

Rhinopharyngoscopy, computed tomography and magnetic resonance imaging

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Rhinitis is defined as nasal congestion, sneezing, itching and rhinorrhoea, recently classified as allergic, infective, structural or “other”. The increasing employment of flexible rhynolaryngoscopy may represent one of the most useful diagnostic tools in the complex differential diagnosis between allergic and nonallergic rhinitis. Furthermore, chronic allergic rhinitis, with secondary impairment of mucociliary clearance and the plethora of frequent anatomical variations, especially in the ostiomeatal complex, appear to predispose the patient to recurrent rhinosinusitis. In the last two decades, a better understanding of mucociliary clearance of nasal cavity and paranasal sinuses has shifted the attention from the maxillary sinuses to the area of the anterior ethmoid sinuses. Plain film radiographic examination, the historical standard, due to its inability to individualize ethmoid and sphenoid disease, is being rapidly supplanted by computed tomography and magnetic resonance imaging in the diagnosis of rhinosinusitis. In allergic and non-allergic rhinitis the diagnostic role of magnetic resonance imaging and computed tomography is still under debate. Computed tomography and magnetic resonance imaging are more efficient in demonstrating the bone wall, mucosal layer and sinus content than classical and computerized radiology; they have a higher diagnostic performance index in spite of a higher cost and, for computed tomography, a higher radiation dose.

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Rhinitis is commonly described as nasal congestion, rhinorrhoea, sneezing, itching and general discomfort of the nasal passages. Although these symptoms and signs can be produced by non-inflammatory stimuli, such as strong odours, irritants, cold air, hot or cold food, sunlight and emotions, most rhinitis is associated with inflammation. The major cause of inflammation of the nasal mucosa appears to be a hypersensitive response to airborne allergens. Inflammation, in turn, can be stimulated by infection, chemical irritants or medications. The most recent proposed classification of rhinitis (1) clearly shows the need for better comprehensive investigation in order to resolve the complex differential diagnostic problems between allergic and nonallergic rhinitis. Such investigations have resulted in new diagnostic techniques that have dramatically changed standards in this context.

Rhinopharyngoscopy

After its introduction by Silberman in 1976, the increasing employment of flexible fiberoptic rhinopharyngoscopy (FFR) in the allergy unit is due mainly to the limitations regarding the usual method of visualizing upper airways. It has become evident that anterior and/or posterior rhinoscopy with speculum and mirror provides very limited information, keeping in mind that a nasal speculum only visualizes the anterior nasal cavity 3 cm from the orifice, while the length of the nasal cavity from the inferior meatus to the choanae is 9–11 cm. Flexible endoscopes with a small diameter (3–4 mm) and a tight light-bending radius (130°) allow detailed examination of the upper airways from the external nares to the glottis. With such instruments there is excellent visualization of the nasal septum, inferior and middle turbinates and

of the deeper recessed areas of the nasal airway, such as the posterior choanae, eustachian tube orifice and adenoidal tissue mass (2).

The maxillary sinus ostia are not visualized with the flexible scope. Ostia seen passing laterally into the maxillary sinuses are generally accessory ostia. The use of the endoscope involves the administration of a topical local anaesthetic and decongestant to the nasal mucosa. In the case of allergic rhinitis, little else but a watery secretion and a swollen mucosa with increased vascularity, sometimes presenting a purplish colour, can be noted. At the other extreme, without using any decongestant, the nose appears totally blocked, allowing no insight at all. We normally use FFR as an objective method of documenting changes in nasal airway function during specific nasal provocation employing powdered allergen extracts. Patients with uncomplicated allergic rhinitis, determined by history and physical examination, with or without nasal cytologic studies and allergen skin testing, do not necessarily need flexible fiberoptic examination of their upper airway.

FFR is of greater value in evaluating patients with nonallergic nasal conditions, such as chronic sinusitis, severe septal deviations polyps, high in the nasal vault and again, in the investigation of symptoms related to postnasal drainage, as structures down to and including the vocal cords may be seen. Obviously, anatomical variations can be well documented. There is wide variation in the anatomy of the normal nasal cavity (e.g. concha bollosa in the middle turbinate, uncinate process simulating a double middle turbinate). Septal deformity and spurs may be seen, especially in the patient who has had nasal surgery in the past. Turbinate shape and size varies considerably and, rarely, the middle turbinate may fuse to the septum. Evaluation of the nasal antral window patency is useful not only to visualize the maxillary sinus but also to know when the window has closed.

