Introduction

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Rhininosinusitis presents an important number of patients in emergency rooms and also in regular consultations in offices of pediatricians and ENT-physicians. Therefore it is important that physicians who are seeing those patients have broad knowledge of the pathology, so they can provide to the patients the best possible management, and also avoid subsidiary examinations and treatments that may not be useful. This chapter gives a broad understanding of the subject, with evidence-based medicine using European guidelines.

When you read this chapter you will be able to differentiate acute cases of rhinosinusitis from chronic ones, as well as be able to apply strict diagnostic criteria. Whenever you are asked for a specific examination, you will be able to recognize predisposing factors and provide the most adequate and efficacious treatment for each situation. The correct utilization of this knowledge will give our patients a better quality of life, with all the benefits of that.

Glenis Scadding

Pediatric rhinosinusitis is a subject close to my heart. It is a very, very common condition. We are going to examine a very new set of guidelines, called the EPOS guidelines. The EPOS stands for European Position Paper on Nasal Polyps and Chronic Rhinosinusitis, and it includes a section on children. But in fact it was largely written by people who see adults, so I think we will probably have a revised children’s version coming out to the European Academy, within the next year or two. We are going to be working on a special children’s version.

In children, the presentation can be different from that in adults, the prevalence is probably fairly similar or possibly even slightly greater than in adults, the causes tend to be different. Fortunately in many children, there is a tendency for Chronic Rhinosinusitis (CRS) to remit spontaneously. That is something we very rarely see in the adult patient.

What we do know is that rhinosinusitis in both adults and children has remarkable effects on quality of life. It reduces quality of life in all these domains: role physical, body pain, general health, vitality, social function, role emotional and mental health. So, pretty well all the different domains of quality of life. So, it matters to our patients, and, therefore, it matters to us.

What about guidelines? Well, we are beginning to see an awful lot of them. The idea is that guidelines are largely based initially on opinion, and they were produced. First was opinion-based medicine (from 1985-1998) then guidelines came on the evidence-based medicine (from 1998-on) – implementation of
guidelines by adequate trials and interventions: guidelines are produced, they are implemented and put to trial and then redone, in order to improve them.

In fact there have been two sets of EPOS guidelines now, the original ones came out in 2005, and a revised version appeared in 2007. So what is rhinosinusitis? The definition is that of a complex of symptoms. Those symptoms are, obstruction of the nose sinuses, especially, at the places where the sinuses drain into the nose, the ostiomeatal complex, which is at the level of the nasal bridge (Figure 1). There is also rhinorrhoea, which can be anterior but is frequently posterior, and a sensation of pressure or pain in the face, together with reduction of smell. The ability to taste is also, of course, affected. This is the EPOS version, which says that the clinical definition is inflammation of the nose and the paranasal sinuses characterized by two or more symptoms, one of which has to be either nasal obstruction or nasal discharge.

**Clinical definition**

Inflammation of the nose and the paranasal sinuses characterized by two or more symptoms, one of which should be either nasal blockage / obstruction / congestion or nasal discharge (anterior or posterior drip). In addition you can have either nasal blockage / obstruction / congestion or nasal discharge (anterior or posterior drip). And that can be one of two things. One of them is by looking into the nose, preferably with a nasal endoscope, and finding evidence of abnormality of the middle meatus, where the sinuses drain. And that abnormality can be polyps or mucopurulent discharge or very edema / swelling mucosal obstruction primarily in middle meatus. An alternative to that are computer tomography (CT) changes at the ostiomeatal complex, at that point where the sinuses drain. But CT is not a prerequisite for the diagnosis of CRS. And that is a very important point. And I will tell you why in a minute. In children, those symptoms can certainly occur, but
other things may happen too. Poor concentration, fetor and cough. Many children with rhinosinusitis will be brought to the doctor because of that cough.

**General classification**

Now, how do we define chronic rhinosinusitis?

**Duration** of symptoms:
- **acute:** > 10 days and <12 weeks complete resolution of symptoms
- **chronic:** >12 weeks, no complete resolution of symptoms

CRS is anything going on for over 12 weeks, with no resolution of symptoms, and acute is between 10 days and 12 weeks. Now, I am going to explain a little bit more about acute rhinosinusitis later.

What about **severity**?

