

Paranasal Sinus Pathology in Allergic and Non-Allergic Respiratory Tract Diseases

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Two hundred and seventy patients with asthma and/or rhinitis (162 or 60% allergic, 108 or 40% non-allergic) were studied for sinus pathology by means of standard X-rays and tomograms. Sinus pathology was defined as abnormal sinus X-rays, either on standard or tomography. Fifty-four percent of the X-rays were classified as abnormal based on mucosal thickening, loss of translucency of the cavities or polyps. Asthma was significantly more often associated with sinus X-ray abnormalities (65.1%) than rhinitis and/or chronic cough (44.4%). Loss of translucency of the cavities is more frequent in children, whereas mucosa thickening becomes more frequent with progressing age. Since in this prospective study the taking of X-rays of the sinuses was not dependent on or related to temporarily occurring symptoms which could be attributed to acute sinusitis, the presence of sinus abnormalities on X-rays can be considered as an indicator of the chronicity of airways diseases and might provide an indication for prophylactic therapy of the associated airway disease in a continuous way. The importance of sinus tomograms is stressed, since only 32.5% of the patients with mucosa thickening could be detected on standard X-rays.

Key words: asthma; rhinitis; sinusitis.

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The simultaneous occurrence of asthma and sinusitis has been described in a number of patients. A clinical history suggestive for the role of allergens, positive skin tests and elevation of allergen-specific IgE (RAST) have been demonstrated in patients with clinically defined chronic sinusitis, (1, 8, 9, 12). On the other hand, clinically defined sinusitis can be found in chronic respiratory tract disease, whether allergic or non-allergic (2, 10, 14).

Two hundred and seventy patients with asthma, rhinitis or chronic cough will be studied in order to determine the occurrence of X-ray-defined sinus pathology in the different patient groups. The influence of allergy and age upon radiographic sinus abnormalities will be evaluated.

Although the superiority of paranasal sinus tomograms over standard X-rays is well known

(4), this subject has not been extensively studied. In this study the importance of sinus tomograms will be analysed.

MATERIAL AND METHODS

Two hundred and seventy patients suffering from asthma, rhinitis or cough were studied. *Asthma* was defined as intermittently occurring bronchial obstruction with symptoms of wheezing, dyspnoea and eventual cough. Bronchial obstruction had to be, at least partly, reversible either spontaneously or after administration of beta₂-agonists. *Cough* indicates another clinical entity of chronic cough without wheezing, induced either by allergic or non-allergic factors. In no patient could it be attributed to chronic bronchitis, tumoural

processes or mechanical factors. *Rhinitis* was defined as sporadically or continuously occurring symptoms of nasal blockage, sneezing, nasal discharge (eventually associated with eye symptoms) (16).

No patients had symptoms or signs of acute exacerbations of sinusitis. Patients were divided into allergic (type I allergy) and non-allergic according to history, skin testing with common inhalant allergens and specific IgE determination via the radioallergosorbent test (RAST) as described previously (16). Allergen provocation was performed when there was discordance between results of history, skin tests and specific IgE dosage.

In each patient paranasal sinus X-rays were performed at the first visit. Standard X-rays including occipito-frontal, occipito-mental and lateral views were taken. Moreover, four hypocyctoidal tomograms were performed in the anteroposterior plane at 1 cm intervals. Firstly, the standard X-rays alone were evaluated by two observers, unaware of the clinical diagnosis. Afterwards a reevaluation was made while interpreting both the standard X-rays and tomograms at the same time.

The paranasal sinus X-rays were scored for mucous membrane swelling (thickening > 2 mm was considered to be abnormal), loss of translucency of the cavities (complete opacifications or air-fluid levels) and the presence of polyps.

For comparison of frequencies the chi-square test was used. For comparison of means the non-paired Student *t* test was used. For study-

ing concordances between different studies, the Friedman test was used.

RESULTS

The study included 270 patients, 137 men (51%) and 133 women (49%). The age of the patients ranged between 3 and 79 years with a mean age of 28.5 years (± 14.8 SD) (Table 1).

One hundred and sixty-two patients were allergic (60.0%), 108 patients (40.0%) non-allergic. The allergic group was significantly younger than the non-allergic: 24.1 (± 12.4 SD) vs. 35.3 years (± 15.6 SD) ($P < 0.001$). A more detailed subdivision into the different diagnosis groups is reported in Table 2.

One hundred and forty-six patients (54.1%) had abnormalities of their paranasal sinus X-rays, taking into account the results of both the standard X-rays and tomograms. By standard X-rays alone, 74 patients (27.4%) had abnormal sinuses ($P < 0.001$).

Loss of translucency of the cavities was encountered in 23 patients (8.5%), three standard X-rays were false-positive (i.e. standard X-rays positive, tomograms negative), seven were false-negative.

