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Management of chronic rhinosinusitis without polyps in adults

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Abstract. Chronic Rhinosinusitis (CRS) is a group of multifactorial diseases characterised by inflammation of the mucosa of the nose and paranasal sinuses with a history of at least 12 weeks of persistent symptoms and signs despite maximal medical therapy. IgE-mediated hypersensitivity and asthma are the two most important associated factors.
Diagnosis of CRS is based upon the medical history and either an endoscopy or CT scan.
Initial medical treatment usually consists of the avoidance of all the contributory factors and then nasal douching and nasal steroids. If medical treatment fails, endoscopic sinus surgery is considered. The authors review the most important factors associated with CRS, the diagnostic work-up and different treatment options. They also present a rationale for treatment.

Definition of CRS

Chronic Rhinosinusitis (CRS) is a group of multifactorial diseases characterised by inflammation of the mucosa of the nose and paranasal sinuses with a history of at least twelve weeks of persistent symptoms and signs despite maximal medical therapy. It is associated with persistent CT changes for four or more weeks after a course of appropriate medical treatment, without any intervening acute episode. The definition also includes four episodes per year of acute sinusitis, each of which last ten days in association with persistent changes on CT scan.[1-5] The severity of the disease can be mild, moderate or severe on a visual analogue scale.

Generalities[6-8]

CRS is one of the commonest chronic conditions for which medical care is sought in Europe and the USA. There is more and more evidence that it is increasing in prevalence and incidence. Nowadays, it affects approximately ten percent of the US and European populations, corresponding to 31 million Americans annually. It is observed in all races and both sexes equally. All age groups are affected. CRS induces functional and emotional impairments with a significant effect on quality of life. The socioeconomic impact of CRS is impressive. In 1995, in the US, it accounted for an estimated 18 to 22 million visits to physicians' offices and the direct medical costs approached US$3.4 billion.

Predisposing factors and diseases associated with CRS

CRS is a complex entity in which inflammation and infection coexist.[9,10] Different pathological situations are associated with the development of this disorder; the most important are listed in Table 1.

These factors can be divided into *environmental and non-host factors* such as pollution, smoking, viral infection, fungus, bacteria, *general host factors* including genetic factors and immune deficiency, and *local host factors* e.g. persistent focal inflammation within the osteomeatal complex.[9]
Some of these factors (allergy, aspirin sensitivity, primary ciliary diskinesia) are clearly associated with CRS whereas others are still under discussion.
Allergic rhinitis is considered to be a major predisposing factor for the development of rhinosinusitis but the mechanism of how allergic rhinitis predisposes to rhinosinusitis or affects the course of rhinosinusitis remains unclear.[11-14] Many authors stress the similarities in inflammatory responses between allergic rhinitis and sinusitis and emphasise the importance of eosinophils, mast cells, T lymphocytes, and their mediators. Others have also proposed a role for neurogenic pathways, whereas yet

Table 1

Predisposing and/or associated factors for CRS

- Allergic rhinitis and asthma
- Non-allergic rhinitis: vasomotor rhinitis – rhinitis medicamentosa – cocaine abuse – aspirin intolerance – non-allergic rhinitis with eosinophils (Nares)
- Immune deficiency: innate and acquired: common variable immunodeficiency, immunoglobulin A deficiency, IgG subclass deficiency
- Autoimmune disease: e.g. systemic lupus erythematosus
- Ciliary impairment: Kartagener's disease, primary and secondary ciliary diskinesia
- Cystic fibrosis
- Vasculitis: Wegener's granulomatosis, sarcoidosis, Churg-Strauss syndrome
- Structural: septal deviation, concha bullosa, Haller cell, paradoxically bent middle turbinate, choanal polyp, tumour obstruction
- Recurrent upper respiratory tract infections – repeated viral infections
- Presence of bacteria (e.g. coagulase-negative staphylococcus, enterobacteriacae)
- Presence of fungus
- Persistent inflammation within the osteomeatal complex and ethmoid sinus
- Hormonal: pregnancy, oral contraception
- Environmental pollution: tobacco, irritants
- Gastrooesophageal reflux disease (GERD)
- Periodontitis/significant dental disease

others have focused on systemic involvement.

