Introduction
Sinus disease is a very common cause of illness in our country. Sinusitis is one of the most common health complaints leading to a physician office visit in the United States1. The nasal mucosa is continuous with that of the paranasal sinuses, so any inflammatory condition of the nasal mucosa usually also involve the paranasal sinuses as well. The term "Rhinosinusitis" is more appropriate than "Sinusitis" because the symptoms of sinusitis and rhinitis overlap to a large extent and both respond similarly to medical and surgical therapy. Similarly the upper respiratory tract (nose and paranasal sinuses) and lower respiratory tract (tracheobronchial tree and alveoli) are closely related from anatomical, physiological and pathological points of view. Chest disease is therefore frequently associated with rhinosinusitis and treatment of one frequently leads to significant improvement of the symptoms of the other.

Children less than 15 years and adults between 25 and 64 years of age are most frequently affected. Over 31 million people in the United States, nearly one in eight, suffer at some time from sinusitis7. General practitioner, medicine specialists, paediatricians, allergists and otolaryngologists see large number of patients with symptoms of facial pain, pressure, nasal drainage; nasal obstruction, and "sinus". In addition to the discomfort from the underlying disease, the cost of medications, and the lack of productivity during acute symptoms, those who develop chronic sinus disease experience health-related quality-of-life decrements in the domains of general health perception, validity, and social functioning comparable to serious diseases, such as chronic obstructive pulmonary disease and angina pectoris3,4,5.

Symptoms
Most common symptoms of rhinosinusitis include:
1. Nasal obstruction / blockage.
2. Mucoid or purulent rhinorrhoea, which maybe anterior or if posterior, often referred to as "postnasal drip".
3. Facial pain/ pressure.
5. Headache.
6. Hyposmia/anosmia.
7. Fever (acute rhinosinusitis only).

In addition patients may also complain of fatigue, low grade fever, (in other than acute rhinosinusitis), halitosis, dental pain, epistaxis, cough, ear pain-pressure/fullness.

Causes
Rhinosinusitis develops from an interaction of environmental and host factors:
1. Most common cause in all age groups is a viral upper respiratory tract infection, with oedema or inflammation of the nasal lining and the production of thick mucous that obstruct the paranasal sinuses and allow a secondary bacterial overgrowth (Figure 1).
2. Next in frequency is atopy (mucosal swelling that impairs sinuosteal drainage).
3. Third commonest cause is anatomical impingement on sinus drainage by various factors e.g. septal deviation, concha bullosa,
paradoxical middle turbinate, agger-nasi pneumatisation polyps etc.

**Less frequent causes include**

4. Mucociliary clearance abnormality-
   a. Primary: less common e.g. Kartagener’s syndrome, Young” syndrome.
   b. Secondary: more common e.g. bacterial and viral infection: of upper respiratory tract.
5. Immunity deficiency-
   a. Primary: Panhypogammaglobinaemia-
6. Granulomatous condition-
   a. Multisystem granulomatous disease: Wegener’s granulomatosis, Sarcoïdosis, Churg-Strauss syndrome, polymorphic reticulosis.
   b. Certain infective agents: Actinomycosis, invasive aspergillosis, blastomycosis, histoplasmosis, leprosy, rhinoscleroma, tuberculosis, syphilis.
7. Autonomic imbalance.
9. Latrogenic-
   a. Rhinitis medicamentosa: patients using topical nasal decongestant for Prolonged period of time.
   b. Aspirin intolerance.
   c. Drugs acting on sympathetic nervous system: guanethidine, methyldopa, reserpine, isoprenaline, ergot alkaloids used for migraine.
   d. Anticholinesterases: Neostigmine.

**Patient evaluation**

All patients presenting with nasal and sinus problem should have a thorough evaluation:
1. Proper history taking and further investigations and referral, if necessary to exclude or to establish-
   a. Systemic conditions,
   b. Pathology around the sinuses e.g. Ophthalmological or Neurological, which might present with symptoms similar to that of sinusitis, like headache, pain around the orbit.
2. Thorough nasal and general head and neck examination:
   *Nasal Endoscopy* is very important in this respect. Both anterior and posterior rhinoscopy gives us only limited view of the nasal cavity and post-nasal space. They give little (if any) view of the areas around middle meati & turbinates and usually no view at all to any area above middle meatus. In the majority of cases of chronic sinus diseases, the pathology usually lies in the middle meatus in the region of the "Osteomeatal Complex" (functional unit that comprises maxillary sinus ostia, anterior ethmoid cells and their ostia, ethmoid infundibulum, hiatus semilunaris, and middle meatus—where frontal and maxillary sinuses, anterior ethmoid and bulla cells open and which lies in middle meatus) (*figure: 2 and 3*).