In 114 patients mucosal thickening was observed (42.2%); in 39 on standard pictures alone (14.4%); there were two false-positives on standard X-rays and 77 false-negatives.

Eighty-six patients (32%) had only mucous membrane swelling without accompanying loss

Table 1
Age distribution

Age range (years)	N (%)	Allergic	Non-allergic
3-10	30 (11)	23	7
11-20	64 (24)	46	18
21-30	64 (24)	50	14
31-40	57 (21)	27	30
41-50	28 (10)	9	19
+ 50	27 (10)	7	20
Total	270 (100)	162	108

Table 2
Diagnosis groups

Diagnosis	N	%
Allergic		
asthma	13	4.8
asthma and rhinitis	67	24.8
rhinitis	59	21.9
rhinitis and cough	23	8.5
Non-allergic		
asthma	23	8.5
asthma and rhinitis	22	8.2
rhinitis	29	10.7
rhinitis and cough	18	6.7
cough	16	5.9
	270	100

of translucency of the cavities or polyps. Polyps were present in 44 cases (16.3%), 29 of them could be diagnosed on standard X-rays (10.7%), there were no false positives.

Table 3 shows that standard X-rays are very specific in revealing sinus abnormalities when compared to tomograms, since there are few false-positive pictures. The sensitivity, however, is low, except for loss of translucency of the maxillary sinus (opacification or air-fluid levels). Almost no abnormalities of the ethmoidal and sphenoidal sinuses can be diagnosed on standard X-rays alone.

Loss of translucency of the cavities is more frequent in children: this was found in eight of 51 (15.7%) children under the age of 15 years. In older patients, the frequency was 15 of 219 (6.9%) ($P < 0.05$). Fig. 1 shows the differences between the different age groups. Mucous membrane thickening is especially prominent in patients of 40 years or more: it was present in 83 of 215 (38.4%) in the age group under 40 years versus 31 of 55 (56.4%) in the older age group ($P < 0.02$).

Polyps are most frequently encountered in the group between 21 and 30 years (Fig. 2).

Sinus pathology is very significantly associated with asthma bronchiale ($P < 0.001$); this

association cannot be found in children. There is no difference in sinus X-ray pathology between allergic and non-allergic patients, nor when the total group of allergic and non-allergic patients is considered, nor when individual patient groups are compared (Fig. 3).

When looking at the frequencies of sinus abnormalities in the different patient groups, a remarkable similarity was found with the frequencies of abnormal bronchial histamine provocation test, reported previously (16) (Fig. 4). In this earlier study the same criteria defining the patient groups were used.

As determined by the Friedman test, a coefficient of concordance of 0.93 was obtained.

DISCUSSION

Sinus pathology is a frequent finding in patients with asthma. However, it is important to distinguish between acute and chronic sinusitis. Indeed, acute purulent sinusitis is mostly due to a bacterial infection and has to be treated with antibiotics (5, 19). On the other hand, chronic sinusitis is a different entity (1, 6, 12, 15, 18). The association between chronic sinusitis and respiratory diseases such as asthma and rhinitis, has already been demonstrated (10, 11, 13).

Table 3
Radiographic findings

Sinus	Abnormal		False		Specificity	Sensitivity
	Standard X-ray	Tomograms	+ ve	-ve		
Cavity						
maxillary	16	13	3	0	98.8	100.0
ethmoidal	2	9	0	7	100.0	22.2
sphenoidal	3	13	0	10	100.0	23.1
Any cavity*	19	23	3	7	98.8	69.6
Mucosa						
maxillary	37	106	1	70	99.4	34.0
ethmoidal	2	15	1	14	99.6	6.7
sphenoidal	4	16	1	13	99.6	18.7
Any mucosa*	39	114	2	77	98.7	32.5
Maxillary polyps	29	44	0	15	100.0	65.9

*"Any cavity" and "any mucosa" catalogue X-rays with at least one cavity or mucosa abnormality; e.g. a standard picture with maxillary opacification and with sphenoidal opacification on the corresponding tomogram is not evaluated as "false negative".

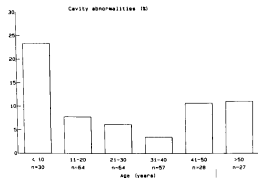


Fig. 1. Frequency (%) of loss of translucency of the cavities according to age. Loss of translucency of the cavities is significantly more frequent in the 1-10 years age group (Chi-square $P = 0.002$).

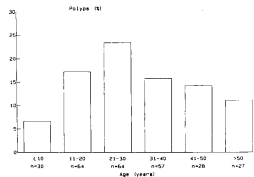


Fig. 2. Frequency (%) of occurrence of paranasal sinus polyps according to age. Polyps occur significantly less frequently in the youngest age group compared with the other groups (Chi-square $P = 0.02$).

