

Handbook of ENT

Diseases and Disorders of the Ear, Nose, and Throat

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Part II

The nose and sinuses

6. Structure and function of the nose and sinuses

ENT surgeons consider the nose in three parts - the external nose, the nasal cavities and associated sinuses, and the postnasal space. See Figure 6.1.

The external nose

The external nose forms a cosmetically significant feature of the human face. The upper portion is supported by the nasal bones projecting from the facial skeleton. The lower portion has a cartilaginous skeleton made up of the alar cartilage and the upper lateral cartilage, and relies for forward projection on the integrity of the nasal septal cartilage whose dorsal free margin acts rather like a tend ridgepole. See Figure 6.2. Adjustments to both elements of the skeleton form the basis of cosmetic rhinoplastic surgery. The skin over the cartilaginous skeleton is rather adherent and contains sebaceous glands. These glands may hypertrophy in old age and the resulting cosmetic deformity is known as rhinophyma.

The nasal cavity and sinuses

The nasal cavity

The nasal cavity opens anteriorly through the nasal vestibule as the nostril and posteriorly into the nasopharynx through what is known as the choana - a congenital obstruction of this opening is known as choanal atresia. The nasopharynx is also known as the postnasal space and is the space above the soft palate which contains the adenoid and the openings of the eustachian tubes. The two nasal vestibules are lined by hair-bearing skin - the hairs are known as vibrissae - and are separated by the columella. The columella forms the front end of the nasal septum and the septum separates the two nasal cavities. The nasal cavities are lined by ciliated respiratory mucosa in which there are mucus-secreting glands which can produce up to 750 mL of mucus daily. The mucus blanket has both protective and cleansing functions and is continually wafted posteriorly by the action of the cilia, where it will eventually be swallowed. Increased mucus production may become noticeable as a postnasal drip.

The **nasal septum** has a cartilaginous skeleton anteriorly and a bony skeleton posteriorly. It is covered by adherent mucosa in which, anteriorly, there are prominent blood vessels. This vascular area is known as Little's area and is a common site for nose bleeds - see *Cauterizing a nose* in Chapter 14. The septum is often deviated into one or both nostrils either as a result of trauma or because of overgrowth during development. If you think about it, if it grows vertically beyond its anatomical confines it can only be accommodated by buckling into either a C- or S-shape. Therefore, if you are going to straighten the nasal septum, an operation known as septoplasty, you will have to both straighten the cartilage and reduce it in size as well - see Figure 8.3.

The lateral wall of the nasal cavity (see Figure 6.3) consists of three bony projections known as turbinates or conchae, covered by lax mucosa beneath which there is a vascular plexus which acts rather like erectile tissue under autonomic control. Sympathetic stimulation of the turbinates causes vasoconstriction and parasympathetic stimulation causes vasodilatation. The turbinates increase the surface area for the 'air-conditioning' function of the nose - warming and humidification of air. The inferior is the largest of the three turbinates, it is about the size of the little finger, and can be seen when examining the nose anteriorly. It can also be seen when examining the postnasal space with a mirror. The other turbinates are smaller but sometimes the middle turbinate can be seen above and behind the anterior end of the inferior turbinate. The spaces beneath the turbinates are known as the meati, of which the most significant is the middle meatus because into this space open many of the sinus drainage channels, known as ostia. The nasolacrimal duct opens anteriorly into the inferior meatus.

The olfactory epithelium is situated above the superior turbinate in the roof of the nose and cannot be seen without special instrumentation (nasal endoscopy). Olfaction, the ability to smell things, depends on scent-laden particles going into solution on the olfactory epithelium. The mechanism of stimulation of the olfactory nerve (1st cranial nerve) is largely unknown. We can, in the clinical situation, consider conductive and sensorineural loss of smell, or anosmia (cf, hearing). Conductive losses are due to obstruction of nasal air flow and sensorineural losses to, for example, fracture of the cribriform plate or a viral neuritis.

As the mucosa over the turbinates swells and shrinks (erectile tissue under autonomic control) the degree of patency or obstruction of the normal nose varies from hour to hour and side to side, this is known as the nasal cycle. You can demonstrate for yourself the difference in air flow by occluding first one side, then the other side of your nose, and sniffing up. Repeating this at intervals will show a side change during the course of the day. The exact reason for this circadian rhythm is obscure, but when it is exaggerated it becomes noticeable and patients may complain about it. In these cases it is often stress that is the perverter of sympathetic/parasympathetic harmony, since a feeling of 'well-being' is dependent on impeccable autonomic balance.

The sinuses

Much of the facial skeleton is hollowed out by air-containing cavities. These are the paranasal sinuses - maxillary, frontal, ethmoidal, and sphenoidal (see Figure 6.4). The most posterior of these is the sphenoidal sinus which opens into the back of the nasal cavity above the choana. The others open into the nasal cavity in the middle meatus beneath the middle

turbinate, having rather complex drainage channels (hence this area is known as the ostiomeatal complex). The ostium of the maxillary sinus (maxillary antrum) is situated high up on its medial wall, the ethmoidal sinuses (a complex of air cells between the nasal cavity and the orbit) drain from one into another before opening into the meatus, and the frontal sinus has a long frontonasal duct. This complexity, together with the narrowness of the middle meatus (which can be rendered even more so by minor anatomical abnormalities in this area), predisposes to the obstruction of the sinus ostia which precipitates sinusitis.

The function of the air-containing paranasal sinuses is uncertain since they are not actively involved in respiration. Suggestions have included that they lighten the skull, resonate the voice, strengthen the facial skeleton, and act as shock absorbers for violent blows.

The sinuses have anatomical relations that are important where spread of infection or other disease is concerned:

- Maxillary sinus - orbit, infraorbital nerve, teeth, nasal cavity, cheek.
- Ethmoidal sinuses - orbit (lamina papyracea), anterior cranial fossa (cribriform plate), lacrimal sac, nasal cavity.
- Frontal sinus - orbit, anterior cranial fossa, sagittal sinus.
- Sphenoidal sinus - internal carotid artery, optic nerve, cavernous sinus (containing the 3rd, 4th, and 6th cranial nerves) and the 1st and 2nd division of the 5th cranial nerve.