The diagnosis of sinusitis can be accurately documented by visualizing purulent drainage from the orifice of the affected sinuses. Many patients with possible episodes of laryngeal oedema are referred to the allergist. The examination of the larynx via rhinopharyngoscopy during an attack may confirm such a suspected diagnosis. The role of FRR is incontestable when there is a lack of response to standard pharmacotherapy and in documenting possible side effects during prolonged (i.e. after 6 months) drug therapies, employing topical corticosteroids.

FFR appears to be well tolerated; in our experience, of 550 examinations performed in 210 patients, 1 h after endoscopy, only 3% of the patients suffered from local discomfort. Sneezing and cough,

the more frequent side effects, may be avoided by instructing the patient to breathe only through the mouth, limiting head movements as much as possible. Obviously, laryngospasm prevention is based on keeping the tip of the instrument over the vocal cords. Even if rare, modest nasal bleeding may be observed. Bronchospasm, syncope and cardiac arrhythmias are to be considered only as potential complications.

Pathophysiology of sinusitis in relation to allergic rhinitis

It is well known (3) that many factors are connected with the pathophysiology of sinusitis, mainly, patency and integrity of the ostiomeatal complex and mucociliary clearance.

Ostial patency is vital for proper gas exchange and prevention of a rise in PCO_2 directly involved in the growth of anaerobic microorganisms. The ostiomeatal complex represents the most important area involved in the pathogenesis of chronic sinusitis as it contains the ostia not only for the drainage of the anterior ethmoid sinuses (4), but also for the frontal and maxillary sinuses. These sinuses depend on the integrity of the ostiomeatal complex for ventilation and mucociliary clearance. In the case of a nasal allergic reaction, a recent study (5) found that decreased mucociliary clearance is a contributory factor in decreased ventilation of the sinuses.

Allergic rhinitis can create an obstruction of the nasal structures, alter the quantity and quality of secretions and impair the function of ciliated respiratory cells. Congestion of the nasal mucosa, caused by oedema, contributes to the apposition of the mucosal layers, obstruction of the ostiomeatal complex and, in turn, to sinus congestion, inhibition of mucociliary clearance, increased production of secretions, sinus stasis and infections (6, 7). The result is that allergic patients with acute or chronic nasal symptoms have a high incidence of sinus disease. A number of studies (8–14) in the literature point to this association and support the concept that allergy is an important probable predisposing factor in sinusitis, and not merely an associated one.

A pilot study by Van Dishoeck (15) looked at adults with chronic maxillary sinusitis and found that allergy was an underlying factor in 40–57% of the cases, in patients with bilateral sinusitis, the percentage reached 80%. Savolainen (11), studying acute sinusitis in 224 army recruits, observed a significant increase in positive skin tests in that group versus a homogeneous control group. Concerning children with chronic sinusitis, Rachelefsky et al. (10) reported more than half (51%) had a positive skin test. Shapiro (13), in 61 children with

chronic sinusitis refractory to standard therapy, observed more than one-third having clearly allergic evidence, with another 25% probably allergic.

CT and MRI

A radiological evaluation of the nasal cavity and paranasal sinuses should ideally depict the ostiomeatal channels, felt to be critical regions in the pathophysiology of recurrent sinus disease secondary to allergic inflammation of the nose. Evaluation of the anterior ethmoid sinuses and the study of mucociliary clearance related to the osteomeatal complex are crucial, as reported by Proctor (16) and Messerklinger (7).

The plain film X-ray, the historical standard, due to its inability to individualize ethmoid and sphenoid disease, has been rapidly supplanted by computed tomography (CT) and magnetic resonance imaging (MRI) in the diagnosis of rhinosinusitis. There is growing consensus advocating the use of CT in diagnosing sinus disease, particularly with the more frequent use of endoscopy (17–21). Coronal thin section (2–3 mm) images offer excellent correlations to endoscopy and CT should be used when endoscopy fails to explain the symptoms of sinusitis.