![Fig. 2: Osteomeatal complex is functional unit that comprises, a. maxillary sinus ostia, b. ant ethmoid cells and c. their ostia, d. ethmoid infundibulum, e. Hiatus semilunaris and, fi middle meatus.ka.](image1)

![Fig. 3: Endoscopic view showing Polyp in the middle meatus](image2)

**Investigations**

A. Radiology
1. *CT Sinuses:*
   *Mainly coronal, thin sections (5 mm)*
contiguous scans. Even thinner sections (3 mm) may be obtained anteriorly in the region of Osteomeatal complex.

- Axial cuts are useful to identify Onodi cells and their relationship to the optic nerve. CT scan gives details of the pathology in the paranasal sinuses. It also shows in details the anatomy of the sinuses. The sinus anatomies vary remarkably from one nose to the other and even in the same nose from side to side. CT sinus is very important for the following purposes:
  a. To have an idea of anatomical details of the sinuses.
  b. To see whether there is any anatomical variant in those areas.
  c. To see any pathology in minute details e.g. subtle areas of ostial obstruction, micropolyps, or mucosal thickening from infection or allergies (figure: 4).

Fig. 4 : CT sinus of a patient with Caldwell-lue procedure and inf. meatal antrostomy -Inspite of that fact patient still has polyp in the middle meatus.

2. X-ray Sinus: Usually does not give sufficient information. In one series the correlation between plain X-ray and CT-scan of sinuses is as follows6:
   a. Maxillary sinus: 70% correlation
   b. Frontal sinus : 75%
   c. Sphenoid sinus: 80%
   d. Ethmoid sinus : 60%

   The correlation of interpretation of plain x-ray sinus between the radiologists and the surgeons and even between the radiologists themselves is very poor indeed.

3. MRI : Its poor delineation of the bony anatomy and higher cost as compared to CT, make MR imaging inappropriate in circumstances other than suspected cranial spread of infection.

B. Laboratory Tests
These investigations play a secondary role and, are usually done only if from the history and examinations, there is sufficient indications for performing these tests-

- Bacterial and fungal culture -in infection.
- In vitro IgE level, PRIEST & RAST tests, and intradermal skin test- in allergy.
- Nasal cytology.
- Mucociliary clearance and Ciliary beat frequency test.
- Mucosal biopsy.
- Blood tests : TC, DC, Hb%, ESR, urea & electrolytes, IFT, serum immunoglobulins.
- Rhinomanometry.

Microbiology

Acute rhinosinusitis :
- Viruses upto 15% -rhinovirus, influenza and parainfluenza virus5
- Strep.pneumoniae - 31% (range,20% to 35%)
- Haem. Influenzae -21% (range, 6% to 26%)
- Anaerobes -6% (range, 0 to 8%)
- Staph. Aureus -4% (range, 0 to 8%)
- Strep.pyogenes -2% (range, 1% to 3%)
- Moraxella catarrhalis -2% (range, 25 to 10%)

Chr. Rhinosinusitis :
- Coagulase (-)ve Staph.species -51% (range, 24% to 80%) • S.aureus -20% (range, 9% to 33%)
- Anaerobes -3% (range, 0 to 82%)
- S.pneumoniae -4% (range, 0 to 7%)
- Multiple organisms are much more common in chronic than in acute conditions and on average in 16% cases7
- Allergic fungal sinusitis -2% to 7% of chronic cases8,9

Treatment

Systemic antibiotic: Broad spectrum.
A. In acute rhinosinusitis :
  1. More than two thirds of infections are secondary to S.pneumo- niae or H.influenzae, hence antibiotics should be selected for activity against these organisms.
  2. Penicillin resistance varies from 2% to 30%.
  3. Penicillin, cephalaxin, erythromycin and tetracycline do not usually cover all the major organisms involved and in some community
amoxicillin effectiveness is less than 70%. 4. Amoxicillin is still the favoured initial antibiotic of choice. Others use amoxicillin-clavulanate, clarithromycin, cotrimoxazole, cefuroxime, ciprofloxacin and levoflaxacillin. 5. Duration of treatment should be at least 10 to 14 days. 6. If initial regime fails then antral lavage or better, endoscopically guided culture and sensitivity should be undertaken, which should include both aerobic and anaerobic culture.