We have shown in adults, that you can define severity very simply by getting the patient to make a mark in a 10 centimeter visual analog scale (VAS), where the left hand end is no symptoms, it is scored a zero, the right hand is the worst possible symptom, and if the patient makes a mark within this line, could be mild, moderate or severe. We have actually validated that with a group of our patients:

- **mild:** VAS score <3;
- **moderate:** VAS score: 3-7;
- **severe** VAS score >7.

If you are doing an **epidemiological** study, you are not going to be able to look into everybody’s nose, or subject everybody to a CT scan, so the EPOS document recommends a very simple diagnose, just based on symptoms, for epidemiological purposes, validation by a telephone interview. And they suggest that the patient should also be asked about allergic symptoms at the same time.

For **research**, the idea is that nasal polyposis, the inflammatory nasal polyps, are a part of CRS and that it is a heterogeneous condition, so that when you are doing research, you need to define your patient population as well as you possibly can, in order to get meaningful evidence. For research definition of CRS with or without nasal polyps should be established endoscopically prior to inclusion in a study.

I do have some figures for the European Union, where everybody will get a common cold at some stage - so, that 500 million people, probably affected, once or twice a year. Acute rhinosinusitis (ARS) affects about 2% of our population, so will be 20 million patients. And CRS, the estimates are around 10%, so that’s about 50 million patients, with nasal polyposis affecting roughly 4%, 20 million patients. So these are large numbers of individuals being affected.

Now, if I did a CT of any group of people, something like **one person in three would have significant abnormalities in that CT scan.** And that is probably because viral colds are in fact a rhinosinusitis. And we have been shown some years ago, that CT changes after a viral cold lasts for about six weeks. **If you do CT or MRI on children, then almost 1 in 2 will have an abnormal CT scan or MRI.**

In a study from Gordts, working with Clement, in Belgium, they looked at the MRI scans of 100 children with CRS, who were being scanned for neurological diseases. And in those scans, 45% had sinusitis changes. The pattern was
different to that of adults (39%). The posterior sphenoids and posterior ethmoids were more likely to be affected in adults, and 100% of children with purulent nasal discharge had an abnormal CT scan. **This is one of the reasons why there is no point in using CT scans for diagnosis, because some of you with abnormal CT scans will be pretty much asymptomatic. So, this is not a diagnostic measure, unless you are suspecting some unusual condition or some very dangerous condition. Do not bother to do a CT scan until you are coming to the stage of failing treatment and needing to do surgery.**

The other thing which I mentioned earlier is that in many children this period of having rhinosinusitis ends when they grow up a bit. Usually somewhere between the ages of seven to nine. The same sort of time period when a lot of them also grow out of their otitis media with effusion. And that probably represents a couple of things. Maybe midfacial growth, but maybe a maturation of their immune system. There are two or three papers suggesting a spontaneous decrease of prevalence after seven years of age. And that means that we should be fairly conservative with most of these children with CRS. And we probably don’t need to operate on the vast majority of them.

**Patho-physiology**

What is rhinosinusitis from the patho-physiological point of view? I have already said it is not one condition; it is a heterogeneous group of things going on. And when you look at the CT scan (**Figure 2**), and this is an adult CT scan, where you can see the eyes, the maxillary sinuses, the nasal septum, inferior turbinates, middle turbinate, and this right middle turbinate has a sinus air cell called concha bollosa. We can see the inflammatory changes around the sinuses, sometimes occupying the whole sinus and we can see how that outflow is blocked.

**Figure 2.** Paranasal sinus CT scan. The arrow shows where outflow is blocked.

Now, that change can be eosinophilic inflammation, and you tend to see that in nasal polyposis and in some syndromes, and in genuine allergic sinusitis. They are all very eosinophilic inflammatory conditions. It can be a neutrophilic inflammation, presumably a response to infection, and you are more likely to see that in immunocompromised children, such as those with cystic fibrosis or primary ciliary dyskinesia or lack of one particular antibody class or subclass.