Asthma and CRS are closely linked diseases occurring as comorbidities in the same individual; the latter is known to influence bronchial asthma in its severity and chronicity. This leads to the concept of a "one-airway disease".[15,16] For example, over 50% of patients with sinus disease have asthma.[17,18] Up to 90% of patients with mild to moderate asthma have abnormal CT findings for the paranasal sinuses and up to 100% of patients with severe asthma have sinonasal involvement.[19] This close connection supports the characterisation of rhinosinusitis and asthma as the two-compartmental expression of a common mucosal susceptibility to exogenous stimuli. In addition, there is evidence that the compartmental processes can affect and amplify each other via a systemic intermediary.

Various mechanisms have been proposed to explain the relationships between sinusitis and asthma. The five most common are the sinonasal-bronchial reflex, inhalation of cold and dry air, aspiration of nasal secretions, the local and systemic propagation of nasal/paranasal inflammation with a particular role for the eosinophils and inflammatory mediators, and diminished beta-agonist responsiveness.

Structural abnormalities such as concha bullosa or Haller cells are not more common in CRS patients than in controls. Their role in the pathogenesis of CRS is questionable.[20,21]

Severe septal deviation can lead to the development of unilateral CRS but septal spur and more limited septal deviation do not.[22]

Gastrooesophageal reflux disease (GERD) or laryngopharyngeal reflux (LPR) seem to be more and more associated with CRS but it has not yet been established with sufficient certainty whether the LPR must be regarded as a causative factor, whether it exacerbates or chronifies the disease or whether it is merely an epiphenomenon which does not require specific treatment.[23-26] To answer this important question we need prospective randomised controlled studies to provide evidence of sufficient quality.

Microbiology

Many bacteria have been reported in samples obtained through endoscopy or sinus puncture in patients with chronic sinusitis: Staphylococcus aureus, coagulase-negative Staphylococci, Haemophilus influenzae, Moraxella catarrhalis, Streptococcus pneumoniae, Streptococcus viridans, Streptococcus intermedius, Pseudomonas aeruginosa and Nocardia species.[27-31]

However, whilst the microbiology and the role of bacteria in the pathogenesis of acute bacterial rhinosinusitis have been well established, the exact role of bacteria in CRS is more elusive. Many questions remain unanswered. Do the bacteria initiate the inflammatory process (primary pathogenic factor) or are they simply a coexistent factor? What is the significance of the presence of bacteria in the nasal cavities in the absence of infection?

Whatever the answers to these questions, bacteria may play a role in CRS through different mechanisms: bacterial infection - bacterial allergy - bacterial superantigen upregulation (mainly for staphylococcus aureus), bacterial bone inflammation and/or infection[9] and finally bacterial biofilm.

Bacterial superantigens mainly involve enterotoxins produced by Staphylococcus aureus. These toxins act as superantigens capable of reacting with T lymphocytes in a non-specific way, resulting in massive cytokine production. This mechanism seems to play a major role in the pathogenesis of nasal polyposis.

Bacterial biofilm is a mode of bacterial growth that can be seen

in "slimes" on a device surface, for example venous catheters, rendering bacteria relatively invulnerable to the host immune response and to antimicrobial therapy. Recent evidence has linked biofilms to a variety of persistent infections, including dental plaque, chronic lung infections in cystic fibrosis, urinary tract infections, recurrent tonsillitis and ear infections. It has also been found on nasofrontal stents and more recently in surgical specimens of patients with CRS recalcitrant to medical therapy.[32-35] The latter seem to be associated with the presence of Staphylococcus and/or Pseudomonas species.

Pseudomonas is not a very aggressive bacteria. It develops where local immunity is impaired, as in cystic fibrosis and primary ciliary dyskinesia.

The clinical significance of coagulase-negative Staphylococcus as a potential pathogen or a contaminating agent remains unclear.

The exact role of enterobacteriacae in CRS is still an open question (36).

Anaerobes[28,37,38] have been documented as the prominent pathogens in CRS in some studies, while others have failed to demonstrate this. The reasons for the variable growth of microbes in the samples obtained from chronic sinusitis may be the prior exposure of patients to various broad-spectrum antibiotics as well a difference in sample collection techniques. The exact role of these microbes in the pathogenesis of chronic sinusitis is another unresolved issue.

