Rhinosinusitis: Current Concepts

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Matthew Ryan, MD
**Introduction**

<table>
<thead>
<tr>
<th>TABLE I. Alternative Therapies Used for the Treatment of Nasal Disease.</th>
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<tbody>
<tr>
<td>Chicken soup</td>
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<tr>
<td>Humidifiers</td>
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<tr>
<td>Nasal hyperthermia</td>
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<tr>
<td>Hot tea</td>
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<tr>
<td>Iodides</td>
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<tr>
<td>Nasal irrigation</td>
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</tbody>
</table>
Introduction

• The medical condition most commonly reported by US Census Department

• Major Factors: Facial pain/pressure, congestion, nao, discolored discharge, hyposmia, pus, fever

• Minor Factors: H/A, fever, halitosis, fatigue, dental pain, cough, ear pain/fullness
## Topical Intranasal Medications

### NeilMed Products: Sinus Rinse
This company offers a simple product that includes an irrigation bottle and 50 packets of a NaCl mixed with bicarbonate. Cost: bottle—$8.95, packets (100)—$9.95. 1221 Farmers Lane, Suite 500, Santa Rosa, CA 95405; TEL: (707) 525-3784; FAX: (707) 525-3785; Toll-Free: (877) 477-8633. Mail questions to QUESTIONS@NEIMED.COM. Web site: http://www.nasalrinse.com

### SaltAire
The SaltAire irrigating solution is made of purified water, sodium chloride, sodium bicarbonate, di basic sodium phosphate, trisodium EDTA, and thimerosal. The product comes prepared in either a 12.5-oz irrigation bottle or a 32-oz refill bottle. Cost: irrigation bottle (12.5 oz)—$12.50, refill bottle (32 oz)—$15.00. Web site: http://www.saltairisinus.com

### Health & Yoga: Netipot
This product includes a stainless steel pot with a conical end that is filled with warm, slightly salted water. The spout of the pot is inserted into one nostril and the position of the head and pot are adjusted to allow the water to flow out of the other nostril. Cost: $13.95. Web site: http://www.healthandyoga.com

### Parnell Pharmaceuticals: Pretz Nasal Products
This company provides a different irrigating solution that includes glycerin and saline formula with an added organic compound called "yerba santa." Yerba santa has not been demonstrated in the medical literature to provide benefit in nasal irrigation. Cost: irrigation bottle (8 oz)—$15.00, refill bottle (32 oz)—$29.95. Web site: http://www.parnellpharm.com/pretz.htm

### Teledyne WaterPik
A pulsating liquid delivery system formerly engineered for use as an oral irrigator and is currently being used for nasal irrigation. This product requires the use of a nasal adapter that can be purchased from various companies including, Ethicare, ENTsol, Kenwood, and HydroMed. Cost: approx. $40–50 (available at most retail stores). Note that the adjustable model is required. Web site: http://www.waterpik.com

### Kenwood Laboratories: ENTsol
This line of nasal irrigation products provides a wide selection. The ENTsol reusable 8 oz. bottle for use as a nasal wash irrigation device can be used with powdered solutions such as ENTsol™ Packets or ENTsol™ Solution. Cost: irrigation bottle—$30.91, packets (10) $7.16, nasal adapter $28.48 (for use with a WaterPik oral irrigator). Web site: http://www.entsolwash.com

### Ethicare: Hydro-Flo
This delivery system is motorized and provides a steady flow (nonpulsatile) of irrigating solution from a sealed 1.5-liter container. Flow rate can be controlled during irrigation. Cost: $78.90 (not including irrigating solution). Web site: http://www.ethicare.com

### Hydromed: Grossan Sinus Irrigator

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*Fig. 2. Nasal irrigation products.*
Topical Intranasal Medications

• 3% NaCl more effective than 0.9% NaCl \textit{in vivo} (Talbot, 1997)
• Lactated Ringers only solution that does NOT affect Mucociliary clearance \textit{in vitro}; 7% NaCl causes complete, partially reversible ciliostasis (Boek, 1999)
• Alkaline milieu thought to lend to “sol” state; no supporting data
• Bactroban only FDA-approved intranasal antimicrobial; safety of others not established
Immunodeficiency

• When to suspect
  – Recurrent acute RS not attributable to other cause
  – Persistent infection unresponsive to antibiotics
  – Infections at other sites (pneumonia, sepsis, meningitis)
  – Unusual sinus pathogens or severe infections
  – Family h/o immunodeficiency

• IgG subclass deficiency (4 subclasses)
  – IgG1 – bacterial protein, 67% (Tetanus, DPT)
  – IgG2 – bacterial polysaccharide, 23% (H. flu, S. pneumo)
  – IgG3 – M. Catarrhalis, S. Pyogenes
Immunodeficiency

Table 4. Correlation of type of infection with the form of immunodeficiency

<table>
<thead>
<tr>
<th>Immunodeficiency</th>
<th>Bacterial</th>
<th>Viral</th>
<th>Fungal</th>
<th>Protozoan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antibody deficiency</td>
<td>+++</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>T-cell deficiency</td>
<td>-</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>T-cell/B-cell deficiency</td>
<td>+++</td>
<td>-</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Complement deficiency</td>
<td>+++</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Phagocytic dysfunction</td>
<td>+++</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

+++ , Strong correlation; ++, correlation; +, slight correlation; --, no correlation.

