obstruction, and poor clearance of mucus. Should secondary chronic infection develop subsequently, the problem is typically made worse, and the hyper-reactivity then further increases. Treatment of

the infection, even when it is low-grade, may, over time, result in a significant improvement in the symptoms of hyper-reactivity.

While many think that sinusitis means infection, infection is only one of many causes of inflammation of the sinuses. Signs of infection include fever, green and foul-smelling nasal drainage, and facial pain.

Causative factors in sinusitis can be considered by categories. Inflammatory factors include upper respiratory tract infections (example, the common cold), allergic rhinitis, vasomotor rhinitis, recent dental work, barotrauma, and swimming. Systemic factors include immunodeficiency, ciliary dyskinesia syndrome, cystic fibrosis, rhinitis of pregnancy, and hypothyroidism. Mechanical factors include choanal atresia, sinonasal polyps, deviated septum, foreign body, trauma, tumor, nasogastric tube, turbinate hypertrophy, concha bullosa, adenoid hypertrophy. Medication-related causes include beta-blockers, birth control pills, antihypertensives, aspirin intolerance, rhinitis medicamentosa (overuse of topical decongestants), and cocaine abuse. Many of these causes will be discussed below. (**12**)

A common cold is a viral infection that typically goes away in a few days. There is no cure for the common cold—it will resolve when it has run its course over a few days. Some evidence suggests that zinc tablets may shorten the duration of a cold. If a patient's nasal and sinus anatomy is particularly narrow, or if the nose is especially sensitive, then the patient is less able to tolerate the swelling of the nasal membrane lining caused by nasal irritants, and a cold could "turn into" a sinus infection. Depending upon the patient's anatomy, and depending upon how the patient's nose reacts to the surrounding world, the individual may be more or less susceptible to sinusitis. Anatomic abnormalities that predispose to sinusitis are typically recognized by the sinus specialist and may be amenable to surgical correction.

It is well known that viral infections destroy the cilia of the mucous membranes, and approximately 6 weeks are required for regeneration. Many doctors therefore believe that this is a predisposing factor for a bacterial sinusitis "super-infection," because these patients have decreased mucus flow, thick abnormal mucus, and osteomeatal complex blockage. In addition to problems, such as the common cold, allergens and nonallergic pollutants are significant triggers to sinusitis. Irritants such as cigarette smoke, perfume, toxic chemicals, and other

pollutants remain a problem for many patients. Environmental pollutants in the air, such as cigarette smoke, can cause increased irritation of the nasal and sinus passages, particularly in people with hypersensitive nasal lining (mucosa). We are also becoming more aware of the effects of general outdoor and indoor pollution. Chemicals used in the manufacturing of carpets, furniture, or buildings may also be a problem for sensitive individuals (Fig. 3).

Patients who smoke should quit promptly. Smoking also causes many health problems besides sinusitis that are not the subject of this discussion. The noses of patients with allergies may react to allergy-inducing substances in the air, such as dust or mold. Allergic nasal and sinus swelling may in turn lead to sinusitis. Food allergies (or sensitivities) can also be an unrecognized cause of nasal congestion and swelling.

Certain conditions that exist within a patient's body can increase susceptibility to sinus infections. For example, periods of emotional stress can result in swelling of the nasal lining. Many female patients develop nasal mucosal swelling during pregnancy. Certain medications used to treat high blood pressure can also cause swelling of the nasal lining. High blood sugar can cause patients with diabetes to be more prone to infections in general. Immune deficiencies can also be an important contributor to a predisposition to sinusitis.

Certain relatively rare disorders such as lupus, cystic fibrosis, Wegener's disease, sarcoidosis, among others are associated with difficult sinus problems. Patients with any underlying medical conditions or illnesses should be under the care of appropriate physicians. It is important for these patients to inform their sinus specialist if they have, or suspect, any other medical problems (**2-6**).

SEEING A SINUS SPECIALIST

Many patients with acute sinusitis are treated initially by their primary care physician with medical treatment. However, patients who develop frequent sinus infections and chronic sinusitis are often sent to a sinus specialist for further medical management, allergy evaluation and treatment, and sometimes surgery. The sinus specialist has all evaluation and treatment modalities at his/her disposal and is well-equipped to tailor the appropriate treatment for each patient.

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 3

QUESTIONS

1. A strong history consistent with a diagnosis of chronic sinusitis includes the presence of :
    A. two or more major factors or one major and two minor factors for greater than 12 weeks.
    B. two or more major factors or one major and two minor factors for greater than 8 weeks.
    C. One major factor and one minor factor for greater than 12 weeks
    D. Four minor factors for greater than 12 weeks
    E. Four minor factors for greater than 8 weeks

2. Compared to CT scans, plain films of the sinuses in children have a false negative rate of
    A. 5%
    B. 45%
    C. 70%
    D. 80%
    E. 95%

3. All of the conditions listed below can increase susceptibility to sinus infections except
    A. emotional stress
    B. Pregnancy
    C. High blood pressure medication
    D. High blood sugar
    E. Impetigo

4. Viral upper respiratory infections destroy the cilia of the mucous membranes,
    A. Which require approximately 1 week for regeneration
    B. Which require approximately 6 weeks for regeneration
    C. Which require approximately 12 weeks for regeneration
    D. Which require approximately 6 months for regeneration
    E. Which require approximately 1 year for regeneration.

5. In addition to problems such as the common cold, all of the following are significant triggers to sinusitis except
    A. allergens
    B. nonallergic pollutants
    C. cigarette smoke
    D. perfume
    E. baby powder

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 4

ALLERGY AND SINUS DISEASE

INTRODUCTION

According to the American Academy of Allergy, Asthma, and Immunology (AAAAI), over 50 million Americans suffer from some form of allergies that greatly impacts their quality of life as well as healthcare costs that are estimated at approximately 20 billion dollars a year. (**1**) Allergic rhinitis alone is estimated to affect 20 to 30 million Americans each year and accounts for an estimated 3% of all medical office visits and ranks as the second most common reason patients seek professional health care.(**1**) In many geographic areas of the United States, allergies play a significant role as contributory factors of sinus disease as well as secondary cause of sinus infections. It is of great value to the practitioner to understand the underlying immunologic factors, available diagnostic tests and treatments. (**2-8**)

It is especially valuable for the practitioner to be well versed in allergy because many patients are confused about the difference between sinusitis and allergic rhinitis. They often do not appreciate that allergic rhinitis is a subset of rhinitis or rhinosinusitis. This is important because if the allergic rhinitis patient is not evaluated for sinusitis, then important other factors may be overlooked, such as structural blockage from polyps, deviated septum, etc The allergic patient should have a thorough examination that includes allergy testing and nasal endoscopy and other evaluations as discussed in this course.

Allergy is a specific way that a patient's body reacts to certain foreign substances. For example, when a patient allergic to dustmites breathes in "dustmite particles," they are recognized by specific allergy receptors in the nose. When the specific "dustmite receptors" recognize the "intrusion" of dustmite particles, they cause the release of substances that are meant to fight the presence of these particles. These include the release of histamine and other substances that create an inflammatory response. These responses were designed as a defense against the "foreign intruder"—for instance, the dustmite particles. However, this allergy response has the unfortunate

consequence of causing unpleasant symptoms such as a scratchy throat, watery eyes, runny nose, sneezing (to expel the intruder), nasal congestion and so forth. Therefore, physicians often prescribe treatments, including avoidance of inciting agents, antiallergy medicines, and at times immunotherapy, to minimize this response and relieve the symptoms of allergy and allergic response. (**2-8**)

A simple screening test for allergy is a complete blood count with differential. Elevated levels of eosinophils are strongly suggestive of allergy. Measurement of serum immunoglobulins can also be diagnostic. Specifically, measurement of serum immunoglobulin type E is useful, and elevated levels are suggestive of allergy. More complicated tests include specialized blood tests for allergies and also the familiar skin scratch tests. (**2-8**)

ALLERGY IN DEPTH

Immunoglobulin IgA, IgD, IgE, IgG and IgM are closely related proteins found in the body that often act as antibodies. There are quantitative tests that measure serum concentration of IgA, IgE, IgM and IgA. IgA is found in exocrine secretions of colostrum, saliva, tears, fluid of the nose as well as intestinal and respiratory mucin. (**7-9**) It primarily aids in the protection of mucosal membranes from microbial pathogens. IgG is the only gamma globulin that has the ability to move across the placental barrier and therefore aids in producing immunity in the developing fetus by neutralizing toxins and viruses. IgM in found in the early phase of almost every immune reaction. The most important immunoglobulin related to allergy is IgE. IgE is a gamma globulin that is produced by cells of the lining of the respiratory and intestinal tracts. Elevated levels of IgE often indicate allergies, atopic disorders, parasitic disease and IgE myeloma. It is the primary carrier of reagin activity (antibodies) and defends against foreign invaders and parasites. (**7-9**)

Immune reactions mediated by IgE cause the release of chemical reactors that produce signs and symptoms of allergy such as allergic rhinitis, uticaria (hives), eczema, and bronchial asthma. The chemical mediators released by the cells include histamine, serotonin (potent vasoconstrictor), kinins (bradykinin causes vasodilation of bronchial smooth muscle contraction), and SRS-A (an acidic lipid involved in anaphylaxis). (**9**) Low levels of IgE are present in

all individuals but in an estimated 30% of the population the IgE level increases as a result of immunologic allergic response. (**9**)

Two things must be present for a true allergic response: genetic tendency and repeated exposures of antigens the body reacts to as being harmful. We do not inherit allergies from our parents, but we do inherit the predisposition of allergy. It is estimated that if both parents suffer from allergies, their children have between 75-80% chances of developing allergies, whereas if one parent has allergies, the tendency decreases to 30% for their offspring.(**9**) This allergic predisposition includes not only allergy, but asthma and/or eczema. Beside the inherited predisposition, one must be exposed to one or many allergens whether it be dust mite particles, pet dander, pollens or mold spores for a continued period of time before the sequence of cellular reactions cause symptoms that become bothersome enough for a patient to seek medical help.

We inhale millions of microscopic particles comprised of dust, pollen, plant spores, cell dander, chemical irritants and various bacteria every time we breathe and our bodies are designed to filter out some of these substances as it protects us from viruses and bacterial infections. As we inhale, air circulates in and around the turbinates of the nose and if irritants enter, they become trapped in the mucus that line those passages. The irritants bind with mast cells present in the tissue that in turn release histamine. The histamine causes blood vessels in the nose to dilate and leaks fluid to flush out the foreign substance thus causing inflammation and itching. In normal circumstances the body ignores harmless substances, but for some the immune system misinterprets them as dangerous and initiates a chemical reaction to rid them from the body. If the irritant is a protein as most pollens, dust mite particles or pet dander particles are, the unfortunate one who has the genetic tendency to react will begin forming antibodies against the allergen each time of exposure causing more severe symptoms. Antibodies remain in the body for long periods of time. For instance, you could experience seasonal allergies as a child and then move to an area of the country where the allergens are not present and live a very comfortable life, but upon returning thirty years later, experience the same miserable symptoms you did as a child. People can develop allergies for the first time at any age. Even though the immune system weakens with age, it is not unusual for patients in their sixties to acquire new allergic symptoms. It takes a good historian to gather information as it relates to patient's symptoms to

identify possible allergen connections as well as an understanding of the seasonal changes in the environment. Not only do tree, weed and grass species vary throughout the country but so do the weather and seasonal patterns that affect pollen counts change throughout the year. For instance, some parts of Texas are inundated with mountain cedar pollen in the winter months while the northeast experiences problems with tree pollen in the spring. Allergies are generally classified as seasonal or perennial (**2-8**).

SEASONAL ALLERGIES

Seasonal allergies and symptoms correlate to the pollens present during a particular season and include trees, grasses or weeds (**7-8**). These pollens are carried by the wind and some can travel miles depending on the air current. Pollens can travel over bodies of water, but typically become trapped in moving water. Most people who experience seasonal allergies prefer the coast or beach since ocean air blows inland with moist, cool air free from pollen. Flowers are pollinated by insects and their pollen tends to be sticky. They can cause symptoms in small enclosed areas or when "wild flowers" that are sometimes weeds and not flowers are mixed into floral arrangements and brought indoors. Many patients with moderate to severe seasonal allergies will concomitantly react to some fruits and raw vegetables complaining of mouth tingling, itchy throats or gastrointestinal distress. For instance, cantaloupe and honey dew melons are from the same family of plants as ragweed and are plentiful in most areas of the U.S. around the same time ragweed pollen is at its peak. When questioned, many allergic patients will report experiencing symptoms during this time. It is best to distinguish the difference between true food allergies and concomitant reactions by an allergy test, though most without true food allergies will not react to pasteurized juices or cooked fruits or vegetables since heat alters the molecular structure. It is important to know that most trees in their active season pollinate one hour after sunrise and pollen counts remain high until midday when the sun dries the air and larger, heavier pollen falls toward the ground. It's a good idea for those allergic to tree pollen to reduce their activity outdoors early in the morning and take medications an hour before going outdoors. In the Northeast Alders, Maples, Elms, Junipers, and Cedars begin to pollinate after four to five days of warm weather. The pollen of these trees visually goes undetected, however often patients will begin to complain of allergy related

symptoms as early as February. The groups of trees in the Northeastern part of the United States that follow include Beech, Poplars, Birch, Oak, White Ash, Hickory, American Sycamore, Cottonwood, Walnut, Hazelnut, Mulberry and Sweet Gum. Many people think that flowering trees and pine pollen (often covering cars and driveways in southern New Jersey) are the culprits for their symptoms, while these visible pollens are large and fall to the ground. These large, heavy pollens are carried by water and not wind. For pollens to cause allergy they must be wind-borne, produced in large amounts (plentiful), and contain a protein that is allergenic. Air conditioning helps to filter pollen and reduces exposure during the active season of spring. Allergic symptoms include nasal congestion, thin or watery nasal discharge, itchy and/or runny nose, dry cough, sneezing, and itchy/watery eyes. Patients who complain of thick nasal discharge, facial pressure or pain, wet cough and/or fever should be evaluated for infection and if possible a nasal culture should be taken to identify the presence of bacteria and determine the correct antibiotic treatment. Patients who suffer during the active pollen seasons and spend a good deal of time outdoors should be instructed on the proper technique for nasal irrigation to decrease their exposure to irritating pollen as well as given demonstrations of nasal corticosteroid sprays and/or nasal antihistamine sprays. Keep in mind that patients who have narrow angled glaucoma should not use nasal steroid sprays as it can increase intraocular pressure. Anyone with long hair should be encouraged to shower after outdoor activities and refrain from wearing contact lenses if the eyes become red and irritated. (**7-8**)

Grass seasons vary according to the geographic location and climate, but when seeds become visible on the blades of grass, they are considered to be active. Mowing the grass is especially irritating to those allergic since it not only artificially pollinates the seeds but because grass pollen is somewhat sticky and clings to long hair and outerwear. To reduce exposure, it is recommended that the mouth and nose be covered with a mask, and removing all clothes after mowing and immediately showering. Patients who reside close to golf courses should inquire when the grass is mowed and avoid being outdoors during those times for extended periods of time - especially on windy days. Grass season in the Northeast generally ranges from May to September. Pollen seasons may be lengthened by rainy summers and shorted in the presence of drought. Cross-reactivity between grass species is not uncommon and due to the extensive variety of grasses, allergy testing and treatment is geared toward identifying the most

allergenic and they rarely treat two grasses that fall within the same family. For instance, the Pooideae subfamily of grass include june, perennial rye, fescue, sweet vernal, orchard, and timothy; however, timothy and orchard are more widely distributed and generally the most commonly tested in the Pooideae group. (**10**) Patients should be made aware that many grains such as wheat come from the Pooideae family and can increase symptoms during the season. Bermuda is from the Chloridoideae subfamily and has little cross-reactivity with Pooideae. (**10**) Though Bermuda is a subtropical grass, it is commonly found on golf courses. The third subfamily is the Panicoideae that includes Bahia, crabgrass, and Johnson grass. (**10**) Bahia is very allergenic and in most cases will be treated regardless of cross-reactivity. Bahia is mostly found in the southern states but has found its way as far north as Washington, D.C., and Maryland. Allergy testing and immunotherapy requires knowledge of the grass distribution within a region as well as knowledge of subfamilies because overdosing of grass antigen is the most common cause of anaphylaxis in treatment programs.

Weed pollen is more pronounced around large open fields or near ponds, lakes and streams. Ragweed pollen is one of the most prevalent weeds in the United States and is found both in urban and rural areas. This stubborn weed can grow between cracks in a paved walk and the pollen it generates can blow up to four hundred miles. The only thing that stops weeds from pollinating is a drought or frost. Patients should avoid open fields on windy days, keep car windows closed, and use air conditioning whenever possible to reduce exposure. There is little cross reactivity with weeds and this should be tested and treated individually according to the greatest distribution within a region. Weeds are generally most troublesome from July to the first frost. English plantain and sheep sorrel begin pollinating in April. Similar to grass, weeds are affected by rainy seasons and drought. (**7-10**)

PERENNIAL ALLERGIES

Perennial allergies are not seasonal in nature and cause symptoms all year. The allergens responsible for perennial symptoms include mold spores, dust mites and animal dander. They become more troublesome during the colder months when the heat is first turned on and the home is closed up. An allergy filter fitted to a heating unit can reduce indoor allergens and should be changed every three months. (**7-8**)

Mold is fungi that serves as decomposers in our environment. Mold spores travel with cold fronts (sudden drop in temperature usually accompanied by blustery winds) and can be found anywhere there is a dark, damp environment with a food source. Wooded areas with leaf and pine litter are a good source for mold outdoors. Mold spores that find their way indoors like dark, damp areas of the house such as basements or attics. Mold spores require a food source that can be anything natural such as cellulose backing of carpet, plant soil, cotton or wool fabric, leather, drywall, ceiling panels, dust, wood and even kitty litter boxes. Homeowners should look for any water intrusion such as leaks or identify dampness in the basement or crawlspace. Dehumidifiers can reduce moisture in basements and visible mold should be treated with a 1:1 mixture of bleach and water. Multiple applications should be used with adequate time for drying between treatments. Basements with untreated block should be sealed to decrease moisture. Carpet over cement without moisture barriers should be checked for the presence of mold. Mold can look like the blackish, brown material often found in bathrooms or take the appearance of a white or yellow powder. Garden mulch is another source for mold spores. Patients who are sensitive to mold should wear a mask while gardening. Those who suffer from itchy skin and hives while gardening should wear gloves and long sleeves and shower with tepid water to remove spores. Mold-allergic people should also refrain from blowing leaves in the autumn, but rather rake leaves when they are damp to decrease their exposure. Those who are mold-sensitive can also implement a mold elimination diet to reduce their symptoms. Many patients who suffer from mold sensitivity also complain of headache, grogginess, fatigue and an inability to concentrate along with the typical symptoms of congestion, runny nose, scratchy throat and post sinus drip. Many mold-sensitive people react when they ingest mold-based cheeses such as feta or blue cheese. Questions relating to home and work environments help target mold sensitivities and identify food reactions after eating mold-based foods such as those previously mentioned and also including smoked fish, sauerkraut, raw mushrooms, dried fruits or starchy leftovers. (**7-8**)

Dust in large quantities is an irritant to almost everyone and dirt alone has never been identified as an allergen. Dust is made up of many things such as pollen, mold spores, dust mite particles and human and animal dander that are protein in nature and can cause an immune response. It is important to identify the allergens

responsible for perennial symptoms and take measures to decrease exposure rather than lump them into the category of "dust allergic." Dust mites are microscopic insects that feed on dead human and animal skin cells. They are decomposers that never bite us or carry diseases, but do excrete a finer protein that can cause an allergic response in humans. Yes, that's right! Dust mite poop and their dismembered body parts can be a source of allergy when either inhaled or touching the skin. Each dust mite produces about twenty droppings a day and there are millions all around us! They usually reside where there is the greatest food source…our bedding. Their microscopic dried droppings become airborne every time someone rolls or sits on a bed or sofa or even walks across a carpeted floor. (Dust mite) Dermatophagoides farinae and (dust mite) Dermatophagoides pteronyssinus are routinely tested by either skin tests or blood for anyone suffering from perennial allergies. Since dust mites are present throughout the year, they can continuously cause symptoms of allergy, asthma or infantile eczema; however, they are more prevalent in the winter months when the house is closed up and the home is warm. Dust mites love warm temperatures of at least 70 degrees with an approximate humidity of 50%, so keep the home a few degrees below 70 and the humidity below 50%. Children with dust mite allergies or asthma should refrain from a bedroom cluttered with stuffed animals especially in the bed. Encasements can be purchased for the mattress and box spring if it makes the patient feel better, but in more recent studies it was determined that dust mites will populate on the surface of the encasements. Encasing a pillow is more beneficial to reduce exposure since we typically launder sheets and not pillows. Pillows and blankets or comforters can be thrown into the dryer for ten minutes each week to remove particles as long as it poses no threat of heat damage. Sheets should be washed in hot water (130 degrees) and changed at least every two weeks. It's actually beneficial to leave the bed unmade and allow the sheets to air dry to decrease the population of dust mites. If possible, refrain from humidifiers in the bedroom during the winter months and either use air conditioning or a dehumidifier during the humid summer months. Freezing temperatures and sunlight kill dust mites but don't eliminate their residue. Allergy filters for home heating units help reduce dust and irritants from the home and an easy makeshift air cleaner (floor fan with allergy filter taped to it) can be used in bedrooms during the day for a few hours with the door closed. Always vacuum carpet with an allergy bag to trap microscopic particles and, if possible, replace carpet with a hard surface flooring material

in the bedroom. Be careful not to vacuum around those who suffer from asthma because in many cases dust mites are a trigger for inflammation. (**7-8.11**)

Animal dander by itself or as part of household dust can cause allergies in some people. Cat dander seems to be more common than dog dander for a few reasons. Cats are not typically bathed and they have more run of the home than their canine counterparts. Cat dander is sticky and often travels on clothes, transporting it to other locations. The protein in cat dander is also a strong trigger for many that suffer from bronchial asthma. (**7-8,11**) The protein responsible for pet sensitivity can be in both the saliva and the skin cells which explain why some people have skin reactions after being licked by some animals. Dogs that are groomed on a regular basis are less of a problem, while on the other hand; hunting breeds and hounds that have musk oil on their coat makes their dander sticky. This sticky dander tends to accumulate in the home and is harder to vacuum. It's important to ask about pets and where they sleep when interviewing patients with suspected allergies. It's best to keep pets out of bedrooms, making it a safe allergy-free sanctuary in order to reduce exposure levels and symptoms. Birds can also be a source of allergy and should not be overlooked when suspecting perennial allergies. Dirty bird cages are a source of mold and feathers with attached skin cells can cause symptoms of allergy. Dogs and cats that go outdoors can often bring grass pollen and weed pollen indoors on their fur. During these seasons it is wise to wipe down pets with a warm cloth before they return indoors. It is often the pollen on their fur that people react to rather than their dander.

