Chapter 18: The catarrhal child

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The period of a child's development between the ages of 4 and 8 years, is often described as the catarrhal stage. This is because of the increased incidence of upper respiratory tract infections which is associated with the start of schooling. The otolaryngologist will spend much of his time advising the parents of normal children with these infections and it is his job to provide reassurance and to prevent unnecessary surgery, at the same time treating those whose life is handicapped by their nasal problems.

While excessive or apparently excessive mucus normally occurs between these years, it may be present from birth and continue throughout adolescence. Mucus hypersecretion is rarely found alone but is frequently associated with other nasal symptoms, particularly blockage, which may be real or apparent. It is important to evaluate all the nasal symptoms, signs and investigations, in order to give a working diagnosis and to tailor the treatment effectively. It is pointless to perform multiple nasal operations for a problem such as the immotile cilia syndrome. Children should be grouped into those who are handicapped but essentially normal and those who have a persistent underlying pathology such as allergy, cystic fibrosis and immotile cilia syndrome.

Social conditions have an effect on a child's response to illness. If they are poor and the diet inadequate, a child's resistance will be lower. Parents may also not be concerned that a child cannot clear his nose. Passive smoking may irritate the nasal mucosa in children whose parents smoke.

A rational approach will produce effective treatment and this chapter will be orientated along these lines rather than describing all the syndromes which may cause mucus hypersecretion (Table 1.1).

Protective function of nasal mucus

The word catarrh is derived from the Greek and means to 'flow down'. In essence it is the increased production of mucus in the upper respiratory tract and it most frequently follows infection and allergic reactions.

Mucus is the product of secretions from the nasal glands, the goblet cells and transudation from the nasal vasculature. The anterior serous glands provide little to the main secretions of the nose. Mucus contributes to all the nasal functions. It covers the nasal mucosa and provides a very effective protection from the environment. It helps physiologically to humidify the air during respiration and it aids in the transport of olfactory molecules to the special sense organs which monitor smell. Its protective function will be considered further.

Mucus is a complex substance which coats the surface of the nose and is propelled backwards by ciliary action to the nasopharynx. Mucus has two definable layers: the outer more viscous layer is above the cilia and underneath is a watery layer in which the cilia move. Abnormality or deficiency may be found in mucus or in the cilia and result in the breakdown of protection which may be temporary or, in more severe cases, permanent.
Table 18.1 The main causes of a catarrhal child

Infective rhinitis
   acute viral (recurrent)
   acute bacterial

Sinusitis
   secondary to infective rhinitis
   secondary to allergic rhinitis
   cystic fibrosis

Allergic rhinosinusitis
   inhaled
      pollinosis
      moulds
      animal danders
      house dust mite, etc
   ingested
      animal proteins (milk)
      eggs
      additives (colourings and preservatives)

Structural
   trauma
   small nasal size (Down's syndrome)
   septal deviation
   posterior choanal stenosis and atresia
   adenoids
   tonsils
   high arched palate

Mucosal abnormalities
   abnormal mucus (Young's syndrome)
   immotile cilia (Kartagener's syndrome)
   exocrine glands (cystic fibrosis)

Immune deficiencies
   IgA and IgG subclasses.

Constituents of mucus (Table 18.2)

As nasal mucus has been little studied, much of the work on it is conjectural resulting from studies of the lower airway (Widdicombe and Wells, 1982).

Table 18.2 Constituents of mucus

Water and ions from transudation.
Glycoproteins: sialomucins, fucomucins, sulfomucins.
Enzymes: lysozymes, lactoferrin.
Circulatory proteins, complement: macroglobulin, C reactive protein.
Immunoglobulins: IgA, IgE, IgG, IgM, IgD.
Cells: surface epithelium, basophils, eosinophils, leucocytes.
Glycoproteins

There are three main groups of glycoproteins produced by the goblet cells - the sialomucins, fucomucins and the sulfomucins. The sialomucins have some antibacterial activity over and above their contribution to the physical characteristics of mucus which provide a mechanical barrier.

Enzymes

Mucus contains a variety of enzymes and the lysozymes are particularly important. Lysozymes are produced locally from the glandular tissue and from tears which pass down the nasolacrimal duct into the nose. The cells which are present in the mucus may contribute to the production of lysozymes, particularly macrophages and polymorphs. Lysozymes may be both bactericidal and bacteriostatic and act also with more specific systems such as complement activation and IgA-mediated immune reactions. The other main enzyme is lactoferrin which is produced by serous cells in the glands. Its mode of action is to remove iron ions from mucus and it is bacteriostatic particularly for staphylococci and pseudomonas. It is not present in serum. There are a number of other antiproteases and macromolecules which may affect bacterial colonization of the nose.

