

Evaluation and Management of Sinonasal Disorders

{ A Primary Care, Evidence-Based Approach

Joshua F. Smith, MMS, PA-C, DFAAPA
AAPA 2020 Conference

Disclosures

I have no financial disclosures.

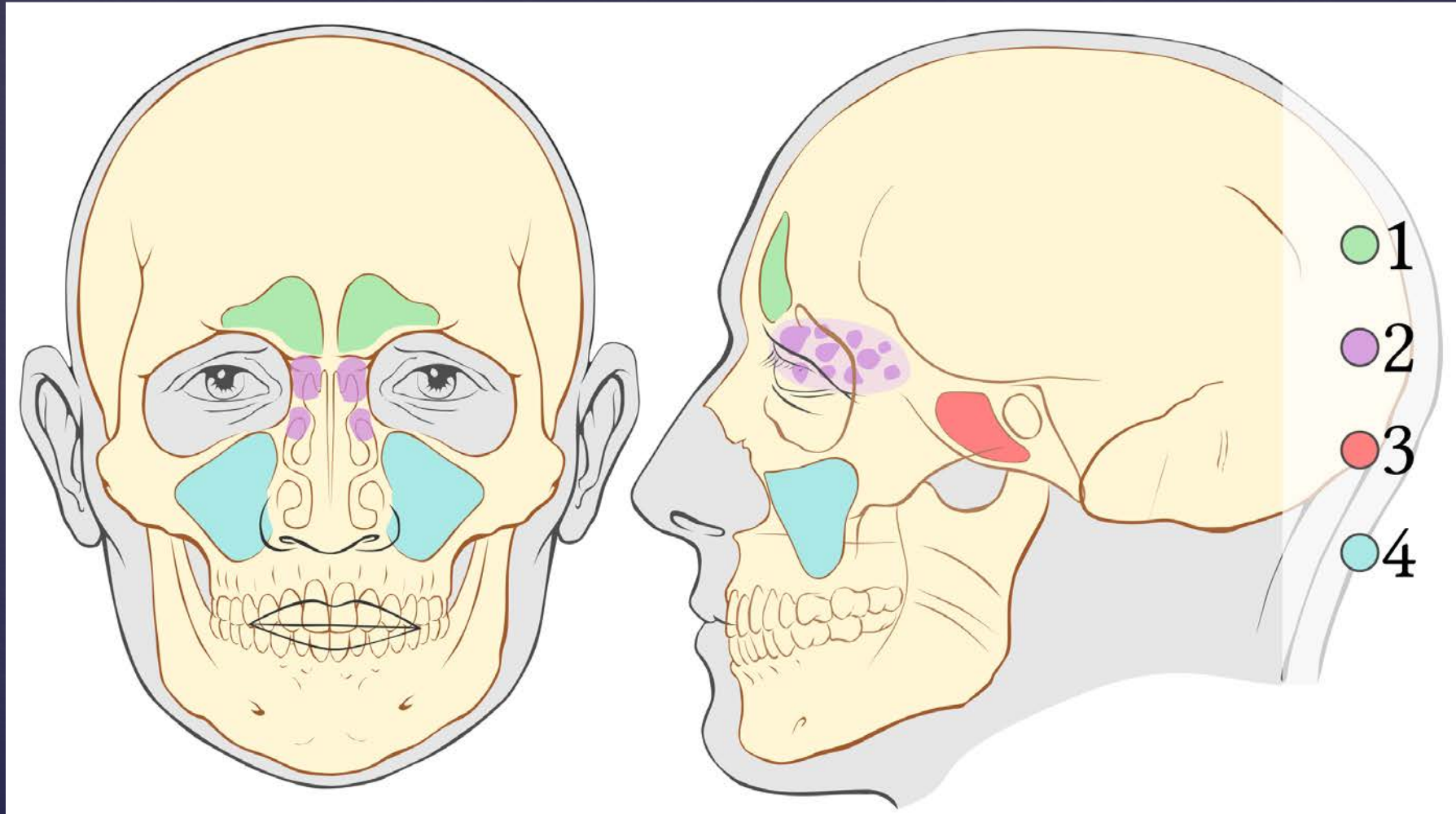
Objectives

- ⌘ Understand the anatomy and physiology of the nose and paranasal sinuses
- ⌘ Recognize conditions commonly mistaken for sinusitis
- ⌘ Be able to differentiate between rhinitis, acute bacterial sinusitis, recurrent acute bacterial sinusitis, and chronic sinusitis
- ⌘ Conduct a work-up, develop a treatment plan, and make an appropriate referral for specialty management of sinonasal disorders

Sinus Anatomy

{ And the critical structures surrounding the sinuses

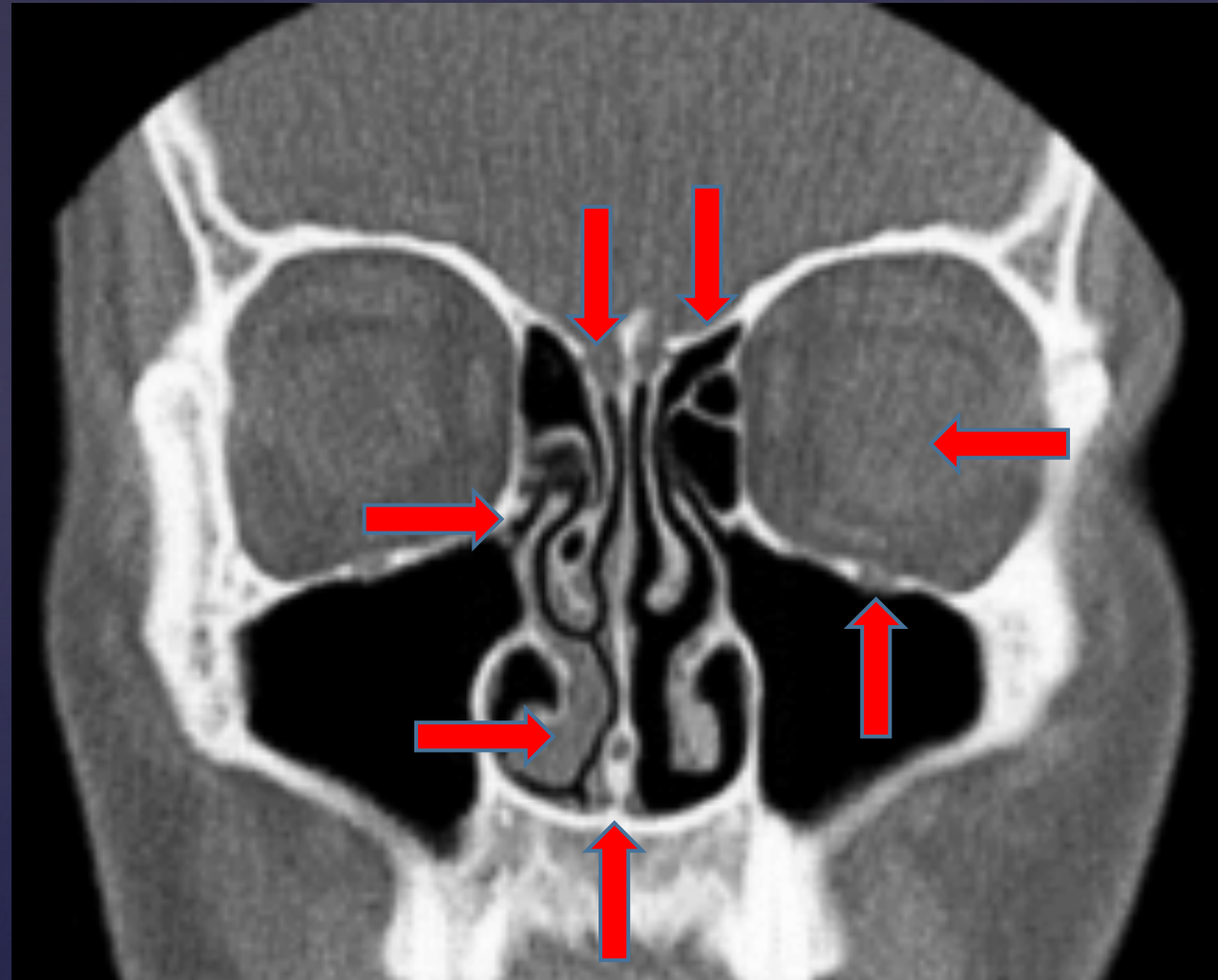
Paranasal Sinuses



Frontal, ethmoid, sphenoid, and maxillary sinuses

Other Nasal Structures

- & Nasal Turbinates
- & Osteomeatal Complex
- & Nasal Septum
- & Nasopharynx
- & Orbits
- & Infraorbital Nerve
- & Skull Base
- & Olfactory Nerve



Epidemiology

{ Why is it important to diagnose and treat rhinosinusitis
{ appropriately?