ALLERGY TESTING

The two most common methods of testing for allergies are the skin test or a mRast blood test. (**2-8**) Skin testing requires patients to discontinue antihistamines for a period of seven days prior to testing. Other drugs that may interfere with testing include proton-pump inhibitors and H2 antagonists. Testing can take anywhere from one hour to an hour and a half. A control screen that includes a prick test of histamine and glycerin should be done to assess if results will be accurate. A small applicator that resembles a toothpick is dipped into a histamine solution and then applied to the skin of the inner forearm. The force of the prick should not cause bleeding and the droplet

of liquid should remain on the skin for 15 minutes. Glycerin is used because most manufactured antigens used for testing and treatments are in a glycerin solution that serves as a preservative. If the control indicates the patient is sensitive to glycerin (a wheal the same size or larger than the histamine control), the test outcome will yield a false-positive result and testing should not continue. A blood test would be a better choice. There are single applicator devices or multiple pronged devices (multiprick) used for skin testing. Multiprick devices test eight different antigens in a given space of approximately three inches. The various antigens remain on the skin for twenty minutes and then cleansed with alcohol or tepid soapy water. Each wheal is measured using the control screen of histamine as a guide. Wheals of 7mm or larger are considered positive with some positive results measuring up to 16mm or larger. Further testing is indicated if the patient's history including environmental factors and symptoms suggest a source of sensitivity. To clarify any questionable negative results, a series of intradermal injections using a less concentrated solution can be administered. Mold sensitivity commonly does not yield a positive result on the prick test, but does with intradermal injections. Treatment serums are then individually created based on the positive test and after arriving at a safe starting dose or concentration. Antigens containing pollen proteins are separated from dust mite, animal dander and mold proteins. The serum is administered by a subcutaneous injection that gradually increases in dose (to .5cc) and in concentration until the patient's symptoms are eliminated. Treatment usually ranges from eighteen months to three years. (**2-8**)

Blood tests require the patient to have blood drawn at a participating lab. Prior to the blood test a good deal of time is spent interviewing the patient investigating possible allergic factors. It is also necessary to understand the geographic region as it pertains to trees, grasses, and weeds in addition to understanding occupational and indoor factors that may play a part in a patient's symptoms. The mRast blood test is designed to detect IgE binding antibodies to various antigens. The results are then classified in a numeric range that correlates to an individual's allergic sensitivity. Classifications are from (I) to (VI) or least to greatest sensitivity. The blood test allows practitioners who suspect food allergies (only those that provoke an IgE response) or bee venom allergies to be tested along with inhalant allergies. Results take between seven to ten days to receive. Insurance policies will dictate what lab the patient should use and will usually only reimburse for one test every twelve months. It is

important that an experienced practitioner interviews the patient and ascertains the proper codes of all the suspected allergens. A total serum IgE level should accompany the test for a complete diagnosis to determine if immunotherapy is warranted. (**7-8**)

FOOD ALLERGIES

It's important to distinguish food allergies from food intolerances (**7-8)**. Food intolerances cause unpleasant symptoms whereas food allergies trigger the immune system to produce IgE antibodies against the ingested food resulting in more severe symptoms each time the food protein is detected. Symptoms of food allergy include tingling of the mouth, hives, swelling of the lips, face, tongue and throat, difficulty breathing, dizziness, fainting and in severe cases, anaphylaxis. Foods that cause severe reactions are usually proteins that are found in eggs, peanuts, shellfish, and tree nuts. In children, common food allergies are triggered by milk, wheat and soy. A family history of inhalant allergies, hives, or eczema is usually found in people who have food allergies.

A blood test is the best method to detect IgE related antibodies. Food elimination and equipping patients with an epinephrine auto injector device is best. Latent food allergies that are not life-threatening but never-the-less cause symptoms are far more difficult to diagnose. A rotation diet is the easiest way to control the amount of food ingested is an identified culprit to decrease symptoms. Rotation diets can be found on the internet according to the suspected food.

First, suggest the patient keep a food diary that includes all foods eaten during a two- to four-week period with a log of symptoms experienced. Review the food diary and symptoms and build a list of suspicious foods. For instance, if the patient becomes symptomatic after eating eggs, cheese and wheat products over the course of a two week research period, a rotation diet that excludes one or two of the culprits and follow the diet for one month. During that month, encourage the patient to continue to keep a food diary for other symptoms related to his/her diet and eliminate them and add them to the list. If no symptoms appear after thirty days, rotate one of the suspected foods back into the diet. If no symptoms appear after three weeks, introduce another food from the list and so on. Culprit foods that are eliminated and then reintroduced will usually cause symptoms within a few days of

eating them. The rotation diets found on the internet take all the work out of designing meal plans and make it easier to understand hidden foods that may contain proteins of the suspected allergen. Many times, by reintroducing foods that cause symptoms in a rotation diet where they are only eaten in small amounts every five to six days, symptoms will disappear.

Dieticians trained in food allergies and rotation diets can be of great help to those suffering from latent food allergies or intolerances who cannot manage investigation of foods on their own. The ELISA blood test detects IgG related food allergies as well as immunodeficiency but is generally not covered by insurance companies. The test can cost approximately $150 but does include dietary assistance for meal planning for a period of one year. (**7-8**)

In the last decade there have been many studies recognizing the significance of allergies as a contributing factor of asthma. Patients who have inherited the genetic tendency may be more susceptible to certain indoor allergens such as dust mites, pet dander, molds, or cockroaches, as well as some airborne pollen. (**12**) For the asthmatic patient who expresses sensitivity to airborne antigens, this may contribute to airway inflammation, thereby causing increased respiratory symptoms. Many food allergy symptoms can be mistaken for asthma symptoms, which is another reason that allergy testing is an important tool to prevent life-threatening scenarios. Experts estimate that 10% of children with asthma have food allergies as well. (**11**)

Symptoms of anaphylaxis can include hives, facial swelling, difficulty swallowing, abdominal cramps, vomiting, diarrhea, a drop in blood pressure, breathing problems and unconsciousness. Many patients experiencing anaphylaxis may not have all of these symptoms during a reaction and they can overlook the potential dangers and opt for their rescue inhaler over their epi-pen. People with asthma are more at risk for severe anaphylaxis when also suffering from food allergies because of the frequency of bronchospasm as a component of their reaction. Patients must be educated about the use of their emergency medications as well as the importance of going to the local emergency room if in doubt for a full evaluation. Medical practitioners must help design emergency action plans for patients to follow in the case of a reaction and instructed on the risks of dying if treatment is delayed. If a patient suffers from both asthma and food allergies, and experiences an asthma attack within 30 minutes of eating, it is best to treat the attack with epinephrine to be safe. Inhalers won't stop anaphylaxis, but epinephrine will stop

either an asthma attack or anaphylaxis. Most fatal anaphylactic reactions are due to the delay in the administration of epinephrine.

Many states are passing legislation to enable children to carry an epinephrine auto injector device with them at all times and provide a spare in the nurse's office. All family members, teachers, co-workers and close associates to patients should be instructed on how to administer the emergency medication of epinephrine. Through the introduction of HR 2023, the Asthmatic Schoolchildren's Treatment and Health Management Act of 2004, and passage into law (Public Law 108-377), Congress provided an incentive for states the protect a student's right to carry and self-administer asthma and/or anaphylaxis medications (www.breatherville.org/cityhall/ch_childrights.htm" (breatherville.org). New Jersey and Delaware have both asthma and anaphylaxis laws in place and Pennsylvania has asthma laws and pending anaphylaxis laws at this time.

LATEX ALLERGY

Latex allergy is a reaction to the proteins in rubber tree sap called latex or natural rubber latex. The proteins in the tree sap can stimulate an allergic reaction after repeated exposures. Many times the exposure is due to an inhaled response from the powder residue of a latex product or through an open cut or sore that comes in contact with the protein. A simple dental procedure or an injection from a vial containing latex can stimulate a reaction. People who suffer from allergies in general and are exposed to latex are more susceptible since their immune response reacts to repeated overexposures of proteins. Medical workers are at the highest risk and it is estimated that 17% of healthcare workers who wear latex gloves every day are allergic as compared to 1% of the rest of the population. (**9**) Allergic reactions vary between skin rashes to full systemic reactions.

Skin rashes are quite different from a contact dermatitis because they often involve a blistering, bumpy red rash, or itchy skin that may appear 24 to 72 hours after contact; whereas, contact dermatitis is an irritation that generally subsides after the area is cleansed. Each exposure can result in more severe symptoms - often leading to a systemic reaction. These symptoms can include hives, sneezing, nasal congestion, tingling lips or tongue, facial swelling, watery eyes and nausea and vomiting. While no two people react the same way to latex, it often lasts a

lifetime and the severity of reactions can often vary. Diagnosis of latex is by blood test only and if positive, the patient is also advised to avoid foods with similar proteins such as bananas, avocados, kiwi and chestnuts. The only way to prevent an allergic reaction to latex is strict avoidance since oral medications, inhaled steroids or allergy shots are not effective treatments. Epinephrine should be carried by patients allergic to latex as well as wearing a medical alert bracelet **(9**).

ANAPHYLAXIS

Anaphylaxis is the sudden and severe allergic reaction that affects your whole body that includes any or all of the following symptoms: hives, swelling of lip, tongue, or throat, nausea, vomiting, diarrhea, abdominal cramping, shortness of breath, wheezing, or severe coughing, drop in blood pressure, loss of consciousness, and if untreated death. (**7-8**) Many times people look for hives or skin symptoms of a reaction and overlook the other organ- related symptoms. Anaphylaxis symptoms can start within seconds of exposure to an allergen such as a food or insect bite or be delayed for hours. Each time a reaction occurs, a person can experience different symptoms and severity but once they begin, they usually progress quickly. People at risk of anaphylaxis are recommended to carry an emergency auto-injectable epinephrine device with them at all times. Epinephrine is an adrenaline hormone that increases the heart rate and blood pressure, relaxes muscles in the airways, and reverses swelling and suppresses the body's immune response that temporarily stops life-threatening effects of an anaphylactic reaction. Because an increased heart rate also can raise the body's demand for oxygen, it puts some people at risk for cardiac arrest or stroke. All patients should be screened for conflicting medications and be advised to go to the hospital immediately after using an epinephrine auto injector device. Epinephrine auto injector devices are about the size of a magic marker and come in a pre-measured dose of epinephrine of two different strengths based on the patient's weight. The needle is designed to penetrate clothing and it is recommended that it be administered in the lateral aspect of the thigh. As many as 25% of people who have an anaphylactic reaction will have a second wave of symptoms, so it is important to always keep two doses of epinephrine on hand at all times. (**13**) It is also important to alert patients of potential side effects of epinephrine such as stomach upset, vomiting, sweating, dizziness, nervousness,

weakness, shaky hands, pale or clammy skin and fast heart beat. For this reason, advise patients to sit before administering the drug. Most patients don't confuse the side effects of the epinephrine with the symptoms of anaphylaxis because after administering the drug, the initial symptoms generally subside and are relieved.

Auto injectors should be stored at room temperature because extreme temperatures could make the drug less effective and they should be kept out of direct sunlight for the same reason. The auto injectors should be inspected periodically for a dark change in color or flakes/particles because it is a sign that the drug has oxidized and is no longer effective - as well as the expiration date checked. (**7-8**)

ALLERGIES AND ASTHMA

It was expressed in the Second Expert Panel on the Management of Asthma published in 1997 that any patient with asthma at any level should be screened for the possibility of an allergic exposure. (**13**) Other factors that influence asthma include rhinitis/sinusitis, gastric reflux, sensitivity to aspirin and other non-steroidal drugs, topical and systemic beta-blockers and viral respiratory infections. Patients who present with symptoms associated with asthma should be worked up for allergies as well and vice versa. Office spirometry is an ideal tool to assess if a patient is at risk for asthma or monitor the progress of medical treatment during active allergic seasons or following upper respiratory infections. (**14**) There are many portable units available that are easy to use and can be incorporated into either a primary or subspecialty practice. Spirometry measures how much air a person can blow out and how fast. Spirometry provides two numeric values that are helpful in the assessment and monitoring of patients with compromised lung function: the forced vital capacity (FVC) and forced expiratory volume measured over one second (FEV1). Airway obstruction is characterized by a decrease in the FEV1/FVC ratio. Spirometry offers a method for assessing lung capacity, disease state, and the severity of patients with lung disease allowing physicians to rapidly obtain results during an office visit while providing meaningful recommendations based on objective measurements.

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 4

QUESTIONS

1. Tests for environmental allergies include all of the following EXCEPT:
    A. CBC with differential
    B. Serum IgE
    C. mRAST
    D. Skin prick test
    E. Fungal swab

2. It's a good idea for those allergic to tree pollen to reduce their activity outdoors early in the morning and take medications before going outdoors, because most trees in their active season pollinate
    A. 1 hour after sunrise
    B. 2 hours after sunrise
    C. 3 hours after sunrise
    D. at noon
    E. at sunset

3. For patients with a history of anaphylaxis, it is important that they always keep two doses of epinephrine on hand at all times, because
    A. as many as 25% of people will have a second wave of symptoms
    B. as many as 35% of people will have a second wave of symptoms
    C. as many as 45% of people will have a second wave of symptoms
    D. as many as 65% of people will have a second wave of symptoms
    E. as many as 75% of people will have a second wave of symptoms

4. Factors that influence asthma include all of the following except rhinitis/sinusitis
    A. gastric reflux
    B. sensitivity to aspirin and other non-steroidal drugs
    C. topical and systemic beta-blockers
    D. diabetes

5. Patients who present with symptoms associated with asthma should be worked up for allergies as well and vice versa. An ideal tool to assess if a patient is at risk for asthma or monitor the progress of medical treatment during active allergic seasons or following upper respiratory infections is
    A. Office spirometry
    B. Skin testing
    C. RAST testing
    D. Challenge test
    E. Rhinomanometry

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 5

ASTHMA AND SINUS DISEASE

INTRODUCTION – THE UNIFIED AIRWAY

The close relationship between the upper (nose and sinuses) and lower (lungs) airways has been widely noted for decades. (**1**) Disease of the nose and sinuses is the most common comorbidity associated with asthma. (**1**) Rhinitis, sinusitis and asthma may represent part of one disease process with manifestations at different sites. (**2**) Patients with asthma and other lung diseases have been observed to also be afflicted with disorders of the nose and sinuses. Studies illustrate that rhinitis is very common in asthma, and associated with worse asthma control. Rhinitis typically precedes the development of asthma. Even in patients with rhinitis without asthma, there is evidence of subclinical change in the lower airways as measured by physiological changes and the presence of inflammatory mediators. (**2**)

We know that patients with asthma are much more likely to have chronic sinusitis than those without asthma. We also know that patients with sinusitis are much more likely to have asthma than those without sinusitis. More recently, scientific researchers have begun to uncover the details of this inter-relationship on a molecular level. Based on considerations of the underlying epidemiology, pathophysiology, histopathology, clinical relationships and treatment outcomes, the links between rhinosinusitis and asthma become evident supporting the unified airway concept. (**3**) This concept treats the upper and lower airways as a unified organ system, and has implications for the diagnosis and treatment of upper airway diseases.

ASTHMA – SIGNS AND SYMPTOMS

The National Asthma Education and Prevention Program is housed in the National Heart, Lung and Blood Institute (NHLBI) of the National Institutes of Health. To help health professionals care for people with asthma, the

NHLBI convened panels of experts twice to prepare guidelines for the diagnosis and management of asthma. The first Expert Panel Report was released in 1991. The new 1997 guidelines are an evolutionary update of the initial 1991 report and are based on an improved understanding of the mechanisms of the disease and newer approaches to treatment. The recommendations with new classifications of asthma severity, and new guidelines for step therapy, are based on a review of more than 6,000 scientific articles reviewed by the Expert Panel over the last two years. The role of patient education in asthma management is emphasized in the report as well as the role of the primary care clinician and the expert consultant. (**4**)

Asthma is characterized by hyper-responsiveness of the lower airway. Patients with asthma typically complain of some combination of coughing, wheezing, chest tightness, dyspnea (difficult or painful breathing), and increased mucous production. Typically these signs and symptoms of airway obstruction are reversible. Patients can experience asthma on a wide- ranging continuum. For some, asthma "attacks" are infrequent and mild. For others, symptoms can seem continuous and may land patients in and out of the hospital on a regular basis (**5**).

In many patients, cough may be the only symptom of asthma. This may make diagnosis particularly challenging, since cough may be a manifestation of a panoply of airway problems ranging from the common cold, acid reflux, and asthma to pneumonia, aspiration, and tuberculosis. Wheezing is perhaps the most "specific" symptom of an adult patient in the general population with asthma. This means that most adult patients who wheeze have asthma. Dyspnea, or shortness of breath, is often described as chest-tightness or a breathless sensation. Ironically, it is veryy difficult to correlate a patient's subjective sensation of shortness of breath with an objective measurement of airway obstruction. What seems to impact this sensation most is the percentage of change in a patient's airway function rather than the absolute value of lung function. While it does remain difficult to qualify, the sensation of dyspnea is common among patients with asthma, and should not be ignored (**5**).

Mucous hyper-secretion is perhaps one of the areas of greatest overlap between patients with sinusitis and asthma. A sensation of "too much mucous" is shared by patients with asthma, rhinosinusits (post-nasal drainage), and laryngopharyngeal acid reflux. In many asthmatics, attacks are characterized by overwhelming quantities of mucous. In fact, some asthmatics seem to have significant increases in the number of mucous-producing (goblet)

cells, and the characteristics of their mucous is much thicker and difficult to manage. As with many of the other symptoms of patients with asthma, careful evaluation must be performed to rule out other causes of thick, profuse mucous, including cystic fibrosis, immotile cilia syndromes, and other mechanical deformities (**1-5**).

ASTHMA –DIAGNOSIS

Patients suspected of having asthma should have a thorough evaluation. In addition to taking a thorough history and performing a complete physical examination, pulmonologists have many adjunctive tools at their disposal for the diagnosis of asthma. Pulmonary function testing is an invaluable tool in the characterization of a patient's lung function. While several methods exist for evaluating pulmonary function, spirometry is one of the most widely available. With simple inhalation and exhalation into a hand-held device, measurements can be obtained which characterize a patient's lung function is detail (**5**).

More than 30 million Americans have chronic obstructive pulmonary disease (COPD) and asthma, with internists, pediatricians, and family physicians providing most of their medical care. Recent management guidelines for asthma and COPD recommend regular use of spirometry for the diagnosis and management of these disorders. Because of the development of easy-to-use office-based spirometers, an increasing number of physicians have ready access to spirometry. Beyond simple spirometry, various tests are available from many pulmonary function laboratories for more detailed evaluation of patients with respiratory disorders. For these reasons, all physicians who care for patients with pulmonary disease must understand basic pulmonary function testing and have a fundamental understanding of more sophisticated tests. A series of performance standards has been developed for improved accuracy and precision of pulmonary function tests. Physicians responsible for administering and interpreting pulmonary function tests, even simple spirometry, must be aware of relevant guidelines. (**5-6**)

Forced expiratory volume$_1$ (FEV_1) is the volume of air that a patient can expire in 1 second of maximal effort. Forced vital capacity (FVC) is the total volume of air that can be expired after a complete inhalation. In patients with normal lung function, FEV_1 is approximately 80% of the FVC. In patients with asthma (and other obstructive airway diseases) there is a decrease in the FEV_1/FVC ratio. These measurements can also be used to qualify a patient's

asthma. For instance, an FEV_1 70-85% of the predicted value (based on normative values) characterizes mild asthma. An FEV_1 60-69% of the predicted value characterizes moderate asthma, and so on. It is notable that this severity system for asthma allows for regular monitoring of the progression of a patient's disease, as well as his or her responsiveness to medical regimens. (**5-6**)

Asthma is notable for its reversibility. Increase in FEV_1 by 12% or more after administration of a bronchodilator supports a diagnosis of asthma. Similarly, airway obstruction can be stimulated in patients with asthma with the administration of provocative agents such as methacholine. This "bronchial challenge" may also be used to confirm a diagnosis suspected by a positive response to a short-acting bronchodilator. (**5-6**)

There are many other tools that a pulmonologist has to diagnose and evaluate patients suspected of asthma. Clinical judgment will often direct a pulmonologist toward one test or another in his or her quest for an appropriate diagnosis.

ASTHMA – MANAGEMENT

Asthma management requires individualized treatment plans, as every patient's asthma impacts their lives in different ways. Moreover, the severity of symptoms may vary based on season, allergies, work environment, stress, and other factors. It is for this reason that patients must have a working relationship with the physician helping to manage their asthma (**5**).

Patients with asthma should be very pro-active in exerting control over their environment where possible. Environmental irritants, cigarette smoke, viral infections, molds, and dust-mites can all exacerbate asthma and lower the threshold for asthma attacks. Overlapping illnesses – acid reflux, sinusitis, inhalant allergies, allergic rhinitis – should also be tightly controlled if possible (**5**).

There are several medications available for the acute and long-term management of asthma. Deciding on a specific regimen should be performed in careful consultation with a patient's physician.

RELATIONSHIP BETWEEN ASTHMA AND SINUSITIS

For several years now, practitioners have noted a link between patients who have asthma and those who have sinusitis. As noted above, patients with asthma are more likely to have sinusitis than other members of the general population, and patients with sinusitis are more likely to have asthma than other members of the general population. Specifically, the prevalence of asthma in patients with sinusitis is approximately 20% compared to around 5% in the general population. (**7**) The prevalence of nasal and sinus symptoms in patients with asthma has been reported as high as 85 to 90%. (**7**) Sinus patients with asthma had a significantly higher prevalence of nasal polyps, olfactory dysfunction, and nasal congestion, than did those without asthma. Patients without asthma had a significantly higher prevalence of headache (72 vs. 53%; p = 0.037) and rhinorrhea (58 vs. 38%; p = 0.047). (**7**) One report found a prevalence of sinusitis in patients with asthma was 36.7%. (**8**) In this study, sinus CT scan abnormalities were detected in 66.3% of patients with asthma. The scans revealed abnormal opacity in 17.9% of asthmatic patients without a history of sinusitis. There was a significant correlation between the rate of asthma severity and sinus morphologic abnormalities in patients with and without sinusitis. The complication rate of sinusitis in asthmatic patients was significantly higher in adult-onset asthma than in non-adult-onset asthma. The authors' findings suggest that bronchial asthma is closely related to sinusitis.

A significant association between asthma and a subset of chronic rhinosinusitis - allergic rhinosinusitis - has also been strongly suggested by the literature. Numerous epidemiological surveys, immunopathological, and clinical studies demonstrate the interrelationship between asthma and allergic rhinosinusitis. (**9**) The literature supports the following concepts: i) allergic rhinitis is associated to asthma and constitutes an independent risk factor for its occurrence; ii) the immunopathological characteristics of allergic rhinitis and asthma are similar; iii) allergic rhinitis and asthma are manifestations of a systemic disease; iv) control of rhinitis favors asthma control. Taking into consideration the close inter-relationship between allergic rhinitis and asthma, the approach to diagnosis, treatment and prophylaxis of these illnesses should be integrated. Therapeutic options that allow for the simultaneous control of asthma and allergic rhinitis offer advantages related both to costs and tolerability.

This clinical and epidemiological observation is now supported on a molecular and a histological level. The "unified airway" concept has demonstrated how the upper and lower airways are inextricably linked. Inflammation in the upper airway (nose and sinuses) may lower the threshold for inflammation in the lower airway (lungs and bronchial tree), and vice-versa. Some have suggested the presence of a "nasobronchial reflex" and a "pharyngobronchial reflex" as a physiological link between the upper and lower airways. In this "nasobronchial reflex," when the nerves of the nasal and sinus passages are irritated, a reflex mechanism activates the parasympathetic nervous system and leads to bronchoconstriction. In the "pharyngobronchial reflex," mucous that drains from the sinus and irritates the pharynx (back of the throat) stimulates a reflex mechanism that activates an inflammatory pathway in the bronchial tree. While these mechanisms are no longer as widely believed to be the definitive link between the upper and lower airways, they do provide an intellectual framework in which to begin to understand how these 2 seemingly distinct systems can interact.