The postnasal space

The postnasal space is the space at the back of the nasal cavity above the soft palate. The space is separated from the pharynx by the soft palate which relaxes to allow air flow and tightens to close off the space to prevent regurgitation into the nose when swallowing. See Figure 6.5. Cleft palate and palatal paralysis are obvious causes for nasal regurgitation. Into the postnasal space on either side open the eustachian tubes. The bulge on the lateral wall made by the cartilaginous skeleton of the eustachian tube is known as the eustachian cushion. The adenoid, which is an aggregation of lymphoid tissue similar to the tonsils, is situated centrally in the roof of the space. It is usually rudimentary at birth, rapidly enlarges throughout infancy, gradually regresses from about mid-childhood and should shrink into insignificance by mid-adolescence. Adenoid hypertrophy is a common cause of snoring and upper airway obstruction in infants and children, and may predispose to middle ear problems as it interferes with eustachian tube function. For some as yet undetermined reason, a combination of Epstein Barr virus colonization of adenoid tissue remnants, a co-carcinogen, and a genetic susceptibility predispose to formation of a carcinoma in the postnasal space and, since this is a hidden area, the first presentation of a carcinoma may be a metastatic neck node.

In summary, the nose has the following functions:

- A respiratory conduit. Note that the neonate appears not to be able to open the mouth to breath and if the nasal passage is obstructed (for example, choanal atresia) will die unless

an oral airway is inserted. This life and death matter puts this function at the top of the list.

- An air conditioner (warms, cleans, and humidifies air).
- A reflex organ (sneezing).
- A phonatory resonator. Pinch your nose closed and then start talking - the intelligibility of speech is markedly decreased by the loss of vocal resonance.
- An olfactory organ.

7. Structured approach to examination of the nose

The summary in Table 7.1 will provide you with a basis for examining the nose.

Table 7.1 Aids to examination in rhinology

The external nose

Is the external nose normal? If not, is there an abnormality of:

- The upper bony portion?
- The lower cartilaginous portion?
- The nasal tip, alar cartilages, and central columella?

The nasal cavities

Trying to determine what you are seeing when you start looking into a nasal cavity is a skill that is a little difficult to master. It helps to try to be dogmatic.

Ask yourself first if the available space in the lumen of each nostril is both adequate and symmetrical as you ask the patient to 'sniff in'. If it is not, then what is impinging on the space?

Lateral impingements

- Collapse or deformity of the supporting alar cartilages.
- Collapse of a nasal valve
 - soft, floppy alar cartilage
 - external compression
- Enlargement of the inferior turbinate:
 - 'normal'
 - allergic
 - non-allergic

Medial impingements

- Symmetrical: some type of swelling of the anterior end of the nasal septum:
 - septal haematoma
 - septal abscess
- Asymmetrical: septal deviation

Impingements in the middle of the space

- Foreign body
- Nasal polyp
- Tumour:
 - benign
 - malignant.

Step 1

Start with a general examination of the face from the front, focus in on the nose; view the profile from the side, focus in on the nose; view from above, focus in on the nose.

- Does the nose look 'normal' in relation to the rest of the face?
- If not, what is wrong about it?

Answer this question by examining each component to the nose individually.

A. Shield the lower cartilaginous portion and examine the upper bony portion from the front and from the side.

Are the nasal bones any of the following?

- Straight - normal
- Deviated - consider nasal trauma
- depressed:
 - centrally - consider congenital causes, nasal trauma, tertiary syphilis
 - on one side - consider nasal trauma
- 'Humped' - consider congenital causes, growth characteristics, 'tumours'

B. Shield the upper bony portion and examine the lower cartilaginous portion from the front and from the side.

The dorsal free margin of the cartilaginous septum forms the central ridge. Is this any of the following?

- Straight - normal
- Deviated - consider deviated nasal septum
- Depressed - consider late complications of either septal surgery or septal haematoma/abscess

C. Tilt the head backwards and examine the nasal tip, the alar cartilages, and the columella.

Is the tip any of the following?

- 'Normally rounded' - normal
- Enlarged and bulbous - consider rhinophyma
- Notched - consider congenital causes
- 'Droopy' - consider congenital causes, loss of support with ageing

Are the alar cartilages any of the following?

- Symmetrical - normal
- Offering good support to the nasal vestibule
- Asymmetrical:
 - Is this because one or both are deformed? Consider cleft lip/palate, other congenital causes, trauma, underlying 'tumour'

Is the columella any of the following?

- Straight and reasonably thin - normal
- Deviated - consider deviated nasal septum (push the skin of the columella to one side or the other and you will see the end of the septal cartilage beneath), cleft lip/palate, other congenital causes, trauma
- Abnormally thickened - consider deviated nasal septum, inflammatory swelling, congenital causes

Step 2

While the head is still tilted backwards, push the tip upwards a little with your finger and look a little further into the nasal inlet. After an initial look, request the patient to forcibly

'sniff in' while you are still looking to see what effect this has.

- Is the visible airway symmetrical on both sides?

- If not, you have to determine what is impinging into the visible space to create the asymmetry. Is it something from the lateral wall, something from the medial wall, or something in the centre? Is this asymmetry the result of anything that you have already identified or is it because there is something a little further back impinging into one or both airways? (This area will be examined next.)

- Does this visible airway space markedly narrow during forcible sniffing in - consider loss of support to what is called the 'nasal valve area' by the alar cartilages.

Step 3

Return the head to the upright position. Using a light and some form of nasal speculum, examine into the nasal cavity for as far back as you can see. While doing this you should be looking for secretions/discharges, assessing the status of the mucosa, and attempting to identify firstly normal structures and secondly abnormal masses. Start by looking along the nasal septum. Move your focus to the floor of the nose. Move your focus to the lateral wall of the nose where you should see the inferior turbinate. Move your focus to the upper portion of the nasal cavity where in some noses you may be able to glimpse the middle turbinate and then return to the nasal septum.

Are secretions/discharges present? If so, is the secretion/discharge any of the following?

- Watery - consider CSF rhinorrhoea

- Clear and mucoid - consider viral rhinitis, allergy

- Mucopurulent - consider bacterial rhinitis, sinusitis. (Note: If unilateral, always consider an FB in a child, a tumour in an adult.)

- Blood-stained - consider infection, causes for epistaxis, tumour

Is the mucosa any of the following?