Table 5. Laboratory evaluation based on the suspected form of immunodeficiency*

**Antibody deficiency**
- Quantitation of serum immunoglobulin (Ig): IgG, IgA, IgM, IgE, and IgG subclasses
- Measurement of antibodies from previous immunization or infection: diphtheria, tetanus, rubella, rubeola, influenza, varicella
- Measurement of preimmunization and postimmunization antibody titers: pneumococcal polysaccharide vaccine, *Haemophilus influenzae* type B vaccine, diphtheria toxoid, tetanus toxoid

**T-Lymphocyte deficiency or dysfunction**
- Complete blood count with differential
- Delayed hypersensitivity skin tests: Candida, tetanus toxoid, diphtheria toxoid, Streptococcus and Proteus extracts
- T-lymphocyte population and subpopulation counts
- In vitro lymphocyte stimulation tests

**Complement deficiency (CH100 or CH50)**
- Serum total hemolytic complement activity (CH50)
- If positive CH50 abnormality: C3, C4, alternative pathway hemolytic activity assay, circulating immune complexes

**Phagocytic dysfunction**
- Complete blood count with morphologic examination of leukocytes
- Nitroblue tetrazolium dye reduction test
- Measurement of leukocyte adhesion molecules (LFA-1 and Mac-1/CRI)

*See Table 4.
Immunodeficiency

• Workup
  – CBC w/ Dif, HIV
  – Ig concentrations, IgG subclass concentrations
  – Test response to DPT, Pneumococcal vaccine
  – +/- T-cell function (in vitro > in vivo)
  – +/- CH-50

• 53.3% abnormal T-cell function (Cheep, 2001)
• IgA deficiency (40%), CVID (25%) (Sethi, 1995)
Immunodeficiency

- **Treatment**
  - IVIG: CVID, Total IgG deficiency, IgG subclass deficiency WITH decreased response to vaccine
  - Long-term antibiotic prophylaxis (Augmentin 500 mg QD)
  - Genetic counseling/testing of family
Cystic Fibrosis

- Most common lethal Auto Recessive disease in Caucasians
- 1:2,000 live births; carrier rate 1:20-25
- Thick, exocrine mucus causing mucostasis
- CFTR gene on 7q31 affecting chloride channel; Delta-F508 – 70% of CF mutations
- Chronic endobronchial infections, progressive COPD, pancreatic insufficiency, male infertility, and CRS +/- polyposis (up to ½)
Cystic Fibrosis

- <10% report troubling nasal sx; 12% vs 71% anosmia
- Dx: 2 + sweat tests (>60 mmol/L), or 1 + sweat test and 2 CF mutations
- False positives: AI, Anorexia, Hypothyroidism, Low Ig

**Table 1.** Preoperative Symptoms Profile of 21 Cystic Fibrosis Patients Undergoing FES Surgery

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal obstruction</td>
<td>90%</td>
</tr>
<tr>
<td>Purulent rhinorrhea</td>
<td>86%</td>
</tr>
<tr>
<td>Headache</td>
<td>75%</td>
</tr>
<tr>
<td>Anosmia</td>
<td>71%</td>
</tr>
<tr>
<td>Limitation of activity</td>
<td>71%</td>
</tr>
<tr>
<td>Facial pain</td>
<td>60%</td>
</tr>
<tr>
<td>Snoring</td>
<td>48%</td>
</tr>
<tr>
<td>Voice change (hoarseness)</td>
<td>15%</td>
</tr>
</tbody>
</table>

**Table 2.** Preoperative Endoscopic Profile of 21 Cystic Fibrosis Patients Undergoing FES Surgery

<table>
<thead>
<tr>
<th>Endoscopic Finding</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mucosal edema</td>
<td>100%</td>
</tr>
<tr>
<td>Mucosal inflammation</td>
<td>100%</td>
</tr>
<tr>
<td>Purulent nasal drainage</td>
<td>86%</td>
</tr>
<tr>
<td>Medial bulging of lateral nasal wall</td>
<td>76%</td>
</tr>
<tr>
<td>Nasal polyps</td>
<td>67%</td>
</tr>
<tr>
<td>Copious clear mucoid drainage</td>
<td>24%</td>
</tr>
<tr>
<td>Nasal septal deviation</td>
<td>14%</td>
</tr>
</tbody>
</table>
Cystic Fibrosis

- Findings on CT: frontal agenesis, medial bulging of lateral wall (63-100%), maxilloethmoid opacification
- Baseline CT in every patient
- ENT “wellness” visits
- Medical Tx: Abx, INS, Buffered Hypertonic Saline, Short-Course Decongestants, Steroids
Cystic Fibrosis

- **Indications for Surgery:**
  - Persistent NAO despite meds
  - Medialized lateral nasal wall
  - Worsening pulmonary status or lung problems associated with sinonasal problems
  - Facial pain or H/A affecting QOL