It is now believed that the upper and lower airways are connected by systemic inflammatory mediators. Stimulation of the nasal passage, for instance, may lead to an inflammatory reaction both in the nose and sinuses, as well as the lungs. Researchers have begun to unlock the complex web of molecular pathways that link these 2 systems. It has been discovered that the inflammatory cells and mediators that are most prevalent in the nose and sinuses of patients with sinusitis are also quite evident in the lungs of patients with asthma. This is supported by similarities in the lining of these distinct organ systems and helps to explain similarities in inflammatory function.

To further develop an understanding of the relationship among upper and lower airway inflammation, and to provide important information regarding this relationship, a multidisciplinary workgroup was impaneled in August 2006. In the treatment of their patients with allergic rhinitis and rhinosinusitis, physicians must be aware of the possible presence of asthma so that appropriate treatment and/or referral can be initiated. Also, in patients with asthma, the possible presence of allergic rhinitis and rhinosinusitis should be considered. The impact of this practice will allow more comprehensive treatment of patients with upper and lower airway disease, and will improve patient symptoms, function, and quality of life. (**10**)

EFFECT OF SINUS MANAGEMENT ON ASTHMA

If asthma and sinusitis are related entities it follows that improved management of one disease might lead to improvements in the other disease. There is, in fact, a fairly abundant amount of data to support this idea. Several studies have demonstrated that improvement in patients' sinus disease may lead to improvement in the lung function of patients with asthma. (**7-10**)

Other studies have shown that sinus surgery in patients with asthma and sinusitis, and whose sinus disease has not improved with medical management, often leads to improvement in lung function of these patients. (**11-15**) These patients with asthma who have undergone sinus surgery have, in several studies, been documented to require decreased amounts of medication to control their asthma. (**11-15**)

Awad et al undertook a retrospective record review was performed of 91 asthmatic subjects with chronic rhinosinusitis. (**11**) Forty-one subjects had aspirin intolerant asthma and 50 subjects had aspirin tolerant asthma. Subjective and objective asthma outcome parameters were used to compare between the two groups at three time points: immediately before ESS and 6 and 12 months after ESS. The asthmatic complaints of aspirin induced asthmatic (AIA) and aspirin tolerant asthmatic (ATA) patients continued to improve significantly over 6 and 12 month after ESS. Although ESS helped both groups of patients, AIA had statistically significant better results compared with ATA patients in asthma severity scores and decreased need for ICS. (**11**)

Batra et al investigated the efficacy of endoscopic sinus surgery (ESS) in the management of chronic sinusitis and asthma in patients with nasal polyps and steroid-dependent asthma with a retrospective chart review.(12) Chronic sinusitis and asthma were evaluated using subjective (patient complaints) and objective (computed tomography scans, pulmonary function tests, steroid doses) criteria. Preoperative data were compared with data obtained 12 to 18 months post ESS. Thirteen of the 17 (76.5%) patients reported improved clinical symptoms post ESS. The group experienced improvement in postoperative forced expiratory volume at 1 second (FEV1) ($P < .014$). Twelve of 17 (70.6%) experienced reduction in systemic steroid usage ($P < .048$). ESS demonstrates a beneficial effect on the sinonasal and asthma symptomatology in patients with nasal polyps and asthma using objective measures.

Subset of aspirin-tolerant patients have statistically better outcome for sinonasal symptoms and pulmonary function testing than aspirin-sensitive patients. (**12**)

Dhong et al undertook a study on the effect of endoscopic sinus surgery on asthma and concluded that both subjectively and objectively, endoscopic sinus surgery can play a significant role in the clinical improvement of asthma when used to treat asthmatic patients with chronic rhinosinusitis. (**13**)

Ikeda et al also evaluated the clinical efficacy of endonasal endoscopic sinus surgery (ESS) in patients with asthma associated with chronic sinusitis. (**14**) Twenty-one patients (13 men and 8 women) from 27 to 72 years old were enrolled in this study. Sinus-related symptoms in the ESS group were significantly improved 6 months postoperatively. The average peak expiratory flow 6 months following surgery was improved in the ESS patients, ranging from 40 to 190 L/min. Seven patients showed a reduction in the need for corticosteroids, whereas two patients were unchanged and two patients required larger dosages. The remaining four patients needed no corticosteroids before or after ESS. No significant changes in sinus-related symptoms or peak expiratory flow were obtained for the control group. Improvement of paranasal sinus disease by successful ESS can alleviate pulmonary dysfunction in asthma associated with chronic sinusitis. The authors believe that adequate and positive treatment for chronic sinusitis would reduce not only the nasal- and sinus-related symptoms evoked by chronic sinusitis, but also some of the signs induced by asthma. (**14**)

Palmer et al report that an association between chronic sinusitis and asthma has been noted for many years, but that the precise nature of the relationship is poorly understood.(15) They report an experience with endoscopic sinus surgery and asthmatics. The authors reviewed the charts of 75 consecutive patients with asthma and chronic sinusitis who underwent endoscopic sinus surgery between 1994 and 1996. Fourteen of the 15 patients meeting study criteria decreased their postoperative prednisone requirement by total number of days (preoperative 84 versus postoperative 63 days [$p < 0.0001$]). Postoperatively, patients required an average of 1300 mg less oral prednisone ($p < 0.033$). Antibiotic use also decreased, with an average use of antibiotic nine weeks preoperatively versus seven weeks postoperatively ($p < 0.045$). This study provides corroborative objective evidence that, at least in

the short term, endoscopic sinus surgery is efficacious in the management of patients with chronic sinusitis and asthma. (**15**)

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 5

DISCUSSION QUESTIONS

1. Compared to patients without asthma, patients with asthma are:

    A. More likely to have sinusitis
    B. Less likely to have sinusitis
    C. Neither more nor less likely to have sinusitis
    D. More likely to have aspirin sensitivity
    E. More likely to live in cities

2. Several studies have evaluated the lung function of patients with asthma after effective treatment of their sinuses. The studies cited in this review have suggested that successful sinus treatment, including sinus surgery, may lead to

    A. Only subjective improvement of lung function
    B. Objective improvement in lung function
    C. Little to No improvement in lung function
    D. Worsening of lung function
    E. An increased lead to an increased need for oral prednisone treatment

    ANSWER: B please give rationale and ref for answer.

3. In patients with sinusitis and asthma, when medical management of the sinusitis does not succeed and endoscopic sinus surgery is undertaken, studies show that

    A. oral prednisone requirements increased
    B. antibiotic use increased
    C. FEV1 worsened
    D. Peak expiratory flow worsened
    E. Peak expiratory flow increased

4. Compared to the general population, in which the prevalence of asthma is approximately 5%, the prevalence of asthma in patients with sinusitis is approximately

    A. 10%
    B. 20%
    C. 40%
    D. 60%
    E. 80%

5. The prevalence of nasal and sinus symptoms in patients with asthma has been reported as high as

    A. 5%
    B. 15%
    C. 35%
    D. 50%
    E. 85

6. Patients with asthma must have a working relationship with their physician to help them manage their asthma. Factors that require attention include all of the following except

    A. Seasonal differences
    B. Allergies
    C. Work environment
    D. Stress
    E. Marital relationships

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 6

REFLUX AND SINUS DISEASE

Gastroesophageal reflux disease (GERD) is a common problem that is expensive to diagnose and treat. The disease is increasing in prevalence in the Western world. Heartburn and acid regurgitation are classic symptoms of GERD, but their sensitivity for diagnosing GERD is poor. Ambulatory esophageal pH testing is the most sensitive test for GERD, whereas endoscopy is the most specific test. Medical treatment with proton pump inhibitors (PPIs) has revolutionized the treatment of GERD and its complications, but long-term side effects do exist. (**1**)

ACID REFLUX DEFINED

Gastroesophageal reflux disease (GERD) is a common medical condition affecting approximately 35-40% of the adult population in the western world. (**1-2**) Acid refluxes refers to the back-flow of stomach secretions, including acids and occasionally ingested foods. Depending on how high the acid travels, this may be known as gastroesophageal reflux disease (GERD) when the acid travels up the esophagus, or as laryngopharyngeal reflux (LPR) when the acid travels past the upper esophageal sphincter and spills over into the larynx (voice box).

SYMPTOMS OF REFLUX

Common esophageal symptoms of GERD include repeated bouts of heartburn, difficulty swallowing, hoarseness, lump-in-the-throat sensation, chronic cough and throat clearing, and mucus buildup in the throat. The role of GERD in causing extra-esophageal symptoms including laryngitis, asthma, cough, chest pain, and dental erosions is increasingly recognized with renewed interest among gastroenterologists and other specialists. Direct injury by mucosal contact, and vagally mediated reflex from distal esophageal acid exposure are the two possible mechanisms by which reflux-related extra-esophageal tissue injuries may occur. (**1-2**)

Acid reflux may exacerbate sinus symptoms, and it can also mimic sinus symptoms. Patients with LPR may experience hoarseness, chronic cough, throat clearing and irritation, and mucus buildup in the throat. These symptoms commonly overlap with the perception of "postnasal drainage," and so patients with these symptoms may believe that they simply have postnasal drip and sinusitis. Patients with LPR may also experience a sensation of something stuck in the throat (globus sensation). Interestingly, patients with LPR often do NOT experience heartburn, since heartburn requires acid to linger in the esophagus long enough to cause symptoms of irritation (**3, 4**). Weldon reports that in patients with chronic and recurrent sinusitis, laryngopharyngeal reflux disease may play a significant role. Laryngopharyngeal reflux disease differs from gastroesophageal reflux disease in the extent of reflux (into the hypopharynx and above) as well as timing (occurring more often when the patient is upright). Most patients are unaware of the extent of their symptoms, and diagnostic tools such as pH probe, multichannel intraluminal impedance, and manometry are required for adequate diagnosis. Although therapy with lifestyle modification and acid-suppressive agents may improve reflux in the majority of patients, for many with persistent symptoms, endoscopic or surgical intervention is required to reduce reflux successfully (**3**)

Several investigational techniques may be used to diagnose gastroesophageal reflux; however, because of the poor sensitivity of endoscopy and pH monitoring, and the poor specificity of laryngoscopy, empiric therapy with proton-pump inhibitors (PPI) is now considered the initial diagnostic step in patients suspected of having GERD-related symptoms. In those who improve with such therapy, it is likely that GERD may be the cause of the extra-esophageal presentation. In those who are unresponsive to such therapy, other diagnostic testing such as impedance/pH monitoring may be reasonable in order to exclude continued acid or weakly acid reflux. However, PPI-unresponsive patients usually have causes other than GERD for the extra-esophageal symptoms and signs. (**2**)

REFLUX AND SINUSITIS

Data linking acid reflux and chronic sinusitis is controversial. Gastroesophageal reflux has been implicated in many disorders affecting the upper airway over the past three decades. Loerhl and Smith reviewed the recent literature regarding the relationship of chronic rhinosinusitis to gastroesophageal reflux (**5**). They report that recent

studies have demonstrated that patients with chronic rhinosinusitis have an increased prevalence of gastroesophageal reflux. In addition, the literature suggests that, especially in pediatric patients, improvement in chronic sinonasal symptoms can be seen after therapeutic trials of antireflux therapy (**5**, **6**). Loerhl and Smith conclude that it is indeed possible that gastroesophageal reflux plays a role in some patients with chronic rhinosinusitis. They suggest that evaluation and treatment should be considered in this patient population. (**5**)

On the other hand, some symptoms associated with sinusitis – post-nasal drainage, and the sensation of hyper-secretion of mucous – may actually be caused by LPR (as described above). Some authors believe that acid can reflux (travel in reverse) all the way up to the nasopharynx and enter the sinonasal cavity where it irritates and inflames the nose and sinus lining. One group of authors found that almost 90% of a group of children slated for sinus surgery avoided surgery by aggressive reflux management.(6) Caruso and Passali report that gastro-oesophageal reflux is common in children, and that in children ENT manifestations of gastro-oesophageal reflux mainly affect the larynx, ears, nose, paranasal sinuses including rhinosinusitis and oral cavity. (**7**)

Another group of researchers found a higher prevalence of stomach acid in patients with chronic sinusitis who failed to respond to medical treatment when compared to normal patients. Unfortunately the jury is still out on this subject, as most of this data has been retrospective and not gathered in a controlled, prospective manner. Hopefully some more light will be shed on this subject in the coming years. In the meantime, it is certainly prudent to evaluate patients with signs and/or symptoms of sinusitis for evidence of acid reflux[i].

Just as important as the issue of whether or not acid reflux may actually CAUSE sinusitis, is the topic that many symptoms of reflux may be confused with symptoms of sinusitis. As noted above, “post-nasal drainage,” “chronic cough,” and “excessive mucous and throat clearing” may in fact be due to LPR (acid refluxing into the larynx) and not from the sinuses (thick mucous dripping down into the throat). Clearly identifying this source of a patient’s symptoms allows for appropriate targeted and effective treatment. It is for this reason that patients with sinusitis should, in most cases, have a clinic evaluation of their throat.

DIAGNOSIS OF REFLUX

Heartburn is often easily recognized by the primary care physician. However, some of the symptoms relating to the throat and voice box should be evaluated by an otolaryngologist or ENT specialist. The otolaryngologist will perform a complete examination including looking at the voice box with a small endoscope placed through the nose. In some cases of patients with known reflux, the otolaryngologist may pass a flexible telescope into the esophagus itself to further evaluate the esophageal lining. This Trans-Nasal Esophagoscopy (TNE) is commonly performed in the clinic setting with local anesthesia. (**8**) Amin, Postma Setzen and Koufman reviewed and summarized the current literature on transnasal esophagoscopy, and compared information with conventional esophagoscopy.(8) The literature seems to support the equivalence of transnasal esophagoscopy and conventional esophagoscopy in image quality and diagnostic capability. It also points to some potential advantages of transnasal esophagoscopy. The authors reported that transnasal esophagoscopy is a useful tool for accurate diagnosis and can be used in a variety of office procedures. (**8**)

A number of tests are available to evaluate patients with GERD. A barium swallow is a series of X-ray films that monitor dye as it travels through the stomach. With pH-probe monitoring 24-hour testing is performed to record the back-flow of acid from the stomach into the esophagus and even the throat. A small flexible tube is placed in the stomach through the nose and is connected to a small computer to record 24-hour acid reflux. Endoscopy is performed to evaluate the esophagus for damage from acid burns and to examine the stomach for irritation and ulceration. Some of these tests may be performed by an otolaryngologist, but many are usually performed under the direction of a gastroenterologist.

TREATMENT OF REFLUX

GERD and LPR are managed with life-style and dietary changes, with medical treatment, and at times with surgical treatment. Lifestyle and dietary changes include avoiding alcohol and tobacco. Both alcohol and nicotine irritate the stomach and increase acid production. Patients with GERD should avoid clothing that is tight around the waist, such as corsets and belts, and generally they should lose weight. When lying down, the head of the bed

should be elevated. This is best achieved not with pillows, but by raising the head of the bed 6–8 inches. This can be done by sliding blocks under the legs at the head of the bed or a wedge under the head of the mattress. The patient with GERD/LPR may wish to avoid coffee and tea, carbonated beverages, alcohol, fatty fried foods, spicy food, citrus fruits and juices, tomato juice, orange and grapefruit juice, tomatoes, onions, peppermint, spearmint, chocolate, cheese, and eggs. The patient with GERD/LPR should avoid large meals, especially in the evening. They should not lie down right after eating, but should instead allow 3–4 hours after supper before lying down. It may be advisable to make the midday meal the heavier meal of the day and eat smaller, more evenly-balanced meals. (**1**)

Medical treatment is based on neutralizing stomach acid, reducing or eliminating stomach acid, and improving gastric emptying. Stomach acid can be neutralized by using over-the-counter antacids in liquid or tablet form, such as sucralfate suspension, aluminium and magnesium hydroxides (Maalox), and magaldrate oral (Riopan). Reducing or eliminating stomach acids can be achieved with H-2 blockers, which depress acid production, such as cimetidine (Tagamet), ranitidine (Zantac), or famotidine (Pepcid). These are also available now over-the-counter at lower (less effective) dosages. Antacids and H-2 blockers should be taken 1 hour apart, because antacids may reduce the other drug's effectiveness. Newer drugs such omeprazole (Prilosec) and esomeprazole magnesium, (Nexium) completely stop stomach acid production. These drugs are generally prescribed for short-term use. (**1**)

Improving gastric emptying can be undertaken by cisapride, metoclopromide, bethanachol, and other drugs. These drugs increase the squeezing action of the esophagus and tighten the esophageal sphincter, in addition to making the stomach empty faster. Surgical treatment is undertaken as a last resort. If the dietary and medical treatments do not bring relief or if the patient finds them hard to comply with, surgery may be indicated. One procedure, called "fundoplication," is performed through an open abdominal approach or, at times, through an endoscope. It involves wrapping the top of the stomach around the top of the esophagus in order to strengthen support and prevent reflux. (**1**)

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 6

QUESTIONS

1. The medical literature makes the strongest connection between acid reflux and sinusitis in

    A. The pediatric patient population
    B. The elderly patient population
    C. The polypoid sinus patient population
    D. The diabetic patient population
    E. The male patient population

2. Symptoms of Laryngopharyngeal Reflux include all but which of the following:

    A. hoarseness
    B. chronic cough
    C. throat clearing and irritation
    D. mucus buildup in the throat
    E. heartburn

3. Stomach acid can be neutralized by using all except

    A. Sucralfate
    B. Cimetidine
    C. Famotidine
    D. Omeprazole
    E. Cisapride

4. Trans-nasal esophagoscopy is most appropriately performed

    A. Under local anesthesia in an office setting
    B. Under sedation anesthesia in an office setting
    C. Under local anesthesia in an Ambulatory Care Facility
    D. Under sedation anesthesia in an Ambulatory Care Facility
    E. Under general anesthesia in an Ambulatory Care Facility

5. GERD AND LPR may be managed in part by lifestyle and dietary changes, including

    A. The use of tobacco products
    B. Social drinking of alcoholic beverages
    C. Tight clothing
    D. Weight loss
    E. Sleeping flat

Allergic and Non-Allergic Sinusitis for the Primary Care Physician:
Pathophysiology, Evaluation and Treatment

CHAPTER 7

SNORING

INTRODUCTION

When we breathe (inhale and exhale) air flows in a smooth, *laminar* manner. Obstructions that occur along the path of airflow lead to irregular, *turbulent* air movement. Air turbulence is often accompanied by irregular vibration of the structures of the upper airway. The resultant sound – snoring – may range from mild to severe. Snoring is believed to affect as many as 50% of adults including both men and women; over 45 million Americans. (**1**) While it is well known that snoring increases with age, it is less well known that the impact on younger patients may also be significant (**1,2**).

IMPACT OF SNORING

Snoring has a negative impact both on the individual who snores, as well as on that person's bed partner. Patients who snore often awake after an unsatisfying, disrupted sleep to encounter a day of sleepiness and fatigue. Drowsiness, irritability, and decreased libido may all be associated with snoring. In addition to these lifestyle challenges, patients who snore has been shown to have increased rates of hypertension (elevated blood pressure) when compared to patients who do not snore. Studies have also documented a positive correlation between loud snoring and risk of heart attack and stroke. A 2008 study found that "objectively measured heavy snoring is an independent risk factor for early carotid atherosclerosis, which may progress to be associated with stroke." (**3**) Another study evaluated over 1500 patients who suffered acute myocardial infarcts (heart attacks), and found that "heavy snoring is associated with case fatality and short-term mortality in patients with a first acute myocardial infarction." (**4)** Yet another study found snoring to predispose patients for the development of hypertension. (**5**) Anatomically, snoring may also lead to an enlarged uvula (the "punching bag" that hangs down from your soft palate), and increased episodes of acid reflux. An enlarged uvula may – in turn – lead to increased snoring,

coughing, and even to a choking sensation. Others have documented the association between snoring and chronic bronchitis. (**6**)

A high percentage of patients who snore also may have obstructive sleep apnea (OSA). It is for this reason that patients who snore should have a sleep study for diagnosis. OSA is well-documented to have a serious impact on a patient's quality of life, work efficiency, and driving safety. Untreated OSA may also lead to hypertension, coronary artery disease, memory impairment, stroke, and adult onset diabetes. In one study, snoring was found to be associated with elevation in blood glucose markers, potential signs of impending diabetes (**7**). Almost 40% of patients with OSA have elevated blood pressure. (**7**) Moreover, it appears that patients with OSA have a 2 to 3 times increased risk of heart attack and stroke. (**7**) Americans who have OSA are more likely to die suddenly of cardiac causes between 10 p.m. and 6 a.m. than during the other 16 hours of the day combined. (**7**)

Snoring may have a severe impact on inter-personal relationships. According to one study of 4900 couples, as many as 80% of snoring couples end up in separate bedrooms. (**8**) Women who sleep with men who snore found that these women were almost twice as likely as women who sleep with non-snorers to report problems with insomnia, daytime fatigue, daytime sleepiness, awakening unrefreshed from sleep, and morning headache. (**8**) A study of 10 married couples found that the bed-partner of the snoring patient gained an additional 74% to 87% of sleep per night after their partner's snoring was corrected. (**9**) Studies have suggested that snoring also seems to be associated with reduced sexual satisfaction in men (**8-10**). It is clear that snoring impacts both the patient who snores as well as his or her bed-partner. Fortunately, several studies have documented statistically significant improvements in marital relations after a patient's snoring was corrected (**9-11**).

WHAT CAUSES SNORING

We inhale air through our nose and mouth. From the nostrils, air flows through our nose over the hard and soft palate in a manner guided by our sinuses and nasal structures. When the air hits the back of our nasal passage it flows over the soft palate and through a small tunnel (*choana*) where it enters the end of the nasal cavity (*nasopharynx*). From the nasopharynx, air flows downward towards the windpipe (*trachea*) and into the lungs. Along

this route air travels past the internal tissues of the neck and the voice box (*larynx*). Air is also inspired through the mouth. When air enters the mouth it flows over the soft tissues of the tongue and between the root, or base, of the tongue and the soft palate and uvula above. Air then flows into the back of the throat (oropharynx) where it meets up with air from the nose on the way down to the voicebox, windpipe, and lungs.

Most snoring is associated with abnormalities of the soft palate or uvula. An overly long or floppy soft palate may vibrate irregularly with airflow. This abnormal vibration makes a sound – snoring. Other sources may also contribute to snoring and, for this reason, careful evaluation is imperative in order to have effective treatment. Nasal sources (deviated septum, inferior turbinate hypertrophy, chronic nasal congestion), oral sources (enlarged tongue base, small jaw, enlarged tonsils), and throat and neck sources (floppy neck soft tissues) may all contribute to snoring and to sleep apnea. In some cases, snoring may be increased by alcohol consumption late at night (which causes the throat to relax and become more floppy).

DIAGNOSIS OF SNORING

Patients with snoring should be carefully evaluated for the anatomical site most likely to contribute to their snoring. Questionnaires should be used to help qualify the degree to which snoring impacts the patient and the patient's bed partner. Patients should also be carefully questioned to see if they have any signs of symptoms of obstructive sleep apnea – often associated with snoring. Several questionnaires exist to assist with this evaluation. One such questionnaire is the Epworth Sleepiness scale shown below:

Use the following scale to choose the most appropriate number for each situation:

0 = would *never* doze or sleep.
1 = *slight* chance of dozing or sleeping
2 = *moderate* chance of dozing or sleeping
3 = *high* chance of dozing or sleeping

Situation	Chance of Dozing or Sleeping
Sitting and reading	____
Watching TV	____
Sitting inactive in a public place	____
Being a passenger in a motor vehicle for an hour or more	____
Lying down in the afternoon	____
Sitting and talking to someone	____
Sitting quietly after lunch (no alcohol)	____
Stopped for a few minutes in traffic while driving	____
Total score (add the scores up) (This is your Epworth score)	____

Epworth Score: Any score greater than 10 is considered significant and suggests that a patient should undergo further evaluation for a sleep disorder, including a sleep study.