Fungi have also been reported in patients with CRS[1,39,40]: Aspergillus species, Cryptococcus neoformans, Candida species, Sporothrix schenckii, Alternaria species. Many studies demonstrate that fungi play a role in the pathogenesis of fungus ball[41,42] and allergic fungal sinusitis[43,44] but the clinical significance in CRS remains unclear since species are identified either in patients with CRS or in controls.[45,46] Some questions that remain open are: Are fungi contaminants or pathogens? Do they directly stimulate the eosinophilic inflammation?

The critical point in the microbiology of rhinosinusitis is the sampling method.[47-50] It is now accepted that the gold standard for microbiological sampling is the collection of pus in the sinus cavity, particularly the maxillary sinus. However, the procedure is not applied as routine for every patient with sinonasal complaints. So direct endoscopic-guided culture of the middle meatus appears to be a viable substitute, with swab and suction methods having similar rates of microbiological contamination. Indeed, studies confirm a good correlation between middle meatus cultures and ethmoid and maxillary sinus cultures. Yet nasal swab is completely inadequate because of the bacterial colonisation of the *vestibulum nasi* by *staphylococcus*.

Diagnosis[51-53]

1. *Symptomatology*[1-3]

In 1997, the American academy of otolaryngology proposed a 'symptom-based definition' of CRS. This definition was intended for general practioners and ENT and did not require CT scans or nasal endoscopy. The symptoms used to make the diagnosis are divided into major and minor ones (Table 2). The presence of two major symptoms, or one major and two or more minor symptoms, result in the diagnosis.

Table 2

Clinical subdivision of symptoms after Lanza and Kennedy

Major symptoms include:
- Nasal discharge: purulent-discoloured anterior or posterior nasal drip
- Nasal congestion or obstruction
- Facial congestion or fullness
- Facial pain or pressure or fullness
- Olfactory disturbance

Minor symptoms include:
- Headache
- Chronic unproductive cough
- Ear pain or pressure or fullness
- Halitosis – fetid breath – unpleasant taste
- Dental pain
- Fatigue
- Fever

2. *Examination*

- **Anterior rhinoscopy** alone is inadequate to confirm the diagnosis but remains the first step in examining the patient. It only provides valid information about the *vestibulum nasi* and the anterior part of the nasal cavity, but little about the different meati, even after decongestion.
- **Transillumination** is also insensitive and unspecific. But it can be of some interest for maxillary or frontal sinusitis.
- **Nasal endoscopy** is a major procedure for every patient suspected of CRS as subjective complaints and objective findings do not always correlate.[54-56] In a recent study, Stankiewicz and Chow[55] demonstrated that, of 78 patients who met the criteria for CRS, more than 50% had no endoscopic or radiographic evidence of sinus disease. Moreover, Kaplan and Kountakis[57] did not find any cor-

relation between nasal endoscopy findings and symptom scores in the specific group of patients undergoing endoscopic sinus surgery for CRS. In patients without asthma, nasal endoscopy findings correlated well with CT grade but this was not the case for patients with asthma.

Nasal endoscopy is better performed after nasal decongestion. It provides a clear evaluation of the nasal mucosa and the lateral nasal wall. It is used to identify structural alterations, for tissue sampling, culture collection and staging of allergic fungal sinusitis.

Nasal endoscopy can visualise four different parameters in mucosa changes: oedema, purulence, crusting and polyps (Table 3).

a) *Oedema and hyperaemia of the mucosa*: this can be seen in allergic and viral rhinitis, non-allergic rhinitis with eosinophils (NARES) and acute or chronic bacterial rhinosinusitis
b) *Secretions* can be classified as watery, serous, mucous or purulent.
c) *Crusting* is an important item in Wegener's granulomatosis, sarcoidosis, ozenae, iatrogenic atrophic rhinitis and empty nose syndrome
d) *Nasal polyps*: Nasal endoscopy quite frequently discloses some small polyps under the anterior end of the middle turbinate or in the superior meatus which have not been identified on the sinus CT scan.