Sinusitis Statistics

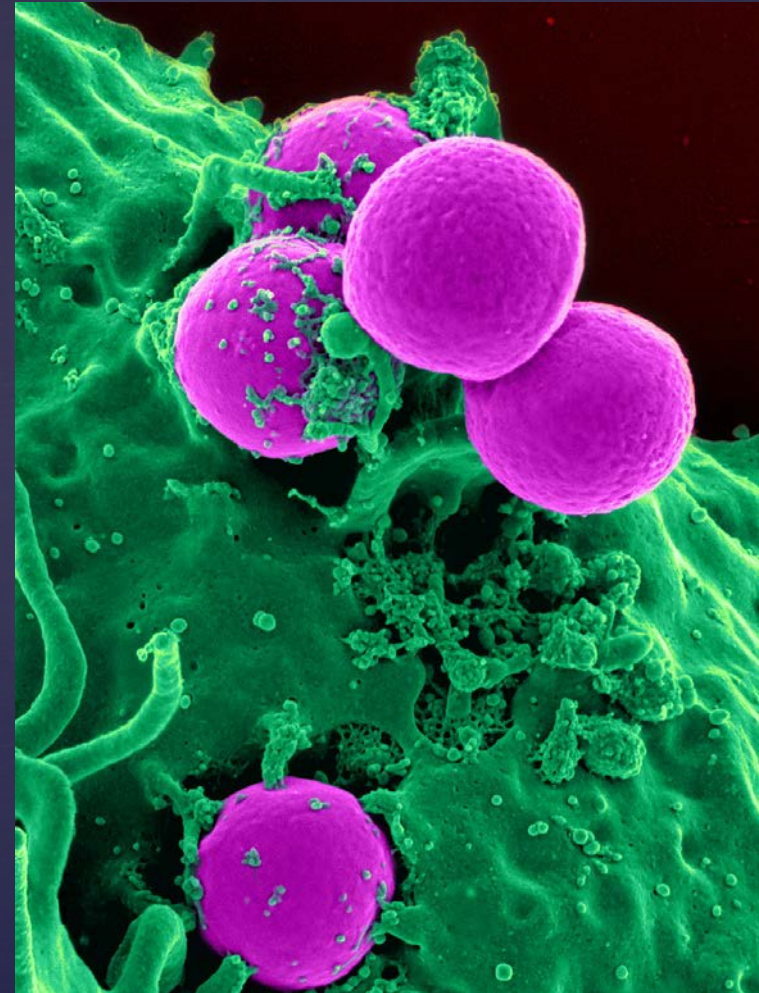
- ⌘ 1 in 8 adults diagnosed with acute rhinosinusitis per year.
 - ⌘ 30 million diagnoses
- ⌘ 1 in 5 adult antibiotics are used for the treatment of sinusitis making it one of the most common reasons for antibiotics to be prescribed.
- ⌘ Has direct cost of \$11 billion per year, more if you consider lost productivity.
- ⌘ Diagnosis and treatment of acute sinusitis across multiple disciplines is highly inconsistent and variable.

Antimicrobial Resistance

- ⌘ Considered one of the top 10 greatest worldwide threats to our health.
- ⌘ 90% of antibiotics are prescribed at the primary care level, mostly for respiratory infections.
- ⌘ Most of these respiratory infections are caused by viruses.
- ⌘ Antimicrobial resistance increases mortality, complications, readmissions and healthcare costs.

Mortality Rates

- ⌘ Kills roughly the same number of people as the following COMBINED:
 - ⌘ Emphysema
 - ⌘ HIV/AIDS
 - ⌘ Homicide
 - ⌘ Parkinson's
- ⌘ 35,000 Deaths annually
- ⌘ Adding in *C. diff* infections, which aren't resistant microbes, but can be caused by antibiotic misuse, the number of death climbs to 48,000 annually.



So.....

It is very important that we get both the diagnosis and the treatment plan right!





What is NOT sinusitis?

- { Allergic Rhinitis
- { Viral rhinitis
- Trigeminal Neuralgia
- TMJ Disorder
- Headache Disorders

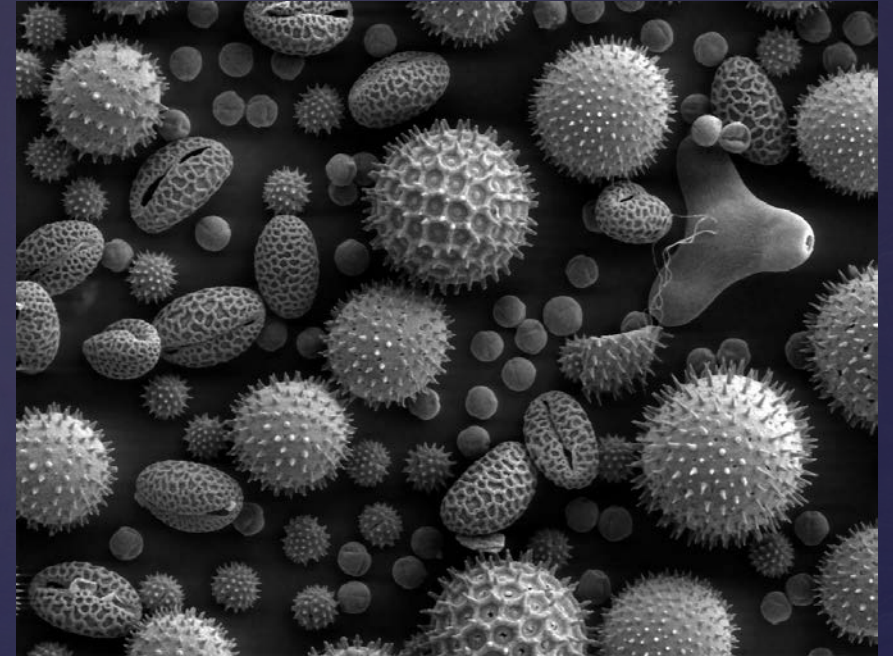
Allergic Rhinitis

- ⌘ IgE mediated reaction causing mast cells and basophils to release histamine, leukotriene, serotonin, and prostaglandins

SYMPTOMS

- ⌘ Nasal congestion
- ⌘ Clear runny nose
- ⌘ Sneezing
- ⌘ Itching
- ⌘ Watery, itchy eyes

- ⌘ Common allergens: Grass/tree pollen, mold, dust, animal dander



Allergic Rhinitis

& SIGNS

- ∅ Pale nasal mucosa
- ∅ Boggy hypertrophied turbinates
- ∅ Clear rhinorrhea
- ∅ Pharynx cobblestoning
- ∅ Nasal bridge crease

& Normal CT sinus



Non-Rx Treatment of Allergic Rhinitis

Avoidance of allergens

Should be allergen specific:

- ∅ Dust covers for pillow and mattress
- ∅ Change filters
- ∅ Vacuum carpet, curtains, sweep floor
- ∅ No pets in bed
- ∅ Insecticides (for cockroach allergy)

Nasal Saline lavage

Rx Treatment of Allergic Rhinitis

Nasal steroid spray

- ∅ Fluticasone, Triamcinolone, Mometasone, Budesonide

Antihistamines

∅ Oral Antihistamines

- ∅ 1st generation Diphenhydramine
- ∅ 2nd/3rd generation antihistamines
 - ∅ Fexofenadine, Cetirizine, Loratadine, Levocetirizine, Desloratadine

∅ Topical antihistamines

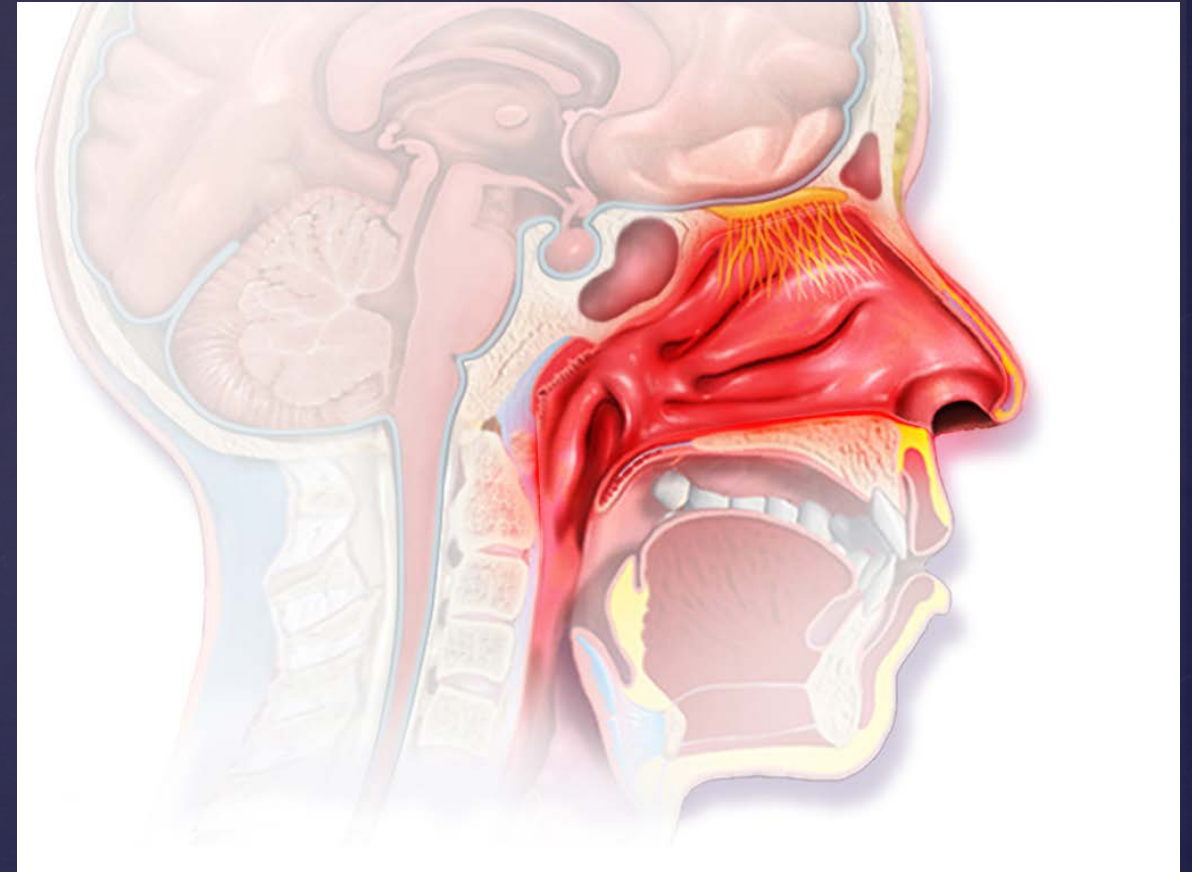
- ∅ Nasal spray: Azelastine or Olopatadine
- ∅ Eye drops: Azelastine or Olopatadine

Leukotriene inhibitor

- ∅ Monteleukast- Use with caution. Black box warning

Viral Rhinitis

- ⌘ Upper respiratory tract infection caused by *adenovirus*, *parainfluenza*, *rhinovirus* (and many more).
- ⌘ Symptoms usually last <7 days
 - ⌘ Sore throat
 - ⌘ Nasal congestion
 - ⌘ Rhinorrhea (may be discolored)
 - ⌘ Fever
 - ⌘ Cough (may be productive)
 - ⌘ Malaise
 - ⌘ Fatigue
- ⌘ Treatment is supportive