Any evaluation for snoring should include a thorough physical examination. The nose, nasal passage, mouth, oral cavity, tongue, soft palate, uvula, mandible (jaw), tonsils, adenoids, and neck soft tissues should all be carefully examined as possible sources for snoring and OSA. Simple, quick, and painless procedures are available for otolaryngologists (ear, nose, and throat doctors) to help pinpoint the source of the problem. Spending the time on the front end to locate the correct site of the problem will save a lot of time and frustration later if treatments are directed at the incorrect site. A sleep study (to qualify and quantify the degree of OSA) should also be considered for patients who complain of snoring, as well as for patients who endorse signs of symptoms consistent with OSA. Recent years have seen the introduction of home sleep studies in which patients wear a monitor while they sleep in the comfort, and natural environment of own bed, instead of sterile sleep labs.

TREATMENT OF SNORING AND OBSTRUCTIVE SLEEP APNEA

Effective treatment of snoring and OSA depends on proper diagnosis and location of the anatomic source of the problem. Treatments can be medical or surgical and vary in efficacy. Medical treatments include lifestyle changes (weight loss and dietary changes), sleep positioning pillows, nasal sprays, dental/oral appliances, nasal strips, and positive pressure mask devices. Medical interventions are preferable to surgery; however, some of the interventions (ie-use of the continuous positive airway pressure device) are uncomfortable and have poor patient compliance. Surgical treatments include nasal surgery, adenoid and tonsil surgery, palate surgery, and jaw surgery (mandibular advancement). Some of these surgeries may be performed with the laser (*laser-assisted uvulopalatoplasty, or LAUP*) Unfortunately most of the surgeries involving the oral cavity (tonsils, palate, jaw) and pharynx have significant pain and morbidity and lengthy patient recovery times with only modest success rates.

While nasal surgery may have a positive benefit on snoring and sleep quality, it is not likely to have a significant effect on sleep apnea. Tosun et al investigated the effect of endoscopic sinus surgery on sleep quality in a patient group who has chronic nasal obstruction resulting from nasal polyposis. (**12**) Twenty-seven patients with nasal polyposis, filling at least 50% of each nasal passage, were enrolled in the study. All patients underwent endoscopic sinus surgery with polypectomy. Sleep quality was evaluated, using visual analog scale, Epworth sleepiness scale, and polysomnography before and 3 months after the surgery. Nasal resistance decreased significantly after the surgery ($P < 0.01$). Snoring scores were significantly improved postoperatively ($P < 0.01$) and completely disappeared in 9 of 27 patients. A significant improvement occurred in mean daytime sleepiness scores in the postoperative period (4.14) as compared with the preoperative values (9.44; $P < 0.01$). There was no significant difference between preoperative (6.85) and postoperative (5.53) mean values of apnea-hypopnea index ($P = 0.55$). The authors concluded that endoscopic sinus surgery with polypectomy significantly improves sleep quality, including snoring and daytime sleepiness in patients with chronic nasal obstruction due to nasal polyposis. However, it has a limited benefit on apnea-hypopnea index scores. (**12**)

Recent years have seen the introduction of minimally invasive procedures – radiofrequency ablation (**13**) and the Pillar Procedure (**14-18**) – with increased efficacy and decreased patient recovery time and morbidity. In the

appropriate patient, these procedures may have a large positive impact. For example, the Pillar Procedure involves the placement of semi-rigid implants into the soft palate, which causes it to stiffen and thereby vibrate less during sleep. This diminishes snoring. The Pillar procedure is performed under local anesthesia and typically takes around 20 minutes to perform in the clinic setting with most patients. While data continues to be collected, some studies have shown a significant decrease in patient snoring intensity with associated decreases in daytime sleepiness and significant improvements in lifestyle after patients underwent the Pillar Procedure. Other studies have demonstrated bed partner satisfaction with the reduction in snoring after the Pillar Procedure at 80% or higher. Studies of patients with OSA demonstrate approximately 80% of patients with a reduction in their AHI (sleep index), and results were sustained at one year after palatal implants/Pillar Procedure (**14-18**). Another study has documented significant improvement in snoring and sleep apnea with insertion of palatal implants in patients who had failed surgical intervention with prior uvulapalatopharyngoplasty (**19**).

Snoring can have a significant impact on the quality of life of patients and their bed partners. Recent years have seen the arrival of some minimally invasive procedures for snoring which appear to be quite effective and promising. These treatments, however, are individualized to each patient's anatomy and should be carefully reviewed with a patient's treating physician.

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 7

QUESTIONS

1. Studies have found snoring to be associated with all of the following except:

    A. Carotid atherosclerosis
    B. Hemorrhoids
    C. Acid reflux
    D. Hypertension

2. Oral sources that contribute to snoring include all of the followingEXCEPT:

    A. Small lingual tonsils
    B. Enlarged tongue base
    C. Small jaw
    D. Enlarged tonsils

3. Many patients who snore also have obstructive sleep apnea (OSA). OSA increases the risk of heart attack and stroke by what factor?

    A. 1 time increased risk
    B. 2-3 times increased risk
    C. 4-5 times increased risk
    D. 6 times increased risk

4. When we breathe, air passes by all of the following structures on the way to the lungs, except for which one?

    A. tongue
    B. soft palate
    C. thyroid gland
    D. choana

5. Which of the following tests should be most seriously considered for patients who complain of snoring and drowsiness?

    A. Hearing test
    B. Neck MRI
    C. Sleep study
    D. Upper GI endoscopy

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 8

UNUSUAL CAUSES OF SINUS DISEASE

INTRODUCTION

Most patients with chronic sinusitis have simple anatomical abnormalities, or mucosal inflammation brought on by inhalant allergies or other chemical or environmental irritants. In some cases, however, patients have less common sources of their sinus disease. These are discussed below.

PEDIATRIC SINUSITIS

Some uncommon causes of sinusitis manifest in childhood. Cystic fibrosis is a life threatening autosomal recessive disease that has been linked to genetic mutations in the cystic fibrosis transmembrane conductance regulator (CFTR) gene which was isolated in 1989. Since this discovery there have been many advances in our understanding of this disease, mostly in its effects on pulmonary function. However, these patients are also afflicted with disease of the paranasal sinuses. In fact, some cases of mild CF may remain undiagnosed until patients present with sinus disease. Interestingly, only a small percentage of children with CF have severe sinus disease. These patients, however, often present with nasal polyps. Any pediatric patient with bilateral nasal polyps should be evaluated for cystic fibrosis. (**1**)

Kartagener's syndrome is a ciliary motility disorder which, like cystic fibrosis, is inherited in an autosomal recessive fashion. Patients have cilia that are non-functioning. With non-motile cilia (which cover the surface of the nose and sinus lining), mucous is not swept away and, instead, stagnates within the sinuses where it serves as a breeding ground for infection. While patients are often afflicted with recurrent pneumonias and other pulmonary symptoms, sinusitis can be a primary symptom. Diagnosis is with ciliary biopsy (**1**).

Immunodeficiencies also may present in children as recurrent sinus infections. Careful evaluation may demonstrate an underlying weakness in the immune system as the source of these infections. This is discussed in greater detail in Chapter 5.

GRANULOMATOUS DISEASES

Granulomatous diseases are characterized by distinct collections of inflammatory cells arranged in a classic, distinctive histological pattern.

Wegener's granulomatosis is an autoimmune disease associated with granulomatous formations in the lungs, kidneys, and nose and sinuses. Sinonasal involvement is common in these patients, and may range from unexplained inflammation and recurrent infections, to more severe destructive processes. Patients with Wegener's may also get secondary infections in their sinuses due to the impaired sinus function brought on by their primary disease. Several laboratory tests may point toward a diagnosis of Wegener's however; definitive diagnosis is via pathological specimen obtained from a lung, kidney, or sinus biopsy. Treatment options vary and include standard treatments for chronic sinusitis as well as such non-standard treatments as cyclophosphamide and anti-tumor necrosis factors.

In Churg-Strauss syndrome patients are afflicted with asthma, sinusitis, and – on occasion – polyneuropathies. From a sinonasal standpoint, these patients may present with or without polyps. Bloodwork on these patients is notable for an extremely high serum eosinophilia (inflammatory white blood cell). These findings – asthma, sinusitis, and serum eosinophilia – should raise suspicion for this disease. As with Wegener's, definitive diagnosis is via tissue biopsy which reveals necrotizing granulomas. (**2-4**)

Sarcoidosis is another granulomatous disease of uncertain origin. While the lung is most typically affected, patients often present with nose and sinus symptoms including sinusistis and poor sense of smell. On endoscopic exam, small nodules can be appreciated. Diagnostic chest x rays are usually performed given the predilection for lung involvement. There are also several simple blood tests that can aid in the diagnosis. Sinonasal sarcoid can be

challenging to treat; however, there are several newer medical regimens aimed at the sarcoid treatment, and management is successful in many cases. (**2-4**)

INFECTIOUS DISEASES

Some patients may present with fungus balls, or "mycetomas" in their sinuses. Mycetomas are densely packed collections of fungi; *Aspergillus fumigates* is most common. These mycetomas are usually isolated to a single sinus, most commonly the maxillary sinus. They do not invade the surrounding tissues, but they often block the sinus outflow via sheer mass effect, and trigger an inflammatory cascade within the sinus. Treatment is surgical opening of the sinus and removal of the sinus contents. Once the fungus ball has been removed, the sinus usually returns to its native function.

Immunocompromised patients such as those with HIV, or those who are solid-organ or bone-marrow transplant recipients, are at risk for an invasive fungal sinus infection. This is a serious condition and has a high mortality rate. In these cases, the fungus – often *Rhizopus* or *Mucor* – invade the surrounding vasculature leading to vascular necrosis and cell death. Tissue invasion is rapid and treatment requires aggressive surgical intervention combined with broad empiric antibiotics and anti-fungal agents.

Allergic fungal sinusitis is an allergic response to native fungi in otherwise healthy individuals. The immune response produces a thick material of peanut-butter consistency which can erode the surrounding bone including the bone of the eye and the skull base. Diagnosis is via endoscopic examination and sinus CT (or MRI in some cases) (FIGURE 1). Treatment involves surgical opening of the sinuses for removal of the thick mucoid material. This is followed by routine medical treatments, often including oral steroids. Some have argued for allergy immunotherapy for the offending fungal agent, although data in support of this is not yet definitive (**2-4**).

FIGURE 1 – This CT demonstrates opacification of the patient's right maxillary sinus. The heterogeneous texture of the sinus contents are characteristic of allergic fungal mucin.

Other uncommon infectious sources of sinus disease include mycobacterial infections and Rhinoscleroma (Klebsiella infection). While these are uncommon entities, having an awareness of their possibility and their presentation gives us a greater ability to identify them when they do occur.

IMMUNOLOGY AND SINUSITIS

Immunology is the study of how our body mounts an immune response to fight infection and protect itself. Via a complex series of molecular pathways and signaling transmitters, the body defends itself against foreign particles and organisms. This defensive immunological system has many layers and overlapping systems.

The working processes of the immune system are beyond the scope of this text but, briefly explained, the immune system can be separated into an innate and an acquired system. This acquired system can be further sub-

divided into humoral and cellular branches. In innate immunity, or non-specific barriers, molecules, and cellular components act to defend the body against invasion. These systems work irrespective of the specific type of invasion or infection. They are generalized immune defenses. In acquired immunity, the body develops defenses to a specific invading organism or particle. The humoral branch of acquired immunity provides for the creation of antibodies which are highly individualized to attack and protect against a particular particle and works in concert with the cellular branch. There are 5 primary types of antibodies, also known as immunoglobulins (Ig) – IgA, IgD, IgE,IgG and IgM. Each type of immunoglobulin has adapted for a specific function in the body's defense.

When patients' immune system is compromised, the abilities of the sinuses - like many other organ systems - to fight infection is diminished. While an uncommon cause of sinusitis, immunodeficiency should be considered particularly in the cases of children with recalcitrant sinus problems. In Common Variable Immunodeficiency (CVID), 2 or more immunoglobulins are lacking. More common is deficiency of a specific immunoglobulin (IgA deficiency is most common). When immunodeficiency is suspected simple blood and other easily obtained tests can be performed to evaluate for immune function.

Treatment of sinusitis in patients with immunodeficiency often involves similar management options as for patients with sinusitis and no immune disease. In some cases, immunoglobulin replacement therapy may also be warranted. Specific treatments are devised and implemented in conjunction with an immunologist. (**2-4**)

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 8

QUESTIONS

1. Granulomatous diseases which may present with signs and symptoms in the nose and paranasal sinuses include all of the following except:

    A. Wegener's
    B. Churg-Strauss
    C. Systemic Lupus Erythemetosus
    D. Sarcoidosis

2. Which of the following is a life-threatening condition which typically requires immediate intervention?

    A. Allergic fungal sinusitis
    B. Invasive fungal sinusitis
    C. Mycetoma
    D. Eosinophilic sinusitis

3. The organism most commonly associated with Mycetoma is which of the following?

    A. Mucor
    B. Rhizopus
    C. Rhinoscleroma
    D. Aspergillus

4. Wegener's granulomatosis can present in the nose and sinuses. Another organ system commonly affected by this disease is which of the following?

    A. Brain
    B. Heart
    C. Lungs
    D. Liver

5. In children with recurrent or chronic sinusitis and nasal polyps, physicians should consider the presence of which of the following systemic diseases?

    A. Ornithine Transcarbamylase Deficiency
    B. Hand-Foot-Mouth disease
    C. Kawasaki Disease
    D. Cystic Fibrosis

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 9

SINUS DISEASE IN PATIENTS WHO HAVE HAD SINUS SURGERY

INTRODUCTION

Small subsets of patients who undergo nasal and sinus surgery have persistent trouble with their nose and sinuses after surgery. Sometimes these problems may require a simple change in medical regimen. Other times revision surgery may be indicated. Any patient who has undergone sinus surgery and whose symptoms persist or have worsened needs a thorough evaluation including a complete history and physical examination including a nasal endoscopy. Office nasal endoscopy is critical in the evaluation of patients who have had prior nasal and sinus surgery. Endoscopy must be performed in order to ensure that anatomic causes of persistent sinus problems are not overlooked.

MEDICAL PROBLEMS

Evaluation of the patient who has had prior sinus surgery requires careful examination of the patient's medications, inhalant allergies, and environmental exposures. New medicines may have side effects that impact a patient's overall hydration and – as a consequence – the viscosity of their mucous. Other medications may be associated with a runny nose, or nasal congestion. Over time a patient's allergy profile may change, and this should be examined closely. Patient's change work and home environments move to new cities with a fresh set of allergens get new pets, develop new habits and exposures. These changes may all impact a patient's allergy profile and their exposure to nasal and sinus irritants.

In some circumstances, patients seem to develop a "tolerance" to certain medications and simply need to try a different nasal steroid, or antihistamine. It is not uncommon to hear a patient say "Medicine X used to work fabulously, but it just hasn't been working as well these past few months." On a similar note, these medical regimens can be burdensome and tedious and, in some cases, the medications have stopped working as well

because the patient has stopped taking the medications on a regular basis. "I used to take that nasal steroid every day, but now I only take it when I'm stuffy" is a statement commonly heard in the ENT office. Fortunately, in many cases, these patients simply need to be re-motivated to get back on their proven medical regimen (In much the same way that we all might go to the gym for a month and then stop going on a regular basis.)

In other cases, a regimen that was working previously has – often for reasons difficult to discern – stopped working as well. Fortunately, in many cases, a short bout of aggressive medical treatment (ie-oral steroids and antibiotics for 3 weeks) can bring a patient back to their previous baseline for their medical regimen to be effective again. Sometimes, this new medical regimen may involve new, and alternative, medications.

ANATOMICAL PROBLEMS

Patients who have had sinus surgery may have persistent symptoms due to anatomic problems unaddressed at the time of surgery. Other anatomic problems may result from poor wound healing and scarring. These abnormalities are discussed below.

The middle turbinate is a vertically oriented structure (discussed in Chapter 1) which is the medial border of the middle meatus into which many of the sinuses drain. This structure is often weakened, or – in some cases – removed at the time of surgery. When weakened or partially removed, the remaining portion may – on occasion – scar to the lateral nasal wall and cause blockage of the surgically opened sinus drainage pathways (FIGURE 1). This is particularly true of the maxillary, frontal, and ethmoid sinuses. It is for this reason that surgeons often attempt to "medialize" the middle turbinate with a variety of methods. In cases where the middle turbinate has been almost completely removed, the superior remnant may scar laterally and obstruct drainage of the frontal sinus. It is rare for the maxillary sinus to be impacted in these cases.

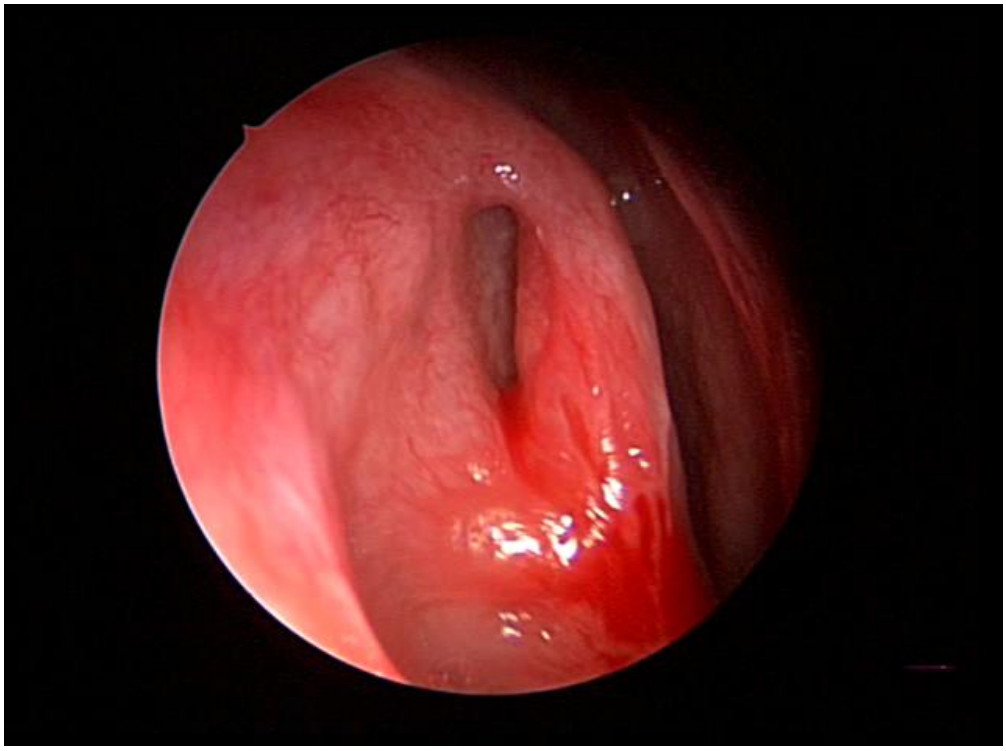

FIGURE 1 – This is an image of a patient's right nasal cavity. This patient has had surgery and the vertically oriented middle turbinate has scarred to the lateral nasal sidewall blocking sinus drainage.

In patients with persistent maxillary sinusitis, the otolaryngologist must carefully examine the patient's post-surgical anatomy with clinic endoscopy. In the "missed ostium sequence" the surgical opening has been created separately (and usually posterior to) the sinus' natural opening (which is more anterior). When these two openings remain unconnected, mucous from the sinus will drain out through the natural opening and then back into the sinus through the surgical opening and so on. This "recirculation" or "circular flow" of mucous may lead to recalcitrant maxillary sinusitis. When the natural ostium is missed it is often associated with a retained uncinate process. The uncinate process is a thin vertically oriented bone situated along the lateral nasal wall. This small bone must usually be repositioned or removed in order to appreciate the maxillary sinus' natural opening. When left intact or "retained" the natural opening often remains hidden from the surgeon's view and may lead to creation of a surgical antrostomy distinct and unconnected to the natural opening. One additional anatomic abnormality that can obscure the maxillary sinus' natural opening is the "Haller" (or infra-orbital ethmoid) cell (FIGURE 2). These are ethmoid sinus cells that migrated during embryonic development into a location just by the orbital floor, slightly

more inferior than normal ethmoid cells. In this location they may abut the maxillary sinus outflow tract and the sinus' natural ostium. If not recognized pre-operatively (on the patient's CT scan) they may easily be missed and the natural ostium will remain obscured by these cells and, consequently, separate from the surgical antrostomy.

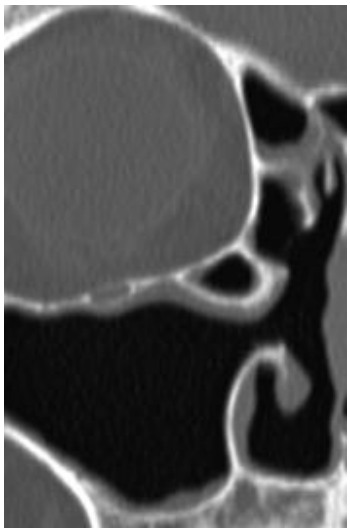

FIGURE 2 – This right sided "Haller" (infraorbital ethmoid) cell is seen on the coronal sinus CT scan of a patient who had previous sinus surgery. Because of its location, it blocked the natural sinus opening form the original surgeon's view and required a second surgery to remove this cell so that the natural opening could be connected to the surgical opening for the sinus to drain freely.

In patients with persistent ethmoid sinus disease there often remain remnant sinus cells that are blocked and unable to drain. Unlike the frontal, maxillary, and sphenoid sinuses which drain are isolated, distinct sinuses which drain through a single opening, the ethmoid sinuses are a labyrinth of small sinuses, much like a beehive formation. Since it is impractical to open each of these tiny cells, the ethmoid sinuses are typically surgically removed by surgeons during sinus surgery rather than being opened like the other sinuses. Ethmoid cells that are left behind may scar, and become diseased, swollen, and infected. With preoperative CT and endoscopic evaluation, the ENT doctor can often determine if the persistent disease represents continued inflammation, an ethmoid abscess, or a mucocoele (FIGURE 3). When this occurs a patient's symptoms may recur. Treatment would usually be a revision, or completion, ethmoidectomy. Care must be taken in these situations, since the ethmoid sinuses abut the thin skull base.

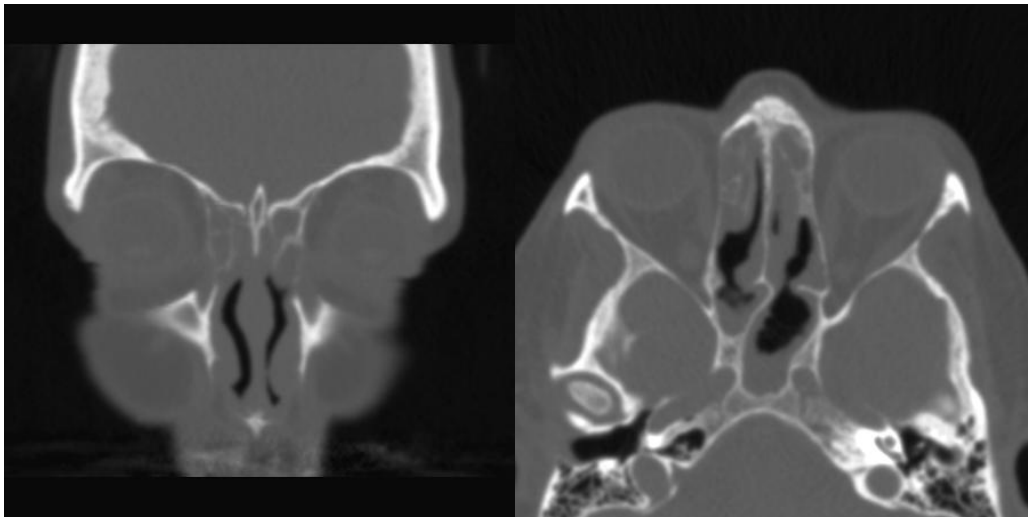

FIGURE 3 – These CT images (coronal on left; axial on right) are of a patient who has had prior sinus surgery and had ethmoid cells left behind. These ethmoid cells have become diseased and will require revision surgery for correction.