However in almost any patient you will find that there is a mixture of inflammatory change and infection. You can alter the composition to some extent by treating the infection, or, by treating the inflammation, then you probably don’t actually augment the infection you probably improve things.
**Figure 3 A and B** shows the sort of thing that often happens. **Figure 3 A** (at your left) shows normal sinus drainage, now this is a wonderful example against creationism. Because, what happened when we stopped walking on all fours, and stood up and put our head up, is that our sinuses, although they go right down to the sinus floor, drain higher up to the ostiomeatal complex, against gravity. That is a system waiting to fail. The mucociliary system takes the secretions up, out through the ostiomeatal complex, into the nose, where they will be taken back, down to the back of the throat, and so on. We are all swallowing secretions like that, all day long, litters of fluid, without noticing it. It is when that fluid changes in composition, becomes thicker, stickier, more irritating that we call it catarrh, and we will report post-nasal drip that make us cough. **Figure 3 B** (right side) shows what happens when you get inflammation. The area is almost completely blocked off, so a helpful ENT surgeon has made a hole down, in this inferior meatal antrostomy to let the secretions drain. But unfortunately you can’t tell the cilia. So, quite often, when you look with an endoscope, you will see the secretions being beaten up, falling back, beaten up, falling back. And the whole system keeps trying to go back, via the usual route. That is why; most ENT surgeons now will operate at the ostiomeatal complex to improve sinus drainage. There are some people in whom it is better to have an operation low down, and they are the ones in whom mucociliary clearance does not work properly. In that case, the inferior meatal antrostomy can be very helpful.

**Figure 3 A**: normal sinus drainage. **B**: inflammation.

Which are the **predisposing factors**?

Certainly rhinitis, allergic, but probably much more often non-allergic rhinitis, immune deficiency can contribute, and the role of anatomical variations is probably not very high. We, a few years, ago looked at anatomical variations in patients with CRS and in normal controls, and they were no different. The incidence was not higher. So, this is a disease of the mucosa, rather more than the anatomy.

Let’s look at **infection**.
Most children will have six to eight common colds per year. And I have already told you that the changes last for six to eight weeks. So, a lot of children will have running noses simply due to having colds. Especially when they first go to nursery or first go to school and meet their peers. And also especially in the autumn, when they’ve had a long holiday, picked up different viruses, they come back in September and share these viruses. This, I’m afraid, is normal for us, and normally does not require treatment. When you have a viral cold, somewhere between 0.2% and 2% of the patients will go on and get a secondary bacterial infection. Now, that may well be cleared up either by natural immunity, or by antibiotics prescribed by the doctor.

But it is thought that in some patients, that clearance is only partial. When that happens there is continual stimulation of local immunity, the cytokine production, influx of inflammatory cells, including neutrophils, which will release their enzymes and damage the mucosa. And that leads to a further possibility, a further infection, so some patients seem to have CRS by circling round like that.

In recent year we have realized that the bacteria may not be the usual kind of bacteria which we are accustomed to dealing with. There is a thing now known as bacterial biofilm, in which colonies of bacteria are living together like sponges, they support one another, and they are also very resistant to antibiotics and to the immune system, because they make a cover over them of alginate (Figure 4). The bacteria in the middle are hardly alive at all, they are not really metabolizing, they are not demanding oxygen, but they are capable of becoming alive at a later stage, if needed. And then every so often some of these bacteria will become much more active, will become fre-swimming planktonic forms. That patient may have an exacerbation, may receive antibiotics for a week or two and begin to feel rather better, but when the antibiotic stops, these things are still there. And will cause problems later. We think this is one of the causes behind a lot of CRS.

Biofilms are actually not new. We get rid of biofilms everyday. They occur around our teeth. And we can cope very nicely with our teeth because we can get at them. And what do we do? We brush them and we throw water around them. We can’t brush our sinuses, but we can wash them out. And I think this is probably the single best measure that we have, for CRS.

The other thing about children with rhinosinusitis is that they often don’t just have rhinosinusitis. The odds ratio of their having other upper respiratory tract infections, such as ear infections and tonsillitis, is somewhere between two and three. And that suggests that it is not just that particular system that has gone wrong, but maybe the immunity is not quite up to scratch.
When we think about immunity, there are two kinds – although they work together very much. There is innate immunity, which is always present - it is first line, and it is not improved by infection – and mucociliary clearance is one of the big parts of that, and now we know about toll-like receptors, for bacteria and viruses, which are also very important. And then, built onto that, as we evolve, as we got out of the mud, we needed a stronger system and we put onto it a secondary system of antibodies and leucocytes, and that is the acquired immune system. That is second-line, it is improved by infection and it shows two major properties: specificity and memory.