Complement

All members of the complement cascade system are found in mucus. Reactions may be triggered specifically by immunological reactions and non-specifically by non-immunological reactions. The immunological reactions require time, whereas non-immunological reactions are immediate. Both pathways act on C3 which is produced mainly in the liver, but is also found in macrophages, and the reactions cause a variety of cellular and mucosal changes. Bacterial lysis can be produced by both pathways through the action of C9. Fragments C3a and C5a act on mast cells and the resulting inflammation causes transudation of plasma protein, chemotaxis of leucocytes, activation of mast cell degranulation and phagocytosis.

Specific immunological substances

The immunoglobulins and interferon are found in nasal secretions. All the immunoglobulins may be produced locally but IgA and IgE are the main types in the surface epithelia.

IgA

This is the specific immunoglobulin for mucosal surfaces and is produced throughout the respiratory and gastrointestinal tracts. IgA is divided into two subtypes IgA1 and IgA2 but both will be considered together here. Nasal IgA is produced by plasma cells in the lamina propria and it is also derived from the circulation. Levels in nasal secretions are well above those of sera and show that most is produced locally. In the mucus the immunoglobulin is a dimer of two IgA molecules which are connected by a junctional chain. When it passes through the surface epithelium and glands a secretory piece is attached. The molecule is stable.
in mucus and forms an insoluble complex with antigen. The complexes are transported backward, swallowed and then destroyed in the stomach.

**IgE**

Levels of this immunoglobulin are much lower than the other classes. IgE is produced locally and is usually considered in the light of its allergic reactions which are pathological. IgE is firmly attached to the tissue mast cell and circulating basophils and two molecules of allergen-specific IgE must be located on adjacent receptor sites in the mast cell for degranulation to occur. Degranulation has two phases - the immediate, when preformed elements in the granules such as histamine are released, and the delayed, when arachidonic acid is mobilized from the cell membrane into the prostaglandins and leukotrienes. Although mast cells and circulatory basophils are found in mucus, mast cells and occasional basophils are mainly subepithelial and thus require allergen to penetrate the epithelium in normal individuals to mount a response.

**IgG**

This group of four subclasses is produced mainly in the lymph nodes and levels in mucus are below those found in sera. Plasma cells which produce IgG are found in nasal tissue and numbers increase during infection.

**IgM**

This is a large less specific macromolecule which can be produced locally but is mainly present as a result of diffusion. It is produced first, before the IgG specific to the allergen, is fabricated.

**Cells in mucus**

A variety of cells are present in mucus. Epithelium is continually being sloughed off and debris is particularly frequent. Infection increases the rate of turnover and other cells are found more frequently at that time. Macrophages, polymorphs, mast cells, basophils and eosinophils may be seen when mucus is stained. Numbers of each cell type vary and no cell type is diagnostic when encountered in a nasal smear. The value of nasal smears is considered later.

**Conclusions**

Mucus and its constituents give the respiratory tract its first line of defence. When it is penetrated the subsequent inflammation results in mucus hypersecretion which is an attempt to achieve homeostasis. The viscosity of this mucus will vary from normal depending on the different proportion of mucins present (which account for 80% of the viscosity and elasticity) and the cellular components of their products.
Microorganisms in the nose

The normal nose is not sterile and great care must be exercised when bacterial cultures are taken both from the nose and the paranasal sinuses. The main problem is to decide when an organism is truly pathological. Most information has been obtained from the anterior nares and the postnasal space; there is little information on the nasal passages. Unless technique is meticulous the postnasal swab may reflect organisms encountered in transit.

The normal nasal vestibule in a child is more frequently colonized with staphylococci, diphtheroids and Gram-negative bacteria. The nasopharynx has streptococci, *Haemophilus influenzae*, staphylococci, Gram-negative bacteria and occasionally the meningococcus. These organisms are found to a lesser extent in the normal adult. A balance exists between the organisms cultured and nasal defences. If this is lost, infection will occur as is frequently seen following a cold or in otitis media in children (Gwaltney and Hayden, 1982).