The frontal sinus is considered by surgeons the most difficult to open and the most difficult to keep open. Its natural opening is small, and surgically opened frontal sinuses may scar directly or be narrowed by a lateralized middle turbinate or middle turbinate remnant (discussed above). Frontal sinus scarring may block the drainage of the sinus and lead to backed up mucous and subsequent infection. While a clinic endoscopy can often identify frontal sinus scarring, a CT is most useful in these situations to determine whether or not the sinus is actively draining or not (FIGURE 4). Frontal sinuses that have scarred openings may require revision surgery to re-open, or enlarge, the drainage tract.

FIGURE 4 – The frontal sinuses of this patient are completely opacified. This patient has had prior surgery, and the frontal sinus openings have scarred close. Revision surgery will be required to remove the scar tissue and open the sinuses so that they may drain freely.

Like the frontal sinus, the sphenoid sinus drains through a single, natural opening. This opening may be blocked by polyps or swelling just anterior to the opening, or by scarring of the opening itself. In cases of polyps and mucosal swelling, often a short course of oral steroids will decrease the swelling so that the sinus can drain freely. If this is ineffective, or if the surgically enlarged sphenoid sinus opening has scarred close, a revision procedure may be indicated to remove the scar tissue and widen the opening.

Patients who have persistent nasal obstruction should also be evaluated for septal deviation, inferior turbinate hypertrophy, and nasal valve collapse. These abnormalities may be previously undiagnosed or persistent after a prior surgery. The surgical management of nasal obstruction is discussed in detail in Chapter 12.

There are patients whose nasal and sinus mucosal lining has persistent severe inflammation in the face of aggressive medical and surgical management. A minority of patients with nasal polyps will re-grow their polyps despite thorough interventions. In these patients, repeat polypectomy may be required on occasion. Fortunately, with the advent of new topical medications, the need for this repeat intervention seems to have decreased.

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CHAPTER 9

QUESTIONS

1. In persistent maxillary sinusitis, one of the most common sources in patients who have had prior sinus surgery is which of the following?

    A. Missed ostium sequence
    B. Lateralized middle turbinate
    C. Medialized middle turbinate
    D. Retained agger nasi cells

2. Patients who have persistent nasal obstruction after sinus surgery should be evaluated for all of the following except:

    A. Septal deviation
    B. Inferior turbinate hypertrophy
    C. Nasal valve collapse
    D. Palatine tonsillar hypertrophy

3. Which of the following is an ethmoid sinus cell that migrated during embryonic development into a location just by the orbital floor, slightly more inferior than normal ethmoid cells, and may narrow the natural drainage pathway of the maxillary sinus?

    A. Agger nasi cell
    B. Haller cell
    C. Onodi cell
    D. Frontal cell

4. Many of the sinuses drain into the space known as the middle meatus. Which of the following is the structure which forms the medial border of the middle meatus?

    A. Inferior turbinate
    B. Middle turbinate
    C. Superior turbinate
    D. Inferior concha

5. If a nasal endoscopy is non-diagnostic, which of the following tests are most useful in evaluation of the patency of the frontal sinus?

    A. Sinus MRI
    B. Sinus CT
    C. Sinus Xray
    D. CT fistulagram

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 10

MEDICAL MANAGEMENT OF SINUS DISEASE

INTRODUCTION

Chronic rhinosinusitis (CRS) is a surprisingly common, poorly defined, and notoriously difficult-to-treat disease. It has a complex pathophysiology that often, but not always, involves nasal or paranasal sinus infection. Anatomic variations that predispose the sinuses to obstruction may play a role, but are unusual sole causes of chronic disease. Other possible causative factors include allergic or nonallergic inflammation, mucociliary dysfunction, aspirin intolerance (Samter's triad), immunodeficiency, and cystic fibrosis. Medical therapy for CRS may include treatment with corticosteroids, antibiotics, antifungal agents, antihistamines, leukotriene modifiers, nasal decongestants, mucolytics, and nasal irrigations. The selection of appropriate medical therapy is based on endoscopic evaluation, sinus cultures, and symptoms. (**1-6**)

Sinus infections are often secondary to sinus inflammation. When a patient gets a sinus infection, there is much more that they should do besides taking an antibiotic. Preventing obstruction to the flow of sinus secretions is critical in reducing the incidence and severity of bacterial and fungal infections. Medications prescribed to reduce sinus inflammation and blockage help a patient’s immune defenses fight back. (**2-6**) Therefore, the use of topical corticosteroids, nasal decongestants and mucolytics, nasal salt water (saline) washes, antihistamines in patients with allergic rhinitis, and other measures are important and effective in treating a sinus infection, in preventing sinus infections in susceptible individuals, and in moderating symptoms when they occur. (**2-6**) Of course, these treatments should only be undertaken under the direction of an experienced physician.

ANTIBIOTICS

A. Role of Endoscopically-guided sinus cultures

In many cases, patients with a sinus infection are prescribed an antibiotic as part of their medical treatment. Often, these antibiotics are chosen based on the "most likely" bacteria to cause an infection. While these choices are often correct, in many instances they are incorrect and ineffective. This may lead to the development of resistant bacteria that are even more difficult to eradicate, and may require long-term antibiotics for successful treatment. In some cases, long-term intravenous antibiotics may be required to treat resistant infections. Antibiotic resistance has been described as "one of the world's most pressing public health problems." (**7**)

Fortunately the easy availability of office-endoscopy allows for endoscopically-guided nasal and sinus cultures. Using micro-culture swabs, an otolaryngologist can obtain a sample of the infectious material in a painless clinic procedure that takes just a few minutes. Endoscopy has been shown to be easily and comfortably performed on adults and children alike. Several studies support the use of nasal endoscopy as well-tolerated in children older than 6 years old.

Once the sample has been obtained, the swab is sent to a lab where the specimen is grown and tested against different bacteria. The treating physician will then know what bacteria is the pathogen causing the infection, and what antibiotic will be most effective. There is an ever-growing amount of data which supports the role of culture directed therapy in the treatment of sinusitis. In fact, one recent study showed that endoscopically guided cultures directed a change in therapy in over 50% of patients with chronic rhinosinusitis.(7) In this manner, otolaryngologists can now assist primary care physicians obtain the most appropriate treatment regimen for patients with sinusitis. (**7-10**)

B. Antibiotic overview

Because sinusitis is a condition in which the sinuses may be infected, antibiotics are often an important component of therapy. (**11-18**) In many cases, a physician may prescribe an antibiotic based on empiric information about which bacteria are most likely to be causing the infection. At other times, a doctor's choice of antibiotic may be based on the bacteria that can be identified from a sample of pus taken from a sinus culture. In refractory cases,

more than one antibiotic may be prescribed to increase the likelihood of completely eliminating an infection. Patients are instructed to complete the entire course of antibiotic, even if they start feeling better, before they are due to finish. (The exception is if the patient is having a side effect from the antibiotic). By failing to complete the entire course of treatment, the patient may be increasing the number of resistant bacteria. This could make further antibiotic therapy ineffective.

Antibiotics may be taken by mouth the great majority of the time. Occasionally, for a more resistant or serious infection (such as when bone is infected, or if resistant bacteria are causing the infection), intravenous antibiotics may be needed. As with any medication, antibiotics can cause side effects. Any antibiotic can cause an allergic reaction, ranging from a rash on the skin with or without itching, to a swollen mouth or tongue, wheezing, and/or trouble breathing. In all cases of an allergic reaction, patients are instructed to stop taking the drug immediately and call their physician. Most allergic skin reactions will resolve with little or no treatment.

A drug reaction, somewhat different from an allergy, can develop from using antibiotics and cause fever and/or joint pain and swelling. Perhaps the most common adverse effect of antibiotics is the gastrointestinal symptoms they produce. These can include stomach pain, nausea, vomiting, and diarrhea. If these symptoms are mild and tolerable they are probably not of concern, but if they are severe, the patient should stop the antibiotic and inform his/her physician. In rare cases, antibiotics can cause a severe diarrhea known as “pseudomembranous colitis.” Patients with this disorder have severe watery diarrhea (not simply loose stools). In this situation, the antibiotic should be stopped and the physician notified immediately. Patients should not try to treat themselves with an anti-diarrheal medication or hope that a severe diarrhea problem will subside. Because antibiotics alter the normal bacteria in the body as well as the disease-causing bacteria, they can cause other side effects. A yeast infection, most commonly in the mouth or vagina, is one such complication.

To minimize the risk of both diarrhea and yeast from antibiotics, doctors commonly recommend daily ingestion of Lactobacillus acidophilus, popularly known as acidophilus. This can be important because with chronic sinusitis patients may need to be on antibiotics for an extended period of time. Acidophilus can be found in two forms; yogurt with active cultures, and capsule preparations. Doctors commonly recommend eating 8 ounces of

yogurt with active cultures daily while on antibiotics and to continue doing so for another week or two following completion of the course of antibiotics. Some brands of yogurt do not contain active cultures, so patients need to read the container carefully. Although yogurt is the preferred source of acidophilus, acidophilus capsules are an acceptable alternative if a patient has a milk allergy or for some reason cannot eat yogurt. Acidophilus tablets can be purchased at most health food stores.

Patients should be sure to inform their doctor if any of the following apply: impaired kidney function, rash when previously given an antibiotic, ulcerative colitis, mononucleosis (mono), anemia, abnormal liver function, myasthenia gravis, pregnancy, breast feeding, other medications, mitral valve prolapse, or prosthetic devices.

A host of information has surfaced in the medical literature about appropriate antibiotic therapy for acute bacterial rhinosinusitis and chronic rhinosinusitis. While this is still a subject of ongoing debate, following is one proposed approach to antibiotic treatment. Antibiotics are designed to kill bacterial pathogens or prevent their growth, and studies suggest that their use shortens the course of an infection and helps prevent complications. However, excessive and inappropriate use has led to the development of resistance. Pathogens are adept at mutation, transformation, conjugation, and plasmid development. The end result is that *Streptococcus pneumoniae* and *Hemophilus influenza* are no longer readily eradicated by the usual course of therapy with antibiotics.

Guidelines promoted by the American Rhinologic Society and the Sinus & Allergy Health Partnership established a new methodology for dealing with this problem. Proper use of the guidelines should improve patient care. (**17**) The guidelines recognize that patients who have been exposed to an antibiotic within 4–6 weeks of their current infection are likely to be infected with a resistant pathogen. Thus, for patients who are evaluated for acute bacterial rhinosinusitis (ABRS) who have ***not*** been exposed to antibiotics within the previous 4–6 weeks, first-line therapy is limited to high-dose amoxicillin, amoxicillin–clavulanate, cefpodoxime, and cefuroxime axetil.

For adult patients with moderate infection and prior antibiotic use, the agents that are indicated are amoxicillin–clavulanate, one of the fluoroquinolones (gatifloxacin, levofloxacin, or moxifloxacin), or a combination therapy—i.e., amoxicillin or clindamycin for gram-positive coverage ***plus*** cefixime or cefpodoxime axetil for gram-

negative coverage. Similar first-line agents are recommended in the pediatric patient population, with the exception of the fluoroquinolones, which still have no pediatric indication.

Despite the recent reports of shorter course therapy, the guidelines still recommend 10–14 days of therapy. (**17**) However, this is probably empiricism. Patients who respond promptly rarely finish the full course. This should be expected, because uncomplicated sinusitis has a high probability of spontaneous resolution and nonbacterial (viral) cause.

The FDA requires sinus puncture and aspiration to be done on a number of patients before a drug can be approved. Therefore, most studies have been done on maxillary sinus secretions. As of April 2000 the FDA had approved a number of antibiotics for use in acute sinusitis. (**18**) They are:

amoxicillin-clavulanate(Augmentin)
ceftinere (Omnicef)
cefprozil (Cefzil)
cefuroxime axetil (Ceftin)
ciprofloxacin (Cipro)
clarithromycin (Biaxin)
gatofloxicin (Tequin)
levofloxacin (Levaquin)
loracarbef (Lorabid)
moxifloxacin (Avelox)

No antimicrobial agent has been approved by the FDA for use in chronic bacterial sinusitis or acute bacterial exacerbations of chronic sinusitis. However, the choice of antibiotic for acute bacterial exacerbations is not different from that for acute bacterial sinusitis. If there are any maxillary dental problems, suspicion of anaerobes rises in patients with chronic sinusitis, making an agent with anti-anaerobic activity preferable.

Pseudomonas aeruginosa and *Staphylococci* are more commonly isolated from patients with chronic sinusitis. Therefore, ciprofloxacin for pseudomonas and/or clindamycin for *Staphylococci* are antimicrobials that may be useful. In choosing empiric therapy, it is important for the sinus specialist to have knowledge of the antimicrobial susceptibility pattern of the organisms most likely to be associated with community-acquired bacterial sinusitis in their geographic area. Because beta lactamase producing strains of *Hemophilus influenza* and *Moraxella catarhallis*

are common in most areas of the United States, ampicillin, amoxicillin, cefuroxime axetil, and loracarbef would not be first-choice agents.

It is extremely difficult to distinguish mild bacterial sinusitis from viral sinusitis (the common cold) during the first 5 days. Some patients will therefore be over-treated. If antimicrobial therapy is believed appropriate for this type of patient, the best initial agents are either amoxicillin or doxycycline, both of which are inexpensive.

Duration of therapy is very controversial, but earlier studies have shown that bacteria persists in large amounts in the sinus after symptoms of acute bacterial sinusitis have resolved. In addition, sinus mucosal healing is variable. Therefore, for acute bacterial sinusitis we favor 10–14 days of antibiotic therapy. Alternatively, azithromycin is given for only 5 days because of its long half-life in tissues. For chronic sinusitis otolaryngologists often treat with 21–28 days of antibiotic therapy. Long–term follow-up studies with varying length of therapy are needed to settle the issue.

Research has shown that some antibiotics, especially macrolides and to a lesser extent quinolones, have immunomodulating action as well as antibacterial activity. This may explain why symptoms of rhinosinusitis appear to respond to antibiotics in the absence of proven bacterial cause. Obviously, patients would request the same drug if they believe it had been effective in relieving symptoms of sinusitis, 90% which are viral. Clearly, more research is needed to define what is helpful from an immunomodulating standpoint in the treatment of both acute and chronic sinusitis.

Patients who fail to respond to initial antibiotic therapy for bacterial sinusitis should have a limited CT scan of the sinuses, and a consultation should be made with an otolaryngologist. This specialist will usually perform a nasal endoscopic evaluation and possibly obtain a specimen for culture and sensitivity. If the CT scan shows no fluid accumulation that would require surgical drainage, a change of antibiotic may be considered. Good second-line agents include augmentin, azithromycin, ceftin, cefuroxime, gadifloxacin, and moxifloxacin.

Sun, Jew and Dasta assessed factors related to prescribing antibiotics for nonspecific upper respiratory tract infections (URTIs) by office-based physicians. (**19**) They looked at osteopathic physicians and undertook a retrospective analysis of physician office visits by patients with URTIs, using the National Ambulatory Medical Care

Survey database for a 5-year period. Antibiotic prescribing was analyzed based on patient and physician characteristics. Multiple logistic regression modeling was then used to assess the independent contribution of these factors. Between July 1, 1997, and June 30, 2001, there were 9.6 million patient visits for URTIs to osteopathic physicians in the United States. Antibiotics were prescribed in 56.4% (5.41 million) of these visits. Adults, non-whites, females, patients with a concurrent condition such as acute bronchitis, acute otitis media, acute pharyngitis, acute sinusitis, or asthma, and patients requiring additional medications for their symptoms were more likely to be given antibiotics. In addition, family physicians, physicians who were not owners of their practices, and those practicing in nonmetropolitan areas were more likely to prescribe antibiotics. The authors found that antibiotics were prescribed in more than 4.8 million (50%) patient visits for URTIs. They suggest that greater efforts are needed to address some of the factors that influence prescribing practices. (**19)**

NON-ANTIBIOTIC MEDICAL THERAPY

Once the diagnosis of sinusitis is made, medical therapy is instituted. Therapy is aimed at relieving obstruction of the nose and sinuses, particularly at the osteomeatal complex. In general, medical management of sinusitis may include one or more of the following: antibiotics, topical decongestants, systemic decongestants, topical nasal corticosteroids, nasal lavage or nasal saline spray, humidification, mucolytics, antihistamines, cromolyn, decongestants, and immunotherapy. Other treatment options are also possible and are discussed below. (**20-31**)

Medical therapy must be undertaken under a doctor's care. Some medications for sinusitis must not be taken if a patient has other medical conditions. For example, if a patient has high blood pressure or is pregnant, certain medications must not be taken. Medical management of sinusitis includes avoidance of airborne irritants such as smoke. In addition, patients with sinusitis should avoid alcohol. Patients with an upper respiratory infection should stay warm, keep well clothed, and drink plenty of fluids. Patients should be instructed to avoid vigorous nose blowing. Adults with colds blow their nose an average of 45 times a day during the first 3 days, producing a pressure of up to 55 mm of mercury. This can push mucus from the nasal cavity into the sinus cavities.

A. Saline Nasal Spray and Irrigations

Saline nasal spray or irrigation is recommended to cleanse thick secretions from the nose and sinuses. (**32**) This simple, economical treatment is effective but is often underused. Saline nasal spray is available over the counter as sterile physiologic saline solution in spray bottles. Alternatively, saline solution may be prepared at home with 1/2 tsp of salt dissolved in 8 oz of water. A pinch of baking soda may be added. The patient should place the solution in a spray bottle or ear bulb syringe for lavage. Two to four puffs of nasal saline spray should be administered at least three times a day.

There is some concern that prepared saline sprays may have deleterious effects in some patient due to the preservative in them. Boston, Dobratz et al reported that the nasal saline spray used in the treatment of rhinitis and sinusitis often contains the preservative benzalkonium chloride (BKC). (**33**) To evaluate the effects of NSS with BKC on human neutrophils. Human neutrophils were exposed to NSS with BKC or to phosphate-buffered saline (PBS) at varying times and concentrations. Neutrophils exposed to NSS concentrations as low as 15% showed near-total cell lysis, and neutrophils exposed to 20% NSS demonstrated no cell viability by trypan blue staining. Phosphate-buffered saline-exposed cells were unaffected. The authors concluded that nasal saline spray with BKC is toxic to human neutrophils, even at concentrations far lower than those found in commercially available preparations. Saline solutions without BKC appear to be safer alternatives, and the authors felt that additional studies are needed to determine the clinical significance of these findings. **(33)**

The Neti Pot is a soothing nasal lavage. A salt mixture of appropriate concentration and temperature is prepared. The patient leans over the sink and applies the Neti Pot to the upper nostril, the saline solution flows through the nasal and sinus cavities and around the back wall of the septum and washes the opposite nasal and sinus cavities before exiting the dependent nostril.

The alternative, more aggressive method is lavage with a bulb syringe while leaning over the sink with the mouth open: the saline solution is prepared as above. Repeated full syringe wash and aspiration is recommended at least three times daily to wash out the secretions if they cannot be effectively removed with saline spray alone. In patients who have already had sinus surgery this is slightly more controversial, since some physicians believe that

vigorous irrigation may leave saline behind - setting up an environment friendly to bacterial overgrowth and infection. Not every patient wishes to perform nasal lavage, but some find it the most effective treatment.

B. Humidification and Hydration

Humidification of inspired air and hydration are other methods recommended to clear thick secretions. A cool mist humidifier, hot steamy showers, and drinking at least 8 full glasses of water per day are considered effective.

C. Over-the-Counter Nasal Sprays

For treatment of acute sinusitis, over-the-counter nasal sprays such as the topical decongestant oxymetazaline. Two puffs in each nostril twice a day for no more than 3–5 days provides rapid and effective vasoconstriction. This decreases the obstruction of boggy turbinates and decreases the inflammation that blocks the osteomeatal complex. However, prolonged use of topical decongestants for greater than three to five days can lead to rebound congestion, or rhinitis medicamentosa. Pediatric strength oxymetazoline frequently works well in adults and produces less rebound congestion.

If the congestion associated with acute sinusitis lasts longer than three days, then an oral decongestant such as pseudoephedrine hydrochloride 30-60 mg two to four times a day should be used. Long-acting preparations of pseudoephedrine hydrochloride are also available. Oral decongestants may be contraindicated in the presence of other medical problems, such as hypertension.

D. Topical Nasal Steroids

Topical nasal steroids, along with antibiotics, are considered primary therapy for chronic sinusitis. While antibiotics treat the infectious component, topical nasal steroids treat the inflammatory component, thereby reducing edema of the osteomeatal complex. (**24-25**) For most episodes of acute sinusitis, patients respond adequately to the above measures without the need for topical nasal steroids. However, these medications have become important in the management of chronic or allergic rhinitis, recurrent acute sinusitis, and chronic sinusitis.

Nasal steroids may have some local effects on the lining of the nose, such as nasal drying, crusting, and bleeding. More extensive local effects such as nasal septal perforations are rare but may occur, especially if the preparations are used more frequently than recommended. Nasal steroids may also produce irritation of the throat.

These agents are highly active topically with the ability to remain in tissues because of their high lipid solubility. The small amounts that are absorbed systemically are rapidly metabolized by the liver, and therefore significant systemic side effects are not expected at the recommended doses. Although steroid nasal sprays usually do not carry the same risks that systemic (oral) steroids do, some of the same serious side effects can occur. An annual ophthalmological examination should be considered if patients are on nasal steroids for prolonged periods, because there is a small potential risk of cataract formation.

Topical nasal steroids are considered safe for chronic use. Individuals should be advised to be patient, because the topical nasal steroids have a delayed onset of full action with clinical improvement expected after 7–10 days (there is some immediate effect, but the full effect can take up to 10 days). Some recommend an oral steroid for an initial 5 days when a more rapid effect is desirable.

The patient must understand that nasal steroids are not as effective on a haphazard, as-needed basis, and that these medications require regular daily administration. Depending on the specific spray, the preparations are prescribed one to four puffs in each nostril once or twice daily. The maximum recommended dose should be used for at least the first four weeks to control symptoms. Otolaryngologists and allergists often advise continued use at this dosage for two months or longer. The dosage may be weaned when symptoms are well controlled.

Most of the topical nasal steroids are available as aerosol or aqueous preparation. Regardless of preparation, local side effects may include burning, irritation, sneezing, drying, crusting, bleeding, and very rarely septal perforation. Many physicians believe that the local side effects are reduced with aqueous preparations. Certainly, patients who complain of nasal dryness should be offered the aqueous type. These patients should also increase the use of nasal saline. The choice of delivery system often depends on physician or patient preference. All patients should be instructed to avoid spraying medially toward the septum to reduce the risk of these local side effects.