Defects of innate immunity are not common, incidence of cystic fibrosis is around one in 2,500, and the incidence of primary ciliary dyskinesia is about one in ten thousand. But those children will nearly always end up in your clinics. So you do need to be able to spot them because they will have chronic ongoing disease, and they are some of the children that will need ENT help. Secondary dyskinesia is much more common. One of the things that has been noted in adults, and later in children, is that heterozygotes, with one gene for cystic fibrosis, are over represented in the CRS population. We’ve always thought that if you had one gene you were a carrier and it did not affect you. But it may be that simply having one gene is enough to have problems with sinus drainage.

I just want to say that at the moment there is no evidence that milk makes mucus more sticky or difficult. This is what all mothers do; they take their children off milk. There is no good evidence for that.

Saccharin test

That is the cheapest test in ENT (Figure 5A, B and C). What is being put in the nose? Saccharin! Yes, saccharin. It is not a very scientific test. But it can help to give you the idea of what might be going on. All you need is a quarter of a grain of saccharin, about a centimetre back inside the nose, put it just there, having asked the patient to blow the nose first. And then you sit them down quietly, ask them to swallow about once a minute, but not to drink or eat anything, not to snort, and see how long it takes for that saccharin to be taken back to the end of the throat, to the back of the tongue, where it will be tasted. And most of us will taste that in around 10 to 12 minutes; certainly practically all of us will have tasted it after twenty minutes. And if it is longer than that, think about looking into mucociliary clearance in more detail. Of course the cilia have a particular structure, and there can be abnormalities in different parts of this structure.

Figure 5A (left). Saccharin test 5B and 5C. (Middle and right) abnormalities in the cilia
Some children have abnormal microtubule and arms, some have abnormal radial spokes, and other has mitochondrial problems. There are even some now that have perfectly normal looking cilia, but they simply do not beat synchronously. There is a need to look at this carefully and count the number of abnormal ones. Now in the UK we have three centres capable of doing this rather detailed work. It is thought to be better if you can culture the cilia as a hanging drop for a few weeks before testing them. Because then you remove all the secondary influences of infection, which can, of course, make the cilia look abnormal. But that is a counsel of perfection and it is expensive.

One of the things that we now use - and which is very useful for making you think about primary ciliary dyskinesia and also for ruling it out, is measuring nitric oxide (NO) (Figure 6).

**Figure 6A** shows an adult blowing into the tube to have nitric oxide measured in his chest. It is a very useful measure of eosinophilic inflammation, if it is elevated in the chest, and we use it in children for that purpose too. You can put an attachment in the nose, suck out nasal air and measure of nasal nitric oxide. If you find that your patient has measures of less than 100, think very hard about primary ciliary dyskinesia (Figure 6B).

![Figure 6A](left). Measuring Nitric oxide. 6B (right). Nitric oxide levels in nasal disease

What we now do, if we test the patient and the reading is, let’s say, about fifty, we will decongest him and repeat the testing in 15 minutes. If it is still very low, we will treat that child for a few days with oral steroids and topical steroids and have the child come back again, when the nose is much freer, re-test and only then, if it is still low, we put them through to the ciliary biopsy stage. By doing that, we actually cut the numbers needed to investigate in detail by about two-thirds. So, those expensive investigations are no longer necessary for so many.

However, lots of other things, on our rather dirty planet, can affect our cilia. Pollution is one of them especially sulphur dioxide, tobacco smoke, infection itself, allergy actually reduces ciliary function, and interestingly, if you take a solution from middle ear effusion and put them on cilia, that damages ciliary function as well.
Figure 7A shows a normal electro-micrograph of the edge of a cilial cell. The next one (Figure 7B) is after an infection.

Some viruses decrease mucociliary clearance. That is maybe why after some viral infections one goes on to have a bacterial problem. What sort of bacteria? Well, I think you are all familiar with the fact that it is the carbohydrate coated bacteria that seem to be major problems in the upper respiratory tracts of children. Things like Streptococcus pneumoniae, Haemophillus influenzae, Staphylococcus aureus, Moraxella catarrhalis. When you try and hang on to those with immune system it is quite hard, because they have a sugar-coating and they tend to slide off the neutrophils, and you need antibodies and complement to attach them really firmly. So if you haven’t got antibody or enough complement, then you may have problems.

This is why research is called “re-search”. Because several people show the same thing over and over again. With CRS, mucociliary clearance is reduced, and it improves after antibiotics. And that has been shown by Pedersen (1992), Wilson (1986) and by ourselves (Scadding 1995), but we did three months antibiotics and in some patients. There was no ciliary beat at all at the start, but after three months of antibiotics - two weeks full-dose, ten weeks low-dose, they were all beating within the normal range. So putting the bacteria on the back foot, by knocking them with antibiotic, can help to improve ciliary clearance and help to get rid of them.