Clinical symptoms

Anterior and posterior nasal discharge

The most prominent feature of the catarrhal child is an anterior nasal discharge. It is usually bilateral and the age of onset will give some indication of the underlying pathology. It is unusual to start in the first year of life and early onset suggests a structural problem or major deficit in nasal protection. It most commonly starts around 3 years of age or later and is frequently worse in the winter when upper respiratory tract infections are more common. Normally, a child will be able to breathe through the nose to some extent even when it is severely blocked by adenoids. The presence of bubbles in the mucus on respiration indicates a patent airway. A unilateral discharge with no evidence of an airway suggests unilateral choanal atresia. Bilateral choanal atresia presents soon after birth and does not present problems with later diagnosis. Unilateral discharge with airflow should indicate the need for a full examination to exclude a foreign body, because, sometimes unknown to their parents, younger children put objects in their ears and noses.

Mucus is usually white or off white in colour and a change in colour can indicate infection. It is an error to assume that all yellow or green mucus is infective. Large numbers of eosinophils will colour the mucus yellow or light green. If infection is to be diagnosed and mucus evaluated correctly then a culture should be taken and a smear made of the material. It is a very easy and a frequently made mistake to dismiss children with greenish secretion and abnormal sinus radiographs as suffering from sinusitis and then to submit them for surgery. Results are unimpressive because allergic reactions may well be at the root of the problem particularly since a large number of children suffer from allergic diathesis.

Frequent colds with a greenish discharge do suggest infection which is usually a secondary bacterial infection and probably colonized from the organisms normally resident in the anterior and postnasal space (*Table 18.3*). It is unfortunate that many children make no effort to clear their noses and so the infection persists for longer than is necessary. Usually such children are not distressed by their nasal condition and cope perfectly satisfactorily at school. They have no demonstrable airway obstruction and surgery is inappropriate. The upper
respiratory tract infections which start around the onset of schooling may be very frequent and distress the parents. They may be improved surgically if the child is handicapped for more than 2 years and has airway obstruction.

If the discharge is associated with nasal irritation, eye problems, eczema or asthma, it is probably caused by an allergic diathesis. Children either rub their noses upwards or sideways depending on habit. Similarly they can cause traumatic epistaxis by putting their fingers up their noses to relieve the irritation and to improve the nasal congestion. Cautery does not solve this problem except temporarily.

The natural ciliary action should clear the mucus backwards. An anterior discharge when the airway is patent either indicates excessive mucus with which the normal mechanisms cannot cope or impaired ciliary mobility.

Postnasal drip is much more common in adults: this may be because children do not complain of the problem. Parents will complain that the child is often full of catarrh, snorts, sniffs or clears his throat. The mucus hypersecretion may be present in the pharynx and trachea and produce a chronic cough. There is no evidence that nasal mucus flows down into the larynx and the trachea. Adenoidectomy has not been shown to improve a chronic cough.

**Nasal blockage**

Nasal blockage is frequently encountered in children and it is up to the surgeon to determine whether the blockage is real or apparent. Young children do not complain of nasal blockage and usually it is only significant if the child has problems eating and persistent snoring. Snoring may be present even when the airway is apparently satisfactory. The problem is caused by the tonsils prolapsing backwards at rest. This may only become apparent during induction of anaesthesia, and is easily overcome by the insertion of an oral airway. Blockage may fluctuate or be seasonal and even young children may develop hay fever. A considerable number of children have apparent blockage and this can be demonstrated easily with a metal spatula which shows a normal misting pattern and thus prevents the unnecessary removal of a child's adenoids. Some children will have an exaggerated nasal cycle and the blockage will fluctuate. If in doubt a lateral radiograph of the postnasal space will indicate the size of the adenoids.

**The nasal cycle**

The nasal cycle is easy to demonstrate in adults and occurs every 4-12 hours (Kayser, 1895). Roughly, the overall airflow is constant for both sides when added together but varies from side to side. It is easily suppressed by exercise, emotion, infection and medication. The effect of infection is temporary. The cycle is more difficult to demonstrate in children but there is evidence to suggest it does occur in the majority of children (Cawenberg and Deleye, 1984). It is important to bear this in mind when examining a child's nose because the cross-sectional area is small. Any structural abnormality such as a slight septal deviation will cause complete blockage at times. Treatment to cure the nasal cycle will end in failure.
**Epistaxis**

Nose bleeds are common in children and it is assumed generally that these are the result of congested or abnormal vessels in Little’s area. Children with chronic rhinitis have nose bleeds simply because they traumatize the nasal mucosa with their fingers while trying to stop the irritation. Crusting and picking also cause trauma and bleeding. It is pointless to cauterize such noses and control of the rhinitis solves the problem. Sprays may also dry the mucosa excessively and cause bleeding; in particular freon propellants have been implicated.

**Pain**

Children do not tend to complain of maxillary or facial pain. Its absence is similar to lack of symptoms in otitis media where children may have an acute episode with apparently little pain. Anatomically, the sinuses are smaller or absent and so may not produce as much in the way of symptoms as in adulthood.