Intranasal steroid spray has also been found to be useful in acute sinusitis. (**34**) Intranasal steroids have been shown to reduce components of respiratory inflammation and increase symptom relief for Acute Rhinosinusitis when used alone or combined with antibiotics. Based on current evidence in support of topical intranasal steroid therapy, the European Position Paper on Rhinosinusitis and Nasal Polyps 2007 guidelines and a recent Cochrane meta-analysis recommend using topical intranasal steroids spray in the treatment of acute rhinosinusitis. (**34**)

E. Antihistamines

Antihistamines should be used to treat allergic sinusitis but should not be used to treat non-allergic sinusitis. It is preferable for patients with acute suppurative, non-allergic sinusitis to avoid antihistamines because they potentially thicken the secretions and lead to crust formation, which can further obstruct the nasal and sinus passageways. (**25-27**) However, if the patient has a significant history of underlying allergies, then antihistamines may be necessary to help control the allergic response. Antihistamines can be quite helpful in profuse rhinorrhea that is obviously the result of allergic sinusitis. There are many different oral antihistamine preparations, each with its own profile and particular set of strengths and weaknesses.

One issue with antihistamines is fatigue. Some antihistamines are sedating, and even non-sedating antihistamines have been associated with fatigue in some studies. (**35-36**) Bhattacharyya and Kepnes' prospective study found that higher fatique symptom scores were associated with the use of non-sedating antihistamines, antibiotic use, but NOT with intranasal steroid use. The authors recommend that the long-term use of nonsedating antihistamines be scrutinized in patient reporting symptoms of fatigue. (**36**)

F. Oral Decongestants

Because the treatment of chronic sinusitis requires a more prolonged course than does acute sinusitis, topical decongestants are not recommended. When topical decongestants are used for more than five days, rhinitis medicamentosa may result. Instead, oral systemic decongestants such as pseudoephedrine and phenylpropanolamine are often used during the full course of treatment, especially if significant congestion is detected on endoscopic exam. However, oral decongestants may raise blood pressure, and patients and their

doctors should monitor blood pressure and may need to discontinue oral decongestants if blood pressure is affected.

G. Mucolytics

The most common mucolytic agent is guaifenesin. (**37)** This has long been used and is considered effective as a mucolytic and expectorant in bronchitis. Guaifenesin is considered effective in liquifying the annoying thick secretions associated with chronic sinusitis. Guaifenesin is an expectorant that is commonly found in over-the-counter cough syrups. For chronic sinusitis the prescription dose of up to 1200 mg two times per day may be prescribed. This is available in tablet or liquid form and may also be found in combination with oral decongestants. In higher doses guaifenesin acts as an emetic, and occasionally the dose used in chronic sinusitis must be limited because of GI discomfort. Other mucolytics, such as saturated solutions of potassium chloride, are occasionally used.

The airways are lined by a layer of protective mucus gel that sits atop a watery periciliary fluid. Mucus is an adhesive, viscoelastic gel, the biophysical properties of which are largely determined by entanglements of long polymeric gel-forming mucins, MUC5AC and MUC5B. This layer entraps and clears bacteria and inhibits bacterial growth and biofilm formation. It also protects the airway from inhaled irritants and from fluid loss. (**38**)

Although guafenisin is commonly prescribed in the treatment of sinusitis, medical evidence of efficacy is scarce. (**39**) Mucoactive medications include expectorants, mucolytics, and mucokinetic drugs. Expectorants are meant to increase the volume of airway water or secretion in order to increase the effectiveness of cough. Although expectorants, such as guaifenesin (eg, Robitussin or Mucinex), are sold over-the-counter, there is no evidence that they are effective for the therapy of any form of lung disease, and when administered in combination with a cough suppressant such as dextromethorphan (the "DM" in some medication names) there is a potential risk of increased airway obstruction. (**38**)

H. Cromolyn Sodium

Cromolyn sodium (also known as Nasalcrom) is a topical nasal spray that stabilizes mast cells, thereby preventing mast cell degranulation and preventing release of inflammatory mediators such as histamine, leukotrienes, thromboxanes, and prostaglandins. **(40)** When used prophylactically, cromolyn can prevent symptoms from occurring. Cromolyn sodium stabilizes mast cells by reducing calcium transport across cell membranes, thereby preventing the calcium-dependant degranulation process. Cromolyn sodium is effective for both seasonal and perennial allergic rhinitis. It works for both acute and late-phase allergic reactions. Cromolyn sodium is most effective when taken before allergen exposure. It is not effective for non-allergic sinusitis, and it is not effective for the treatment of nasal polyps. Cromolyn sodium is available as a spray pump. The standard initial dose is one spray in each nostril every 4 hours while awake. Relief of symptoms usually occurs within 4–7 days, after which the dose may be reduced to a maintenance level geared to the particular patient. Local and systemic side effects are generally minimal. Systemic absorption is less than 7% with rapid renal and biliary excretion. Common local side effects include sneezing, burning, and irritation. (**40**)

Ratner et al report on the use of cromolyn for allergic rhinitis. (**40**) They describe the need for an efficacious agent with minimal adverse effects and a lack of drug interactions to help simplify treatment of allergic rhinitis, especially in patients with comorbidities. They report that controlled studies of intranasal cromolyn sodium therapy for patients with seasonal and perennial allergic rhinitis, comparing cromolyn with placebo, intranasal corticosteroids, and antihistamines, have shown the efficacy of cromolyn in relieving rhinitis symptoms. In addition, because cromolyn is poorly absorbed systemically, it is well-tolerated and not associated with drug interactions. Intranasal cromolyn has an excellent safety record, is available as an over-the-counter medication, and has been proved to be efficacious in patients with allergic rhinitis. (**40**)

Baroody reviewed the broader disease effects of allergic rhinitis and theimplications for management. (**41**) He points out that poorly controlled allergic rhinitis can trigger exacerbations of asthma, sinusitis, and otitis media, diseases with which it shares common pathophysiologic elements. Consequently, early diagnosis and treatment should be a priority for patients and physicians, not only to control the symptoms of allergic rhinitis but also to

improve the management of associated diseases. Several pharmacologic therapies can be considered in an armamentarium that includes intranasal cromolyn, antihistamines (intranasal and systemic), intranasal anticholinergic agents, intranasal steroids, systemic steroids, immunotherapy, and, leukotriene receptor antagonists. Often, combinations of these treatments are used to maximize control of refractory symptoms. (**41**)

I. Leukotriene Esterase Inhibitors

Leukotriene esterase inhibitors include montelukast (Singulair) and zyleuton (Zyflo). These are medications that are used in pulmonary diseases such as asthma. Their exact biochemical effect is to interfere with a unique inflamatory pathway and thereby diminish inflammation and swelling. Because they do not work in the same way as steroids, they can have an additive effect when used in conjunction with steroids and other medications.

Leukotrienes are inflammatory mediators that are known as the slow-reacting substance of anaphylaxis produced by a number of cell types including mast cells, eosinophils, basophils, macrophages, and monocytes. Synthesis of these mediators results from the cleavage of arachidonic acid in cell membranes, and they exert their biologic effects by binding and activating specific adaptors. This occurs in a series of events that lead to contraction of the human airway smooth muscle, chemotaxis, and increased vascular permeability. These effects have led to their important role in the diseases of asthma, allergic rhinitis, and possible paranasal sinusitis with the formation of nasal polyps. Because these agents lead to the production of symptoms in patients that are asthmatic, the use of leukotriene enzyme inhibitors, particularly montelukast, and zafirlukasts seem appropriate. These classes of drugs can block the binding of leukotrienes to CysLT(1) receptors. Zileuton is a 5-lipoxygenase inhibitor that prevents the formation of leukotrienes and can also result in the prevention of leukotriene activity. (**42**)

Haberal and Corey review the role of cysteinyl leukotrienes (cysLTs) in nasal allergy. (43) The purpose was to provide knowledge of the role of cysLTs in the pathophysiology of nasal allergy and the role of antileukotrienes in the treatment of nasal allergies. They conducted a literature review. The proinflammatory effects of cysLTs have been well described in asthma. Antileukotrienes have proved to be an effective anti-inflammatory treatment for asthma patients. Similar to pathogenesis of asthma, cysLTs exert potent inflammatory effects in the upper airways and play a role in the pathogenesis of allergic rhinitis and other nasal allergies. **(43)**

Parnes points out that a number of studies have demonstrated efficacy of leukotriene esterase inhibitors in inhibiting nasal symptoms in asthmatic patients. (42) In addition, it has been suggested by serendipitous observations that many of the aspirin-intolerant patients have nasal polyps and that treatment with the leukotriene inhibitors has resulted in improvement and resolution of the polyps. Therefore, these agents may also play a role in patients afflicted with chronic sinusitis with concomitant nasal polyposis. **(42)**

Wilson et al add a practical "real-life" report to the randomised controlled trial evidence that leukotriene receptor antagonists are efficacious in chronic rhinosinusitis. **(44)** They report on a case series of 32 patients referred from primary care with uncontrolled chronic rhinosinusitis (allergic or non-allergic). The authors treated these patients with montelukast in their joint medical/surgical rhinology clinic. They reported significant improvements in subjective scoring for headache, nasal discharge & blockage, sense of smell and daily activity when montelukast was added along with other alterations in chronic rhinosinusitis medication (all receiving intra-nasal corticosteroids). Subgroup analysis of 10 patients, where the addition of montelukast was the only change to medical therapy, showed significant ($p < 0.05$) improvements in headache, nasal discharge and blockage and their daily activity. (**44**)

J. Astelin

Azelastine hydrochlorid (Astelin), azelastine Astepro, and olopatadine (Patanase) are antihistamine nasal sprays. They can be used in patients with nasal allergy symptoms or in addition to an oral antihistamine. While it tends to have an unfavorable taste (and aftertaste), there are new preparations in development intended to address this issue. (45)

Steroid sprays and antihistamine nasal sprays appear to have a synergistic effect. Ratner et al evaluated the efficacy of azelastine hydrochloride nasal spray in combination with an intranasal corticosteroid to determine if greater efficacy could be achieved with the intranasal antihistamine azelastine and the intranasal corticosteroid fluticasone propionate used concurrently compared with the efficacy of each agent alone.(46) This randomized, 2-week, multicenter, double-blind trial was conducted during the Texas mountain cedar season. After a 5-day placebo lead-in period, 151 patients with moderate to severe nasal symptoms were randomized to treatment with the

following: (1) azelastine nasal spray, 2 sprays per nostril twice daily; (2) fluticasone nasal spray, 2 sprays per nostril once daily; or (3) azelastine nasal spray, 2 sprays per nostril twice daily, plus fluticasone nasal spray, 2 sprays per nostril once daily. The primary efficacy variable was the change from baseline in the total nasal symptom score (TNSS), consisting of sneezing, itchy nose, runny nose, and nasal congestion. All 3 groups had statistically significant ($P < .001$) improvements from their baseline TNSS after 2 weeks of treatment. The TNSS improved 27.1% with fluticasone nasal spray, 24.8% with azelastine nasal spray, and 37.9% with the 2 agents in combination ($P < .05$ vs either agent alone). All 3 treatments were well tolerated. The significant improvement in the TNSS with combination therapy relative to the individual agents alone is in contrast to previously published studies that found no advantage with an oral antihistamine and an intranasal corticosteroid in combination. Azelastine nasal spray and fluticasone nasal spray in combination may provide a substantial therapeutic benefit for patients with seasonal allergic rhinitis compared with therapy with either agent alone. (**46**)

K. Atrovent

Ipratropium bromide (Atrovent) is an anti-cholinergic nasal spray. The spray acts to decrease mucous secretions and is particularly useful in patients with nasal hyper-secretion or rhinorrhea which has persisted despite other medical interventions. Atrovent may be useful for patients with allergic and non-allergic sources of their rhinorrhea and mucous over-production, especially vasomotor rhinitis. (**47**) As with azelastine hydrochloride (Astelin), ipatroprium bromide (Atrovent) nasal spray is also known to have an unfavorable taste.

Lal and Corey report on advances in the study of the pathophysiology of vasomotor rhinitis.(48) Electron microscopic and ultracytochemical evaluation of the nasal mucosa in vasomotor rhinitis demonstrates an emerging role of neuropeptides and nitric oxide in the pathogenesis of vasomotor rhinitis. Ozone, cigarette smoke, and other environmental factors may trigger neurogenic mechanisms that lead to vasomotor rhinitis. Objective tests have documented the presence of hypoactive sympathetic autonomic dysfunction. Such assessments also suggest autonomic dysfunction as a possible link between vasomotor rhinitis and gastroesophageal reflux disease. Recent publications propose nasal secretory protein analysis as a possible diagnostic tool. Evidence-based review of

treatment outcomes shows topical sprays of azelastine, budesonide, and ipratropium to be of benefit in vasomotor rhinitis. (**48**)

Dolovich et al undertook a randomized, double-blind, placebo-controlled trial of ipratropium bromide nasal spray with 25 patients with vasomotor rhinitis.(49) Criteria for selection of patients were (1) clear watery nasal discharge more than 1 hour each day, (2) absent or mild nasal obstruction, (3) no known allergic cause, and (4) no satisfactory response to previous alternative medications. Ipratropium bromide, two sprays (20 micrograms per spray) in each nasal cavity four times daily, for 3 weeks, produced a major reduction in nasal discharge severity and duration. Local mild side effects were reported in 21/25 (84%) with ipratropium bromide and 8/25 (32%) with placebo ($p = 0.0004$). Pulse and blood pressure were not affected.

In an ensuing 1-year open trial in which the frequency of use of ipratropium bromide nasal spray was selected by the subjects, the dosage chosen was considerably lower than that used in the controlled trial. The authors concluded that topical nasal ipratropium bromide is highly effective in the control of the rhinorrhea of vasomotor rhinitis. Drug dosage is a major determinant of local nasal side effects.

Jessen and Bylander compared the effect of ipratropium and beclomethasone administered as nasal aerosols in a double-blind, double-dummy, randomized, cross-over designed study. (49) Twenty-four patients with non-allergic, watery hypersecretion participated in the trial. According to the patients' daily registration of nasal symptoms, no significant difference could be found between the two drugs. It was not possible to characterize patients who would benefit from treatment with either ipratropium or beclomethasone. (**49**)

L. Sporonox

Itraconazole (Sporonox)) is an antifungal medication. There is a current theory that some chronic sinusitis is caused by fungus. In these cases, it is thought that antifungal medication may be of benefit, just as antibiotics are of some benefit to many patients with chronic bacterial sinusitis. (**28-31,50**) An article published in the Mayo Clinic Proceedings of September 1999 reported that using specialized techniques, fungal growth was found in 96% of patients with chronic sinusitis.(50) Fungal growth was found in 100% of normal healthy volunteers, people without sinusitis.(50)

Why is this interesting? This fungus is in the nose, but it does not enter into the body—it just sits on the surface. The researchers at the Mayo Clinic have reported that chronic sinusitis patients react differently to the fungus, which is present in all of our noses. The immune systems of chronic sinusitis patients become activated against the fungus, while the immune systems of normal healthy people do not. In normal healthy people, the fungus and fungal spores that are breathed into the nose appear to do no harm. In chronic sinusitis patients, the immune reaction against the fungus causes immune cells to release substances that kill the fungus. It is believed by the researchers at the Mayo Clinic that these substances also damage the nasal and sinus linings and cause them to become inflamed and irritated. (**50**) The immune system of chronic sinusitis patients is activated against the fungus but ends up hurting the patient.

The studies at the Mayo Clinic suggest the possibility that therapy against fungus may help control sinus inflammation.(50) Early reports are mixed, but the results of further research is eagerly awaited. Itraconaxole (Sporonox) has some potentially serious side effects, including the risk of damage to the liver. Therefore, it must be given only under the care of a physician. Liver function tests are obtained before and 2 weeks into treatment. Treatment is terminated if the patient's blood tests are elevated by the medication, or if the patient develops any concerning symptoms such as abdominal pain. Topical anti-fungal medications have also been tried, however, results have been similarly mixed.

Itraconazole (Sporonox) also has an effect of increasing the effectiveness of prednisone. So, if a patient on prednisone is given itraconazole and reports improvement, this improvement may not necessarily have been caused by an antifungal effect, but it may have been caused by the effect of improving the action of the prednisone. There is anecdotal evidence that this treatment can be beneficial, but there is not yet strong evidence in the medical literature. Certainly, itraconazole is a medication that should not be used routinely.

M. Macrolides

Macrolides are a class of antibiotics. An example is erythromycin. In Japan, these antibiotics are used commonly in patients with sinusitis, not for their anti-bacterial effect but for their effect on the immune system. Research has indicated that macrolides upregulate (improve) certain aspects of the immune system and can thereby

help the body fight sinusitis. (**51-52**). However, one criticism of this use of the macrolide antibiotics is that there is a risk that bacteria could become resistant to these antibiotics if they are overused, thereby potentially creating a difficult problem in treating infection with resistant bacteria.

N. Steroids

Steroids are anti-inflammatory medications which are used in the treatment of sinusitis in both a topical (nasal spray) and systemic (pill) form. (**19-27**) Because topical steroids are quite effective for allergic and non-allergic rhinitis, systemic steroids are used less commonly than steroid sprays.

Steroids help prevent and decrease swelling of the lining of the nose and sinuses. They also help to decrease the size of polyps and may prevent them from recurring once they have been removed. Steroids work by several mechanisms, including the stabilization of lysosomal membranes, blockage of migratory inhibitory factor, and decrease in capillary permeability.

Because steroids can also decrease the immune response, there are certain risks associated with the use of topical nasal steroids; these risks are relatively limited compared to those found with oral steroids because they do not have the same degree of widespread effect on the body that may occur with oral steroids. However, the same sorts of risks exist as with oral steroids. Steroids are normally produced by our bodies and are an essential part of our daily functioning. When oral steroids are taken, the body's natural production of steroids decreases. If oral steroids are discontinued suddenly, the body may not have sufficient time to respond and increase its natural steroid production to the normal rate. Therefore, a steroid prescription is typically written so that the patient will slowly decrease (i.e., taper) daily steroid dose prior to stopping completely.

It is not infrequent for patients to have some increased appetite or to retain some fluid when on oral steroid therapy. Patients should therefore watch their diet. An initial high dose may make a patient feel hyperactive, and the patient may feel somewhat down as the dose is decreased. However, with appropriate management of the steroid dosage, these effects can usually be minimized.

For patients on oral steroids for long periods of time, it will be necessary to increase their steroid dose (steroid boost) if they develop a significant infection. The physician would typically instruct the patient how to do

this. Patients on long-term steroids should also increase their dose if they have surgery or are involved in a major accident. Some patients may, therefore, wish to wear a Medic-Alert bracelet. Fınally, individuals at risk for osteoporosis, especially women who have undergone menopause, should have a bone density study performed every 1–2 years if they are on long-term steroids. An annual ophthalmologic examination is also recommended.

In general, systemic steroids should be avoided during pregnancy or if the patient has a history of a bleeding abnormality, tuberculosis (TB), glaucoma, significant clinical depression, or an immune deficiency. There may be exceptions to this generalization on a case-by-case basis. If the patient has a history of a stomach or intestinal ulcer, he or she should inform the doctor. If steroids are required in these cases, the doctor will prescribe some medication to protect the stomach.

Adverse effects that may occur with oral steroid use include the risk of cataracts, glaucoma, high blood pressure, high blood sugar (as with diabetes), mood changes, stomach irritation or ulcer disease, bone-thinning (osteoporosis), and menstrual irregularities. Thus, patients with a history of any of these problems should inform their doctor.

A serious but very rare adverse reaction to oral steroids (avascular necrosis) can result in permanent damage to an affected joint. Fortunately, this is very uncommon. However, patients should inform their physician if they develop significant joint pain while taking oral steroids.

It would be worthwhile to ***summarize*** and repeat certain points about oral steroids. It is increasingly recognized that oral corticosteroids can provide significant temporary relief in patients whose rhinosinusitis responds incompletely to decongestants, antihistamines, topical nasal steroids, or surgery. Some of the more common side effects that might be encountered with oral steroid therapy include increased appetite or fluid retention. Patients may also experience mood swings. An initial high dose may make the patient feel hyperactive or experience insomnia, and the patient may feel somewhat down or depressed as the dose is decreased.

Some of the less-common side effects include, again, the risk of cataracts, glaucoma, high blood pressure, high blood sugar (as with diabetes), stomach irritation or ulcer disease, bone-thinning (osteoporosis), loss of

potassium, and menstrual irregularities: The risk of these may increase with oral steroid use. Patients with a history of any of these problems should be sure to inform their doctor.

Some of the rare side effects must also be noted. A serious but very rare adverse reaction to oral steroids—avascular necrosis—can result in permanent damage to an affected joint, including chronic debilitating pain that may result in the need for joint surgery. Fortunately, this is very uncommon. However, patients should inform their physicians if they develop significant pains while taking oral steroids. With appropriate management of the steroid dosage, side effects can usually be minimized. Below are instructions for taking this medicine to decrease side effects and increase effectiveness.

- Take the medication exactly as prescribed.
- Take between 6am and 8am, when the body secretes a natural steroid named cortisol.
- Avoid excessive consumption of stimulating substances, such as decongestants or caffeine. They may add to the increased energy level and cause irritability, restlessness, and insomnia.
- Avoid steroids during pregnancy or breast feeding, or if you have a history of bleeding abnormality, tuberculosis (TB), significant clinical depression, or immune deficiency.

If oral steroids are discontinued suddenly, the body may not have sufficient time to respond and increase its natural steroid production to its normal rate. Therefore, steroid prescriptions are generally written so that the patient will slowly decrease (taper) their daily steroid dose prior to stopping completely. Patients should not stop their steroid medication suddenly without consulting their physician. The following are recommended to monitor for complications during long-term use of oral steroids:

- annual ophthalmologic examination
- bone density scan
- TB test

The vast majority of patients treated with short courses of systemic corticosteroids do not suffer significant side-effects and tolerate the medication well. However, as with all medications, patient and physician should be on alert for potential side-effects. It is hoped that, with research, more effective options with fewer side-effects will be developed.

O. Complementary and Alternative Medicine in Sinusitis

As many as one third of the American population has used some form of alternative medication, and nearly three fourths of these did not inform their physician of this. (**53**) The most common forms of alternative medicine employed include herbal medications, acupuncture, homeopathy, massage, mind-body medicine, and chiropractic manipulation. Although anecdotal evidence supports many of these practices, few corroborative clinical trials have been performed. Clinicians must be aware of these practices and actively query their patients as to their use of complementary and alternative treatments, not only for their potential benefits but also because they may have potential adverse effects. (**53**)

DISCUSSION AND CONCLUSIONS

Careful evaluation of patients with sinusitis includes a thorough history and a careful endoscopic exam. CT scanning and other diagnostic testing may be undertaken as indicated. This evaluation allows an exact diagnosis and guides proper medical treatment. Under these circumstances, the medical treatments outlined in this chapter are effective for the vast majority of patients with sinusitis.

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 10

QUESTIONS

1. Which of the following is a quick, well-tolerated, office-based procedure which can help in the choice of effective antibiotics for patients with sinus infections?

    A. Anterior nasal swab
    B. Sublabial sinus tap
    C. Maxillary sinus "wash-out"
    D. Endoscopically guided middle meatal culture

2. Which of the following nasal sprays should not be used in a long-term fashion, since long-term usage may lead to rebound congestion, or rhinitis medicamentosa?