One other interesting little molecule, that helps to stick sugar-coated things onto neutrophils, especially in very small children, under the age of about two and a half, is this mannose binding protein – it is actually called mannose binding lectin (MBL) now (Figure 8).

MBL recognizes a sugar and then is recognized by the neutrophils and picked up together with the sugar-coated bacterium. Defects of MBL are not uncommon in the population. It is made up of twisted little polypeptide chains, and there are various single amino-acid substitutions so that chain cannot fold properly, and levels...
of MBL can be very low in some children. They tend to have a lot of infections when they are little; the majority of them improve around the age of three, because they develop their IgG subclasses. And the last IgG subclass to develop is IgG2, and that is directed mainly against carbohydrate coated bacteria. Again it was thought that possession of a MBL defect later in life did not matter to you, but it may do. There may be associations with infections with things like Chlamydia, and possibly also with myocardial infarction. So we are a bit more careful about what it means to have odd little defects.

You can have abnormalities with your lymphocytes, of course, and in your immunoglobulins, and the common things are IgA – one in five hundred people lack IgA, and that is the mucosal antiseptic paint. IgG or G subclasses - we have not found many of these with our children. But if they tend to have both together – and that quite often happens, IgA deficiency plus a G subclass, they do not do well. But again, this maybe a transient problem. It maybe a delay in maturation rather than an absolute defect. IgA has two molecules, back to back, held together by a J chain, and covered by a secretory component, put on by the epithelial cell, when it passes on to the mucosal surface. That helps to protect it from digestion by bacteria, as those bacteria, as part of their virulence factors, try and break down IgA. Some children seem to take a long time to make their immunoglobulins. Figure 9 shows the normal range for children going up from six months to thirty six months, and you can see that in this particular patient was not making much immunoglobulin at all until 18 months. And it was not until about two years of age, within the normal range, but about two and a half, things were looking much better. We see many children who have a lot of problems up to about their third birthday, and then they get much better. So, again, the idea of temporizing, treating them with antibiotics over the winter, if they need it, treating them carefully, is good.

In most of the world, however, secondary immunodeficiency often secondary to malnutrition, sometimes secondary to invasive infection (viral, bacterial, mycobacterial), iatrogenic problems due to corticosteroid use, immunosuppressants, phenytoin, antibiotics, hyposplenism, and things like diabetes, can be responsible for problems with getting rid of bacteria.

What about allergy? We all know allergy is incredibly common, below is the initial ISAAC study, and in many parts of the world you can see over 20% of the people, children affected, these are the ones aged 13-to-14 years. When the ISAAC study 3 was repeated in many countries in the world, allergic rhinitis is still increasing, far more than it is staying the same, or decreasing. Figure 10 shows a very simple illustration that is extremely helpful.

**Figure 9.** IgG in transient hypogammaglobulinaemia

![Figure 9. IgG in transient hypogammaglobulinaemia](image-url)
Many people think of allergic rhinitis as a very quick reaction, running, itching, sneezing, and that’s it. For some patients that’s true. It is often very true when they meet their allergen intermittently. So, the allergen is there, the B-lymphocytes and the IgE, the mast cells are covered with IgE, the allergen is re-met, and in many of those sensitized patients there will be a reaction, mast-cell mediated release, immediate symptoms. That is standard allergy. It is very easy.

But in many patients, when the allergen contact is prolonged, the arm of the response is much more obvious. And this arm, as T lymphocytes making other cytokines and pulling in an inflammatory exudate. So, what these patients complain of is not the allergic reaction that you see above. But they have got chronically blocked noses, they do not smell very well, and they have got post-nasal secretions. And that kind of swelling is often missed, and those children are sent to you, as ENT surgeons, for treatment of their turbinates or adenoid hypertrophy.

In fact, some of them will have a chronic ongoing rhinitis, to something that they are meeting all the time: house dust mite, mold, cat, mouse urine and cockroach. Again, that sort of swelling can cause these problems, at the ostiomeatal complex. And we think that allergy possibly leads to infection because of the oedema, possibly because of the increase in ICAM-1, which is what a rhinovirus latches on to, because it decreases mucociliary clearance, and because the eosinophils called in can cause very damaging molecules which reduce the ability of the mucosa to resist infection.