Trigeminal Neuralgia

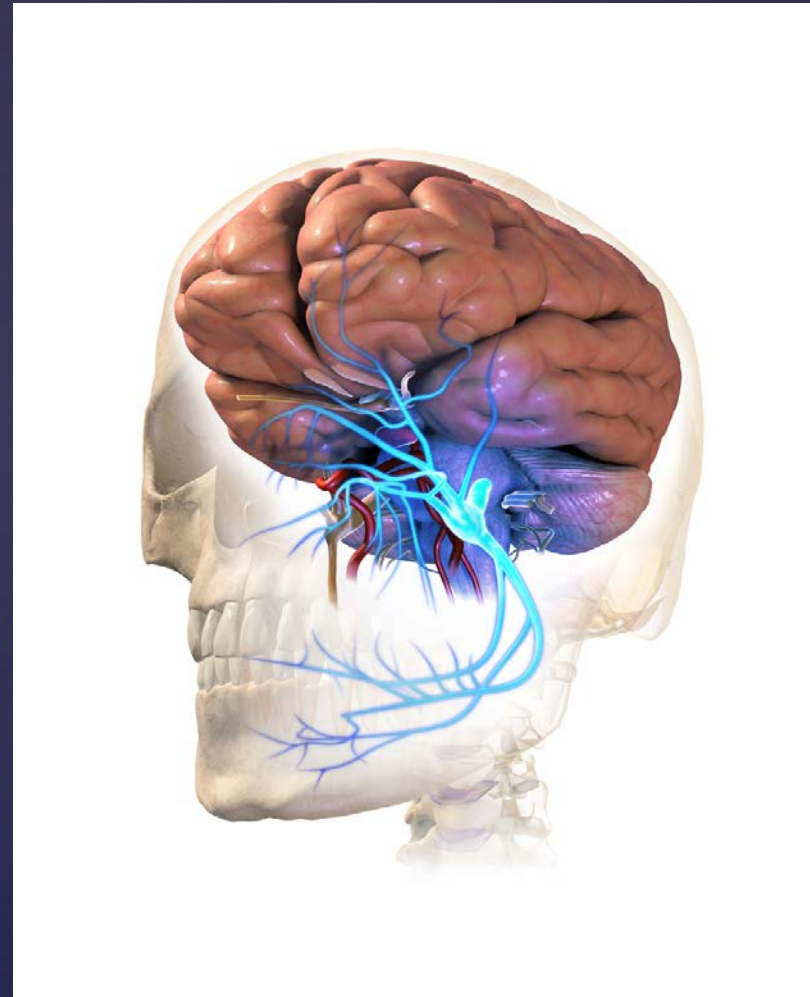
& Neuropathic pain along the V1, V2, or V3 distribution of the trigeminal nerve

& Symptoms

- ⌘ Unilateral, hemifacial shooting or burning pain
- ⌘ Transient

& Normal nasal and sinus exam

& Normal CT sinus



TMJ Dysfunction

⌘ Myofascial Pain

- ⌘ Arthritic
- ⌘ Muscular

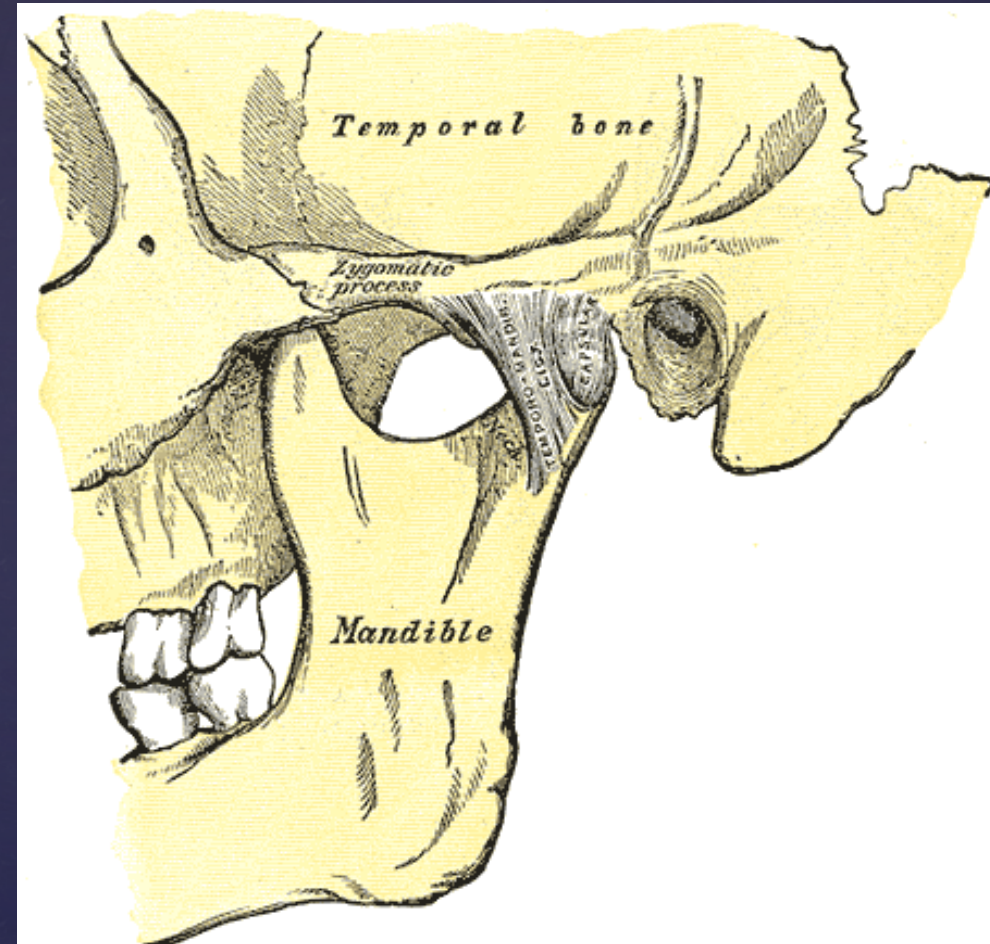
⌘ Symptoms

- ⌘ Episodic stabbing ear pain
- ⌘ Neck pain
- ⌘ Facial pain

⌘ Signs

- ⌘ Tender TMJ
- ⌘ Popping/Crepitus
- ⌘ Asymmetric ROM

⌘ Normal CT sinus



Headache Disorders

& Muscle tension headache



Band-like pressure around head and down neck

Normal CT sinus

Headache Disorders

- & Muscle tension headache
- & Migraine headache



Throbbing, often unilateral headache associated with:

- Nausea
- Photophobia
- Visual Scotoma
- Dizziness

Normal CT sinus

Headache Disorders

- ⌘ Muscle tension headache
- ⌘ Migraine headache
- ⌘ Cluster headache



Unilateral, periorbital pain with:

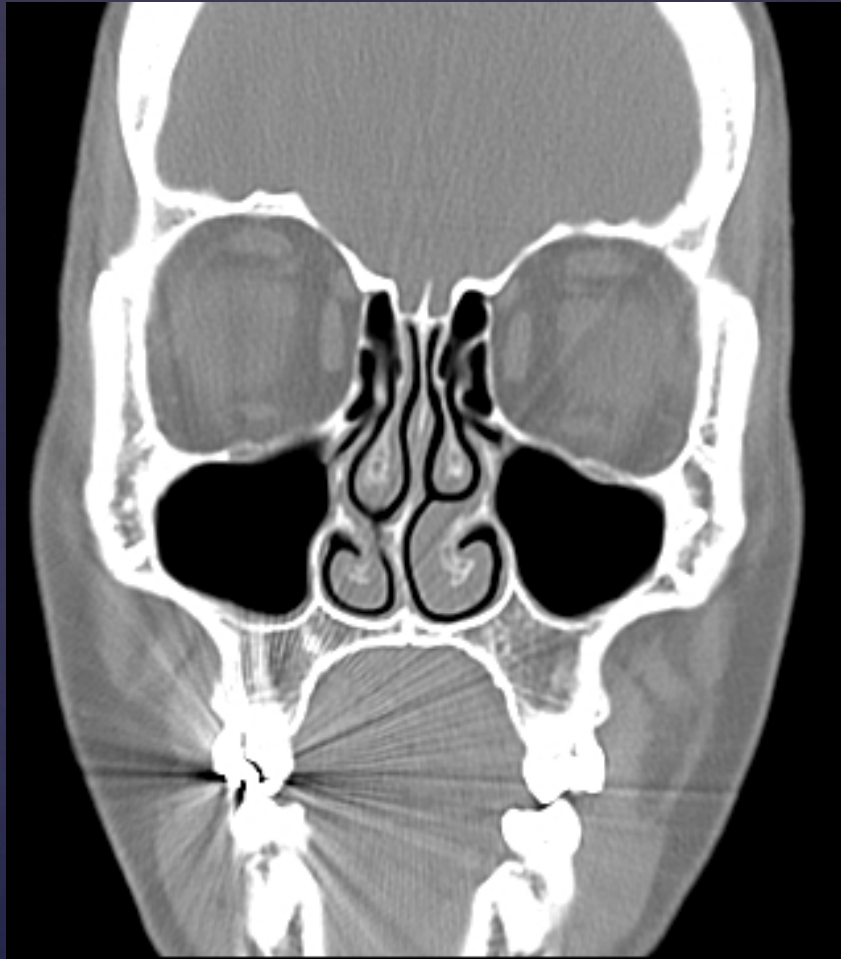
- Lacrimation
- Clear rhinorrhea

Normal CT sinus

What do these conditions
have in common?



A Normal CT Sinus!