- **Double CFTR mutations associated w/ CRS in non-CF patients (Wang, 2000)**

- **CFTR mistrafficking associated w/ CRS in children (Coltrera, 1999)**
Allergic Fungal Rhinosinusitis

- First described by Safirstein, 1976
- Analogous to Allergic Bronchopulmonary Aspergillosis (ABPA)
  - Molds=Hyphae, Yeasts=Spores, Pseudohyphae=Chain of spores
- Dematiaceous fungi: Bipolaris, Alternaria, Cladosporium, Curvularia, Drechslera, Exserohilum

### TABLE III.
Fungal Antigens in Current Testing and Treatment Protocol at the University of Texas Southwestern Medical Center at Dallas (in approximate relative order of local [Dallas, TX] importance).

<table>
<thead>
<tr>
<th>Fungal Antigen</th>
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<tbody>
<tr>
<td>Helminthosporium</td>
</tr>
<tr>
<td>Alternaria</td>
</tr>
<tr>
<td>Stemphyllum</td>
</tr>
<tr>
<td>Curvularia</td>
</tr>
<tr>
<td>Aspergillus</td>
</tr>
<tr>
<td>Epicoccum</td>
</tr>
<tr>
<td>Fusarium</td>
</tr>
<tr>
<td>Mucor</td>
</tr>
<tr>
<td>Pullularia</td>
</tr>
<tr>
<td>Cladosporium</td>
</tr>
<tr>
<td>Penicillium</td>
</tr>
</tbody>
</table>

Allergic Fungal Rhinosinusitis

• 5-10% of CRS cases, though marked geographical variation; common in warm, humid climates
• AR (67%), Asthma (50%)
• Early=gradual NAO, semisolid nasal crusts; Late=extensive nasal polyposis, CRS (1/2 unilat)
• Pain is uncommon (suggests bacterial infection)
Allergic Fungal Rhinosinusitis

- Allergic Mucin
  - Thick, tenacious
  - “Peanut butter”, “Axle grease”
  - Noninvasive
    Hyphae w/in sheets of Eosinophils & Charcot-Leyden Crystals (lysophospholipase)
Allergic Fungal Rhinosinusitis

- Diplopia, proptosis, telecanthus despite NON-invasive dz
- CT: High attenuation w/in expanded sinuses (fungus) and hyperdense areas (metals/calcium), Bony erosion (98%)
Allergic Fungal Rhinosinusitis

- MRI: Central hypointensity on T1, central signal void on T2; increased peripheral enhancement
Allergic Fungal Rhinosinusitis

• Diagnosis (Bent and Kuhn Criteria, 1994):
  – Type-I Hypersensitivity
  – Nasal Polyposis
  – Characteristic CT signs
  – Eosinophilic mucus without fungal invasion
  – Positive fungal stain and/or fungal culture
Allergic Fungal Rhinosinusitis

- Treatment (3 points of attack)
  - Atopy: Immunotherapy (must be initiated POST-operatively)
  - Remove antigenic burden: FESS, antifungal meds (Itraconazole-$$$$$$$$$$$$$$)
  - Halt inflammatory cascade: Topical and systemic corticosteroids
- Total serum IgE used to monitor dz
Allergic Fungal Rhinosinusitis

- Polyps/mucin facilitate surgical access
- “Follow the polyps”
- Complete removal of mucin, adequate ventilation w/ intact mucus, post-op access
Allergic Fungal Rhinosinusitis

- Surgery
- Irrigation
- Antifungals

Anatomic Factors

- Edema
  - Obstruction
  - Stasis
  - Decreased ventilation

- Bacterial Infection

Exposure
  - Fungal Proliferation
  - Antigen Exposure

Allergic Mucin

Inflammation
  - Eosinophilic inflammation
    - (MBP, ECP, etc)

Inflammatory Trigger
  - Gell & Coombs I/III
  - T-Cell
  - Other

Immunotherapy
- Steroids
Allergic Fungal Rhinosinusitis

• Fungal pan-antigen?
• THE CONTROVERSY
  – Ponikau, 1999: 96% of CRS patients grew out fungus; 100% of healthy controls grew out fungus; 93% of surgical pt’s met their criteria for AFRS (excluded atopy)
  – If IgE-mediated, then why unilateral?
  – Immunotherapy works, but not by changing fungal-specific IgE
  – IgG immune complexes have not been found
  – TH2 CD-4 cells
Allergic Fungal Rhinosinusitis

Schubert, 2001
Case Study

- 12 yo female with chronic cough, referred by PCP
Case Study

- **History:** No sinonasal complaints, denies allergic rhinitis. Previous hospitalization for pneumonia.
- **Family hx:** Maternal grandfather died from “pneumonia” at age 32
- **PMH/PSH:** Asthma, No prior surgeries
- **Physical exam:** Small for age, widened nasal bridge
Case Study

- Labs: Sweat chloride 63 mmol/L
- ABX, hypertonic saline, INS
- Repeat sweat test 68 mmol/L
- Steroid burst
- FESS – cough better, food “tastes” better