Some semi-quantitative scores (Lund-Mackay scores) may be used for each item.[58]

Table 3

CRS and pertinent endoscopic findings

Endoscopic findings suggestive of rhinosinusitis are:
- Oedema and hyperaemia of the nasal mucosa
- Purulence
- Polypoid changes
- Crusting

Imaging[1,52,53,59,60]

- In addition to the medical history and the endoscopic findings, the cornerstone of the diagnostic workup of CRS is imaging.
- **Plain sinus radiograph** Routine sinus radiographs are insensitive and have only limited value in the evaluation of CRS due to a number of false positive and negative results. In plain X-rays, mucosal thickening superior to 5 mm or sinus opacities may be observed. Air fluid levels are not common in CRS. Plain sinus films do not show ethmoid sinuses and the osteomeatal complex adequately.
- **CT scanning** is an important diagnostic instrument for CRS but it must be integrated in the overall clinical picture because of the poor correlation between symptoms and CT scan findings. A medical therapy for CRS can be almost always initiated on the basis of the medical history and the endoscopic findings without a CT scan. But the CT scanning is essential to assess whether there has been complete recovery after successful medical treatment or, after treatment failure, to assess the extent of the disease and anatomy before FESS. It is also indicated for the evaluation of suspected complications and there is a concern about a possible neoplasm. A coronal CT scan of the sinus (at least 1 mm slice every 4 mm; bony window) fits in better with the surgical approach, permitting the visualisation of the anatomy of the osteomeatal complex, sinus cavities and surrounding structures such as the ethmoidal roof, optic nerve, carotid artery and cribriform plate. Dental pathologies are visualised well. Specific entities in the sinus cavity, such as fungal ball and antrochoanal polyp, can also be identified.
- **MRI** is rarely necessary as a routine procedure for the diagnosis of CRS. It is mainly useful to differentiate inflammatory lesions from tumours (mucoceles, inverting papilloma, tumours). It can be of some interest for fungal sinusitis even if false negatives are a possibility.[60] In addition, it can also be used in combination with CT scanning for complex cases, mucoceles, inverted papilloma, tumour or complicated sinusitis. It provides excellent information about soft tissue and liquids. Mucocele, for example, appears as a homogenous, poorly vascularised expansive lesion typically associated with a rim enhancement after the injection of gadolinium in a T1-weighted sequence and a hypersignal in a T2-weighted sequence. On the other hand, inverted papilloma appears as a non-homogenous process that is enhanced after the injection of gadolinium.

Other investigative procedures

- **Allergic skin tests**
  Since allergic rhinitis is one of the most important predisposing factors associated with CRS, allergic skin tests are part of the diagnostic workup in every

patient with chronic sinonasal complaints. In some exceptional cases, it can be complemented with radioallergosorbent testing.

- **Laboratory tests**
  When routine investigations fail to produce a definitive diagnosis or when there is a suspicion of a systemic disease such as vasculitis, Wegener's granulomatosis, sarcoidosis or immunodeficiency, laboratory tests are indicated. They include:
  erythrocyte sedimentation rate, full blood count, total eosinophil count, anti-neutrophilic cytoplasmic antibodies, acetylcholine esterase, anti-nuclear antibodies, titration of the immunoglobulins or the IgG subclasses.
- **Biopsy**
  Histopathologic examination is indicated to identify the presence of fungal elements in the mucus or the tissue. It must also be performed in every case of unilateral polypoid change to exclude inverted papilloma or neoplasm and when there is a suspicion of ciliary dyskinesia or granulomatous disease.[61]
- **Nasal cytology**
  This procedure is not needed in daily practice but it can help to classify the inflammation as an eosinophilic or neutrophilic process.[62]
  Eosinophilic infiltration is usually associated with allergic rhinitis, aspirin sensitivity, NARES, and nasal polyposis whereas neutrophilic process is associated with chronic bacterial infection, primary ciliary dyskinesia, cystic fibrosis or immunodeficiency.

Medical treatment[1,10,52,53,63-73]

- Environmental factors or allergic factors may predispose individuals to CRS. In these patients, the following preventive measures may be helpful:
  the reduction of exposure to pollution, cigarette smoke, dust, moulds and other environmental chemical irritants.
  Nevertheless, there is no evidence for efficacy in CRS.
- Despite these measures, a lot of medical therapies have been used to reduce inflammation and congestion and to improve mucociliary clearance.[52]
  Different medications are listed in Table 4 with references to **the European position paper** on rhinosinusitis and nasal polyps published in *Rhinology* in 2005 and with a specific reference to Belgian practice.[53]