Let's Define Sinusitis

{

- Acute Rhinosinusitis (ARS)
 - Viral Rhinosinusitis (VRS)
 - Acute Bacterial Rhinosinusitis (ABRS)
- Recurrent Acute Bacterial Rhinosinusitis
- Chronic Rhinosinusitis (CRS)

Acute Rhinosinusitis (ARS)

↳ ARS can be categorized into two different conditions:

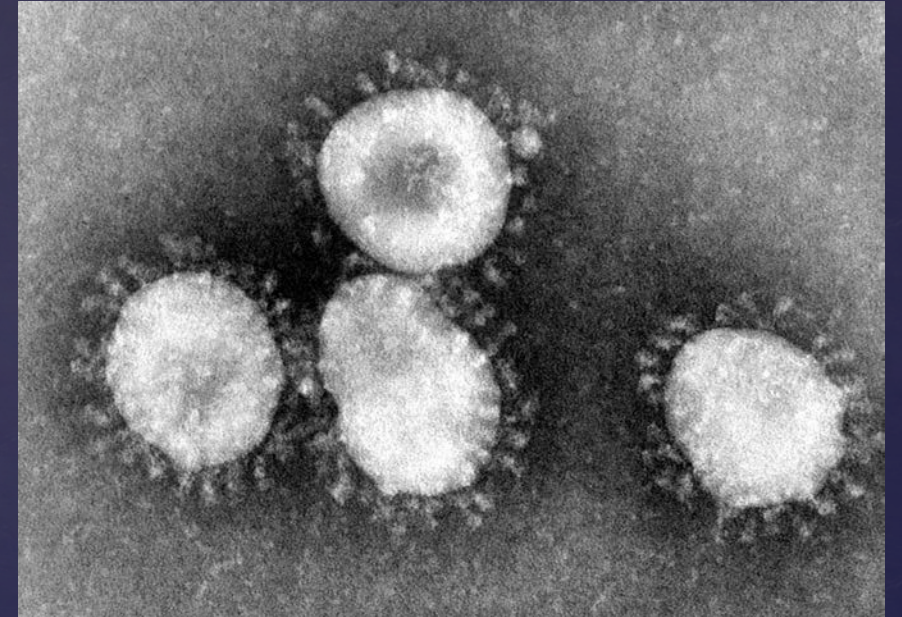
- ↳ Viral rhinosinusitis (VRS)
- ↳ Acute bacterial rhinosinusitis (ABRS)

↳ < 4 weeks of “Sinus Symptoms”:

- ↳ Purulent nasal drainage: Cloudy or colored discharge, different than clear discharge seen in allergic rhinitis
- ↳ Nasal obstruction: congestion, blockage, or observed during physical exam
- ↳ Facial pain and pressure: located in the anterior face or periorbital
- ↳ Loss of smell

Viral Rhinosinusitis (VRS)

- ⌘ ARS caused by a viral infection
 - ⌘ Sinus symptoms present for < 10 days
 - ⌘ Symptoms do not worsen
- ⌘ Viral rhinosinusitis accounts for the majority of cases of sinusitis
- ⌘ Treatment:
 - ⌘ Self-limiting
 - ⌘ Do NOT prescribe antibiotics
 - ⌘ Can treat with adjunctive/supportive therapies (more on this later)



Acute Bacterial Rhinosinusitis (ABRS)

↳ ARS caused by bacterial infection

↳ To make a clinical diagnosis of ABRS:

1. Sinus symptoms present for >10 days

↳ This carries a 61% probability that the patient has ABRS.

↳ Although the color of nasal secretions has no significant predictive value in determining bacterial infections, the presence of localized facial or tooth pain with purulent nasal secretions has an 85% rate of reliability.

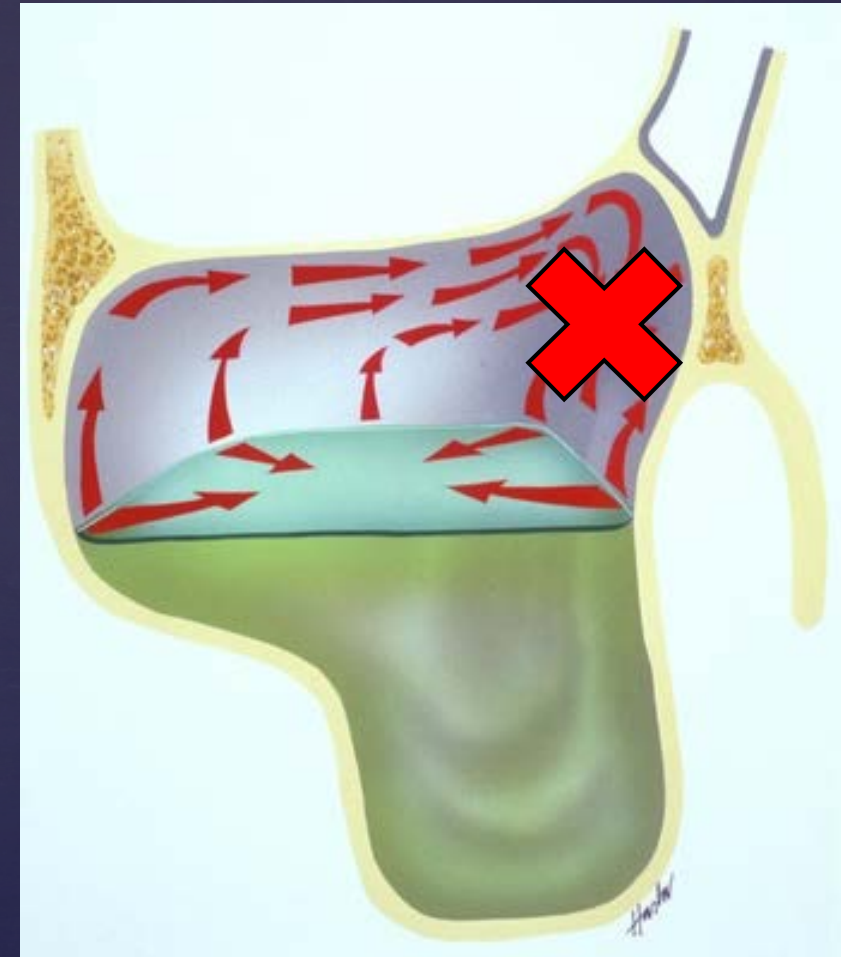
2. Sinus symptoms worsen within 10 days after initially improving from viral URI (double sickening)

Causes of (ABRS)

↳ Preceding viral URI is the leading cause of ABRS

↳ Other factors include:

- ⌘ Nasal obstruction
 - ⌘ (septal deviation, polyps, large turbinates, tumor)
 - ⌘ Mucosal edema
 - ⌘ (URI, allergic rhinitis)
 - ⌘ Iatrogenic
 - ⌘ (NG tube, nasal packing, ventilation)
 - ⌘ Ciliary motility dysfunction
 - ⌘ (smoking, CF)
 - ⌘ Dental infections
-
- ⌘ The factors listed cause stagnation of secretions which lead to bacterial growth



VRS vs. ABRS

- ⌘ ARS (both VRS and ABRS) can be diagnosed clinically.
- ⌘ In the first 3-4 days, one cannot distinguish between viral and bacterial rhinosinusitis.
- ⌘ Note: Imaging/Radiography should NOT be obtained for diagnosis and confirmation of uncomplicated VRS or ABRS.
- ⌘ If complication is suspected, get CT sinus and refer to ENT.

Complications of Sinusitis

Complications of Sinusitis

& Periorbital cellulitis



Complications of Sinusitis

- & Periorbital cellulitis
- & Orbit abscess



Complications of Sinusitis

- & Periorbital cellulitis
- & Proptosis of the eye
- & Persistent high fever (>102)



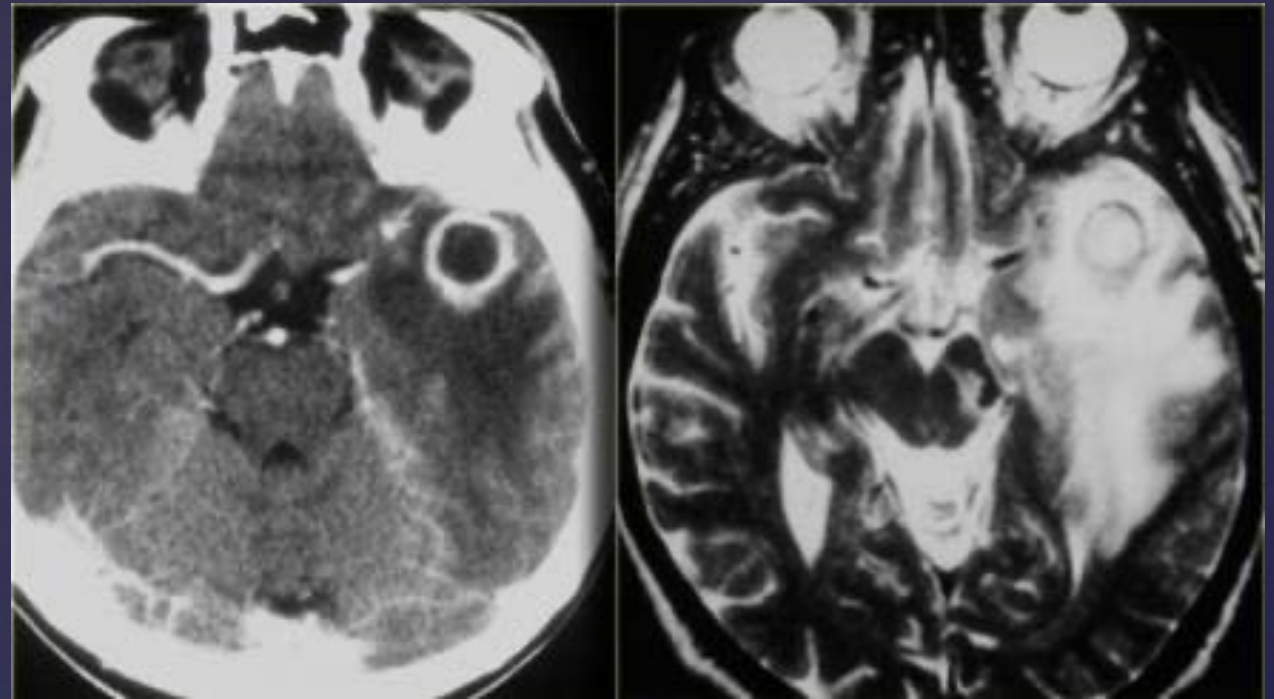
Complications of Sinusitis

- & Periorbital cellulitis
- & Proptosis of the eye
- & Persistent high fever (>102)
- & Vision loss or double vision



Complications of Sinusitis

- ⌘ Periorbital cellulitis
- ⌘ Proptosis of the eye
- ⌘ Persistent high fever (>102)
- ⌘ Vision loss or double vision
- ⌘ Severe headache or altered mental status
 - ⌘ Meningitis
 - ⌘ Intracranial abscess



Treatment of ABRS

{ Antibiotic Therapy
Adjunctive Therapy

Treatment Algorithm of ARS

- ⌘ For ARS <7 days, watchful waiting, especially since many of these cases are actually VRS and are self-limited.
 - ⌘ 47% of patients improved by day 7 on observation.
- ⌘ For ABS >7-10 days, antibiotics can be prescribed if symptoms worsening.
- ⌘ For ABRS >10 days, antibiotics can be prescribed.
- ⌘ For ABRS >10 days, consider watchful waiting with conditional Rx.
- ⌘ Antibiotics can be prescribed in 5-10 day courses for most adults.
 - ⌘ A 5 day course may be just as effective as a longer course and has less side effects.