    A. Ipratropium bromide nasal spray
    B. Oxymetazoline nasal spray
    C. Azelastine hydrochloride nasal spray
    D. Steroid nasal spray

3. All of the following are recommended to monitor for complications during long-term use of oral steroids except for?

    A. Annual prostate examination
    B. Annual ophthalmologic examination
    C. TB test
    D. Bone density scan

4. Ipratropium bromide is used to treat patients with which of the following?

    A. Mucous hyper-secretion
    B. Mucous hypo-secretion
    C. Hyper-osmia
    D. Hyposmia

5. In patients who use oral decongestants such as pseudoephedrine, which of the following signs should be checked for abnormalities?

    A. Liver function
    B. Blood pressure
    C. Pulmonary function
    D. Visual acuity

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 11

SURGICAL MANAGEMENT OF SINUS DISEASE

INTRODUCTION

Surgical management of sinusitis is considered when medical management fails to relieve the patient of the symptoms of sinusitis. Surgical management is also considered when the patient's condition, unrelieved by medical therapy, is associated with lower respiratory tract problems such as chronic bronchitis and asthma, and when complications of sinusitis are present or threatening.

Surgical intervention for chronic sinusitis is reserved for those patients in whom medical therapy has failed. Functional endoscopic sinus surgery has become the most widely accepted approach for patients requiring surgical intervention for chronic sinusitis. The goal is to return the sinuses to as near normal anatomic state as possible. This surgery is intended to correct conditions that impede mucocilary clearance of the sinuses, especially through the osteomeatal complex. Respect of the normal drainage patterns of the sinuses and elimination or improvement of obstruction of these drainage pathways promotes the resolution of mucosal hypertrophy and infection and the return to a normal disease-free state.

All patients who have recurrent acute sinusitis or chronic sinusitis should be referred to an otolaryngologist/sinus specialist for nasal endoscopy and evaluation. The sinus specialist can make an accurate diagnosis based on history and endoscopy combined with findings on CT scans. Any patient suspected of having significant allergic disease should also undergo a thorough allergy evaluation. In general, patients who fail medical therapy are candidates for surgical management.

INDICATIONS FOR FUNCTIONAL ENDOSCOPIC SINUS SURGERY (FESS)

Surgeons refer to the guidelines that help determine whether surgery is warranted as the *indications* for surgery. (**1-3**) Indications for surgery may be absolute, meaning that surgery is absolutely necessary, or they may be

termed *relative,* meaning that the patient and the surgeon must weigh the potential risks and benefits, but that surgery may be considered a viable option given the patient's history and physical findings.

Absolute indications for sinus surgery include bilateral extensive and massive obstructive nasal polyposis with complications, complications of adult rhinosinusitis (such as subperiosteal or orbital abscess, meningitis, or brain abscess from progression of sinus disease), chronic rhinosinusitis with mucocele or mucopyocele formation, invasive or allergic fungal adult rhinosinusitis, cerebrospinal fluid rhinorrhea, and tumor of the nasal cavity or paranasal sinuses. (**4**)

Relative indications for sinus surgery include persistent chronic adult rhinosinusitis despite medical therapy. Endoscopic evidence of persisting sinusitis may include polyps, mucosal hypertrophy, edema, and mucopurulent discharge from a sinus orifice. Associated factors exist that may alter the threshold for surgery; these include congenital variations in the anatomy of the nasal cavity and paranasal sinuses. A relative indication for functional endoscopic sinus surgery (FESS) exists in adults who have persistent, troubling symptoms despite medical therapy; who have persisting endoscopic and/or CT scan evidence of sinusitis or anatomic obstruction; and persistent disease despite medical therapy. There is not to date a standardized, universal treatment protocol that constitutes "maximum medical therapy." This will vary from patient to patient. Prior to surgery, the patient and doctor should review the treatment to that point. Decongestants, mucolytics, nasal steroids, antibiotics, and other medications are recommended for the treatment of chronic sinusitis. Allergy workup and immunotherapy are recommended in individuals with significant allergies. Immunodeficiency and mucociliary dysfunction represent special situations. Patients with immunodeficiency may require immunoglobulin administration by an infectious disease specialist or an immunologist.

A relative indication for FESS is the presence of significant episodes of recurrent acute sinusitis. This refers to the situation in which a patient has repeated acute sinus infections but is relatively symptom-free between these infections. Relative indications for FESS exist in adults and in children over 12 who have recurrent acute sinusitis. While each patient's situation is unique, general guidelines do exist for surgery for recurrent acute sinusitis. These guidelines include (1) four or more episodes of infection during the past 12 months; (2) a trial of immunotherapy for

allergic rhinosinusitis or absence of allergy; (3) presence of an anatomic variant, especially one causing OMC obstruction; and/or (4) prophylactic use of nasal steroids, mucolytics, and decongestants without benefit.

FUNCTIONAL ENDOSCOPIC SINUS SURGERY (FESS)

In 1985, the use of nasal endoscopes for the diagnosis and surgical treatment of sinus disease was introduced in the United States. This brought dramatic positive change, because FESS essentially replaced the traditional procedures for the surgical management of sinus disease. With nasal endoscopes, the narrow anatomical region of the osteomeatal complex can be visualized and accurately approached surgically. Sinus surgery involving rigid nasal endoscopes has brought dramatic positive improvement in the surgical treatment of sinusitis. FESS is aimed at restoring patency and normal mucociliary flow of the natural sinus openings. (**1-3**)

The key underlying concept behind minimally invasive FESS is based on the concept of the osteomeatal complex (FIGURE 1). The osteomeatal complex, or OMC—the small compartment located in the region between the middle turbinate and the lateral nasal wall in the middle meatus—represents the key region for drainage of the anterior ethmoid, maxillary, and frontal sinuses. Obstruction of the OMC causes a vicious cycle of events that lead to sinusitis. OMC obstruction leads to mucosal congestion that decreases airflow and leads to further obstruction. A progressive downward spiral leads to chronic sinus symptoms and signs.

Endoscopic sinus surgery aims to restore patency and normal mucociliary flow to the osteomeatal complex, thereby reversing the vicious cycle and restoring normal sinus function. Some estimates suggest that more than 200,000 sinus surgical procedures are performed each year.(1-3) One way that FESS differs from conventional sinus surgery is that an endoscope is used in the nose to view the nasal and sinus cavities (FIGURE 2). This generally eliminates the need for an external incision. The endoscope allows for better visualization of diseased or problem areas. This endoscopic view, along with detailed X-ray studies, may reveal a problem that was not evident before.

Another difference is that FESS focuses on treating an underlying cause of the problem. The ethmoid area is usually opened, which allows for visualization of the maxillary, frontal, and sphenoid sinuses. The sinuses can then

be viewed directly and diseased or obstructive tissue removed, if necessary. There is often less removal of tissue, and the surgery is commonly performed on an outpatient basis.

FIGURE 1 – When anatomic abnormalities exist and are contributing to sinusitis, and when other therapies have failed, these anatomic or structural abnormalities can be surgically corrected.

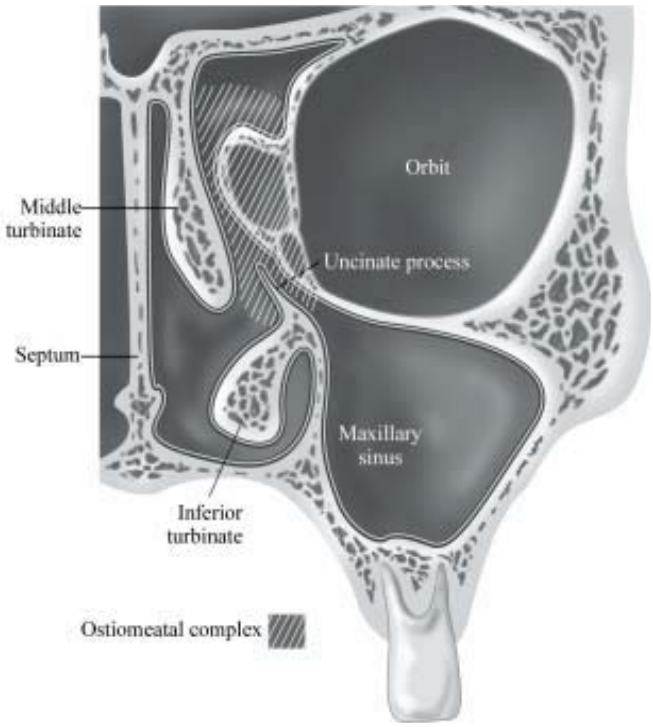

FIGURE 1A – The key underlying concept behind minimally invasive, functional endoscopic sinus surgery (FESS) is the ostiomeatal complex (OMC). (a) The OMC—the small compartment located in the region between the middle turbinate and the lateral nasal wall in the middle meatus—represents the key region for drainage of the anterior ethmoid, maxillary, and frontal sinuses. Obstruction of the OMC causes a vicious cycle of events that lead to sinusitis. Ostiomeatal complex obstruction leads to mucosal congestion that decreases airflow and leads to further obstruction.

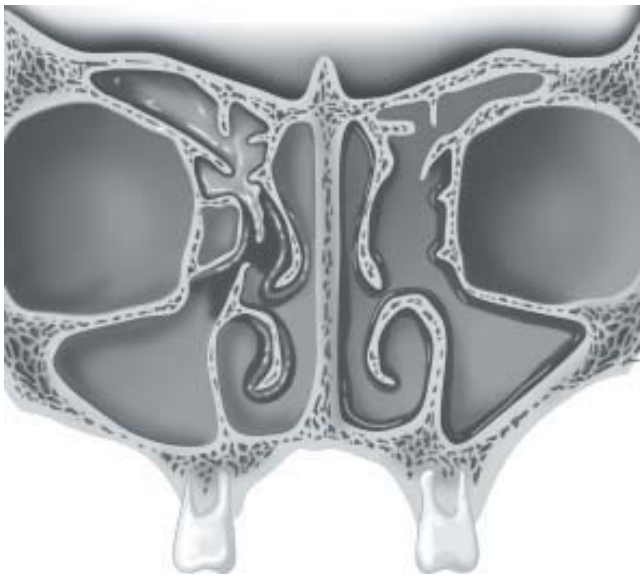

FIGURE 1B – The concept of surgical correction of the OMC resulting in reversal of congestion and improvement of airflow is illustrated by this "before" and "after" diagrammatic illustration.

FIGURE 1C – CT scan showing a deviated septum. Surgery may be required to return the septum to midline by means of septoplasty.

FIGURE 1D – This CT scan demonstrates a straight septum. Large, bilateral concha bullosa, or aerated middle turbinates, worsen this patient's nasal obstruction.

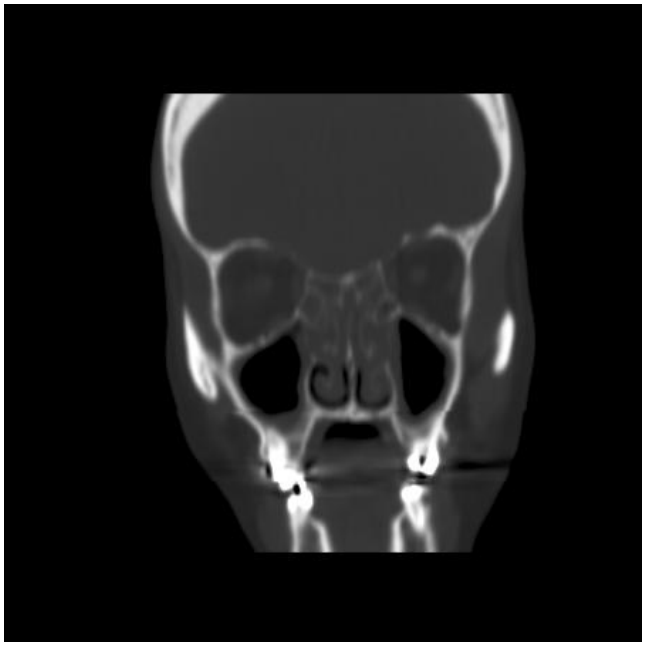

FIGURE 1E – CT scan of a patient with chronic sinusitis, with blockage.

FIGURE 1F – CT scan of patients with nasal polyps causing sinus blockage.

There are some important dos and don'ts for the patient prior to endoscopic sinus surgery. Here are some of the dos:

1. The patient must remember to notify the physician in the office of any medical condition (such as mitral valve prolapse or a prosthetic valve) requiring prophylactic antibiotics before surgery.
2. The patient must read material on the planned surgery to fully understand the procedure, including the reasons it is being recommended, the expected recovery process, the potential benefits and the potential risks.

FIGURE 2 – One way that FESS differs from conventional sinus surgery is that an endoscope is used in the nose to view the nasal and sinus cavities.

Here are some of the don'ts:

- The patient must ***not*** take aspirin or salicylate containing analgesics (example ibuprofen, Advil, or Motrin) for at least 10 days prior to surgery. Aspirin, even in small quantities, can significantly increase bleeding during and after surgery.
- The patient must ***not*** take non-steroidal anti-inflammatory drugs (eg ibuprofen, Advil, Motrin, Aleve, etc.) for at least 5 days prior to surgery. These drugs will also increase bleeding, although the effects on the blood are shorter.
- The patient should ***not*** smoke for at least 3 weeks prior to surgery. Not only does smoking worsen sinus symptoms, smoking in the weeks before or after surgery will result in excessive scarring and may result in failure of the operation.
- The patient must ***not*** eat or drink anything beginning at midnight the night before surgery. If the patient is taking medications, during the pre-surgical evaluation it must be determined if these can be taken on the morning of surgery.

The surgery is typically not uncomfortable and should not be an unpleasant experience. While the operation can be performed under general anesthesia or monitored sedation, most endoscopic sinus surgeries today are

performed under general anesthesia. The physician will discuss the advantages and disadvantages of each type, and together the physician and the patient will decide which is right for the patient.

Regardless of whether sedation or general anesthesia is used, topical and injected anesthesia is also applied to the sinus area after the patient is asleep. This medication usually includes epinephrine. These locally applied medications reduce bleeding during surgery and also reduce the amount of general or sedation anesthesia needed. This helps the patient recover faster from the general or sedation anesthesia.

A. Surgical Risks

The potential complications of FESS are the same as of traditional sinus surgeries. Although there are potentially serious risks from surgery in this area, the incidence of these risks is low. Below is an incomplete list of some potential complications from sinus surgery. Any surgery (sinus or otherwise) should be preceded by a frank and complete discussion between a patient and a physician during which the possible risks and complications of surgery are reviewed. (**1-4**)

Some possible complications of sinus surgery are listed below:

Bleeding

Although the risk of bleeding appears to be reduced with this type of sinus surgery, on occasion significant bleeding may require termination of the procedure and the placement of nasal packing. Bleeding following surgery could require placement of nasal packing and hospital admission. A blood transfusion is rarely necessary.

Blood transfusion

In the very rare instance that a blood transfusion is necessary, there is a risk of adverse reaction or the transfer of infection.

Cerebrospinal fluid (CSF) leak

All sinus surgeries carry a rare chance of creating a leak of CSF (the fluid that surrounds the brain). Should this rare complication occur, it creates a potential pathway for infection which could result in meningitis (inflammation of the brain), or brain infection/abscess. A CSF leak is typically repaired at the time of the sinus

surgery if it is recognized. A CSF leak would extend the patient's hospitalization and may require further surgery for repair.

Decreased sense of smell and/or taste

Permanent loss or decrease in the sense of smell can occur following surgery. However, in a number of patients, it is already decreased prior to surgery, and typically it improves with surgical intervention. Because the sense of smell and taste are closely linked, a decreased sense of smell may lead to a decreased sense of taste as well.

Visual problems

Orbital injuries may include exposure of orbital fat, hemorrhage into the orbit, extra- ocular muscle injury, globe injury, or optic nerve injury. Although extremely rare, there are reports of visual loss after sinus surgery. In these cases, loss of vision can be permanent. Temporary or prolonged double vision has also been reported after sinus surgery.

Numbness of the lip, teeth, cheek, forehead

These complications are very uncommon, but may occur in specific circumstances. When numbness does occur after surgery it is usually temporary, however, cases of permanent numbness have been reported. Since the nerve supply to the upper lip and upper teeth is located in the vicinity of the nasal septum, these nerves may be injured during septoplasty. This is more likely in cases where the septal deviation is in the caudal location and significant work is required in this area. In other cases of severe maxillary sinus disease, some patients may require access to their sinus via a small entry point under the lip. This "canine fossa" approach may have an adverse effect on the nerves in this area that provide sensation to the upper lip, teeth, and cheek. While this complication is uncommon it is usually temporary when it does occur (although cases of permanent numbness have been reported). Patients with frontal sinus disease may require an external approach through a small incision in their eyebrow. Since the nerves that supply sensation to the eyebrow and forehead area are in this vicinity there is the possibility that they may be damaged with consequent numbness (usually temporary) of the area.

Change in voice

The sinuses help with vocal resonance. Change in the sinuses may result in change in vocal resonance. This may be of particular concern to voice professionals (singers, musicians, etc).

Atrophic rhinitis/Empty nose syndrome

Nasal and sinus surgery may lead to changes in the nose and sinus lining which may result in crusting and congestion. In empty nose syndrome, patients have a persistent sensation of nasal obstruction and congestion despite an apparently enlarged nasal airway.

Anesthesia risks

Because sedation or general anesthesia is often used, the patient would be subject to the occasional but possibly serious risks involved. Adverse reactions to anesthesia may be further discussed with the anesthesiologist.

Nasal septal surgery risks

In some cases it may be necessary to repair the nasal septum at the time of sinus surgery, or alone without sinus surgery. If this is required, additional risks associated with septal surgery are possible. If nasal septal surgery is performed, the patient could experience numbness of the front teeth, bleeding and infection in the nasal septum, or creation of a septal perforation. A septal perforation is a hole in the septum, which may cause difficulty breathing through the nose. It can also lead to bleeding, whistling, or crusting from the nose. Because the cartilage in the septum has a "memory," it may shift postoperatively and result in a renewed deviation. There is also a small risk of a change in the shape of the nose, such as a "saddle nose deformity."

Brain damage and death.

There are reported cases of permanent catastrophic injury and death during sinus surgery. These cases are few and far between, but they have occurred.

Other Risks

Tearing of the eye can occasionally result from sinus surgery or sinus inflammation and may be persistent or even permanent. The patient may experience numbness or discomfort in the upper front teeth for a period of time. Swelling, bruising, or temporary numbness of the lip may occur, as well as swelling or bruising around the eye.

Scars or “synechiae” can form postoperatively, and if not recognized they can lead to obstruction of the sinuses and recurrence of sinus symptoms. Meticulous postoperative care by both the patient and the otolaryngologist will minimize problems with synechia.

B. Surgical Technique – FESS (1-3, 5-9)

FESS is performed in the operating room under either local anesthesia with intravenus sedation or general anesthesia. This decision usually is based on patient or surgeon preference. Some physicians feel that local anesthesia with sedation results in less bleeding because of greater vasoconstriction. On the other hand, there are also many who support general anesthesia and feel that blood pressure can be more easily maintained in a relatively hypotensive state to keep bleeding to a minimum. General anesthesia also prevents any movement of the patient during the procedure.

Regardless of whether i.v. sedation or general anesthesia is used, the nasal mucosa is decongested with topical oxymetazoline, phenylephrine, cocaine, or other topical decongestant. The lateral nasal wall is typically injected with lidocaine with epinephrine for hemostasis during the procedure. Some physicians also inject the greater palatine fossa (in the mouth) to cause vasoconstriction of the internal maxillary and sphenopalatine arteries which provide partial blood supply to the nose and sinuses. The lidocaine with epinephrine should be injected at least 10 minutes before the surgeon starts the procedure in order for it to take its full effect.

Endoscopic sinus surgery is performed in either an anterior-to-posterior (front-to-back) or posterior-to-anterior direction. In general, the anterior-to-posterior technique may be considered the more conservative approach and is best for limited disease that involves the anterior ethmoid, maxillary, or frontal sinuses. The posterior-to-anterior technique may be used for patients with pansinusitis or who have had prior sinus surgery that resulted in loss of anatomic landmarks. Also, combinations of both approaches may be used—the skillful sinus surgeon has both techniques in his or her armament and applies them as the need arises.

There are many variations of a general approach to FESS. Following we will detail one approach. It should be recognized, however, that there are several other approaches to FESS which are time-tested and effective. Rigid nasal endoscopes are used to visualize the nasal cavity and lateral nasal wall. In general, 4 mm rigid nasal

endoscopes with 0°, 30°, and 45° lenses are used. Occasionally, a 70° angled lens is used. The procedure is begun with the 0° scope. The middle meatus is visualized. Some surgeons remove all or part of the middle turbinate. An incision is created in the mucosa just anterior to the uncinate process and the uncinate process is removed. This exposes the ethmoid bulla, which represents the most prominent and anterior cell of the ethmoid sinuses. The natural sinus ostium of the maxillary sinus is next identified and may be widened if necessary.

Next, the ethmoid bulla may be entered, and additional anterior ethmoid cell partitions are removed, if necessary, back to the ground lamella. The ground lamella or basal lamella represents the anatomic division between the anterior and posterior ethmoid cells. If the patient's CT scan or endoscopic examination suggests posterior ethmoid disease, the ground lamella is opened and surgery proceeds into the posterior ethmoid cavities. Normal-appearing mucosal linings are maintained rather than stripped out. During sinus surgery, the surgeon addresses specific anatomic variations such as nasal polyps or other anatomic problems. For instance, a deviated nasal septum may be repaired during surgery if it is felt to be contributing to nasal obstruction or if it is blocking access to the sinuses themselves. If the frontal sinus is involved, completion of the anterior ethmoidectomies is confirmed, and the frontal recess is cleared of any obstruction. If there is sphenoid disease, the sphenoid ostium is located with the aid of the 0° endoscope. The ostium is enlarged, and any disease is removed. Normal appearing mucosal linings are maintained rather than stripped out.

The posterior-to-anterior technique differs from the anterior-to-posterior in that it begins in the sphenoid sinus and proceeds anteriorly through the ethmoids. Again, this technique is generally reserved for extensive pansinusitis or revision cases in which there has been loss of anatomic landmarks.

C. Balloon procedures for the sinuses (**10-16**)

Balloon procedures to open the sinuses were introduced in 2005 The idea is to use catheter based technology (much like in angioplasty) to "stent" open the sinus drainage pathway via inflation of a balloon under high pressure. The balloon remodels the surrounding bone and soft tissues leaving behind a larger sinus opening for drainage. The balloon procedure is FDA approved, and there have been several studies in recent years reporting positive results. More recently, a second company – has introduced a balloon-catheter based device to open the

maxillary and anterior ethmoid sinuses via inflation of a balloon in the infundibulum through a trans-antral approach. In this approach, a small puncture is made under the lip for direct insertion of the device into the maxillary sinus and the infundibulum. As a newer technology, there are few studies at this point demonstrating definitive or long-term results. However, the procedure does seem that it might be of benefit in certain cases. The key with balloon procedures is realizing that every patient's sinus anatomy and sinus disease is unique and that while balloon procedures may be appropriate for some patients, they are not appropriate for all patients. Decisions over which technique is used to address the sinuses should be discussed with a patient's surgeon.

D. FESS in Children (**17-22**)

Children with sinusitis require specialized care. The sinuses of children are smaller than the sinuses of adults. Obstruction from adenoids and other causes can frequently cause sinusitis in children. Treatment of obstructing adenoids when they exist can frequently relieve the child's sinusitis. There are other special considerations unique to sinusitis in children. When children do require sinus surgery, great emphasis is placed on a minimally invasive approach.

TECHNOLOGICAL ADVANCES IN FESS

A. Powered Instrumentation

Powered instrumentation, also known as *microdebriders* or *soft tissue shavers,* represent one of the more recent advances in endoscopic sinus surgery. The powered instruments have been clearly established as a useful tool in minimally invasive endoscopic sinus surgery (**23-28**) (FIGURE 3).