**Sneezing**

The most frequent cause of repeated sneezing is allergy. Children suffer both irritation and sneezing and tend to rub their noses. Sneezing is associated with foreign bodies, viral rhinitis, chemical and other irritants. Older children may have fake sneezing and apparently sneeze for weeks. It is an hysterical symptom comparable to aphonia.

**Anosmia**

Children do not complain of anosmia and parents are unable to gauge how well a child can smell because they rarely notice any problem.

**Halitosis**

Bad breath results from excessive mucus, infection in the nose and paranasal sinuses, from nasal blockage and secondary obstruction by the tonsils and adenoids, and is usually worse in the morning. Parents frequently complain about this condition. Treatment depends on the underlying problem.

**General health and development**

When any child who is catarrhal is assessed it is most important to evaluate the general health, social skills and development of the child. If a child is healthy, socially adjusted and performing well at school there is little that probably needs to be done apart from reassuring the parents. Nasal and upper aerodigestive problems may cause severe educational and social problems and debilitate a child so that he or she does not grow well. These children need prompt action which is frequently surgical if they are to develop their full potential. The ill child needs to be assessed carefully to ensure that there is no more serious pathology underlying the cause of his upper respiratory problems.
Examination

An overall assessment of the child will show if there is any developmental syndrome which may be associated with nasal problems, such as Down's syndrome. The general size, development and facial features should be evaluated.

It is most useful clinically to divide children into those who have nasal symptoms, particularly anterior discharge with nasal obstruction, and those who have a patent airway. It is pointless giving inhalational sprays to completely obstructed noses. When children suffer from nasal obstruction, the doctor should have the site of obstruction clearly in his mind by the end of the consultation. Obstruction may be a consequence of the size of the nose, the anterior nasal valve, the turbinates, septum, foreign body, the posterior choana, the postnasal space, and finally the oropharynx and palate. Once the level of obstruction is known then the decision has to be made whether the obstruction is the major symptom or if it is secondary to an underlying problem which, when cured, will relieve the obstruction.

The nasal airflow can be assessed very simply and objectively by asking the child to breathe through the nose and by watching the misting pattern on a nasal spatula. Many children who mouth breathe will have no nasal obstruction and the habit has been picked up following previous episodes of obstruction. Children will continue to mouth breathe after adenoidectomy but the symptom eventually will resolve.

The thumb can be used to turn the tip of the nose upwards and because the structures are so elastic a metal speculum is rarely needed. The secretions, septum and turbinates and colour of the mucosa may be assessed.

Secretions

Secretions may be obvious at the time of examination and are either unilateral or bilateral. They may be profuse or scanty, mucoid or clear. If they are infected or if an eosinophilia is present they may be yellow or green. Often the secretions are not present at the time of interview. They may be confined to the nasal passages or may be seen to originate from the middle meatus. If the secretions come from the middle meatus then the maxillary sinuses are involved. When the oral cavity is examined, mucus may be seen in the postnasal space.

Intranasal examination

Besides the airflow and secretions, it is important to examine the mucosa and the nasal structure. The mucosa may be normal, congested or hypertrophied and its colour may vary from bright red to deep blue. The septum, lateral cartilages, turbinates and postnasal space should be examined. The postnasal space is frequently difficult to examine in younger children and the child should not be upset by any medical procedure if at all possible.

It is possible to obtain some idea of structural obstruction and it may be caused by previous nasal trauma resulting in nasal or septal deformity. The anterior nasal valve may be small and the nose generally smaller. Polyps are unusual and if present in the infant may be caused by herniation or ectopic tissue from the anterior cranial fossa. Polyps in older children
should be investigated to exclude cystic fibrosis. An antrochoanal polyp may be seen and is associated with an opaque maxillary sinus radiograph. It may be possible to determine the presence of choanal stenosis, but usually this requires general anaesthesia. Unilateral choanal atresia may be diagnosed radiologically when radiopaque dye is placed in the nose. A computerized tomographic scan will show whether the obstruction is membranous or bony. The remaining examination will show if the adenoids and tonsils are contributing to nasal obstruction and adenoid enlargement may restrict palatal movement. The soft palate may also be poorly developed and the hard palate highly arched restricting the nasal size. Syndromes such as Down's, are associated with small noses, large tongues and such children are catarrhal.

The examination will give four different parameters which may be assessed in making the diagnosis and initiating the subsequent treatment: the airflow, the nature and extent of secretions, the state of the mucosa, and the structure of the nose itself.