- Normal in colour, not too wet, and not too 'thickened' - normal

- Pale, wet, and thickened - consider allergy

- Inflamed, wet, and thickened - consider rhinitis, overuse of decongestant sprays/drops (known as rhinitis medicamentosa)

- 'Cyanosed', not too wet and thickened - consider 'vasomotor rhinitis' (non-allergic rhinitis)

Is the septum any of the following?

- Straight - normal
- Deviated:
 - C-shaped
 - S-shaped
 - spurs
 - other

(If it is deviated, you should consider whether or not the deviation corresponds to symptoms of nasal obstruction.)

Are the blood vessels on the septum particularly prominent?

- Does this correspond with a history of epistaxis?
- Does touching these vessels make them bleed?

Consider cautery.

Are the inferior turbinates any of the following?

- Symmetrical - normal
- Enlarged - consider rhinitis, allergy, vasomotor rhinitis
- Abnormally small - consider turbinectomy surgery, atrophic rhinitis

Are there any abnormal masses in the nasal cavities?

- FB
- Nasal polyp
- Tumour

If after completing your examination you are unable to determine a cause for the patient's complaint, you will have to consider other likely causes for the complaint that may indicate that the problem area is beyond the limit of your examination, for example, adenoid hypertrophy in a child, some form of mass - benign or malignant - in an adult, or a posterior site for epistaxis. Consideration may have to be given to further examination by radiology or to referral for an ENT specialist opinion.

8. Core knowledge of nose and sinus disorders

Vestibulitis and impetigo

The openings to the nasal cavities (the nostrils or nasal vestibules) are lined by hair-bearing skin. This area is subject to trauma, predominantly digital. Any breach of the skin surface predisposes to infection - particularly when associated with a rhinitis. This infection may be localized as a furuncle in a hair follicle or there may be ulceration. If the infection is staphylococcal, it may spread to the surrounding facial skin (impetigo). In addition to these factors, this is a common site for herpes simplex 'cold' sores. Warts are not uncommon. Suspect malignancy in persistent ulceration in adults. Consider use of an antibiotic for any significant infection in this area as it is part of the 'danger area' for infection - some of the venous drainage is backwards and intracranially with potential for an infected cavernous sinus thrombosis. Penicillin (erythromycin) is required for impetigo and a furuncle but usually all that is needed for ulceration is cleansing and application of an antiseptic. A proprietary remedy is useful for cold sores.

Rhinitis/Sinusitis

Rhinitis

Almost everyone will experience episodes of viral rhinitis - the common cold. Apart from systemic malaise making them feel miserable, the nasal mucosa responds with inflammatory swelling (nasal obstruction), irritation (sneezing), and excessive mucus production with impaired ciliary function (rhinorrhoea). The swollen mucosa and impaired ciliary function predisposes to obstruction of the drainage passages (ostia) of the sinuses with accumulation of exudate in the sinuses (feeling of stuffiness in the head and loss of vocal resistance). Treatment of viral rhinitis is not strictly required. Isolation to prevent spread of infection is desirable but not usually practical. Analgesics may ease the viral malaise and steam inhalations may be soothing to the nose, but many patients resort to use of nasal decongestants. The immune system should resolve the infection in a few days. Secondary bacterial infection is common, manifesting by change to a mucopurulent nasal discharge. At this stage infection may spread to the sinuses, the middle ear, the tonsils and adenoid, and the lower respiratory tract. Some patients appear to be predisposed to involvement of one or more of these sites. This secondary bacterial infection may require the use of antibiotics.

Remember to consider syphilis in babies with 'snuffles' - persistent rhinitis.

Remember to consider a foreign body in all cases of unilateral rhinitis in children (often foul-smelling) and tumour in all cases of unilateral rhinitis in adults.

Sinusitis

Sinusitis is usually precipitated by a viral rhinitis and in children the ethmoidal sinuses are as likely to be involved as the maxillary sinus. Dental roots project into the floor of the maxillary sinus and these can be a source of infection. Acute pressure changes, for example, during diving, can force contaminated material into the maxillary sinus. The frontal and sphenoidal sinuses only begin to become well pneumatized after about ten years of age, and

of these two, the frontal sinus is the more likely to become infected, sphenoidal sinusitis being uncommon (deep-seated headache). The potential to develop sinusitis is exacerbated when the complex drainage channels of the sinuses are obstructed (anatomical abnormalities, oedematous mucosa) or when there is impaired ciliary function. The predominant symptom of sinusitis is pain associated with 'stiffness' and a mucopurulent nasal discharge. Treatment involves the use of antibiotics and topical nasal decongestants, and should be continued for at least two weeks.

Potential complications. With ethmoidal and frontal sinusitis, infection may spread into the orbit (orbital cellulitis) or into the anterior cranial fossa. Rarely, involvement of venous channels may precipitate a cavernous sinus thrombosis. All such complications require emergency referral to a specialist service.

Inadequate treatment of acute sinusitis predisposes to establishment of chronic sinusitis (nasal obstruction, stiffness, mucopurulent nasal discharge, or postnasal drip). This predisposition may relate to underlying allergic rhinitis, anatomical deformities in drainage passages or, rarely, cystic fibrosis or mucociliary transport disorders. Failure of resolution after a prolonged course of antibiotic (based on bacterial culture) and nasal decongestant requires referral to a specialist service, since by this stage surgery is probably required.

Atrophic rhinitis

The cause is usually obscure in this, fortunately rare, condition. Atrophy of the nasal mucosa results in excessive drying and crusting of nasal secretions with infection and ulceration of mucosa beneath the crusts further damaging the mucosa. A foul nasal odour is the basis for its other name of ozaena. If cleaning by irrigation and moistening by use of glycerine/glycerine drops is not helpful, there are a number of surgical procedures to reduce nasal airflow that may need to be considered.

Allergic rhinitis

Sensitized individuals undergo a Type I hypersensitivity reaction in the nasal mucosa. The allergen binds to IgE on the surface of mast cells within the mucosa, causing mast cell degranulation and the release of two kinds of allergic mediators. Early mediators such as histamine cause vascular dilatation and mucosal oedema (nasal obstruction), mucosal irritation (sneezing), and mucus hypersecretion (rhinorrhoea). Reflex stimulation of parasympathetic nerves perpetuates the nasal congestion. Late mediators promote migration of eosinophils into the mucosa and these release substances such as leukotrienes which are responsible for the persistent nasal congestion. See Table 8.1.