B. In chronic rhinosinusitis:
1. Antibiotic must cover S.aureus and beta-lactamase producing organisms, which is more common in chronic diseases.
2. The need for anaerobic cover is also more important than acute cases.
3. Duration of treatment should be at least 4 weeks.
4. In allergic fungal sinusitis: Fluconazole or itraconazole for 1 to 3 months after surgery is usually sufficient.
5. In immunocompromised patients or those who acquired infections in a hospital setting: culture and sensitivity at the time of initial therapy, rather than waiting for 5 to 7 days to see response to therapy, is mandatory.

Topical nasal steroids: are commonly prescribed to diminish nasal oedema particularly in patients with allergy. They fail to penetrate thick secretions well, so are not effective in acute rhinosinusitis and in chronic rhinosinusitis is less effective than in the uninfected patients. They are most effective when given in head downward and forward position (Mecca position) and must be prescribed for 4 to 6 weeks to have the maximum effect.

Topical decongestant: xylometazoline or oxymetazoline, can- not be used for more than couple of days (may be as less as 3 days) without risking rebound congestion and usually only given during the first few days of treatment. Systemic decongestant: e.g. pseudephedrine, phenylpropanolamine are less effective than topical decongestant but can be used indefinitely.

Antihistamines: mainly used for patients with allergic rhinitis. Even the newer Jonsestive antihistamines have improved patient tolerance, the anticholinergic activity of antihistamines increases the viscosity of nasal and sinus secretions and may lead to impair drainage.

Topical antihistamines: Topical ipratropium is helpful in patients with non-specific watery rhinorrhea and does not have the general effects of systemic antihistamines.

Systemic corticosteroids: for short term use only in patients with chronic rhinosinusitis who are also atopic or who have nasal polyps. Beware of its indiscretion use particularly in ignorant and lay patients.

Hyposensitisation: is more effective in children than adults, and usually of proven value in the treatment of single allergen (pollen or house dust mite) disease. It carries considerable risk of anaphylaxis and must be performed in centres well equipped to fight this type of emergency situations.

Indications for surgery
• Massive nasal polyposis
• Acute complicated rhinosinusitis
  Subperiosteal or orbital abscess
  Brain abscess or meningitis
  Putt’s puffy tumour
• Chronic rhinosinusitis refractory to full medical therapy
• Invasive allergic fungal rhinosinusitis
• Mucocoel or mucopyocoel
• Suspected tumour causing nasal or sinus symptoms
• CSF rhinorrhoea

Traditional open surgical approaches has been shifted dramatically favour of the use of endoscopic sinus surgery over the recent year.
Functional endoscopic sinus surgery (fess)
The technique emphasizes accurate evaluation and conservative surgery designed to restore normal drainage pathways of the paranasal sinuses for the treatment of chronic sinus diseases. The current interest in endoscopic sinus surgery stems from several developments.

First: has been the advent of compact, multiangled telescopes that allow excellent visualisation of the nasal cavity for examination of all areas of the nose and the maxillary sinus during procedures, including such areas as the maxillary sinus and the frontal recess.

Second: has been the great work by Messerklinger that most infections of the larger sinuses are rhinogenic, i.e., disease spreads from the nose to the paranasal sinuses. Although the clinically dominating symptoms may be due to disease inside the frontal or the maxillary sinuses, in most of the cases the underlying causes are not to be found in the affected sinuses themselves, but in the lateral nasal wall. There, normally very narrow clefts of the anterior ethmoid hold a key position for the normal function and the pathophysiology of the larger paranasal sinuses. They can be seen as "prechambers" of the dependent frontal and maxillary sinuses, providing ventilation and drainage for the latter. Many anatomical variants can stenose these prechambers even more and thus predispose these spaces to recurrent infections 11,12. The development of a surgical concept aiming at the diseased area in the ethmoid prechambers instead of the secondarily involved larger sinuses was a logical consequence. When this technique replaced more radical sinus procedures in 1970, it was possible to see that even massive mucosal pathologies in the dependent frontal and maxillary sinuses could heal without surgery after the ethmoidal key areas had been cleared with usually very limited procedures.

Third: has been computed tomography (CT) scan.

Prerequisite for FESS: Exact diagnostic identification of the conditions in the lateral nasal wall, which underlie acute or chronic recurring sinusitis, is essential. We establish this by:

- A thorough nasal endoscopy and
- Coronal as well as axial CT of the sinuses.