What about Gastroesophageal reflux (GERD)?

This is a difficult area. There is some evidence, in the Barbero study (1996), that 16 out of 22 have an abnormal pH, and 10 had a complete treatment response. Five out of 11 (Halstead 1999): (Phipps CD, 2000) 19 out of 30. Of the ones with the problem, some will respond to treatment. It is probably more relevant for the very small children, with nasal problems. It is probably worth considering this, when you manage the patient.

So, let’s move on to what we do with these patients.

First of all we take a history – it is really important to know when the
problem started, whether it is there all the time or whether it comes and goes. If it is coming and going, than it may simply be frequent colds. In most children it is helpful if you can look properly into the middle meatus with an endoscope. You certainly can in bigger children, in smaller ones it is more difficult, you might need to take swabs. You may want to do a CT scan, but it is certainly not a prerequisite. But I think you should be doing skin prick tests, you might want to do blood tests, for immunodeficiencies, and Nitric oxide is a very useful, very simple measurement. We do it in all children five and over.

**History is important.** Especially: are other members of the family affected? Because that makes you think much more of an immunodeficiency, or possibly allergy. And very important, what their environment is like? Are they in a house where both parents smoke all the time? Are they constantly exposed to tobacco smoke? Does the cat sleep on their bed? And then, what treatment they’ve had? Whether they’ve bothered to take it. And how they took it. Because a lot of children will come along and the parents will say, “oh, they’ve had this, this and this”, but when you ask them if they gave the child the medicine they say “oh, no, I didn’t like to, it was a nasal steroid, I was frightened, I didn’t use it”. So make sure what went on.

Don’t leap into the **patient’s nose; just take the time to have a careful look.** You may often see a little sign, the allergic crease, that’s from itching the nose all the time, and because the nose itches, the itchy nose makes you think of allergy. Certainly do some skin prick tests on that child. You might also see other signs of allergy. Often you will find a double crease under the eyes, the angular oculosis and eczema, facial ectasia, because the child had so many steroids on his skin.

The other thing to notice about him is **how he’s breathing.** He cannot breathe through his nose at all. It is completely blocked. So you can pick up a lot of things, by simply looking. When the child is in front of you it is also quite nice to use a cold spatula just to see whether there is a spatula mist in there. Not a great scientific test, but quite useful.

What do you think that might be (**Figure 11**)? Just looking from the bottom of the nose? It is a rather red one, it should be more greyish. It is a **polyp.** If you see polyps in a child, what test do you send them for? Sweat test. Always check children with polyps for cystic fibrosis. Not everyone will have it, but a lot of them will. So, **polyps in children: sweat test.**

**Figure 11. Nasal polyp**
The endoscope was a British invention - Mr. Harold Hopkins (Figure 12) from Wales - and it is a very neat system, giving out a small diameter, wide angle lens, looks beautifully in the dark places.

Figure 12. Mr. Harold Hopkins. The endoscope inventor

What about good old sinus X-rays? Sinus x-rays these days are discouraged. Because if you compare them with CT scans you will see sinus X-rays are giving wrong information, a lot of the time. In a study by R. Lusk, 45% of patients with normal plain X-rays had abnormal CT scans; 34% of patients with abnormal plain X-rays have a normal CT scan. So, I think forget the plain sinus X ray. It is misleading and unhelpful.

When we look at CT scans, I mentioned that one third of any group of people would be abnormal; there is no correlation between symptoms and CT scan changes. So, operate on the patient, not the scan.

And then, how do we treat?

First of all, if you find out exacerbating factors like an allergen, avoid that. Avoiding virus is somewhat difficult. But in fact a lot of virus is spread by hand. So just hand washing can make a great deal of difference. Using a tissue, and binning it afterwards. Pollution is difficult to avoid, but the parents that smoke in the home, a simple thing to do is to ask them please to give up smoking, if possible, or only smoke outside the home.

Douching. Douching is one of my favorite forms of treatment to this problem. Attention to other underlying factors, AR, immune deficiency, GERD. Reducing the inflammation by a topical nasal corticosteroid and then possibly antibiotics. This is douching, and there are a couple of studies. We did a Cochrane review recently, and saline irrigation “saline irrigations relieve symptoms, help as an adjunct to treatment and are well tolerated” (Figure 13). We can’t recommend any particular solution, dosage or delivery. And there don’t appear to be any significant side effects. It is simple, cheap and pretty safe.