Two broad types of allergic rhinitis are recognized although they are not mutually exclusive - seasonal allergic rhinitis (predominantly pollen) and perennial allergic rhinitis (predominantly house-dust mite and animal dander). A good history usefully serves to distinguish these types. Further investigation by skin prick testing or allergy assay (phadiotype, RAST) may be utilized to identify the specific allergens.

Table 8.1 Allergic rhinitis

Allergen Mast cell	
Early mediators	Late mediators
Histamine	Chemotaxis
Sneezing	Eosinophils
Itching	Leukotrienes
Rhinorrhoea	Obstruction
Obstruction	

Treatment is by avoidance (usually impractical), antihistamine (useful for acute reactions), 'mast cell stabilizers', such as sodium cromoglycate (useful for seasonal rhinitis), or topical steroid nasal sprays (the mainstay of therapy). Systemic steroids are useful to ameliorate symptoms for important events (exams, interviews, weddings, etc).

Allergic rhinitis predisposes to acute and chronic sinusitis.

Non-allergic rhinitis

The nasal mucosa of sensitized individuals reacts adversely to irritants - dust, fumes, vapours, pollutants - with similar symptoms to those of allergic rhinitis but with different emphasis - usually a 'dry' nasal obstruction (the term 'vasomotor rhinitis' is often applied to these individuals on the assumption that parasympathetic overactivity is the underlying cause). There is no IgE elevation and specific allergens cannot be identified in these individuals. Hence treatment is often difficult but many respond favourably to topical steroid nasal sprays. In those individuals in whom nasal congestion predominates, abuse of nasal decongestant sprays can be a problem with the risk of developing a condition known as '**rhinitis medicamentosa**'. As the effect of the vasoconstrictor wears off, there is a reactive vasodilatation and a tendency to re-use the spray. If this is repeated often enough, tachyphylaxis results in increased use of decongestant until a state of chronic mucosal swelling causes continual obstruction.

Nasal polyps

See Figure 8.1. The exact aetiology of nasal polyps (polyp - protruding growth from a mucous membrane) is unknown. Simplistically, they arise from the small ethmoidal sinuses when an oedematous reaction in the sinus mucosa causes it to fill the sinus and then protrude through the sinus opening (ostium) to expand within the nasal cavity. Hence they are often associated with nasal allergy and/or asthma. Another frequent association for some unknown reason is with aspirin sensitivity. They are most often bilateral. (Note: Unilateral nasal polyps should always arouse suspicion of neoplasia.) Polyps usually have the appearance of greyish, smooth-surfaced masses but with exposure to the drying effect of air they sometimes acquire a 'mucosal' appearance and the polyp then needs to be distinguished from a turbinate by its insensitivity and mobility when palpated with a probe. The symptoms they produce are of nasal obstruction and, because this extends to obstruction of air flow to the olfactory area in the roof of the nose, loss of the sense of the smell (anosmia).

Treatment. Polyps may regress after a course of systemic steroid reinforced by topical steroid nasal spray. Failure to respond requires surgical removal followed by topical steroid nasal spray to prevent recurrence. Further recurrence is an indication for sinus surgery.

Epistaxis

Bleeding from the nose is a common problem. Both rhinitis and periods of hot weather seem to predispose to nose bleeds but fortunately 90 per cent of these will arise from the anterior, visible portion of the nasal cavity. These are best thought of as the 'easy' epistaxis because the site of bleeding is frequently from Little's area on the nasal septum. Here it can be controlled by pinching this portion of the nose for a few minutes and this area is also accessible for cautery.

Bleeding from the posterior regions of the nasal cavity tends to present problems in management - the 'difficult' epistaxis. These will usually be adult patients - posterior bleeding is unusual in children - and it is exacerbated when there is co-existing arteriosclerosis and hypertension. Pressure can only be applied in this area by some form of nasal packing and it is sometimes difficult to achieve adequate haemostasis. Examination under anaesthetic and attempts at cautery may be required. As a last resort, ligation of nasal feeding vessels - ethmoidal and maxillary arteries - may be needed. (See Figure 8.2.)

Although most nose bleeds are minor and inconsequential, it has to be remembered that some nose bleeds, particularly posteriorly, can be torrential and life-threatening in themselves and also that they may be an indication of life-threatening disorders - local: nasal tumours; general: blood disorders - anti-coagulants, liver problems, leukemia, etc.

The list of potential causes for epistaxis includes:

Anterior:

- Rhinitis
- Minor and digital trauma
- Foreign body
- 'Bleeding septal polypus'

Superior:

- Trauma to nasal skeleton

Posterior

- Spontaneous
- Rhinosinutitis
- Bleeding disorders, anticoagulants, chronic liver disease, blood dyscrasias
- Nasal tumours, particularly the angiofibroma of adolescent males

Generalized:

- Bleeding disorders
- Haemorrhagic telangiectasia (Osler's disease), fortunately rare.

Management of epistaxis is detailed in Chapter 9.

Nasal septal deviation

Nasal septal deviation is a common finding. It arises either because the septum, during growth, has exceeded the dimensions allowed for it in the nasal cavity (in order to 'fit' it has had to either buckle into a C- or S-shape, or dislocated from its inferior attachment to the floor of the nose), following trauma (this trauma may have occurred during birth when the nose is compressed during passage through the birth canal) or because a mass in one nasal cavity is forcing the septum across the midline into the other side. Septal deviation may cause symptoms of nasal obstruction by its anatomical shape which alters the normal pattern of air flow but more usually the turbinates expand to fill any extra capacity created in the nasal cavity by the septal deformity. The indications for surgery are either nasal obstruction or cosmetic deformity of the cartilaginous nasal skeleton. Surgery involves reducing the septal cartilage dimensions, straightening cartilage angulation, and removing areas of bony septal deformity. See Figure 8.3. Care has to be taken to assess the extent of turbinate hypertrophy and to reduce turbinate bulk when required. Potential complications of surgery are loss of septal cartilage with consequent 'saddle' deformity of the cartilaginous nasal skeleton and septal perforation.

Nasal trauma

Blunt trauma to the nose is a common problem. The mechanism of injury is divided into lateral injuries (lateral displacement) and frontal injuries (depression). See Figure 8.4. Bony components of the nasal skeleton tend to fracture, cartilage components tend to buckle (but may also fracture). In the assessment of nasal trauma, two questions have to be answered. The first is 'has the patient broken his nose?' (local tenderness and swelling). The second is 'Is the skeleton displaced?' (visible deformity, obstructed airway). Displacement is the indication for manipulation.