Advantage of FESS:
- Physiological: it is based on the normal mucociliary activity of the sinuses. The mucociliary transport of mucus occurs in definite predetermined pattern. (figure 5 & 6). The transport will be always towards the natural ostium and a dependent opening like the intranasal antrostomy does not necessarily improve drainage.

Better access: as endoscope is used, we can reach many areas which is difficult or sometimes impossible to reach with traditional surgery, with inflicting

- Less trauma to the body, so body's metabolic response to trauma is less and hence less morbidity, and better & smoother recovery from surgery.

Anaesthesia
Locals:
- Premedication with Inj. Pentazocine and Phenergan with
- Titrated i.v. midazolam together with
- Local packing (2% lignocaine and 1 :15,000 adrenaline) and
- Local infiltration (2% lignocaine with 1:200,000 adrenaline).

General:
- Deep General anaesthesia with hypotension, together with
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• Local packing and local infiltration (as above).

Indications

• Chr. Rhinosinusitis • Polypoid sinusitis
• Dacryocysto-rhinitis • Orbital decompression
• Optic nerve decompression • Closure of CSF leak
• Trans-sphenoidal • Management of mucocoele
• Hypophysectomy
• Diagnosis, biopsy and follow-up of sinus tumours

Certain relative contraindications

• Absence of specific osteomeatal complex abnormalities.
• Osteomyelitis involving the sinuses.
• Frontal sinus disease with stenosed internal os.
• Threatened intracranial and/or intracerebral complications.
• Inaccessible lateral frontal sinus disease.

Fundamental steps in fess

Uncinectomy (Infundibulotomy): To remove the uncinate process to gain access to the ethmoid infundibulum, to expose the frontal recess and to identify the frontal recess. Middle meatal antrostomy: To open up the natural ostium of maxillary antrum.

Anterior ethmoidectomy: To remove the bulla cells and ant. ethmoid cells anterior to the ground lamella. Anterior base of the skull and the anterior ethmoid artery can be exposed. Posterior ethmoidectomy: Ground lamella is penetrated and the posterior ethmoid cells are opened. Posterior base of skull and the posterior ethmoid artery, the orbital apex and the optic nerve can be exposed. Sphenoidotomy: sphenoid is opened through the natural ostium or less commonly from the posterior ethmoid cell. Pituitary gland can be reached through the roof of the sphenoid sinus. Frontal recess surgery: To open up the frontal sinus.

Techniques of fess

Messerklenger technique (1985):
• Anterior to posterior approach.

Wigand technique (1978): e.g. Total sphenoethmoidectomy
• Posterior to anterior approach.
• Is ideal for patients with pansinusitis who has or is apt to fail, the more limited Messerklinger approach.

Follow-up

At least twice:
• Once during immediate post operative period for cavity toileting.
• Another in 2 to 3 months time to detect complications if any, and for functional assessment.

Complications

Major
• Orbital complications: haematoma formation, Damage to the eyeball etc.
• Optic nerve damage.
• CSF leak.
• Intracranial complications.
• Major bleeding - Internal carotid artery

Minor
• Synechia formation.

Conclusions

For both the physicians and the patients the diagnosis and management of chronic sinus disease is frustrating and challenging. With the proper evaluation of the patients through history, nasal endoscopy and CT scanning, a diagnosis can be made and proper treatment initiated. Functional endoscopic sinus surgery has proved to be a safe and efficient method of dealing with this difficult situation (figure 7). Numerous studies on the outcome of FESS have reported symptomatic improvement of between 80.1% and 97.5%, whereas improvement rate after conventional intranasal ethmoidectomy ranged from 44% to 83% (13,14,15). Nasal endoscopy provides us an illuminated view of the nasal cavity and the sinuses during surgery, which not only help us to deal with the sinus problem accurately but also gives us an easy access to areas far beyond the nose and paranasal
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sinuses, like orbit, nasolacrimal duct, base of the skull, pituitary, to deal with the pathologies in those areas as well.

Fig. 7: Coronal CT sinus showing OMC is blocked on the right and open on the left—patient could be badly symptomatic on the blocked side. Plain x-ray will fail completely to identify this pathology.

Reference
1. Osguthorpe J. Medical Clinic of North America, vol 83, no 1, 17-41, Jan 99
2. Levine H., Laryngoscope 100, 79-84, Jan 90