The use of powered instrumentation has become almost standard in sinus surgery because they offer the endoscopic surgeon great technical precision. The powered instrument consists of the power source and a handpiece with a disposable shaving cannula. Each shaving cannula has a blunt tip and a lateral aperture near the tip that faces 90°. The shaver sucks soft tissue into the lateral opening and subsequently cuts, or "shaves," it with a rotating or oscillating inner blade. Because the blade is guarded, the instrument provides excellent control for precise resection of soft tissue without damaging surrounding tissues. Newer blades enable surgeons to resect both

soft tissue and bone. Built-in suction continuously removes blood, secretions, and debris and maintains a clear surgical field. Newer modifications of the shaving cannulas enable a combination of soft tissue and thin bone resection known as *micro-excision.* Furthermore, the cannulas have become available in a variety of pre-bent angles and bendable types for work in difficult areas such as the frontal recess or the maxillary sinus. The powered instruments offer the potential advantages of less trauma, decreased bleeding, shorter surgical time, greater comfort, improved recovery, and more rapid healing.

FIGURE 3 – Powered instrumentation, also known as microdebriders or soft tissue shavers, represents one of the more recent advances in endoscopic sinus surgery. Powered instruments have been clearly established as a central tool for minimally invasive endoscopic sinus surgery. The use of powered instrumentation has become almost standard in sinus surgery because these instruments offer the endoscopic surgeon great technical precision.

The most dramatic advantage of powered instrumentation has been seen in treatment for nasal polyps. Traditionally, nasal polyp surgery has been performed with manual instruments that work by avulsion of the polyps. This causes tearing of the tissues, which can include adjacent normal mucosa. As a result, the field is often obscured by blood, thereby increasing the potential to damage important structures. For these reasons, it was not uncommon for the surgeon to abort the procedure before all the polyps had been removed. These patients also almost invariably required nasal packing for at least 24 hours.

The soft tissue shaver helps make this procedure routine. The shaver allows for excellent visualization of the anatomy while the polyps are precisely and quickly removed. Because the oscillating blade is guarded, important structures are less likely to be damaged. The continuous suction allows relatively uninterrupted dissection in a clear

field. Packing is usually not required. Overall, a more complete removal is possible with less bleeding and greater comfort. Guarded bone drilling burs are also available in various configurations for removal of larger quantities of more dense bone. For example, these burs are used in frontal sinus "drillout" procedures to reestablish proper frontal sinus drainage in some advanced cases of chronic frontal sinusitis (FIGURE 4).

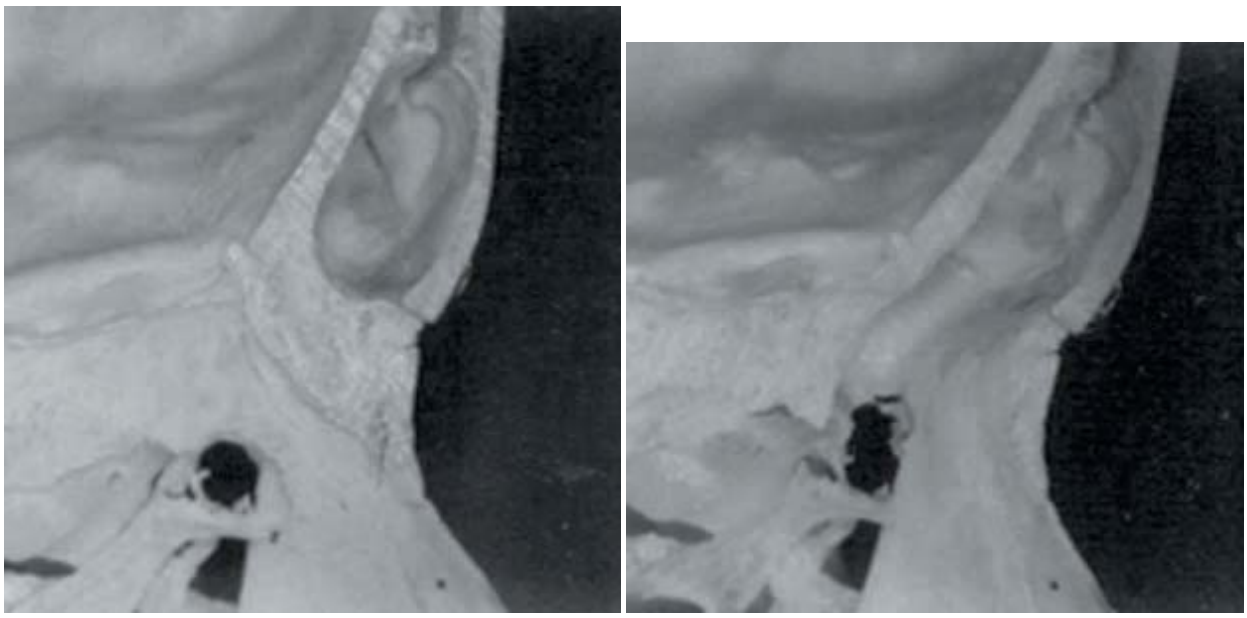

FIGURE 4 – Guarded bone drilling burs are also available in various configurations for removal of larger quantities of more dense bone. For example, burs are used in frontal sinus "drillout" procedures to reestablish proper frontal sinus drainage in some advanced cases of chronic frontal sinusitis. The removal of bone undertaken in this procedure, and the kind of improvement possible for the drainage pathway in these patients, is illustrated in this skull specimen before (a) and after (b) drilling away of the frontal sinus floor.

B. Computer-Assisted Surgery

Computer-assisted surgery, (**1-3**,**24,28-30**) also known as *image guided surgery,* was initially developed for accurate localization during neurosurgical procedures. The application of this technique in endoscopic sinus surgery is available in many major centers. This system allows the surgeon to localize the tip of the surgical instrument in the paranasal sinuses, generally within 1-2 mm of accuracy on coronal, axial, and sagittal CT images (FIGURE 5). Computer-assisted endoscopic sinus surgery can potentially aid the surgeon, especially when working in or near difficult areas such as the frontal sinuses, sphenoid sinus, skull base, and orbit. Computer-assisted endoscopic sinus surgery is especially useful in cases with poor surgical landmarks caused by previous surgery, dense scarring, or

extensive disease. These systems are not universally available. While they are helpful in specific cases, they are not necessary for an experienced, skillful surgeon to perform difficult procedures. They are not, at this stage, associated with decreased surgical risk, although many surgeons feel they add an extra layer of security when operating along the anterior skull base (roof of the sinus cavities).

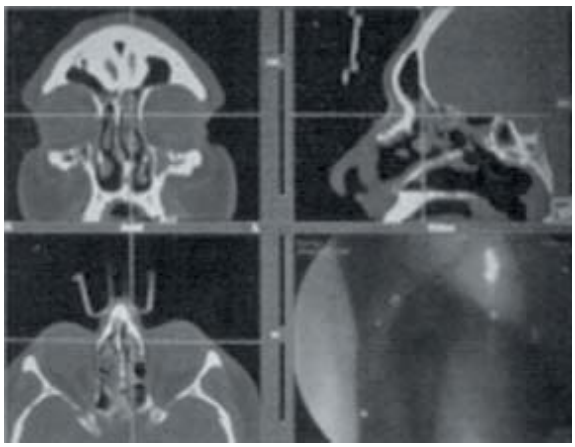

FIGURE 5 – Computer-assisted surgery was initially developed for accurate localization during neurosurgical procedures. The application of this technique in endoscopic sinus surgery is available in many major centers. This system allows the surgeon to localize the tip of the surgical instrument in the paranasal sinuses, generally within 2 mm of accuracy on coronal, axial, and sagittal CT images

POSTOPERATIVE VISITS

Postoperative visits are an indispensable part of the surgery and help promote healing and prevent persistent or recurrent disease. Follow-up visits are usually arranged at approximately 1 day, 1 week, 2 weeks, and 4 weeks after surgery to clean crusts from the nose. A family member or friend should drive the patient to and from the first postoperative visits, and thereafter as instructed by the surgeon.

The patient should anticipate periodic visits to the surgeon's office until healing is nearly completed (usually 4–6 weeks). During follow up visits, any persistent inflammation or scar tissue will be removed under local anesthesia. Although the chances of complications from these manipulations are rare, the potential risks are the same as with the surgery itself. Consent to surgery also includes consent to postoperative care. Careful postoperative care is essential to the success of this surgery. The patient will typically be provided with written

postoperative care instructions. It is very important that the patient follow these instructions, as well as any other instructions given by the surgeon, to promote healing and decrease the chance of complications.

The postoperative care is as important as the surgery itself. Patients are instructed to use both saline nasal spray and saline irrigations in the nose several times a day to cleanse the nose of crust and clots. This maintains a healthy, moist environment that will heal well.

Frequent endoscopic cleanings are performed as necessary to prevent formation of granulation tissue, adhesions, and scars that can re-obstruct drainage of the sinuses. Usually the nasal mucosa has healed and normal mucociliary flow is reestablished within 6-8 weeks. The patient can expect to experience some bleeding from their nose for several days after the surgery and again after each office debridement. This is normal and slowly improves. If bleeding is severe or persists for an extended period of time, the patient should notify the surgeon's office.

As the sinuses begin to clear themselves after 2–3 weeks, the patient can expect to have some thick brown drainage from their nose. This is mucus and old blood. This is expected and does not indicate an infection. The patient may experience some discomfort postoperatively due to manipulation and inflammation. The patient should take pain medication as directed (often extra-strength acetaminophen is sufficient). The surgeon may advise the patient to take medication for pain prior to the postoperative visits, when the nose is most sensitive. If the medication is sedating, the patient should be sure to have someone available to provide transportation to and from the visit. Patients who undergo FESS for extensive sinonasal polyps require continued surveillance for months to years. The sinuses of post-FESS patients are typically easily accessible with office nasal endoscopy. Earlier regrowth of polyps can be identified and controlled by removing the polyps endoscopically in the office setting.

Sinusitis is a chronic problem, and while symptoms may improve or even disappear after surgery, the patient's nose and sinuses still have the potential to be irritated by pollen, dust, pollution, etc. The patient should realize that some medical therapy is usually continued after surgery, especially if allergy or polyps play a role in the sinus disease. This is necessary to control or prevent recurrence of disease. Overall, the majority of patients have had significant improvement with the combination of surgery and continued medical management. FESS, performed

as a result of medical therapy failures in acute and chronic sinusitis, is associated with a success rate of 75–95%, according to sources in the literature. (**31-33**)

RESULTS OF FESS

Overall, the majority of patients have had significant improvement with the combination of surgery and continued medical management. FESS performed as a result of medical therapy failures in acute and chronic sinusitis is associated with a success rate of 75–95%, according to sources in the literature. (**31-35**)

Endoscopic sinus surgery is generally well tolerated with a brief recovery period (**35**) Chester and others report that fatigue and bodily pain is clinically and statistically improved by surgery. (**36-38**) Patients with severe fatigue showed a more pronounced improvement than patients less severely fatigued. (**37**) Significantly greater improvement occurs in patients with fibromyalgia and in patients that are more severely fatigued at presentation, compared to patients with mild fatigue. (**37**)

Soler et al (2008) report that nasal congestion, fatigue, decreased sense of smell , nasal drainage, and facial pain-pressure showed significant and sustainable postoperative improvement at 3, 6, 12, and 18 months after surgery. (**39**)

DISCUSSION AND CONCLUSIONS

In the 21st Century, state-of-the-art technology facilitates the sinus surgeon's ability to open obstructed sinus passageways. The advent of endoscopic techniques and the introduction of powered instrumentation and image guidance allow a minimally invasive, endoscopic approach to sinus surgery.

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 11

QUESTIONS

1. Absolute indications for sinus surgery include all of the following except for:

    A. Orbital abscess arising from a sinus infection
    B. Chronic rhinosinusitis
    C. Invasive fungal sinusitis
    D. Cerebrospinal fluid rhinorrhea

2. Known risks of sinus surgery include all of the following except

    A. Decrease of sense of smell
    B. Cerebrospinal fluid leaks
    C. Decrease of hearing acuity
    D. Damage or the eye and vision

3. Success rates of sinus surgery are thought to be:

    A. 0-25%
    B. 25-50%
    C. 50-75%
    D. Greater than 75%

4. Several studies have shown that sinus surgery performed with image-guidance stereotactic navigational systems is associated with improved outcomes and decreased surgical risk.

    A. True
    B. False

5. Which of the following is a small compartment located in the region between the middle turbinate and the lateral nasal wall in the middle meatus, and represents the key region for drainage of the anterior ethmoid, maxillary, and frontal sinuses. Obstruction of this compartment causes a vicious cycle of events that may lead to sinusitis.

    A. Frontal sinus drainage pathway
    B. Osteomeatal complex
    C. Sphenoethmoidal recess
    D. Ethmoturbinal ridge

Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 12

SURGICAL MANAGEMENT OF THE SEPTUM, TURBINATES, AND OTHER "NON-SINUS" CAUSES OF NASAL OBSTRUCTION

INTRODUCTION

A detailed history and physical examination are critical first steps in the evaluation and treatment of every patient presenting with nasal obstruction. This review has focused on the sinuses, and it is true that chronic nasal obstruction is the most common presenting symptom of anterior ethmoid sinus disease. Still, there are other causes of nasal obstruction, these include septal deviation, inferior turbinate hypertrophy, nasal valve collapse, air filled middle turbinates (concha bullosa), polyps (FIGURE 1A), tumors, and others (TABLE 1). In this chapter, we will briefly discuss the surgical management of the deviated septum, and the inferior turbinates.

FIGURE 1A – Nasal polyps may cause nasal obstruction. This endoscopic photograph demonstrates nasal polyps emanating from the middle meatus into the nasal cavity.

Table 1. Differential diagnosis of nasal obstruction

Cause	Example
Allergic	Allergic rhinitis
Congenital	Encephalocele (iatrogenic or posttraumatic), glioma, teratoma
Chronic rhinosinusitis	
Endocrine	Pregnancy, hypothyroidism, adrenal insufficiency, menstruation
Iatrogenic	Atrophic rhinitis, overresection, overnarrowing after osteotomies
Infection	Acute and chronic rhinosinusitis, septal abscess
Inflammatory polyposis	
Mechanical	Deviated septum, nasal valve collapse, synechiae, nasal polyps, inferior turbinate hypertrophy, middle turbinate hypertrophy (including concha bullosa), adenoid hypertrophy, choanal atresia, septal hematoma
Medicinal	Rhinitis medicamentosa
Neoplastic	Benign and malignant nasal tumors
Foreign body	
Nasal cycle	
Other	

SEPTUM

The septum is the wall that divides the nose down the middle, into a right and left side. It is made of cartilage and bone and has a mucous membrane lining on both sides. When the septum is straight, it simply acts as the divider of the nose and allows for streamlined, aerodynamic airflow and easy nasal breathing. While the septum may be slightly deviated to one side or the other in many patients, in some patients this deviation will cause a functional obstruction. If it is substantially deviated or twisted, the septum can cause nasal obstruction. The septum can twist to the right and block the right side, and then come around further back in the nose and twist to the left to block the left side as well. Some areas in particular are more likely to cause functional obstruction. The front of the nares – the "nasal vestibule" – is the most narrow portion of the nasal airway. Deviation in this already narrow area (Caudal Septum) will also often lead to functional obstruction. (Figure) (**1-5**)

METHODS – SEPTOPLASTY

There is no medicine that can straighten a deviated septum. If the septum is causing nasal obstruction, only surgery can correct it. This surgery is called a *septoplasty.* A septoplasty is performed through a small incision made on the inside of the nose (no external incision is typically necessary). The lining of the septum—the mucous membranes—are lifted off of the cartilage and bone. The cartilage and bone are sculpted and repositioned, and a portion may be removed to achieve the desired straightening of the septum. The mucous membrane lining is then sewn back together with absorbable sutures (no stitch removal is necessary).

In the authors' practice, no nasal packing is placed. Packing was used traditionally and is still used by many surgeons today. However, experienced surgeons have found that packing is not necessary in their hands. This is helpful because packing can be extremely painful, and it can be associated with the risk of Toxic Shock Syndrome. (**1-6**)

ENDOSCOPIC SEPTOPLASTY

Surgeons who are trained in endoscopic techniques may use the endoscopic approach in certain situations. Endoscopically guided septoplasty is useful in difficult revision nasal surgeries in which obstructing septal deviation persists. For example, if septal deviation persists posteriorly after a septoplasty, persisting nasal obstruction may require revision septoplasty. Because the mucosal flaps are often densely adherent after a septoplasty, revision septoplasty involving a traditional approach may present technical difficulty, including significant risk of septal perforation. Endoscopic septoplasty is a relatively recent and important technique and makes this repair significantly less difficult.

The endoscopic approach may be a useful adjunct in difficult revision cases in which complete elevation of a mucoperichondrial flap presents difficulties, such as a persistent posterior septal obstruction after prior septoplasty or after septal injury (such as hematoma or abscess) with loss of cartilaginous septum. In these cases, typical surgical dissection planes are obliterated and complete elevation of a mucoperichondrial or mucoperiosteal flap

may be difficult. The ability to address a persisting deviation, elevating the mucosal flap directly over the offending deviation using endoscopic techniques greatly facilitates treatment. (**7-12**)

TURBINATES

The inferior turbinates are highly vascular structures that extend from the front of the nose along the side of the nasal floor all the way back towards the opening into the throat (nasopharynx). These are the only structures within the nasal cavity that freely swell and shrink on a routine basis (the nasal cycle). When these structures are enlarged (hypertrophied), especially at the front of the nose, they can cause significant functional obstruction. In many instances patients with inferior turbinate hypertrophy can be managed with medical and allergy treatments. In other cases surgical reduction of the inferior turbinates may be indicated. (**1, 13-17**)

METHODS – INFERIOR TURBINATE REDUCTION

Treatment of the inferior turbinates is a matter of some controversy. Some authors advocate inferior turbinate sacrifice as an almost routine treatment of nasal obstruction; others categorically advise against surgical reduction because of the risk of atrophic rhinitis. In our view, there should be a cautious, balanced approach. A thorough search to determine the cause of nasal obstruction is essential, and that cause should be addressed. The proper treatment of nasal obstruction is not simply turbinectomy. By the same token, it is unlikely that the inferior turbinates are immune from pathologic conditions; turbinate hypertrophy must be recognized. A graduated stepwise approach to the inferior turbinates is prudent. It is possible that atrophic rhinitis does develop in some patients after inferior turbinectomy, so we undertake this procedure with great caution. Also, newer techniques have been designed specifically to limit the incidence of atrophic rhinitis

Radiofrequency (RF) volumetric tissue reduction uses radiofrequency heating to induce submucosal tissue destruction, leading to reduction of tissue volumes, represents a potentially conservative procedure that may be considered as an alternative to more aggressive approaches.

When more aggressive treatment of the inferior turbinates is warranted, a submucosal elevation of the turbinate with or without resection of the bulky bone of the inferior concha is preferred. With newer techniques

using powered instrumention, the submucosal tissues of the inferior turbinate, which provide the bulk of the turbinate, can be removed in a fairly atraumatic fashion with a resultant decrease in the overall size of the turbinate. (**1, 13-17**)

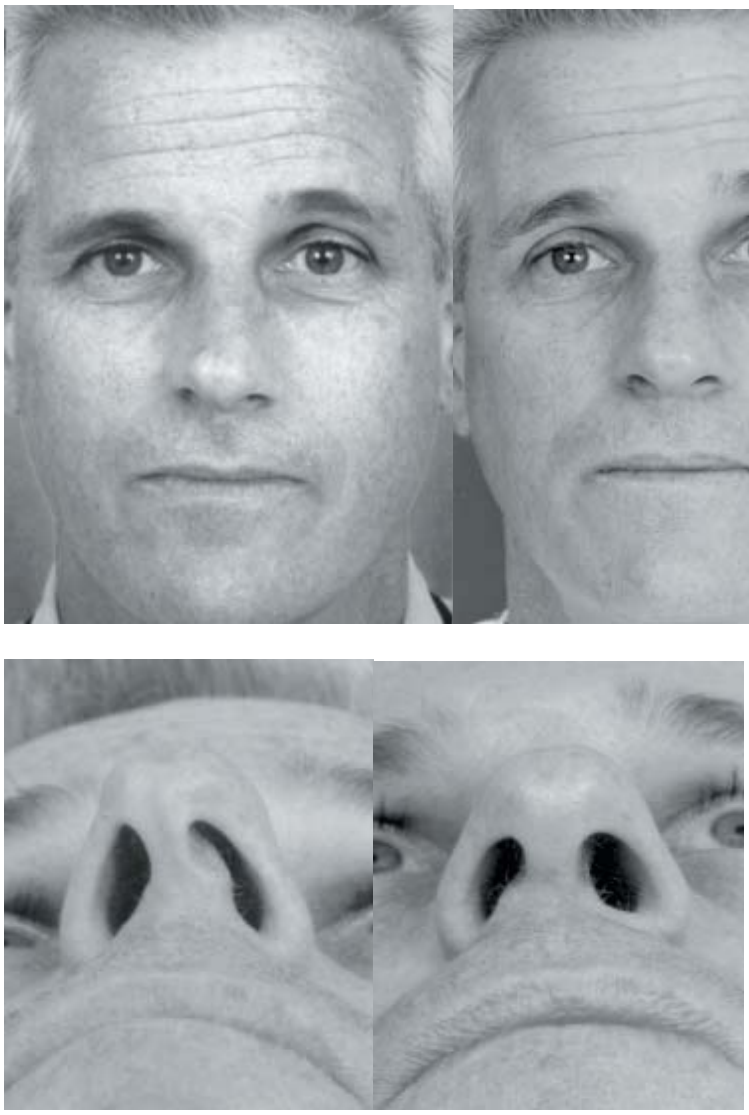

FIGURE 2 – This patient had a caudal septal deviation and also had an excessively concave lateral crura contributing to nasal obstruction. In this case the caudal septum was straightened and the right lateral crus was excised and "flipped" to achieve both aesthetic improvement and improvement in the nasal valve area. (a,b) preoperative; (c,d) postoperative. (Reprinted with permission from www.therhinoplastycenter.com.)

CONCLUSION

Careful evaluation of patients presenting with nasal obstruction should include a thorough history and physical examination, usually with nasal endoscopy. Identification of the correct source(s) of obstruction allows for an appropriate, targeted surgical intervention.

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Allergic and Non-Allergic Sinusitis for the Primary Care Physician: Pathophysiology, Evaluation and Treatment

CHAPTER 12

QUESTIONS

1. Mechanical causes of nasal obstruction include all of following except for:

    A. Nasal polyps
    B. Adenoid hypertrophy
    C. Rhinitis medicamentosa
    D. Deviated nasal septum

2. What is the name of the most narrow portion of the nasal airway?

    A. Nasal vestibule
    B. Nasal angle
    C. Nasal corridor
    D. Nasal runway

3. Which of the following are the only structures within the nasal cavity that freely swell and shrink on a routine basis, and may lead to nasal obstruction?

    A. Inferior turbinate
    B. Middle turbinate
    C. Superior turbinate
    D. Supreme turbinate

4. Which approach may be most useful in resolving a persistent posterior septal deviation in a patient who has had a prior septoplasty?

    A. Open septoplasty
    B. Standard septoplasty
    C. Endoscopic septoplasty
    D. Rhinoplasty

5. Endocrine causes of nasal obstruction include all of the following except:

    A. Pregnancy
    B. Encephalocele
    C. Hypothyroidism
    D. Adrenal insufficiency