Manipulation is usually undertaken a week to ten days after injury when swelling will have settled enough to assess the extent of displacement and the results of manipulation. However, there are potential complications from septal injury which require urgent referral. See Figure 8.5. When a haematoma forms beneath the septal mucosa it tends to become rapidly infected and the resulting septal abscess invariably destroys the septal cartilage with an end result of a depressed 'saddle' nasal profile. Urgent drainage and antibiotics may salvage the septal cartilage.

Septal trauma as a result of repetitive digital trauma, repeated cauterization, or septal surgery may cause a septal perforation.

Paediatric rhinology

Choanal atresia

Choanal atresia (rare, occurring in about 1:20000 births) is a condition in which the posterior openings of the nasal cavity into the nasopharynx fail to develop. Neonates are obligatory nasal breathers and will not breathe through their mouths if the nasal passages are obstructed unless an airway is strapped in place. This is the emergency treatment for choanal atresia. After confirmation of the diagnosis, either by direct examination with an endoscope or use of contrast radiology, the choanal openings are created surgically.

Foreign body

Foreign bodies are a common problem (see Figure 8.6). Small children frequently put objects into their own and other children's body orifices - often the nose. Stasis of secretions around the object predisposes to infection with a foul smell and a mucopurulent, sometimes blood-stained, unilateral nasal discharge. Removal (see *Removal of a foreign body from the nose*, Chapter 14) resolves the situation.

Adenoids

The adenoid is the first site of contact between lymphoid tissue and inhaled allergens, organisms, and pathogens. Hence in infancy it is in a constant state of hyperactivity as the body reacts to develop immunity to all these factors. The most common cause of upper airway obstruction in children is adenoid hypertrophy.

Upper airway obstruction itself is common in infants and small children and is always associated with persistent snoring and mouth breathing. The more severe degrees of obstruction are associated with restless, disturbed sleep, enuresis, and struggling for breath when sleeping. At its worst this struggling manifests with episodes of obstructive apnoea (which may be one cause for Sudden Infant Death Syndrome - SIDS). Failure to thrive is frequent in these more severely obstructed infants (a lot of energy is involved in breathing against an obstruction) and prolonged obstruction may precipitate cardiac failure (hypoxia - pulmonary vasoconstriction - pulmonary hypertension - cor pulmonale - cardiac failure).

Adenoiditis is one source for ascending infection of the middle ear via the eustachian tube (acute otitis media) and adenoid hypertrophy is a common cause of eustachian tube dysfunction (middle ear effusion). Check the ears and hearing of snoring infants and children.

These symptoms are all indications for referral to an ENT specialist service for removal of adenoids (adenoidectomy).

Snoring

The negative pressure in the upper airway generated during inspiratory efforts not only causes ingress of air but also inward prolapse of the soft tissue walls and any protruding masses, for example tonsils and tongue (Bernoulli effect). If this prolapse is sufficient to cause air-flow obstruction, the negative pressure increases, the obstruction is overcome, air

flow returns, prolapse recurs, and a cycle is established. The vibrations created produce the characteristic sound known as stertor or snoring. See Figure 8.7.

Snoring is a common problem both in children (see above) and in adults. Not only is it disruptive to others but it also has serious implications for the snorer (see above, the same mechanism operates in adults). In adults, snoring is predominantly vibratory (for example, lax soft palate and uvula), predominantly obstructive (usually associated with obesity), or a combination of both.

The basis of treatment is to identify factors contributing to obstruction of air inflow into the upper airway. Relieve the obstruction and less negative pressure generation is required for air inflow. The nasal airway is the narrowest portion of the airway and factors operating here that contribute to snoring include:

- Excessive narrowing or collapse of the 'nasal valve' area - see Chapter 7.
- Enlarged nasal turbinates.
- Deviated nasal septum.
- Nasal polyps and other nasal 'masses'.
- Adenoids in children, nasopharyngeal tumours in children and adults.

Other functions to be considered are pharyngeal - soft palate/uvula, tonsils, pharyngeal and parapharyngeal 'masses' - and laryngeal disorders (stridor can be mistaken for stertor).

Treatment is directed to the affected anatomical area and its abnormality.

Neoplasia of the nose and sinuses

Although neoplasia is uncommon, an awareness that neoplasia may be the underlying cause for nasal symptoms needs to be maintained. In the absence of an obvious cause for symptoms, refer for specialist opinion. Many of the tissues in the body that can potentially undergo neoplastic change - both benign and malignant - are found in and around the nose and sinuses and the potential list of such tumours is extensive.

Dictums to remember are:

- The cause for unilateral nasal obstruction always needs to be determined.
- Unilateral nasal discharge in a child is usually caused by a foreign body but in an adult a tumour needs to be excluded.
- Beware of unilateral middle ear effusion in an adult - a nasopharyngeal tumour always needs to be excluded.
- Beware of a blood-stained nasal discharge - a nasal tumour always needs to be excluded even though the most common cause is infection.
- Beware of the 'node in the neck' with no obvious primary neoplasia. The nasopharynx is one area for a hidden primary.
- Be aware of aetiological factors - smoking snuff usage, wood-workers (adenocarcinoma).

The general principles of management that apply to neoplasia of the nose and sinuses are similar to those that apply for other ENT areas in which neoplasia occurs. These are given in more detail in Chapter 12. In summary, these principles include:

- Diagnosis by suspicion, examination, and biopsy.
- Assessment and staging - TNM system.
- Therapy - modalities include:
 - Surgery - this encompasses ablation, reconstruction, prosthetics, rehabilitation, and support.
 - Chemotherapy.
 - Radiotherapy.
 - Other - for example, hormone manipulation for pituitary tumours.
- Follow up to detect recurrent disease, second primaries, and distant metastasis.
- Terminal care when the disease becomes incurable.

9. A practical approach to nose and sinus disorders

As noted previously, most patients do not know exactly what they are suffering from. They usually complain about a collection of symptoms and expect you to tell them what is wrong. Without specialized equipment and skills, examination of the nose will reveal only cosmetic deformities and anteriorly situated pathology or deformity. Therefore a practical approach is largely based on patient symptoms. The symptoms arising from nasal and sinus disorders are described below.