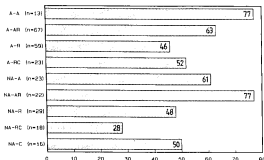


Fig. 3. Frequency (%) of overall sinus pathology in the different patient groups. A-A: allergic asthma; A-AR: allergic asthma and rhinitis; A-R: allergic rhinitis; A-RC: allergic rhinitis and cough; NA-A: non-allergic asthma; NA-AR: non-allergic asthma and rhinitis; NA-R: non-allergic rhinitis and cough; NA-C: non-allergic cough.

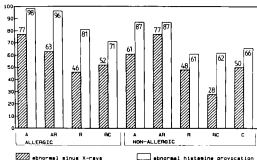


Fig. 4. Frequency (%) of bronchial hyperreactivity assessed by histamine provocation test and frequency of sinus pathology in the same diagnosis groups. Same diagnosis groups as in Fig. 3. Coefficient of concordance between frequencies is 0.93 (Friedman test).

However, a distinction between allergic and non-allergic patients was often not made, and frequently it was not mentioned whether one was dealing with acute or chronic sinusitis, or both. The clinical and radiological criteria for the diagnosis of sinusitis are also very heterogeneous between the different authors.

To our knowledge, there are no prospective studies in which the occurrence of chronic sinusitis, measured by standard X-rays and tomograms, is examined in both allergic and non-

allergic patients. We therefore studied a number of patients prospectively to evaluate the occurrence of X-ray defined sinus pathology in a population with recurrent symptoms of asthma, rhinitis, cough, or combinations of these disorders. However, since tomographic pictures are necessary in providing an accurate view on paranasal sinuses (4) and considering the paucity of symptoms and signs relative to chronic sinus disease (13), tomographic pictures are recommended in the evaluation of sinus

pathology in patients with respiratory diseases. In this study the number of tomograms was restricted to four in order to reduce radiation stress.

Bjuggren et al. (3) found 32% abnormal (standard) X-rays in a population study of 324 children, aged 3-8 years. X-rays were considered as pathologic when a "definite mucous membrane thickening" was found. In our study, 12 of 17 children (70.6%) under the age of 8 years had abnormal sinus X-rays.

Kovatch et al. (7), taking X-rays for cerebral trauma and seeking carefully for airway infections, found that only 7% of asymptomatic children between 1 and 16 years had abnormal sinus X-rays, against 57% in the group with airway infection. They considered a mucous membrane swelling > 3 mm as abnormal.

According to Rachelefsky (11), infection is the most common cause of sinus X-ray abnormalities in children. The same author reported 53% of X-rays abnormal in allergic children with asthma and rhinitis between 3 and 16 years (10). Every visible mucous membrane swelling was considered as abnormal in this study. This would explain the higher prevalence of opacified sinuses in children.

In asthmatic adults, on the other hand, micro-organisms are seldom found in sinus cultures of patients with abnormal sinus X-rays (2).

In our study the most frequent sinus abnormality was mucous membrane thickening (42% of the patients). The mean thickening of the mucous membrane was 6.7 mm. The importance of making routine tomograms is demonstrated since only 32.5% of the mucosal abnormalities could be detected on standard X-rays, whereas the sensitivity of standard X-rays for loss of translucency of the cavities and polyps was higher (respectively 70% and 66%).

There were no overall differences in the frequency of the sinus abnormalities between children and adults. As mentioned above, loss of translucency of the cavities was more frequent in children, probably due to infection with mucopurulent secretion. This, in combination with the smaller diameter of children's sinuses, will more rapidly cause total opacification. The

occurrence of mucosal membrane thickening increased with the age. This could be explained by a more long-standing involvement of the mucosa in the disease in adults as compared to children (13). Since polyps are more frequent in younger age groups another pathogenesis could be supposed.

There are indications that chronic sinus pathology is facilitated by hyperreactivity of the mucosa. Indeed, in other studies bronchial hyperreactivity (measured by a histamine provocation test) was disclosed not only in asthma, but also in rhinitis patients suggesting a generalised hyperreactivity of the respiratory tract in asthma and rhinitis patients (16, 17). The same hyperreactive status would logically be present in the respiratory mucosa of the paranasal sinuses. Sinus pathology was more frequent and severe in asthma patients as compared to rhinitis patients. This may seem paradoxical, but could also be explained by a more pronounced non-specific hyperreactivity of the airways. In favour of this concept is the strong concordance between the frequencies of airway hyperresponsiveness and the frequencies of sinus pathology.

Following this hypothesis, one might consider the different forms of sinus abnormalities as an indicator of a chronic pathological process in the respiratory tract.

As a consequence, abnormal sinus X-rays can be regarded as an indication for a more continuous preventive treatment of the associated respiratory symptoms, especially asthma, instead of prescribing drugs at exacerbations of symptoms.

In summary, we would suggest including standard X-rays and tomograms in the evaluation of patients with asthma or rhinitis, and in the case of pathology, consider this as a supplementary indication for providing these patients with a better treatment continuum.

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