**Investigations (Table 18.4)**

Many children require no investigation to evaluate their nasal problems. The following investigations may be of benefit in selected cases.

**Table 18.4 Investigations for the catarrhal child**

Full blood count and differential white count.
Serum immunoglobulin, IgA and IgG subclasses.
Complement levels.
Radioallergosorbent test (RAST), allergen specific IgE.
Radiographs of the sinus, postnasal space and chest.
Ultrasound of the maxillary sinuses.
Nasal clearance.
Nasal smears.
Skin tests.

**Blood investigations**

A full blood count will demonstrate acute infection, anaemia or eosinophilia which may be present occasionally in gross allergic disease. Recurrent infections may be a consequence of leukaemia or more rarely immune deficiency. If the latter is suspected then the serum immunoglobulins may prove useful. A temporary deficiency may occur during some infections so any abnormal result requires confirmation. Any obvious medical problem should be corrected before surgery is contemplated. Total and allergen specific levels of serum IgE may be helpful occasionally in difficult allergic problems or if the diagnosis is unclear. Unfortunately there is considerable overlap in the levels of total IgE between the normal and allergic patients. The radioallergosorbent test which is allergen specific is of more value in cases where multiple skin tests are positive or food allergy is suspected.

**Radiology**

Routine sinus radiographs including the postnasal space may be of value, particularly when there is some degree of nasal obstruction. The relative size of the adenoids may be
determined and this helps when the nasal mucosa is congested as a result of secondary stasis of secretions. Unfortunately, one-third of all children have some degree of mucosal thickening of the maxillary antrum which makes interpretation difficult. Assessment should be made of the development of all the sinuses, the bony walls, the presence and degree of mucosal thickening and fluid levels. A completely opaque sinus suggests a significant problem. In the older male an angiofibroma may cause anterior bowing of the posterior wall of the maxillary sinus. If bony erosion is suspected then computerized tomography is needed. Any suspected neoplasm or anterior cranial fossa defects also require computerized tomography to be undertaken.

A normal sinus radiograph does not exclude maxillary sinusitis if mucopus or pus is seen to originate from the middle meatus. The necessary steps should be taken to exclude infection by proof puncture.

A chest X-ray may show changes of bronchiectasis, and dextrocardia which is associated with ciliary abnormalities.

**Transillumination and ultrasound**

The vogue for transillumination of the maxillary sinuses with an oral light source has now passed. The subject was studied in a darkened room, the side with less light suggesting more antral disease. Unfortunately, there are too many variables such as different tissue thickness, bony development, teeth development and inter- and intrasubject variability for any reliability to be placed on the results.

Ultrasound now occupies the place of transillumination. There is little published work confined to children, but studies of adults show it to be no better than radiology for patients with chronic sinus disease (Pfleiderer, Drake-Lee and Lowe, 1984). It gives far less structural information and its only theoretical advantage is the lack of a minute dosage of radiation.

**Nasal clearance**

If ciliary abnormality is suspected, the simplest test of nasal ciliary clearance is the saccharine transit time. It has been thought to be unreliable but when performed by someone familiar with nasal anatomy and able to use both hands to examine a patient, it is reproducible. The saccharine should be placed behind the first 1 cm of the inferior turbinate. Only a small particle is used and the time taken for the patient to notice a sweet taste is noted. The usual interval is under 20 minutes. Older children will be able to undertake the test, and it is possible to perform it on 5 year olds and sometimes on 4 year olds (Andersen et al, 1974).

**Nasal smears**

The value of nasal smears is underrated in the UK. Mucus may be collected by blowing out or mopping the inside of the nose and smearing the swab on a slide. When fixed and stained the slide may be evaluated to see the number of eosinophils, polymorphs, leucocytes, basophils and epithelial cells. The presence of polymorphs and leucocytes indicates infection whereas eosinophils indicate either allergy or rhinitis. Its value lies in
helping to categorize nasal disease and preventing unnecessary surgery. It also requires someone who is experienced at examining the films.

**Skin tests**

Many parents are worried that allergy may be responsible for the symptoms in their child. Skin tests by the prick method are simple to perform, cause no significant morbidity and, if negative, help reassure parents. The tests provide a simple working classification by categorizing patients into two groups: those who are atopic and liable to have allergic reactions and those who are non-atopic where allergy is much less likely. While they give limited information on the nature of the allergen they demonstrate the type of reaction occurring in the nose and are useful when counselling parents.

**Differential diagnosis**

The causes of nasal symptoms are many, only the common and more frequently found of the rarer causes will be discussed. Although the causes may be divided into congenital or acquired ones, the approach used here will consider the different areas from which disease may arise, such as infection, allergy, structural variability and abnormality, and finally mucosal abnormalities (see Table 18.1).