As to rhinitis, if you find allergic rhinitis as an underlying factor, the ARIA guidelines are very useful. And I think you probably know all about ARIA. If you don’t, there is a Web site here to go to, it uses evidence, and they are globally based. ARIA considers co-morbidity, and ARIA classifies rhinitis in a way that
is very helpful. It is either intermittent, less than four days a week or less than 4 weeks at a time; or it is persistent, being longer than both of those; and then it is either mild, In which case it isn’t bothering the daily life; or it is moderate to severe, in which case sleep, daily activities, sport and leisure are affected, or there are problems caused at school or work or there are troublesome symptoms. The patients who are likely to have problems with rhinosinusitis are are likely to have persistent, moderate to severe allergic rhinitis.

**Figure 13. Nasal douching**

**Skin prick testing** I think is extremely useful. The patient very much likes to know what is going on.

If you look at the ARIA scheme for treatment, if you have moderate to severe rhinitis, intranasal steroid is probably the treatment of choice.

We did a trial, a few years ago now; we wanted to do a trial in children less than four year of age. We did a trial using **fluticasone propionate**, they gave a Japanese inhaler, which is much smaller and neater, and we got the children to use it . We did a double blind, double dummy study against anti-histamine. We showed that in fact the improvement, substantial or ordinary improvement, was much greater with the steroid than it was with the antihistamine.

So, **antihistamines** are not particularly effective at unblocking the nose, steroids are. If you have got problems with the sinuses you need to unblock the nose. Then you really do need to use a steroid.

Now, I just want to talk briefly on **acute rhinosinusitis (ARS)**.

**In the common cold, the symptoms should last less than 10 days.** But ARS occurs with at least two of the symptoms below, the same symptoms as for chronic, and they have to increase after five days or persist after 12 days but be gone after 12 weeks.
Sudden onset of at least TWO symptoms:
- nasal congestion /blockage;
- discoloured discharge /postnasal drip;
- reduction / loss of smell;
- facial pain / pressure (mainly unilateral).

ENT examination should include nasal endoscopy. Imaging: plain X Ray is not recommended, CT scan also not recommended, unless additional problems are present, such as very severe disease, immunocompromised patients, or signs of complications. So, that is the EPOS recommendation for acute.

The chart showed at **Figure 14** just stresses this definition: we see on the lower left corner the common cold, and then either an increase in symptoms after five days, or persistent symptoms after 10 days. This is acute rhinosinusitis.

![Figure 14. Definition of Acute Non-Viral Rhinosinusitis](image)

In recent years, there have been studies looking at intranasal steroids, in acute rhinosinusitis: steroids used with antibiotic, showing additional relief of symptoms with mometasone furoate nasal spray. So, rather against expectations, steroid helps to improve the infection. But you remember, mucociliary clearance is damaged by infection. Actually steroids improve mucociliary clearance.

So, what about **monotherapy**?

Recently there have been studies, published in 2005, with mometasone furoate nasal spray (MFNS) on its own, 200 mg a day — this is in adults — versus amoxicillin and placebo. MFNS does better than antibiotics, which is actually no better than placebo.

So, the EPOS recommendation for children with ARS do not only include antibiotic, they also include topical steroid. The combination of both topical nasal steroid and saline douching for children is very good.

In **Figure 15** we have a treatment scheme for children with ARS. Symptoms less than five days, common cold, symptomatic relief. Persistence or increase after five days, moderate - if they have asthma or bronchitis, symptomatic relief - if they are worse you can consider antibiotic and the non-severe ones, that are not toxic, antibiotic; severe or toxic, hospitalization and IV antibiotics. The dangerous
signs are all listed on the right. Eventually: hospitalizations, nasal endoscopy, culture, Imaging, IV antibiotics and/or surgery. The guidelines are accessible on the internet.

**Figure 15.** Treatment scheme for children with acute rhinosinusitis

The other thing that has been shown in the last few years after MFNS treatment is reduced adenoid size. None of these are very good studies, but in some patients, respondents (21 or 27%) had a remarkable reduction in adenoid size (Figure 16). Because the adenoid is lymphoid tissue, the steroid was also going down the back of the throat.