Pathogens in ABRS

↳ The most common pathogens in bacterial sinusitis are:

↳ *Streptococcus pneumoniae*

↳ *Haemophilus influenzae*

↳ *Moraxella catarrhalis*

↳ *Staphylococcus aureus*

Antibiotic Treatment of ABRS

⌘ First line:

- ⌘ Amoxicillin 875mg po BID x 5-10 days
- ⌘ Amox/clav 875/125mg po BID x 5-10 days

⌘ For Amoxicillin resistant *Strep p.*

- ⌘ Amoxicillin (high dose) 1g TID-QID, 5-10 days
- ⌘ Amox/clav XR 2000mg/125mg BID x 10 days

⌘ 2nd Line

- ⌘ Doxycycline 100mg BID x 5-10 days
- ⌘ Levofloxacin 750mg QD x 10-14 days
- ⌘ Moxifloxacin 400mg QD x 10-14 days

Empiric Therapy?

⌘ Because of the high rates of resistant *Strep pneumo* and *H flu*, the following antibiotics are NOT recommended for empiric therapy:

- ⌘ Macrolides (azithromycin, clarithromycin)
- ⌘ SMX/TMP
- ⌘ 2nd and 3rd generation cephalosporins
- ⌘ Clindamycin

Adjunctive Therapy

& Recommended within first 7 days and
with antibiotic therapy:

Adjunctive Therapy

⌘ Recommended within first 7 days and with antibiotic therapy:

- ⌘ Analgesics (APAP or NSAIDs)
 - ⌘ Relieves pain and fever



Adjunctive Therapy

⌘ Recommended within first 7 days and with antibiotic therapy:

⌘ Analgesics (APAP or NSAIDs)

⌘ Relieves pain and fever

⌘ Intranasal steroids

⌘ Reduces mucosal inflammation, facilitates drainage



Adjunctive Therapy

⌘ Recommended within first 7 days and with antibiotic therapy:

- ⌘ Analgesics (APAP or NSAIDs)
 - ⌘ Relieves pain and fever

- ⌘ Intranasal steroids
 - ⌘ Reduces mucosal inflammation, facilitates drainage

- ⌘ Nasal saline lavage
 - ⌘ Improves mucociliary clearance
 - ⌘ Use distilled, boiled or filtered water



Adjunctive Therapy

Not recommended (due to ineffectiveness):

- ⌘ Decongestants (pseudoephedrine, phenylephrine)
- ⌘ Antihistamines
- ⌘ Guaifenesin
- ⌘ Narcotics

Recurrent Acute Bacterial Rhinosinusitis

{ 4 episodes or more in 1 year of ABRS with complete resolution
and asymptomatic in between

Treat each individual episode per the previous guidelines

Put the patient on nasal steroids and BID nasal saline lavage

Refer to ENT after 4 episodes

Chronic Rhinosinusitis

{ >12 weeks of persistent ABRS

Chronic Rhinosinusitis

⌘ Chronic rhinosinusitis (CRS):

⌘ Meets criteria for ABRS >12 weeks

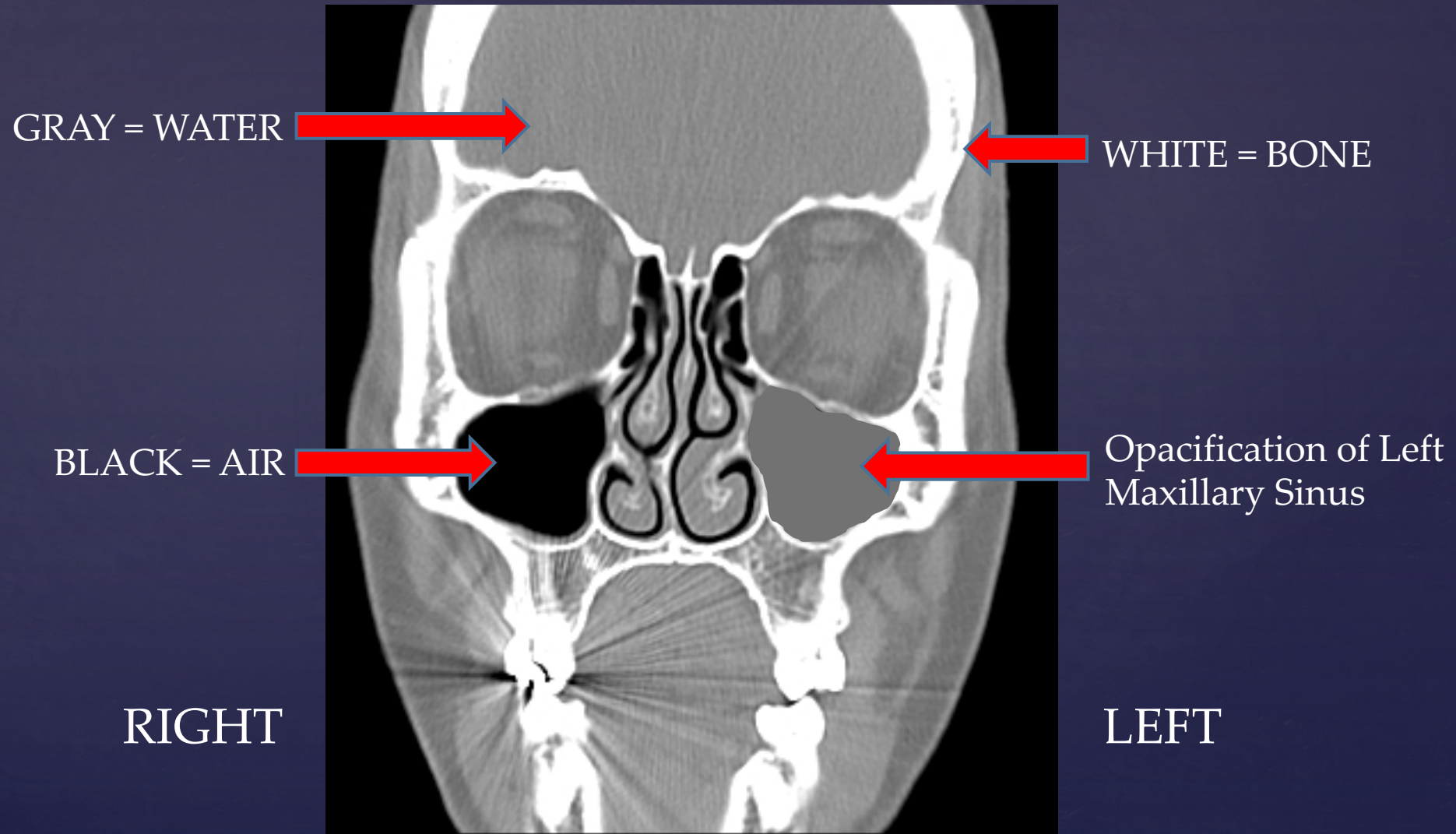
AND

⌘ Inflammation seen on physical exam by documenting one:

- ⌘ Purulent mucopus and edema in the middle meatus
- ⌘ Nasal polyposis
- ⌘ Abnormalities seen on CT sinus following treatment

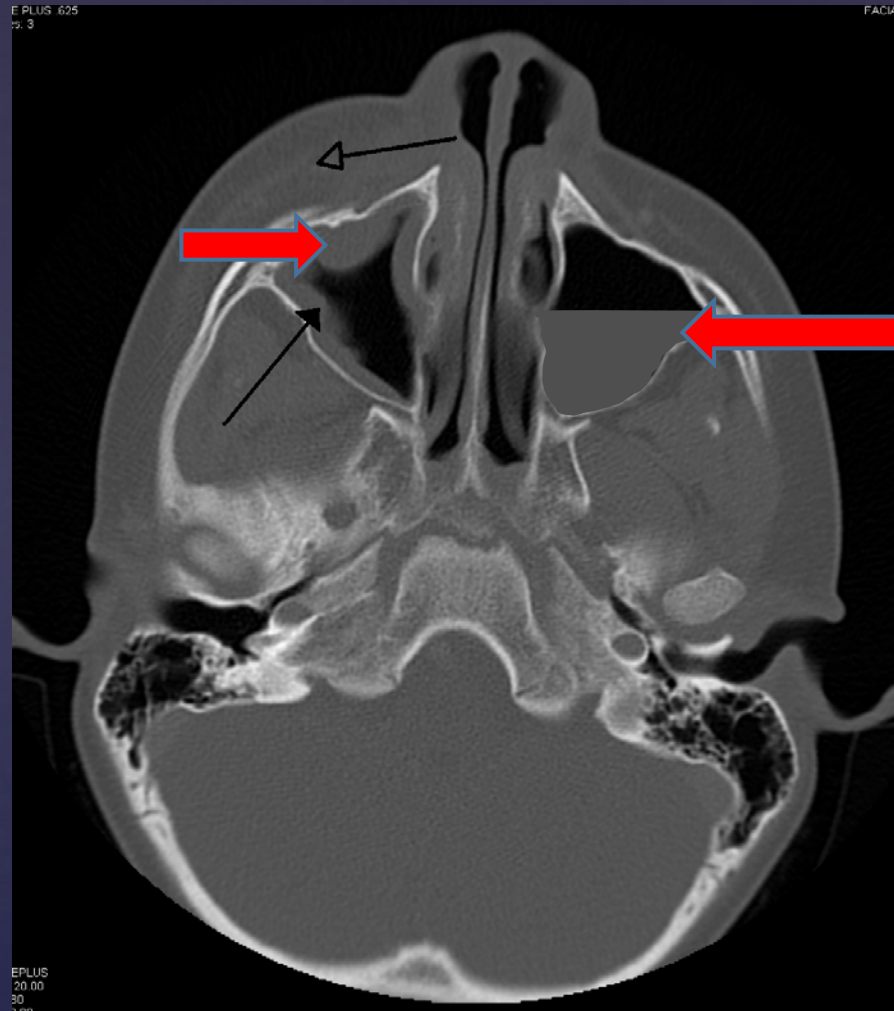


How to Read a Sinus CT Scan



Abnormal CT Sinus findings:

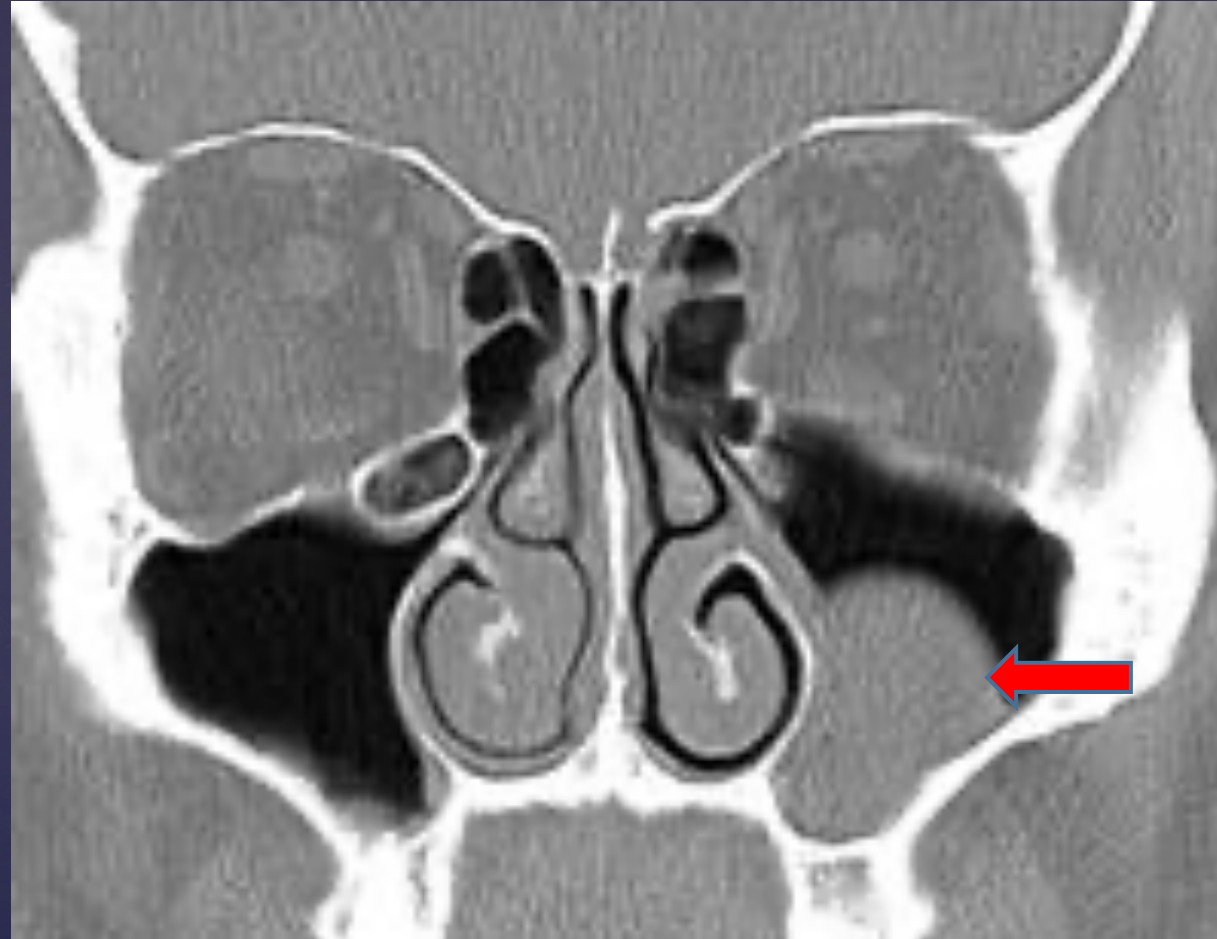
Abnormal CT Sinus findings:



Air-Fluid Line
Acute left maxillary sinusitis

Mucosal Thickening

Abnormal CT Sinus findings:



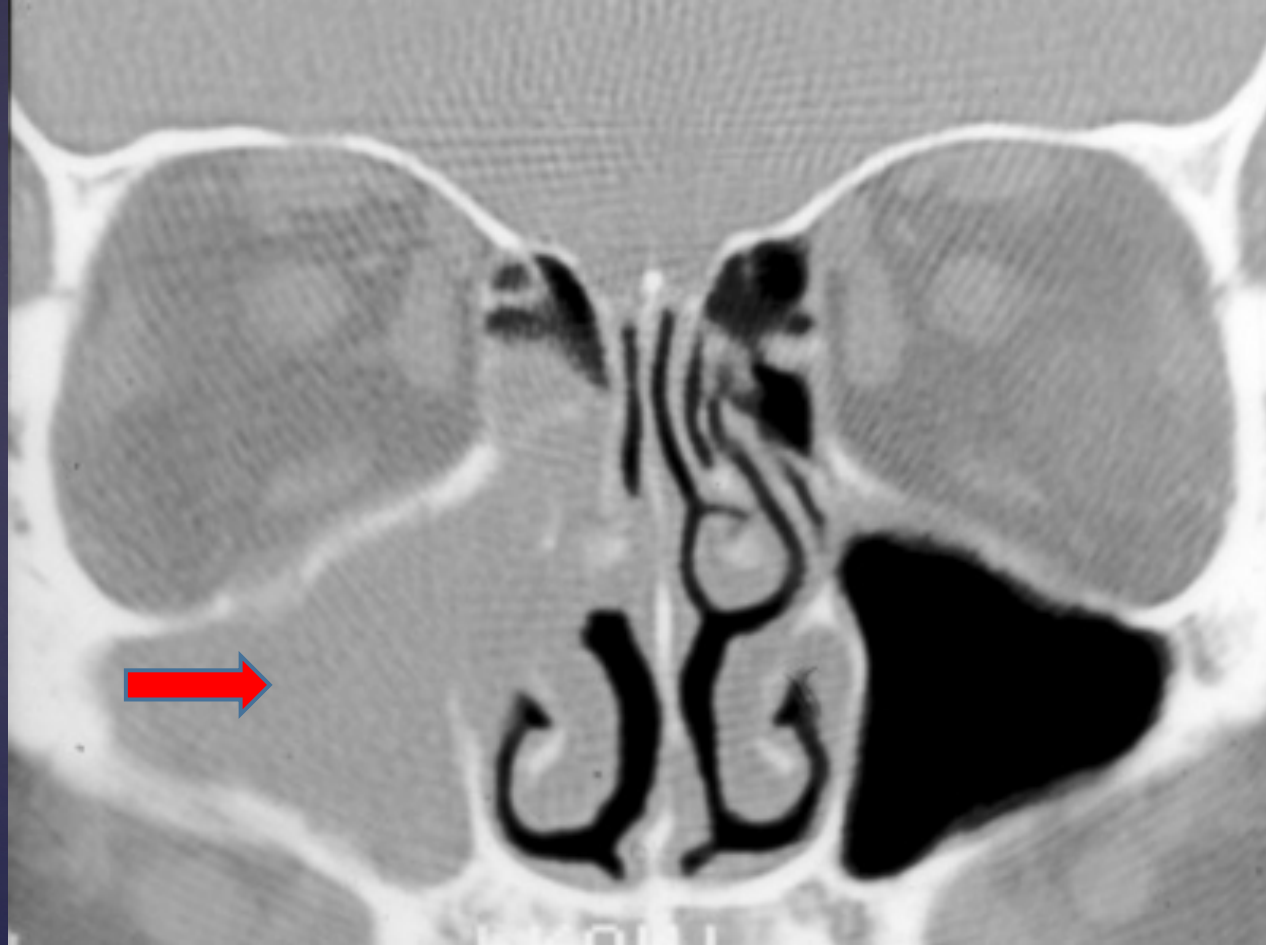
Mucus Retention Cyst

Abnormal CT Sinus findings:



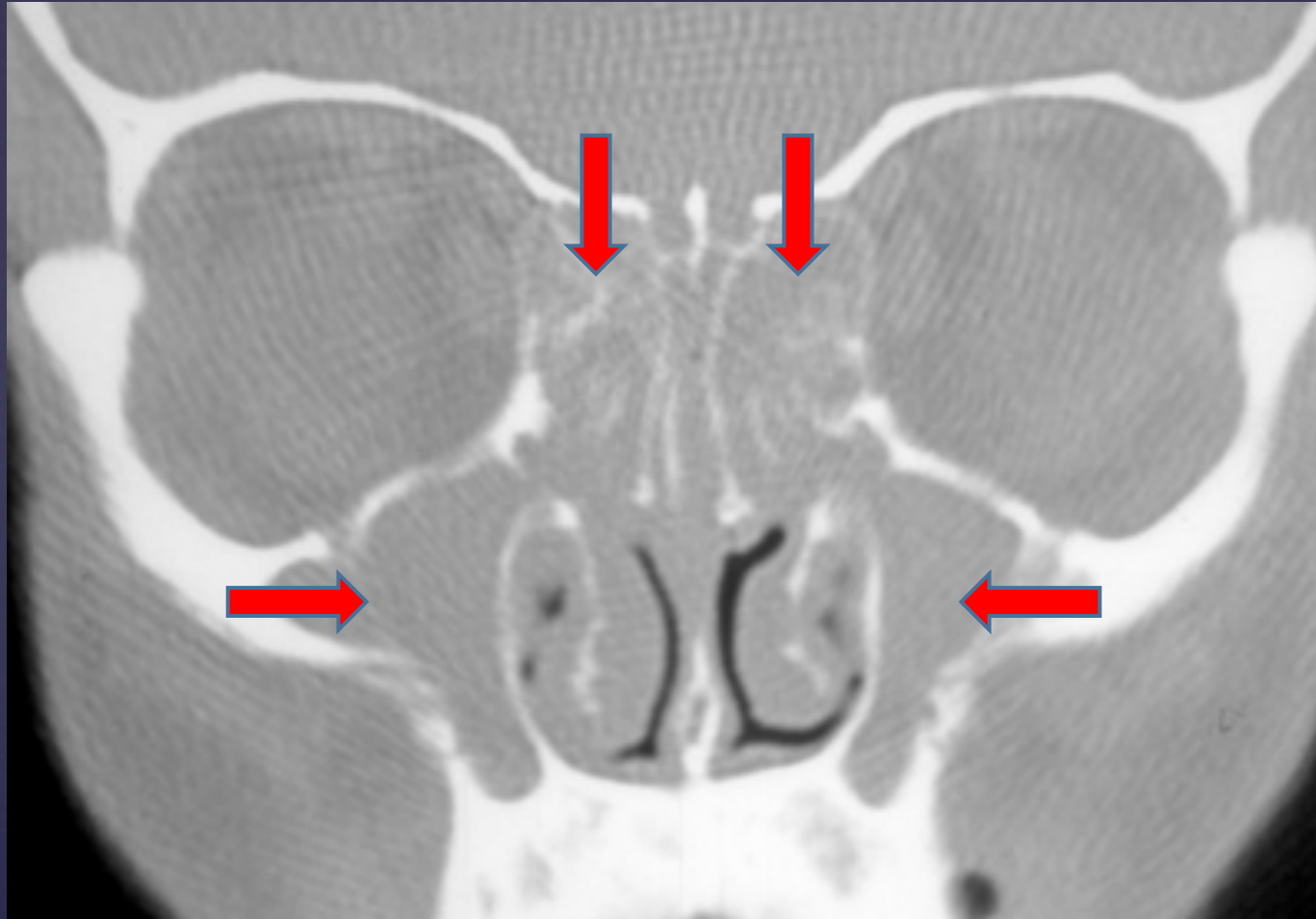
Right Maxillary Sinusitis
Left Maxillary Mucosal Thickening
Bilateral Ethmoid Sinusitis

Abnormal CT Sinus findings:



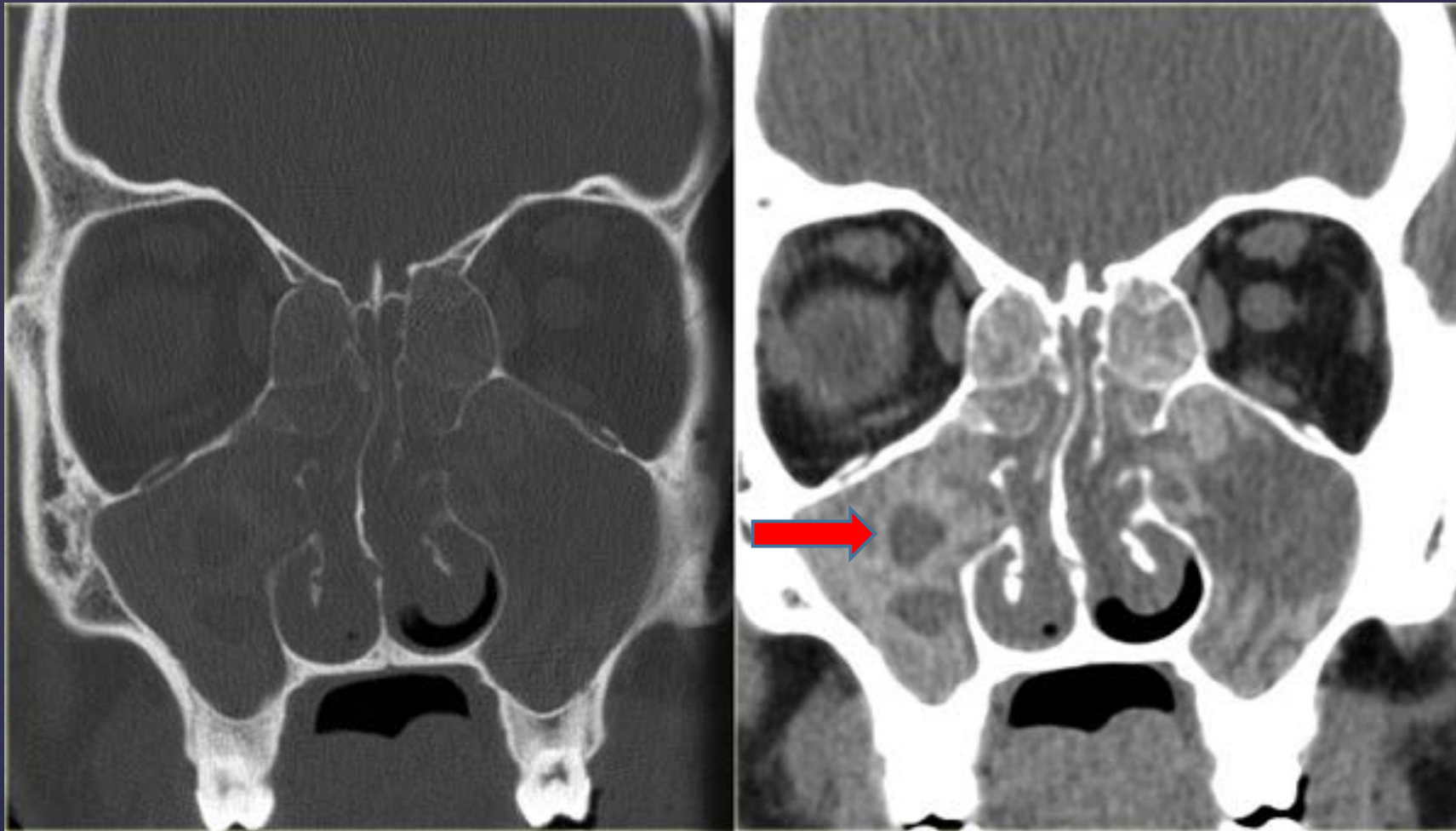
Unilateral Maxillary Sinusitis

Abnormal CT Sinus findings:



Pansinusitis

Abnormal CT Sinus findings:



Allergic Fungal Sinusitis



To Refer or Not to Refer...

When NOT to refer:

⌘ Conditions which are not sinusitis

- ⌘ TMJD
- ⌘ Migraines
- ⌘ Trigeminal Neuralgia
- ⌘ Viral URI
- ⌘ Allergic rhinitis

⌘ Uncomplicated or untreated Acute Rhinosinusitis

- ⌘ Allow 4-6 weeks for recovery after treatment

⌘ Chronic sinusitis patients should be maximally treated prior to referral

What the PCP can do with CRS

- ⌘ Follow the antibiotic algorithm and treat with at least 3 weeks of oral antibiotics.
- ⌘ Also treat with 10-12 days of oral prednisone.
- ⌘ Ensure allergic rhinitis treatments are being used:
 - ⌘ Nasal steroids
 - ⌘ 2nd generation antihistamines
 - ⌘ Topical antihistamine spray
 - ⌘ Nasal Saline lavage
- ⌘ Get a POST TREATMENT non-contrasted CT sinus.
- ⌘ Refer to ENT if there is sinusitis on the CT despite the above interventions.

Indications for referral to ENT

- ⌘ You can refer for any sinus reason! Otolaryngology is happy to evaluate any of your patients if you need guidance.
- ⌘ Surgical evaluation for anatomic defect/obstruction
- ⌘ To get a sinus culture
- ⌘ Recurrent acute bacterial sinusitis (4 episodes or more per year)
- ⌘ Chronic rhinosinusitis with abnormal CT
- ⌘ Fungal sinusitis on CT scan
- ⌘ Severe sinusitis in setting of uncontrolled diabetes (Urgent!)
- ⌘ Patient has sinusitis complication (periorbital cellulitis, etc.)
- ⌘ Patient has cystic fibrosis with sinus disease
- ⌘ Resistant or atypical bacteria which cannot be treated with oral antibiotics

What the ENT can do with CRS

- ⌘ Perform nasal endoscopy
 - ⌘ Confirm sinusitis
 - ⌘ Evaluate for nasal obstruction
 - ⌘ Culture the mucopurulent secretions for directed antibiotic therapy
- ⌘ Add surfactant disrupter to saline
 - ⌘ Baby shampoo
- ⌘ Add glucocorticoid to saline
 - ⌘ Budesonide 0.5mg/2mL
- ⌘ Add topical antibiotic to saline lavage
- ⌘ Sinus Surgery
 - ⌘ Functional Endoscopic Sinus Surgery (FESS)

AAOHNS Guidelines

- ⌘ Published by the American Academy of Otolaryngology, Head & Neck Surgery (AAOHNS) in 2015.
- ⌘ These guidelines are evidence-based.
- ⌘ The target for these guidelines is 18+ years old.
- ⌘ I did not list all the guidelines below, just the ones pertinent to this lecture.

Classification of Evidence-Based Statements

↳ Statements reflect both

- ⌘ Quality of evidence
- ⌘ Balance of benefit versus risk

↳ Strength

⌘ Strong Recommendation

- ⌘ Benefit clearly exceeds risk and there is a high degree of evidence

⌘ Recommendation

- ⌘ Benefits clearly exceed the risk, but evidence is not as high

⌘ Option

- ⌘ Quality of evidence is suspect or studies show equivocal results

Pop Quiz!