Two causes may coexist in the same child, for example an allergic child may suffer from recurrent viral rhinitis.

**Infective rhinitis**

There are a large number of viruses which can cause infective rhinitis and rhinoviruses have many different antigenic serotypes. The main groups are rhinoviruses, coronaviruses, respiratory syncytial virus, influenza and parainfluenza viruses, enteroviruses, and adenoviruses. All except the last are RNA viruses. Adenoviruses may chronically infect the lymphoid tissue of children and may explain some chronic symptoms in the absence of any response to antibiotics. The most common cause of chronicity is recurrent infection. Viral infections lower the normal nasal resistance to bacterial invasion, thus a secondary bacterial infection may develop. It can become persistent in the nose and sinuses. Infection causes mucus hypersecretion, and as a result of prolonged infections a child becomes catarrhal, particularly if adenoidal hypertrophy is marked and prevents the free drainage of mucus posteriorly. Unfortunately, recurrent viral infections do not respond to treatment and there is a great degree of variability between individuals and their susceptibility.

If the adenoids are causing problems because of obstruction then removal will help to resolve the prolonged catarrhal stage.

**Sinusitis**

Perhaps the most overworked diagnosis in current otolaryngological practice is chronic bacterial sinusitis. Undoubtedly in the preantibiotic era it was a common entity and was associated with poor nutrition and social conditions. It is similar in this respect to recurrent acute otitis media and mastoiditis. Mucosal congestion, oedema and mucus hypersecretion
may affect the sinuses as well as the nose, but unless the ostia of the sinuses are blocked for a prolonged period, infection will not persist. The contents of the sinuses are rarely purulent on wash out and no studies have shown conclusively that surgical enthusiasm in the sinuses is effective in hastening resolution of the mucosal changes.

*Allergic rhinitis*

Although rhinitis can be caused by a large number of allergens a simple classification can be devised if the allergens can be identified from the history and investigations. Three main groups of inhaled allergens are:

1. grass and tree pollens and moulds;
2. animal allergens;
3. the perennial allergens, house dust mite, its faeces and moulds.

Ingested allergens such as food additives and dyes, and milk products may also cause nasal symptoms and diagnosis is by exclusion and re-introduction into the diet. Treatment is by avoidance and, in selected cases, topical nasal medication, systemic therapy and, in a very few cases, surgical procedures.

*Non-allergic or vasomotor rhinitis*

This condition is less common in children, but in some there is an eosinophilia in the nasal secretion in the absence of any allergen. The condition is sometimes labelled non-allergic rhinitis with eosinophilic secretions (NARES!). All that can be said is that non-allergic rhinitis probably comprises a miscellaneous collection of entities. If turbinate obstruction is the major problem then these patients may be best treated surgically.

*Structural variation and abnormality*

Considerable variation of nasal size is encountered both within and between racial groups. The smaller the nose the more likely obstruction becomes. Change in diameter will cause symptoms and in a certain number of children it will be the main contributing factor. The smallest cross-sectional area is the external nasal valve, trauma will cause trouble if the septum is dislocated or a haematoma develops and organizes. The child's nose is smaller and more malleable than the adults and is also more resistant to trauma.

Although the anterior diameter is smallest, posterior stenosis or atresia will cause stasis of secretions. If atresia is bilateral it presents at or soon after birth. Unilateral atresia may not be diagnosed until the early teens. Adenoids, if grossly enlarged, will block the posterior choana as will hypertrophy of the posterior ends of the turbinates. An antrochoanal polyp will block both sides of the nose if very large.

Palate size and mobility may cause symptoms, and this may be a problem in Down's syndrome. Children with Down's syndrome have nasal symptoms for a variety of reasons
including small nasal size, increase in connective tissue bulk and a large tongue which restricts palate movement. The problem is refractory.

**Mucosal abnormalities**

Nasal disease may result from abnormalities of the protective mechanisms. The commonest faults are immotile cilia, exocrine gland abnormality and immunodeficiency. They are not found frequently and may be overlooked.

Temporary ciliary paralysis occurs with acute infection but quickly reverts to normal. In chronic infection it may be difficult to determine whether paralysis is primary or secondary. The abnormality involves both the nose and the paranasal sinuses. The value of the intranasal antrostomy has been questioned as a result of ciliary motility studies in the normal sinuses: it must be remembered that ciliary paralysis is one of the first mucosal abnormalities in infection, and this invalidates these studies. Stasis of secretions with ciliary paralysis causes the maxillary sinus to act as a sump. Treatment by either indwelling cannulae or antrostomy may well aid resolution.