Table 4
Medications used in CRS

Therapy	**Level**	**Grade of recommendation**	**Relevance**	**Usual practice in Belgium**
Oral antibiotic therapy, short-term - <2 weeks	III	C	No	Yes
Oral antibiotic therapy, long-term ~12 weeks	III	C	Yes	Yes
Antibiotics-topical	III	D	No	No
Steroid-topical	Ib	A	Yes	Yes
Steroid-oral	IV	D	No	Yes
Nasal saline douche	III	C	Yes, for symptomatic relief	Yes
Decongestant oral/topical	No data	D	No	Yes
Mucolytics	III	C	No	Yes*
Antimycotics-systemic	No data	D	No	No
Antimycotics-topical	Ib	D	No	No
Oral antihistamine added in allergic patients	No data	D	No	Yes
Allergen avoidance in allergic patients	IV	D	Yes	Yes
Proton pump inhibitors	III	C	No	No
Bacterial Lysates	Iib	C	No	No
Immunotherapy	No data	D	No	Yes
Phytotherapy	No data	D	No	No

- Use of intranasal saline has been shown to reduce nasal symptoms in allergic rhinitis and chronic sinusitis.[63,65,66] It improves quality of life in patients with CRS. Nasal douching is much more popular in the UK and France than in Belgium. It reduces the amount of secretions, postnasal drip and the load of mediators in the secretions.

- Cromoglycate (Lomusol) has no real place in the treatment of CRS. Even in allergic rhinitis, its

place in the rationale for treatment is negligible.

- Topical nasal glucocorticosteroids[67,68] are the most effective form of treatment for allergic rhinitis as they reduce nasal congestion and eosinophilic inflammation significantly. In CRS without polyps, they are the only treatment that has been the object of randomised double-blind studies. The studies demonstrate modest benefits in non-operated patients. This can be explained by a lack of penetration into the sinuses by topically applied drugs. If the pathologist identifies eosinophils in surgical specimens from operated patients, topical steroids are routinely prescribed for at least three to six months. With the recent molecules, the risk of systemic adverse events due to resorption is nearly non-existent. Local side-effects such as crusting and bleeding are rare.

- Oral antihistamines are mostly prescribed in allergic patients but there is little evidence of their efficacy in non-complicated CRS.

- Decongestants[69]: although there is little supporting evidence, these medications are commonly prescribed since many topical specialities are OTC. A study using MR imaging showed only a brief and transient decongestant effect on inferior and middle turbinates with no shrinking of maxillary and ethmoid linings when xylometazoline was used.

- Oral broad-spectrum antibiotics are indicated for the treatment of acute bacterial exacerbation of CRS. Amoxicillin (high dosage) and amoxicillin plus clavulanic acid remain the first choices. There are few indications for long-term antibiotic therapy. In Belgium, we have little experience with prolonged use of low-dose macrolides by comparison to other countries such as Japan.[70-73] The use of fluoroquinolone for upper respiratory tract infections is controversial. If we have to prescribe one, it must be effective against Gram-negative bacteria, Staphylococcus aureus and Streptococcus pneumoniae. So the molecule should be from the new generation of fluoroquinolone: levofloxacin[74,75] and mostly moxifloxacin.[76] There is no indication for treating patients who are carriers of coagulase-negative Staphylococcus aureus.

- Antifungal agents: since Ponikau has suggested that most of the cases of nasal polyps and chronic rhinosinusitis are of fungal origin,[43] there are some publications about the efficacy of antifungal nasal washes for chronic rhinosinusitis.[77-79] We have not enough experience to recommend this therapy in daily practice for patients with CRS without polyps.

- Proton pump inhibitors are the modality of choice for the treatment of gastrooesophageal reflux but efficacy for sinus symptoms is modest.[23,24]

Surgery

Recent advances in endoscopic technology and an improved understanding of the importance of the osteomeatal complex in the pathophysiology of sinusitis have led to the establishment of functional endoscopic sinus surgery (FESS). FESS facilitates the removal of disease in key areas, restores adequate aeration and drainage of the sinuses by establishing the patency of the osteomeatal complex, and causes less damage to normal nasal functioning. Endoscopic sinus surgery is reserved for patients with recurrent acute rhinosinusitis and anatomic abnormalities such as a deviated nasal septum or concha bullosa or for patients with CRS in whom maximal medical therapy has failed. Postoperatively, the majority of the patients experience significant reduction of headache, nasal obstruction and postnasal drip and their quality of life scores improve.[80-82] In patients with asthma, FESS improves peak expiratory flow and reduces the use of inhaled and systemic corticoids.[83-88] The Algortihm, modified from Fokkens and van der Baan, summarises the rationale for diagnosis and treatment in adults with chronic rhinosinusitis without polyps.[89]