Your patient has had sinus symptoms (facial pain, pressure, discharge) for 3 days and insists that she has a sinus infection and requires antibiotics. Is antibiotic treatment appropriate?

A. Yes

B. No

AAOHNS Position Statement 1a

Clinicians should distinguish between ABRS and VRS

Strength: Strong recommendation

Remember: You cannot distinguish between VRS and ABRS in the first 3-4 days

Pop Quiz!

Your patient has had sinus symptoms (facial pain, pressure, discharge) for 10 days and insists that he has a sinus infection and requires antibiotics. Which of the following should you do first?

- A. Obtain Sinus Radiograph
- B. Obtain CT sinus without contrast
- C. Get a sinus culture
- D. None of the above

AAOHNS Position Statement 1b

Clinicians should NOT obtain radiology studies for patients with ARS unless a complication or alternative diagnosis is suspected

Strength: Recommended

Remember: Acute bacterial sinusitis can be diagnosed clinically:

- 1. Sinus symptoms present >10 days**
- 2. Sinus symptoms after viral URI (double sickening)**

Pop Quiz!

Your patient has had sinus symptoms (facial pain, pressure, discharge) for 3 days and after discussing with her that antibiotics are not yet indicated, you recommend which of the following? (Pick more than 1)

A. Ibuprofen

B. Saline lavage

C. Sudafed

D. Guaifenesin

E. Levofloxacin

F. Fluticasone nasal spray

AAOHNS Position Statement 2 & 3

Clinicians may recommend analgesics, topical nasal steroids, and/or saline irrigation for VRS and ABRS

Strength: Optional

Remember: Evidence Based Studies give the option to use:

NSAIDs, Saline, nasal steroids

Evidence does NOT support the use of:

Guaifenesin, Pseudoephedrine, Antihistamines, Opioids

Pop Quiz!

Your patient has had sinus symptoms (facial pain, pressure, discharge) for 10 days and you have diagnosed him with acute bacterial rhinosinusitis. The patient doesn't like the idea of taking antibiotics. Is it appropriate to hold off on the antibiotic and only treat with adjunctive therapies?

A. Yes

B. No

AAOHNS Position Statement 4

Clinicians may choose to treat ABRS initially with either watchful waiting or antibiotics.

Only choose watchful waiting if you can be assured that there is adequate f/u and the patient can be given an antibiotic if no improvement after 7 days.

Strength: Recommended

Pop Quiz!

Assuming the patient has no allergies, what antibiotic should you choose for your initial treatment of ABRS?

- A. Cefdinir
- B. Cephalexin
- C. Amoxicillin
- D. Azithromycin
- E. Levofloxacin
- F. Doxycycline

AAOHNS Position Statement 5

If the clinician chooses to treat ABRS with antibiotics, it should be with either amoxicillin or amoxicillin with clavulanate for 5-10 days

Strength: Recommended

Remember:

- 1. Amoxicillin or amox/clav is first line**
- 2. Doxycycline, Levofloxacin, Moxifloxacin is 2nd line**
- 3. Don't prescribe other antibiotics without a culture**

Pop Quiz!

Your patient was diagnosed with acute bacterial sinusitis and you prescribed amoxicillin with clavulanate, twice a day for 7 days. After three days, the patient calls back stating that she is not any better and has worsened facial pain and continued green post-nasal drainage. What should you do next?

- A. Change the patient's prescription to doxycycline
- B. Obtain CT sinus without contrast
- C. Get a sinus culture and treat with culture-directed antibiotics
- D. Give the patient ceftriaxone IM and start on oral clindamycin

AAOHNS Position Statement 6

If the patient worsens or fails to improve by the 7th day after diagnosis, the clinician should confirm the diagnosis of ABRS, and then either start antibiotic therapy (if watching) or change antibiotics (if on antibiotic already).

Strength: Recommended

Pop Quiz!

Your patient has had sinusitis for the past 4 months and has been on prednisone as well as multiple different rounds of antibiotics including, amoxicillin with clavulanate, doxycycline, and moxifloxacin. What else can you do for this patient?

ANSWER: The patient has likely chronic sinusitis. Management includes:

1. Confirm the diagnosis of sinusitis with post-treatment CT sinus
2. Ensure the patient is treated with a maximal allergy regimen including nasal steroids, antihistamines, topical antihistamines and saline lavage
3. Refer to ENT for further management

AAOHNS Position Statement 10

The clinician should confirm the presence or absence of nasal polyposis in CRS

Strength: Recommended

AAOHNS Position Statement 11

Clinicians should recommend nasal saline and/or intranasal steroids for CRS

Strength: Recommended

Conclusion

- ⌘ Antibiotic resistance is a very real problem. Misdiagnosed sinusitis is a leading cause of inappropriately prescribed antibiotics. Make a good diagnosis and pick the correct treatment.
- ⌘ Prior to referral to ENT for chronic sinusitis
 - ⌘ Maximize allergy medications.
 - ⌘ Treat with antibiotics x 3-4 weeks and prednisone 12 days (if appropriate!).
 - ⌘ Get a post-treatment CT sinus.
- ⌘ If the sinus CT is normal, the patient does not likely have chronic sinusitis and alternative diagnoses should be considered.

Clinical References

- ⌘ Rosenfeld R, et al. "Clinical Practice Guidelines (Update): Adult Sinusitis Executive Summary. Otolaryngology- Head and Neck Surgery 2015, Vol 152(4) 598-609.
- ⌘ Aring A, Chan M. "Current Concepts in Adult Acute Rhinosinusitis." American Academy of Family Physicians 2016, Vol 94(2) 97-105.
- ⌘ Hwang P, Patel Z. "Acute Sinusitis and rhinosinusitis in adults: Clinical manifestations and diagnosis." UpToDate 2017.
- ⌘ Hamilos, Daniel. "Chronic rhinosinusitis: Management." UpToDate 2017.
- ⌘ Llor, Carl and Bjerrum, Lars. "Antimicrobial Resistance: Risk Associated with Antibiotic Overuse and Initiatives to Reduce the Problem." Therapeutic Advances in Drug Safety 2014, Dec; 5(6) 229-241.
- ⌘ <https://www.who.int/news-room/feature-stories/ten-threats-to-global-health-in-2019>
- ⌘ https://www.uptodate.com/contents/pharmacotherapy-of-allergic-rhinitis?search=allergic%20rhinitis&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1

Photo References

- ⌘ https://en.wikipedia.org/wiki/Rhinorrhoea#/media/File:Misc_pollen.jpg
- ⌘ <https://commons.wikimedia.org/w/index.php?curid=822112>
- ⌘ Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". WikiJournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=27924396>
- ⌘ By James Heilman, MD - Own work, CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=16263221>
- ⌘ Gray's Anatomy, Plate 309, Public Domain, <https://commons.wikimedia.org/w/index.php?curid=85394>
- ⌘ By BruceBlaus - Own work, CC BY-SA 4.0, <https://commons.wikimedia.org/w/index.php?curid=44968538>
- ⌘ "Medical gallery of Blausen Medical 2014". WikiJournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own work, CC BY 3.0, <https://commons.wikimedia.org/w/index.php?curid=27924377>

Photo References

- ⌘ CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=422289>
- ⌘ <https://commons.wikimedia.org/w/index.php?curid=29540596>
- ⌘ <https://www.freepik.com/free-photos-vectors/people>">People
photo created by freepik - www.freepik.com
- ⌘ <https://www.stockvault.net/photo/125957/pills#>
- ⌘ <https://www.stockvault.net/photo/96876/pills#>
- ⌘ [https://www.stockvault.net/photo/171144/apple-and-orange-
fruit-on-brown-wood#](https://www.stockvault.net/photo/171144/apple-and-orange-fruit-on-brown-wood#)
- ⌘ [https://www.stockvault.net/photo/226778/right-wrong-
buttons-shows-correct-or-incorrect#](https://www.stockvault.net/photo/226778/right-wrong-buttons-shows-correct-or-incorrect#)
- ⌘ [https://radiologyassistant.nl/head-neck/paranasal-sinuses-
mri](https://radiologyassistant.nl/head-neck/paranasal-sinuses-mri)
- ⌘ [http://otitismedia.hawkelibrary.com/normal/Dr_M_Hawke_0
01](http://otitismedia.hawkelibrary.com/normal/Dr_M_Hawke_001)

Photo References

- ⌘ http://rhinitis.hawkelibrary.com/album14/138_G
- ⌘ <http://rhinitis.hawkelibrary.com/album14>
- ⌘ http://rhinitis.hawkelibrary.com/album12/150_G
- ⌘ http://rhinitis.hawkelibrary.com/album14/137_G
- ⌘ http://nosephotographs.hawkelibrary.com/albums.php?set_albumListPage=16
- ⌘ <https://pixabay.com/illustrations/head-pain-stress-man-ache-elderly-3390247/>
- ⌘ http://ctscans.hawkelibrary.com/album07/Air_Fluid_Level_1
- ⌘ [https://es.wikipedia.org/wiki/Archivo:Celulitis_Periorbitaria_\(Preseptal\).JPG](https://es.wikipedia.org/wiki/Archivo:Celulitis_Periorbitaria_(Preseptal).JPG)

Photo References

- ⌘ https://commons.wikimedia.org/wiki/File:Celulitis_ocular_izq.JPG
- ⌘ <https://www.flickr.com/photos/niaid/46057881342>
- ⌘ <https://www.wikihow.com/Flush-Sinuses>
- ⌘ http://rhinitis.hawkelibrary.com/album14/135_G
- ⌘ https://en.wikipedia.org/wiki/Yorick#/media/File:Young_Man_with_a_Skull,_Frans_Hals,_National_Gallery,_London.jpg
- ⌘ <https://commons.wikimedia.org/wiki/File:Pharyngitis.jpg>
- ⌘ <https://pixabay.com/illustrations/fever-sick-cold-flu-thermometer-3590869/>
- ⌘ https://en.wikipedia.org/wiki/File:Misc_pollen.jpg

Thank You!

Contact: joshua.f.smith@duke.edu