Symptoms

- Nasal obstruction.
- Nasal discharge (rhinorrhoea) and postnasal drip.
- Pain.
- Epistaxis (bleeding).
- Sneezing.
- Snoring.
- Loss of vocal resonance.
- Loss of smell.
- Cosmetic deformity.

Nasal obstruction

The sensation of nasal obstruction is very subjective and it may sometimes be difficult to determine the cause. It is relatively easy when there is an obvious obstructing element but the dimensions of the nasal cavity vary tremendously as the mucosa swells and shrinks not only with the 'nasal cycle' but under the influence of the autonomic system and in response to allergens and irritants. If you add to this the need for rigidity or support of the airway walls, and the effects on these walls of muscle relaxation when sleeping, it can be seen that the situation pertaining at the time of consultation may not be representative of the situation when the sensation of obstruction is at its worst. Another factor that seems to play a role in the sensation of obstruction is alteration of the pattern of air flow through the nasal cavity. Some patients may complain of an obstructive sensation even when the nasal passages appear

to be adequate.

Potential causes and treatment

The underlying disorders that may potentially cause nasal obstruction are described below.

Infection, such as viral rhinitis, acute and chronic bacterial rhinosinusitis, is always accompanied by mucosal swelling and nasal discharge. Viral rhinitis should need no more than symptomatic treatment for the malaise but many patients resort to decongestants, either systemic or topical. The onset of facial pain may be indicative of acute sinusitis, usually heralded by a change from mucoid to purulent discharge, and this should be treated with an antibiotic and topical nasal decongestant to improve drainage from the sinuses. Inadequately treated acute sinusitis may progress to chronicity with purulent nasal and postnasal discharge. A deep nasal swab should be taken to guide a much longer course of antibiotic and decongestant.

Allergic rhinitis is suggested when there is a triad of nasal obstruction, watery or mucoid discharge, and sneezing in response to exposure to an allergen. The allergen can usually be identified from a carefully taken history - seasonal is usually due to pollens, perennial is most often due to house-dust mite but may also be caused by moulds and animal dander. Often the patient can identify the allergen when the allergic response is caused by a known contact such as animal dander, or by a situation such as a particular room or building. Antihistamines and sodium cromoglycate are useful for contact or seasonal rhinitis but perennial rhinitis usually requires topical nasal steroids.

Non-allergic rhinitis is in many ways similar to allergic rhinitis but one symptom - usually nasal obstruction - predominates. There is a strong element of parasympathetic overactivity to this disorder - 'My nose always blocks up in a stuffy room', '... in the evening', etc - and characteristically the inferior turbinates are enlarged with a rather cyanotic appearance. It is a much more difficult disorder to treat - good response to topical decongestants tends to lead patients to overuse these with ensuing problems of rebound congestion and eventual rhinitis medicamentosa, and they should be avoided. Some patients respond well to topical nasal steroids but many require referral for surgery to reduce the bulk of the offending turbinates.

Anatomical deformity - deviated nasal septum, nasal 'valve' collapse - is suspected when nasal obstruction is present all the time. Careful examination should detect the underlying abnormality and when this is a septal deviation the turbinate in the nasal passage with more space is often enlarged - compensatory hypertrophy. These patients require referral for assessment for surgical correction of the deformity.

Nasal polyps are often associated with allergy, although this is more often asthma than allergic rhinitis, and present with nasal obstruction and loss of smell. Polyps can usually be seen in the nose and sometimes have to be distinguished from an enlarged turbinate - a turbinate is sensitive when touched with a probe whereas a polyp is insensitive. They are usually bilateral and treatment is with a short course of systemic steroid supplemented by topical nasal steroids which are continued for three months. This should shrink most polyps

but if they do not respond or recur, referral for nasal polypectomy will be required. There is a variant - the antrochoanal polyp - that arises on one side only and is unresponsive to steroids. It can grow to such a size that it protrudes either anteriorly or posteriorly from the nasal cavity.

Adenoid hypertrophy is the most common cause of nasal obstruction and snoring in children. There is not a lot that can be done to shrink the adenoid but any nasal allergy or rhinitis should be treated. The indications for referral for adenoidectomy include persistent nasal obstruction, snoring associated with airway obstruction when sleeping, recurrent middle ear infection, and persistent middle ear effusions.

Nasal and nasopharyngeal tumours should be suspected when there is a history of recent onset of nasal obstruction. The other sinister sign associated with a tumour is bleeding or a blood-stained nasal discharge. Sometimes the presence of a malignant tumour may produce no symptoms until a neck node appears. Any suspicion of a tumour is an indication for an urgent referral.

Rhinorrhoea (nasal discharge) and postnasal drip

Up to 750 mL of watery mucus can be produced daily by the nasal mucosa to assist its air-conditioning function. Normally this is propelled posteriorly by the mucosal cilia. Any increase in production may be perceived as 'catarrh' or 'postnasal drip'. Posterior obstruction (for example, adenoids in children) may cause stasis and accumulation of secretions.

When the normal situation is altered and there is a nasal discharge, the character of the discharge is perhaps the most helpful factor in determining the aetiology of any underlying disorder.

Potential causes and treatment

Watery/mucoid:

- Viral rhinitis.
- Allergic rhinitis.

These have been discussed in the previous section on nasal obstruction.

- CSF leaks are very uncommon. They are usually precipitated by trauma that is associated with a fracture of the cribriform plate but on rare occasions may be congenital when they are associated with recurrent meningitis. CSF is distinguished from other watery nasal discharges by the presence of glucose and this is easily tested by using a glucose 'dipstick'.

Mucopurulent:

- Bacterial infective rhinitis.
- Acute and chronic sinusitis.
- Nasal polyps.

These have been discussed in the previous section on nasal obstruction.

- Unilateral purulent discharges should raise suspicion of a FB in children or a tumour in adults. In children the discharge is often associated with a foul smell. Children usually need to be restrained to examine the nose, which can often be done by tilting up the tip of the nose with a finger. Any discharge needs to be sucked away to see what is behind it. To see further back into the nose try using an otoscope. If a FB is seen, try removing it - see Chapter 14.