Axial images are particularly useful for the evaluation of the extra-sinusal complications of sinusitis (22). Since its introduction in 1974, CT has been considered the “gold standard” for delineating sinus and nasal anatomy and diseases (21). CT’s ability to optimally display bone, soft tissue and air facilitates an accurate definition of regional anatomy and disease extent. MacAlister et al. (19) reported X-ray limitations vs CT in a prospective study of 70 infants and children with recurrent sinusitis, showing that sinusitis is often under- or overdiagnosed by X-ray. In particular, in 75% of patients, there was no correlation of radiographs to CT scans. In 45% with normal X-rays, at least one sinus was shown to be abnormal on CT scan. In 35% there was an “abnormality” on X-ray, but the sinus was clear on CT. In another study, of 91 paediatric patients with chronic sinusitis, Garcia (23) compared the sensitivity and specificity of a single Waters view with CT performed with a limited number of slices (four) and a low-dose technique (low mAs). Concerning the efficiency of the two techniques, the authors found 20% abnormal frontal sinus radiographs vs 100% of abnormalities on CT scans, and 0% abnormal sphenoidal sinus radiographs vs 82% of abnormalities on CT scans (23). Although CT can visualize the mucosa, it cannot distinguish allergic reactions, fungal or bacterial infections (24).

Thus, in allergic rhinitis, CT alone appears to be of limited value; in addition, the suitability of this

technique for infants is limited by the need for sedation. The relative radiation doses for X-rays and CT are difficult to measure and will vary among different apparatus. With conventional X-rays, dose will vary with type of films and screens used, with mAs, collimation, age and size of patient and with the number of exposures (25–27). The reported dose will vary depending on whether the entrance skin dose, organ dose or internal scatter is measured (25–27). In a survey of 250 CT systems, McCrohan et al. (28) reported that the average radiation dose for each head CT scan image ranged from 2.2 to 6.8 rad, whereas one view of a sinus radiograph averaged about 0.6 rad. The higher radiation exposure in cases of repeated CT evaluations for chronic inflammatory diseases needs to be decreased by using lower milliamperes and shorter scanning times.

Magnetic resonance imaging, especially on T2-weighted images, offers better soft tissue delineation than CT, but it is less suited to show the anatomy of the ostiomeatal complex due to its inability to display compact bone (29). Normally, bacterial and viral infections within the frontal, maxillary or sphenoid sinuses produce a very bright signal on T2-weighted images (30). On the other hand, in cases of infection or allergic reactions caused by mould, there is a marked hypointense signal on T2-weighted images, similar to that of air. Iron, manganese and calcium concentrations in the mycetoma are higher than in bacterially infected mucus and give characteristic MR findings (30). In a retrospective study, Conner et al. (31), reviewing more than 1000 patients who had cranial MRI scans, showed a distinct seasonal pattern for sinus abnormalities unrelated to viral illness and probably due to allergen exposure.

In patients with nasal diseases involving mainly the ethmoid sinuses, the signal intensity on T2-weighted images is not necessarily indicative of disease, as the mucosa in the ethmoid sinuses cycles together with the mucosa in the nasal cavity (32). As the mucosa of frontal, maxillary and sphenoid sinuses does not undergo cyclical oedema, MRI is extremely sensitive in evaluating their disease. Thus, to avoid false positivity, Zinreich et al. (32) considered a mucosal thickening of more than 3 mm indicative of a flogistic, and not hyperaemic, mucosa. Major MRI limitations are represented by high costs, claustrophobia, poor availability and relatively long imaging time that makes sedation necessary in most children.

Currently, the role of MRI imaging is restricted to the evaluation of intracranial and intraorbital complicated sinusitis, paranasal sinus neoplasms and fungal diseases, also using gadolinium-enhanced T1-weighted images. The absence of radiations

together with possible future technical improvements in bone definition may make MRI the modality of choice in the follow-up of nonallergic rhinitis with an eosinophilia syndrome, that is often involved in nasal polyposis pathogenesis.

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