**Figure 16.** Mometasone furoate nasal spray (MFNS) in pediatric patients with adenoid hypertrophy. Change in the adenoid size.
MFNS also shows improvement in sleep apnea. In paediatric patients on intranasal steroids had some interesting properties, with pediatric sleep apnea. We are treating otitis media with effusion by treating rhinitis with steroids. What this says to me is that if you can keep the nose working properly, the things attached to it functions better.

You have to be very careful you are not going to harm the child with steroid. The newest intra nasal steroids (INS) have lower bioavailability. The ones I would recommend are mometasone furoate, fluticasone propionate, or fluticasone furoate.

**Be careful in children with asthma and eczema as well, because you will be putting steroids on three sites.** And you do need to monitor the child, the child’s growth.

**Anti-infective, macrolide therapy for CRS in adults**

*In vitro:*
- inhibition of pro-inflammatory cytokines eg IL8;
- 2 to inhibition of transcription factor NK-B;
- attenuation of neutrophilic inflammation;
- inhibit bacterial virulence;
- inhibit biofilm producing by ↓ quorum sensing.

*In vivo* cytokines in nasal lavage & secretion

Clinically ↓ pain, headache, postnasal drip, better quality of life, fewer exacerbations of sinusitis.

**Antifungals**

Ponikau suggests that all CRS and Nasal Polyps are fungal, based on eosinophils & fungi in mucus. But we all have got fungi in our noses. Effect of topical Amphotericin B in Ricchetti 2002 study: 39% of polyps are gone.

If fungus is the cause for CRS, the case remains unproven.

I certainly don’t think this is something that should be done in children.

Some Japanese studies suggest **macrolides work**, not particularly high-level evidence.

Remind data on mucociliary clearance, we have done a randomized trial in adults, prospective randomized trial, and effectively, the treatment with three months of macrolides, plus topical steroids was as good as symptom reduction and was as good as surgery. Using the visual analog scale (VAS) after six months and after 12 months, we had similar results both in the surgical and the medical groups, with polyps and without polyps. So, we don’t need to treat all these patients surgically, we can do just as well medically. Problem is, antibiotics very rarely cure CRS, and we are worried about resistance. So, we do need to find some other way of treating this.

One of the interesting things out of our study was that nasal Nitric oxide (NO) correlated very well with the initial CT changes, and with the improvements following treatment. We think that nasal NO is very important, it is made at levels in the sinuses that kill bacteria, virus, fungi and tumour cells. And getting nasal NO going round the system may be vital.

The other interesting thing is that the lower respiratory tract was also helped
in these patients in our study. Fortunately in our study we have monitored that carefully and we showed that by treating the upper airway, the lower one improved.

One of the messages is that we should be working always with chest physicians. **What about surgery? When do the children need surgery?**

- Antral puncture/sinus washout – nobody does them any more.
- Endoscopic sinus surgery – sometimes, but not often.
- And possibly adenoidectomy / tonsillectomy – possibly, in younger children.


About tonsillectomy, there are some trials, the pooled risk difference, and half an episode per year if you undertake a tonsillectomy.

**DO be careful about the midface.** These are twins (Figure 17). And the one who had the injury when he was young is the one who does not look like Leonardo di Caprio today. So, be careful about midfacial surgery in children.

![Figure 17. Before and after nose surgery.](image)

One of the things that happen when you have inflammation of the lower sinuses is that the lower airway is also affected. Many years ago Rachelefsky showed in this paper that children with rhinosinusitis have symptoms that are just like those of asthma. But when you treat their sinus properly, in many of those children, those symptoms go away. So again, a lot of lower respiratory tract symptoms may actually relate to the upper airway.

So, what I have told you is that CRS is heterogeneous, we do need research on well characterized subgroups, particularly in children, paediatric CRS will resolve with growth in many of them, inflammation and infection are both relevant, medical treatment is as effective as surgery in adults, and surgery rarely needed in children. What the EPOS says, about what we should be using. Saline douching YES, topical corticosteroid YES, but small effects from antibiotics and therapy for gastro-oesophageal reflux when necessary.
Figure 18 shows the plan that you can find at Fokkens W, Lund V, Mullol J, on behalf of the EP3OS Group. European Position Paper on Rhinosinusitis and Nasal Polys. Rhinology 2007;45 (suppl 20):1. Also at: http://www.rhinologyjournal.com

Figure 18. Treatment scheme for children with chronic rhinosinusitis (EPOS)

References