Blood-stained:

- Epistaxis is considered in a separate section later in this chapter.
- Infection. Most blood-stained nasal discharges are associated with infection but this diagnosis should be made only after excluding all other causes.
- Trauma. CSF leaks associated with trauma were mentioned above. Initially these are blood-stained. Digital trauma is very common and children have a habit of putting a variety of other things up their noses that can precipitate minor bleeds and blood-staining of nasal discharges. Trauma also includes things like vigorous nose blowing which, particularly when there is nasal infection, may precipitate a small bleed.
- Neoplasia. Blood-stained, unilateral nasal discharges are always indicative of tumours and if there is nothing obvious to see when examining the nose an urgent referral is necessary.

Pain

Pain arising from nasal and sinus disorders usually remains localized in this anatomical area although there may not be precision in localization. Potential disorders that may cause pain are described below.

Potential causes and treatment

Vestibulitis/vestibular furuncle. These should be obvious on examination. Vestibulitis is often due to herpetic infection and needs no more than application of a proprietary cold sore remedy. When there is added bacterial infection, children often disseminate this by scratching until it becomes a frank impetigo. Antiseptic cream and a systemic antibiotic should clear this. An antibiotic should be considered for furuncles as this is the 'danger area' of the face with venous drainage backwards into the cavernous sinus.

Acute and chronic sinusitis. Acute sinusitis is always painful but when sinusitis becomes chronic, pain has more the character of discomfort or headaches associated with nasal stuffiness. Some clues as to which sinus is involved are obtained from the distribution of pain:

- Maxillary - in the cheek or upper dentition.
- Ethmoidal - between the eyes.
- Frontal - above the eyes, tends to be exacerbated by bending over.
- Sphenoidal - deep-seated.

It is reasonable to treat acute sinusitis on clinical diagnosis from a history of a recent cold, onset of pain and purulent nasal discharge, and both an antibiotic and topical nasal decongestants should be given. Chronic sinusitis requires X-rays for a definitive diagnosis and the treatment is initially with a two to three week course of antibiotic - best guided by a deep nasal swab - and topical nasal decongestants to improve drainage. Failure to clear the infection is an indication to refer for some sort of sinus drainage procedure.

Neuralgia from pressure on the middle turbinate by a deviated septum. This may be the cause of troublesome, recurrent, deeper seated pain. It is not an easy diagnosis to make, since often this area of the nasal cavity cannot be easily seen. Such patients should be referred for more detailed examination. Once diagnosed, the treatment is to straighten the nasal septum and relieve the pressure. Pain in and around the eyes may be a part of other neuralgias and migraine headaches that have facial pain as part of the symptomatology.

Neoplasia is an ever-present worry when there is persistent pain in and around the nose and, if there is nothing to find on examination, can only be excluded by both specialist examination and radiology.

Epistaxis (bleeding)

Patients may present either actively bleeding or with a history of epistaxis.

Active bleeding. These patients will initially require first aid measures to control the bleeding. These follow a stepwise progression:

- Ninety per cent of epistaxis arises anteriorly in the nose (the 'easy' epistaxis) and this can usually be controlled by requesting the patient to sit upright, lean forward, and pinch the nose. The effect of pressure can be enhanced with some vasoconstriction - soak a piece of cotton wool in adrenaline or one of the nasal vasoconstrictor drops, place this in the nose and apply pressure.

- For the remainder with posterior bleeding (the 'difficult' epistaxis) - these will almost always be adults since posterior bleeding is uncommon in children - pinching the nose will result in the blood trickling posteriorly into the pharynx. To apply pressure posteriorly implies some form of packing (see Figure 9.1) and this is so unpleasant for the patient that it is worth trying to spray vasoconstrictor deep into the nasal cavity and waiting a few minutes to see whether the bleeding will stop before resorting to packing. If it doesn't, the nasal cavity will have to be packed deeply. Many of these patients with posterior bleeds are middle-aged or elderly and absorption of vasoconstrictors, particularly adrenaline, will have cardiac side-effects. Therefore use either Vaseline gauze or ribbon gauze soaked in BIPP.

- If there is still a significant amount of blood trickling posteriorly after packing, some form of tamponade of the posterior choanae will be required. (See Figure 9.1.) The most useful method is to pass a Foley catheter through the nasal cavity, inject 5 mL of water into the bulb, and draw the catheter forwards until the bulb impacts in the choana. If the nasal packing had to be removed to do this it will need to be replaced.

- All of these patients with posterior bleeds require referral for admission to an ENT specialist service. So once the bleeding is controlled, check for signs of hypovolaemic shock, set up an intravenous fluid line, resuscitate if necessary, take blood for cross-matching if there has been significant blood loss, check for systemic causes - anticoagulants, liver dysfunction, blood dyscrasias - then treat appropriately and arrange for transfer. If this will be delayed admit locally for strict bed rest with sedation and half-hourly pulse and blood pressure monitoring. See Table 9.1 below.

Table 9.1 Epistaxis

Bleeding: pinch nose.

Bleeding controlled:

Examine the nose for pathology or for a bleeding point requiring cautery. Refer to ENT if epistaxis has been recurrent and troublesome and you are unable to find a bleeding point to cauterize.

Bleeding uncontrolled:

Bleeding anteriorly. Try pinching again after inserting a superficial nasal pack soaked with a vasoconstrictor. Follow this with cautery of any accessible bleeding point. Refer to ENT if these measures do not control bleeding.

Bleeding posteriorly (blood trickles into the pharynx even when the nose is adequately pinched.) Try instilling vasoconstrictor as drops/spray or soaked into a deep nasal pack. If bleeding remains uncontrolled, insert a postnasal balloon and repack. All these patients need to be admitted for bed rest and sedation or to be referred for ENT admission.

Not actively bleeding. Obtain a good history and then examine the nose to see if an identifiable cause or accessible bleeding site can be identified.

- Consider removal of the cause (digital trauma, foreign body) or treatment of the cause (infection, bleeding disorder).

- Consider cautery of the bleeding point (see *Cauterizing the nose*, Chapter 14) if the bleeding has been recurrent or the vessel is particularly prominent.

- Consider referral for specialist management if there is:

- anterior or posterior bleeding uncontrolled by first aid measures (resuscitation, bed rest, and sedation while awaiting referral).
- posterior bleeding that has required packing/tamponade for control (resuscitation, bed rest, and sedation while awaiting referral).
- an identified cause requiring specialist management (nasal skeletal trauma, bleeding polyp, nasal tumour, haemorrhagic telangiectasia, bleeding disorders).
- troublesome bleeding for which a cause or a site have not been identified.