**Immotile cilia syndrome**

This was first described by Kartagener (1933) and it is now seen to be related to a primary ciliary abnormality. The internal ultrastructure of the cilia is responsible for activity. A central pair of microtubules is surrounded by nine similar pairs which are connected by dynein arms. The central microtubules are connected to the peripheral pairs by radial spokes and the dynein arms are arranged in inner and outer pairs. An inherited lack of intracellular ATPase is the cause of immotile cilia in those where there is no obvious ultrastructural deficit. In severe cases marked abnormalities of the microtubular system are seen.

The syndrome may present as infertility, with immotile sperms, sinusitis and bronchitis, and situs inversus in one-half of the cases. A chest X-ray is useful in diagnosis.

Patients can present from infancy onwards and any child who has had mucopurulent nasal discharge for a long time, particularly if there is no obvious nasal obstruction, should have chest and sinus radiographs taken. If the radiograph is normal and the child is old enough ciliary clearance and biopsy of the inferior turbinates may be carried out. Material is best fixed for electron microscopy in glutaraldehyde 2.5% with magnesium phosphate buffer (Fox, Bull and Arden, 1980). Ciliary abnormality is frequently observed in normal nasal mucosa and so over one-half of the cilia should be abnormal.

Treatment of the condition is difficult. The maxillary antrum acts as a sump and drainage may be required. Removal of the mucosa will rarely produce any more than the most temporary benefit. A long-term patent antrostomy is difficult to achieve in children.

The rhinosinusitis and bronchitis occur together and treatment of the sinus appears to have little effect on the chest. Vigorous antibiotic therapy will improve both conditions and long-term therapy may be required.
Young's syndrome

Sinusitis, bronchitis and infertility result from abnormally viscous mucus. The condition is similar to Kartagener's syndrome but spermatozoa are mobile and ciliary activity is normal unless destroyed by recurrent infection.

Cystic fibrosis

One-third of children with cystic fibrosis have nasal symptoms and under 10% develop nasal polyps (Schwackhman et al, 1962). In mild cases, nasal polyps may be the first sign of the disease. They are rare in children under 10 years of age and when seen, children should have cystic fibrosis excluded by a sweat test. Mucopurulent rhinorrhoea is the commonest symptom and is associated with blockage. The endocrine glands produce an abnormal mucus which does not give the usual protection and leads to recurrent infection.

Radiographs of the sinuses are abnormal in virtually all children with cystic fibrosis. Culture of wash out material is sterile or similar to those organisms usually encountered in the sinuses. There is no correlation between bacterial culture from the sputum and those from the sinus which indicates that the sinuses do not constitute a reservoir for chest infection.

Glue ear is no more frequent than to be expected for the general population and argues against the belief that sinus disease predisposes to glue ears (Taylor, Evans and Hope, 1974).

Treatment of cases is symptomatic and conservative, extensive sinus surgery has not been shown to be of any benefit in children with severe recurrent nasal polyps. If mucosal disease is severe and occurs before the symphyses are fused, the pressure in the ethmoids results in expansion in the base of the skull and so hypertelorism will be produced.

Glue ear (otitis media with effusion)

Glue ear is frequently called catarrhal otitis media. Changes in the respiratory mucosa of the middle ear cleft result in goblet cell hyperplasia and the prolonged presence of mucus in the middle ear cleft. Its pathogenesis and management is considered elsewhere (Chapter 12).

Treatment

The treatment of the catarrhal child depends on the underlying cause. Many children will not be easily classified and so a general approach to treatment is required.

Although many medical practitioners feel that chronic rhinitis is trivial, it causes morbidity and distress to children and parents. Children will put up with symptoms which are treatable and the general ill health may affect schooling and subsequent achievements. The first goal is to determine which children require treatment and which parents have difficulty in coping with normal children.

Chronic rhinitis may be divided conveniently into three types - allergic, non-allergic and infective - which may be found singly or in combination.
**Allergic rhinitis**

**Avoidance**

The inhaled allergens can be avoided to some degree. Domestic animals should be excluded from the sleeping area if symptoms are trivial or removed from the home altogether if severe asthma coexists. It may be possible to minimize seasonal allergic symptoms by keeping the child indoors and the windows closed. Children who are sensitive to house dust mite can have their lives made a misery by excessive allergen avoidance. Changing the bedding, vacuuming the mattress weekly and covering it with polythene reduces the contamination of allergen.