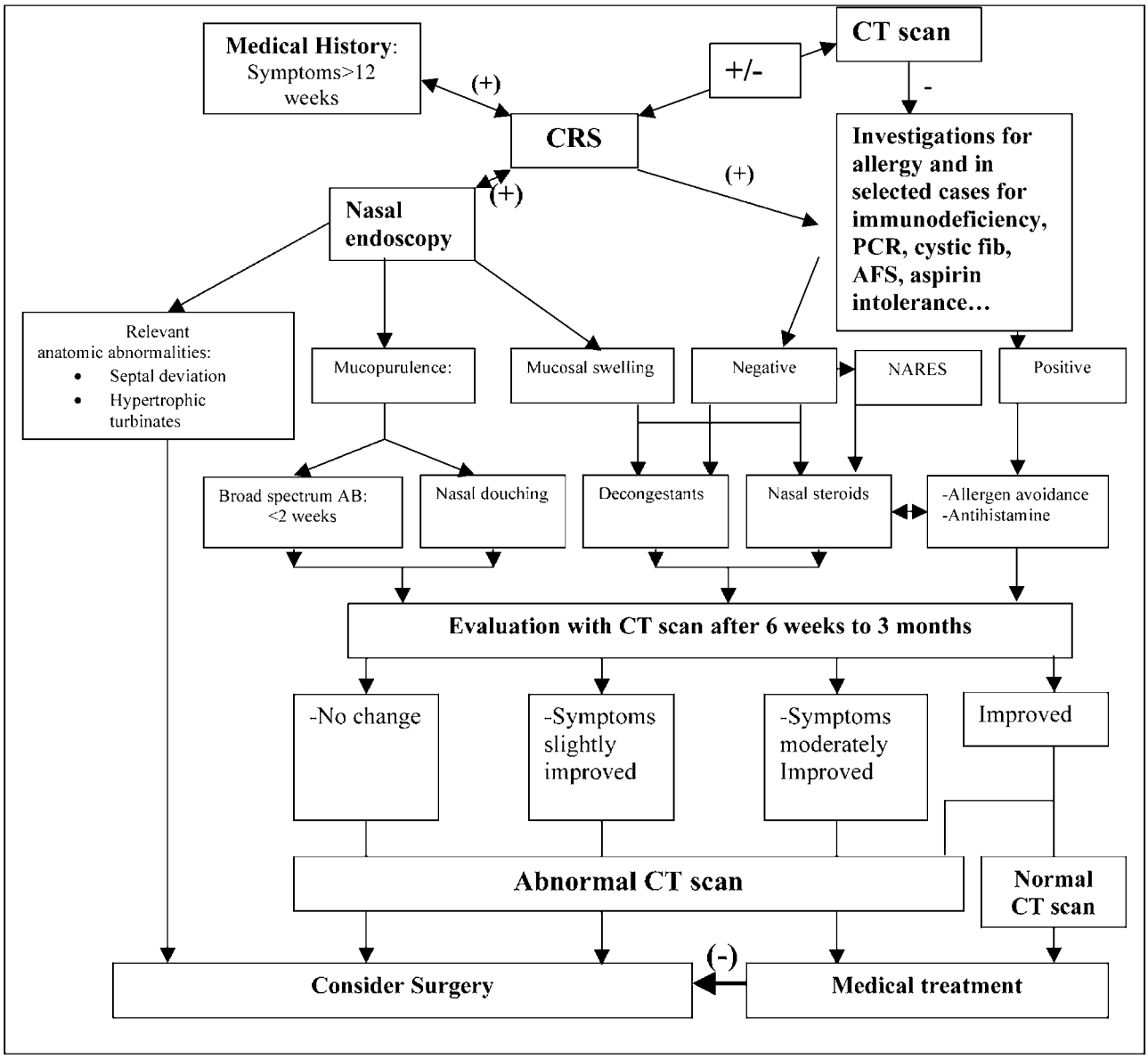
In the past, surgery was preceded by antral lavages. This approach was indicated in cases of persistent purulent discharge despite appropriate broad-spectrum antibiotics. Sinus lavages help to reduce infection, make surgery easier (less bleeding) and then improve the quality of the healing process.[90,91] Nowadays, these procedures are performed only in selected cases (immunodeficiencies, patients in intensive care unit,..).