Sneezing

A cause for sporadic sneezing can usually be identified - a list of potential causes is given below - and removal of the cause or treatment/resolution of the disorder may resolve the problem. Patients often need a little prompting to help them identify precipitating factors or situations which they may then be able to avoid. Disabling, persistent, uncontrollable sneezing (fortunately rare) usually has no identifiable cause but may result from brain-stem pathology.

Potential causes

- Infection - particularly viral rhinitis.
- Irritants.
- Allergic rhinitis.
- Non-allergic rhinitis, especially with temperature change and bright light.
- Foreign body.

Snoring

Potential causes

Snoring or stertor is the sound produced by vibrating tissue in the upper airway. Simple vibratory snoring is produced by turbulent air flow. However, there is a more sinister aspect to snoring since it usually indicates a greater or lesser degree of airway obstruction (see Chapter 8), a situation with potential complications. In children with this type of obstructive snoring the usual cause will be enlarged adenoids. In adults it is most commonly associated with obesity.

Treatment

In a practical approach to snoring the history is of prime importance in determining the need for intervention but unfortunately the patient is unable to provide the relevant history, apart from the effects of the resulting disturbed sleep. The observations of those others affected by the snoring are needed for this information but are not always available. In this situation one often has to resort to admission and observation - at its most sophisticated in a 'sleep laboratory'. Apart from the usual information regarding onset, duration, etc one needs to know about the degree of obstruction associated with snoring. Does the patient appear to struggle for breath? Is there sternal recession or rib retraction? Are there episodes of obstructive apnoea? Does the patient become cyanosed?

Examination is of importance in directing intervention. There are two elements to this. First, identify vibrating structures in the pharynx, which is usually a lax soft palate with an enlarged uvula. Second, identify anything obstructing inspiratory air inflow that causes an increase in the negative pressure generated by inspiratory efforts that in turn causes soft tissue structures in the upper airway to prolapse, exacerbating the situation. These latter include:

- 'Nasal valve' collapse.
- Deviation of nasal septum.
- Turbinate hypertrophy.
- Nasal polyps, nasal tumours.
- Adenoids in children.
- Nasopharyngeal tumours in adults - lymphoma, carcinoma.
- Enlarged tonsils.
- Retropharyngeal and parapharyngeal 'masses' - abscess, nodes, tumours.

Having obtained an overall picture of the problem and identified potential causes, appropriate referral can be made. Management relates to both of the above elements. As a first step, any cause for inspiratory air-flow obstruction should be treated or surgically removed. Then vibrating structures should be considered for procedures to reduce bulk or 'tighten up' laxity, for example, uvulo-palatopharyngoplasty.

Loss of vocal resonance

Three mechanisms operate in altering the resonant quality of the voice. 'Nasal escape' imparts a quality known as hypernasality and nasal obstruction a quality known as hyponasality. The main causes for these are listed below. A mass in the pharynx imparts a quality known as a 'hot potato' voice.

Potential causes and treatment

Hypernasality:

- Palatal defects, particularly cleft palate.
- Palatal paralysis - diphtheria in children, bulbar and pseudobulbar palsy.
- Destructive disease or surgery.

Some form of reconstructive surgery may be possible in some of these patients but by and large the results of surgery are not very satisfactory in improving the voice quality.

Hyponasality:

- Rhinosinusitis.
- Allergic rhinitis.
- Non-allergic rhinitis.
- Nasal polyps.
- Adenoids in children.
- Nasal and nasopharyngeal tumours in adults.

Vocal quality generally improves with treatment of these disorders but conditions such as allergic rhinitis and nasal polyps tend to be chronic or recurrent and anatomical defects may be the end result of treatment of tumours.

'Hot potato' voice:

- Pharyngeal tumours.
- inflammatory swellings and masses in the pharynx.

The change in voice is only part of the problem in these conditions and airway obstruction is more usually the prime consideration.

Loss of smell

Taste and smell are intimately linked and it is as well to be aware that many patients may not clearly distinguish between these when trying to describe their symptoms.

Potential causes and treatment

In a similar manner to hearing loss, loss of smell may be considered as either conductive or sensorineural. A list of potential causes is given below:

Conductive causes:

- Viral rhinitis.
- Allergic rhinitis.
- Acute and chronic sinusitis.
- Nasal polyps.
- Tumours.

The sense of smell should return when these conditions are treated but it has to be remembered that conditions such as allergic rhinitis and nasal polyps tend to be chronic or recurrent. Treatment of tumours may leave anatomical defects and radiotherapy is permanently damaging to the sensory mucosa.

Sensorineural:

- Viral olfactory neuritis.
- Trauma to cribriform plate.
- Neurosurgical procedures in the anterior cranial fossa.

It is unusual to regain the sense of smell after these disorders.

Cosmetic deformity**Potential causes and treatment**

The nose occupies a very prominent position on the face and consequently tends to be a focus for attention. Body image is a very personal concept and tolerance of any deformity perceived or obvious varies tremendously. This is entering the realm of cosmetic rhinoplasty surgery which at its most refined can sculpt a nose into a desired shape but is more often used to improve the grosser deformities. There is another element to nasal

deformities that has to be taken into consideration in determining the need for corrective surgery, which is more the concern of ENT. It is the extent to which the deformity is causing nasal airway obstruction, since it is important to relieve obstruction when undertaking any corrective procedure on the deformity.

The list of causes for the grosser nasal cosmetic deformities includes:

- **Congenital** - particularly cleft lips and palates.
- **Growth** - humps, septal deviation, tip deformation.
- **Ageing** - drooping tip, rhinophyma (hypertrophy of sebaceous glands over the nasal tip).
- **Trauma** - lateral trauma causes deviation, frontal trauma causes depression. These injuries may be associated with lacerations and scarring. Septal surgery can result in a 'saddle' depression if there is loss of cartilage support.
- Gross **nasal polyposis** and **nasal tumours** cause expansion of the nasal skeleton.
- **Infection** - both septal abscess with loss of cartilage and tertiary syphilis with bone destruction cause 'saddle' depressions. TB causes fibrosis and contracture in the vestibular area. 'Noma' or 'cancrum oris' result in loss of tissue and gross deformity.