Food allergy can cause problems, but although it is a fashionable diagnosis, it is difficult to prove and can only be satisfactorily diagnosed by removing the suspected allergen from the diet and reintroducing it after a period of 2-4 weeks. Diets may be worth trying if the parents are willing, the rhinitis does not have an inhaled allergic element and is non-infective. Books on diets are available but the allergens can be simply grouped into areas - milk and its products, eggs, animal meat proteins and finally dyes and added preservatives. Certain products advertise the lack of colouring and preservatives and if in doubt books can be bought listing all the E numbers used for identifying additives; for example E102 is tartrazine. Very occasionally spectacular results are achieved if one of these major groups is excluded from the diet.

**Desensitizing**

The only allergen which has been shown to be effectively controlled by desensitization is mixed grass pollen. There is a definite risk of anaphylaxis and so adrenaline, corticosteroids, and antihistamines should be available when desensitizing injections are administered. Desensitization should only be given to older children and to adolescents. Dust mite desensitization has no proven place in management and is not used by the author.

**Non-allergic rhinitis**

**Topical medical treatment**

Both allergic and non-allergic rhinitis respond to topical medical medication. Children under the age of 5 years do not comply well with sprays or nose drops.

**Vasoactive compounds**

These are of use occasionally in recurrent acute infection, unfortunately they are freely available and, although not subject to the same misuse as in adults, may cause rhinitis medicamentosa.

**Corticosteroids**

Corticosteroids may be used after the age of 5 years and have not been shown to have any side-effects even if used for up to 3 months. A 3-month trial may cause a break in the
cycle of congestion and secretion and resolve the rhinitis completely. The same sprays may be used as in adults, for example flunisolide and beclomethasone. The dose should be halved for younger children.

**Sodium cromoglycate**

This may be tried for the treatment of non-allergic and allergic rhinitis but its main disadvantage is the need for application four times a day. It has the theoretical advantage of being free from the side-effects that corticosteroids may induce.

All spray should be given one week before the presumed start of the hay fever season since this gives better control. If patients have nose and eye symptoms it is preferable to use two topical medications than an oral antihistamine.

**Systemic medication**

Systemic medication may be divided into decongestants, antihistamines, mucolytics and antibiotics. Apart from antibiotics which have a distinct role in infection, there is little evidence that other medications have a proven place in the management of the catarrhal child. Pressure from parents ensures that they are widely prescribed. If the child has an allergic history the antihistamines may be useful in some cases. There are no guidelines on when and how to prescribe decongestants, mucolytics and antihistamines and personal choice plays a large part in therapy. Except in the severest cases the author does not prescribe any medication, and usually starts with a decongestant followed by a combined preparation which includes an antihistamine. There are virtually no indications for systemic corticosteroids in younger children although they may improve nasal symptoms dramatically.

**Antibiotics**

Antibiotics are widely and indiscriminately prescribed to children with nasal symptoms. Unless there is a diagnosed disease such as cystic fibrosis, mucociliary abnormality or immunodeficiency, antibiotics should be withheld in the first instance.

Since the anterior nares harbour bacteria in health, nasal swabs are of limited value. A nasal cytology smear gives more reliable evidence of infection. Despite parental pressure to prescribe, most mucoid discharge is not infective and there is no evidence that antibiotics help in this condition. A persistent profuse bilateral green discharge in the absence of allergy should be treated with broad spectrum antibiotics for 10 days. Other factors such as poor housing, and nutritional and social factors may be more important in the perseverance of symptoms.

Systemic antibiotics may be required in chronic disease states and may help prevent chronic sinusitis and irreversible lung disease in patients with mucociliary abnormality.

**Surgery**

Unfortunately much unnecessary surgery is performed in children, and often on an *ad hoc* basis before the surgeon is clear in his own mind exactly why the child is having
symptoms. The indications for adenoidectomy and tonsillectomy are discussed elsewhere in this volume as is surgery for other problems such as choanal atresia.

Chronically hypertrophied inferior turbinates respond to submucous diathermy if the child is not allergic. Some surgeons prefer to trim or remove turbinates.

Unless there is major nasal deformity following trauma, the septum should not be corrected or resected since deformity will be increased during the pubertal growth spurt.

Infection of the maxillary sinus may be improved by irrigation and the insertion of indwelling cannulae. The intranasal antrostomy is of limited value since it will be closed within 12 months.

**Conclusion**

The catarrhal stage is common and many children outgrow it without any treatment. The place of the otolaryngologist is in recognizing those patients who are abnormally handicapped or who have an underlying abnormality. A logical approach will prevent unnecessary surgery and will give the correct diagnosis.