Finally, in some selected cases, a Caldwell-Luc procedure is still indicated, for example when there is persistent symptomatic hyperplasia of the sinus mucosa despite a large middle antrostomy with persistent purulent discharge and in case of recurrence after endoscopic surgery.

Conclusion

Chronic rhinosinusitis is a catch-all category for a group of multifactorial diseases characterised by inflammation of the mucosa of the

Algorithm
Rationale for diagnosis and treatment of CRS without polyps in adults



nose and paranasal sinuses with a history of at least 12 weeks when aetiology and pathophysiology remain unclear. The diagnosis is based on a combination of the medical history, endoscopic findings and computerised tomography scanning. Investigations must identify predisposing factors. Management begins with avoidance or treatment of these factors. The medical treatment usually includes nasal lavages and topical steroids. Antibiotics are restricted for the treatment of acute exacerbations. They are rarely prescribed for more than 15 days. Surgery is reserved for failure after maximal medical treatment. FESS is the modality of choice, leading to an improvement in symptoms and quality of life and, in patients with asthma, to an improvement of the peak expiratory flow and reduction of the use of inhaled and systemic corticoids. The Caldwell-Luc approach is restricted to recalcitrant cases.

Information to the patients

Chronic rhinosinusitis is a group of multifactorial diseases characterized by inflammation and/or infection of the mucosa of the nose and paranasal sinuses with a history of at least 12 weeks in duration.

Many factors predispose to the development of chronic sinusitis, e.g. recurrent viral and bacterial infections, respiratory tract allergy to house dust mite or grass pollen,

gastroesophageal reflux disease, aspirin intolerance, smoking or anatomic variations such as septal deviation or a concha bullosa.

The diagnosis is based on a combination of the medical history, endoscopic findings and computerized tomography scanning (CT scan).

Allergic skin prick tests and a sinus CT scan are routinely performed to make the diagnosis.

Management begins by avoiding or treating the favorizing factors.

Then a medical treatment is always prescribed for at least 6 weeks to 3 months. It usually includes nasal lavages, topical steroids and in some cases mucolytics. Antibiotics are restricted for the treatment of acute exacerbations. They are rarely prescribed for more than 15 days.

When the medical treatment fails, surgery is considered.

Functional endoscopic sinus surgery (FESS) is nowadays the modality of choice. It is performed under general anaesthesia and through the nasal cavities. There is no facial scar. Usually there is no nasal packing except in case of concomitant nasal septum surgery.

Surgery improves the majority of the symptoms (nasal obstruction, headache, postnasal drip) and also has a great positive impact on asthma.

Complications are extremely rare in the hands of experienced and skilled surgeons.

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CME questions

1. Which following sentence is wrong?

   A - Chronic sinusitis is a group of multifactorial diseases characterized by inflammation of the mucosa of the nose and paranasal sinuses with a history of at least 12 weeks of persistent symptoms and signs despite maximal medical therapy.
   B - The definition also includes four episodes per year of acute sinusitis each lasting 10 days without persistent changes on CT scan
   C - Nowadays, it affects approximately 10 percent of the US and European populations, corresponding to 31 millions Americans annually.
   D - In 1995, in US, it accounted for an estimated 18 to 22 million visits to physicians' offices and the direct medical costs approached US$ 3.4 billion

2. Chronic sinusitis is definitively associated with one of these factors

   A - Structural abnormalities such as Concha bullosa, Haller cells and septal deviation play a major role in the pathogenesis of CRS.
   B - Gastroesophageal reflux disease (GERD) or laryngopharyngeal reflux (LPR) seem to be more and more associated with CRS and must be regarded as a causative factor because it exacerbates or chronifies the disease.
   C - Asthma and CRS are closely linked diseases occurring as comorbidities in same individual wherein latter is known to influence bronchial asthma in its severity and chronicity. This leads to the concept of "one airway disease"
   D - Allergic rhinitis is considered a major predisposing factor for the development of rhinosinusitis but the mechanism of how allergic rhinitis predisposes to rhinosinusitis or affects the course of rhinosinusitis remains unclear.

3. Bacteria play a certain role in the pathogenesis of CRS. What proposal is wrong?

   A - Pseudomonas is not a very aggressive bacteria. It develops where the local immunity is impaired such as in cystic fibrosis and primary ciliary dyskinesia.
   B - Anaerobes have been documented as the prominent pathogens in CRS in some studies while others have failed to demonstrate this. The reason for the variable growth of microbes in the samples obtained from chronic sinusitis is due to prior exposure of patients to broad-spectrum antibiotics
   C - Bacterial superantigen mainly concerns the production of enterotoxins by Staphylococcus aureus in nasal polyposis.
   D - Bacterial biofilm has been described with nasofrontal stents and more recently in surgical specimen of patients with CRS recalcitrant to medical therapy

4. Which following sentences are right?

   A - Many studies demonstrate that fungi are important element in the pathogenesis of fungus ball and allergic fungal sinusitis. The clinical significance in CRS is evident: they directly initiate and stimulate the eosinophilic inflammation.
   B - It is now accepted that the gold standard for microbiological sampling is the collection of pus from the middle meatus, particularly for maxillary sinusitis.
   C - Nasal swab is inadequate because of the bacterial colonization of the *vestibulum nasi* by *staphylococcus*
   D - Bone inflammation or infection plays a role in chronic sinusitis recalcitrant to medical treatment.

5. Which is the right proposal?

   A - In 1997, the American academy of otolaryngology proposed a "*symptom-based definition*" of CRS. This definition is supposed to make the diagnosis of CRS without imaging and endoscopy.

B - The presence of 1 major and 2 minor symptom are enough to make the diagnosis of CRS.
C - There is no correlation between nasal endoscopy and CT scan in patients with CRS.
D - One of the classification for nasal endoscopy has been proposed by Lund and Mackay

6. What is wrong about imaging and CRS?

A - Routine sinus radiographs are insensitive and have only limited value in the evaluation of CRS.
B - CT scanning is essential to make the diagnosis of CRS but needs to be confronted to the nasal endoscopy and the medical history.
C - The parameters for a sinus CT scan are: 1 mm slice every 4 mm; bony window.
D - MRI can be of some interest in case of fungal sinusitis even if false negative exist.

7. Concerning the medical treatment of CRS, which treatment is not applied routinely in Belgium?

A - Oral antibiotic therapy- short term - <2weeks.
B - Oral antibiotic therapy-long term ~12 weeks.
C - Proton pump inhibitors.
D - Long-term of topical nasal steroids.
E - Prolonged use of low-dose macrolide.

8. Concerning the surgical treatment which proposals are wrong?

A - Functional endoscopy sinus surgery (FESS) is the modality of choice for cases resistant to medical treatment.
B - FESS is proposed to a patient with persistent of CT scan abnormalities but improved symptomatology.
C - Antral lavages can precede FESS in patients with purulent secretion despite broad spectrum antibiotics;
D - Caldwell Luc procedure has no place in the treatment of chronic sinusitis;
E - FESS improves quality of life of patients with CRS (improvement of headache, nasal obstruction and postnasal drip) but has no definitive effect on asthma.

9. Concerning the medical treatment, what do you recommend as the first medication for CRS whatever is the etiology?

A - Nasal douching with saline
B - Topical glucocorticoids
C - Topical antihistamine
D - Topical broad spectrum antibiotic

10. What are the wrong proposals?

A - Chronic sinusitis is the 6th chronic disease in United States;
B - The role played by the fungi in CRS seems to be less important that the role of the enterotoxins produced by Staphylococcus aureus.
C - The theory of bacterial Biofilm can explained the resistance of bacteria to conventional medical therapy.
D - CRS is increasing more and more in prevalence and incidence but a lot of questions about its pathophysiology and optimal outcome remains unanswered; Double blind randomized studies are needed in the future to clarify these points.

Answers:1B; 2C; 3B; 4CD 5all; 6none; 7C; 8BDE; 9B; 10none.