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## Correlation between clinical features of asthma and computed tomographic findings of nose and maxillary sinus

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**Abstract :** Extent of nasal and maxillary mucosa lesion was estimated in 26 asthmatics using computed tomographic scan in relation to clinical features of the disease. 1. No significant differences were present in nasal mucosal thickening between atopic and non-atopic subjects. No significant differences were also present in occupancy rate of mucosa in maxillary sinuses between the two asthma types. 2. Nasal mucosal thickening was not significant different between subjects with steroid-dependent intractable asthma (SDIA) and those without SDIA. Maxillary mucosal lesions were more extensive in subjects with SDIA than in those without SDIA. However, no significant differences were observed in occupancy rate between the two types. 3. No significant differences were observed in nasal mucosal thickenings between in subjects with and without aspirin-induced asthma (AIA). Although maxillary mucosa lesion in subjects with AIA was more extensive than that in those without AIA, the differences was not significant. 4. There was not any correlation between nasal mucosal thickening and amount of expectoration per day. However, significant differences were observed in maxillary sinus lesion between subjects with less amount ( $<50\text{ml}/\text{day}$ ) and those with large amount of expectoration ( $100\text{ml}/\text{day}\leq$ ) ( $p<0.002$ ), and between subjects with moderate amount ( $50-99\text{ml}/\text{day}$ ) and those with large amount of expectoration ( $p<0.002$ ). The results might suggest that in asthmatics with large amount of expectoration, sinus diseases affect pathophysiology of asthma, and asthmatics with large amount of expectoration should have therapy for sinus disease to improve asthmatic status.

**Key words :** bronchial asthma, sinusitis, nasal disease, CT scan, expectoration

## Introduction

It is well known that bronchial asthma is often accompanied with allergic rhinitis and sinusitis. As many as 80% of patients with asthma have rhinitis, whereas 5% to 15% of patients with perennial rhinitis have asthma<sup>1)</sup>. Challenge of silica particles to nose and nasopharynx of patients with no pulmonary disease showed significant increases in airway resistance, and the increase of airway resistance was improved by atropin administration<sup>2)</sup>. Forty-eight children with asthma and sinusitis revealed marked improvement of asthma symptoms after having treatment with antibiotics and decongestants<sup>3)</sup>. Patients having therapy for sinusitis using sphenoidectomy showed marked improvement of bronchial asthma<sup>4, 5)</sup>. These findings might suggest that upper respiratory disease affects the pathogenesis of bronchial asthma.

From 40% to 60% of asthmatics had the radiographic evidence of sinusitis<sup>6, 7)</sup>. A recent study indicated that 75% of patients admitted to hospital with asthma attack had abnormal sinus x-ray findings<sup>8)</sup>. Recently, the computed tomography scan made prominent development in diagnosis of nose and sinus mucosal lesions, and enabled to quantitate extent of sinus mucosal lesions.

The present paper reported the correlation between clinical asthma features and extent of nasal and sinus mucosal lesions in patients with asthma.

## Subjects and Methods

The subjects in this study were 26 patients with asthma (17 females and 9 males, mean age 58.6 years). Serum IgE level and IgE antibodies against several inhalants were examined by radioimmunosorbent test (RIST)

and radioallergosorbent test (RAST), respectively. Patients with IgE antibodies and/or IgE level more than 200IU/ml were assessed as atopic. Disease severity was evaluated according to the criteria for asthma severity of Japanese Society of Allergology. Patients treated with glucocorticoids for more than 2 years were assessed as having steroid-dependent intractable asthma (SDIA). Sixteen of the subjects has SDIA. Sixteen patients were regarded as atopic, and 10 cases were non-atopic. Regarding asthma severity, 9 subjects had mild, 14 had moderate and 3 had severe asthma. Five asthmatics had aspirin-induced asthma (AIA).

Computed tomographic (CT) scans of nasal cavity and maxillary sinuses were performed in all patients. Maximum thickenings of nasal mucosa and occupancy rate of mucosa in maxillary sinuses were measured on CT scan. Clinical feature were evaluated for age, atopy, steroid-dependency, AIA and the amount of expectoration per day during asthma attacks.

Statistically significant differences were evaluated using unpaired student's test. A *p* value of <0.05 was regarded as significant.

## Results

Nasal mucosal thickenings ranged from 1.82 to 7.86mm (mean 4.78mm). No significant correlation was shown between nasal mucosal thickening and age ( $r=0.01$ ). Mucosal lesion in maxillary sinuses ranged from 0 to 94.09% (mean 16.36%). There was no significant correlation between mucosal lesions in maxillary sinuses and age ( $r=0.049$ )(Fig. 1.). No significant differences were observed in nasal mucosal thickenings between atopic ( $5.03 \pm 1.63$ mm) and non-atopic subjects ( $4.37 \pm 1.66$ mm). Mucosal occupancy rate in maxillary sinuses

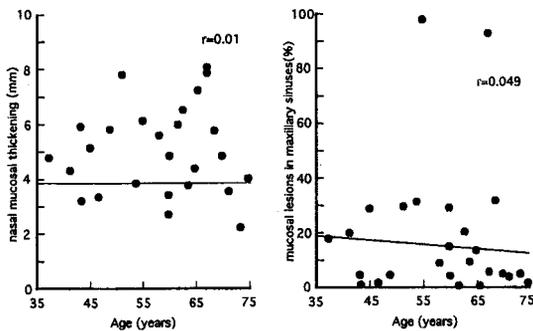


Fig. 1. No significant correlation was shown between nasal mucosal thickening and age. Mucosal lesion in maxillary sinuses ranged from 0 to 94.09% (mean 16.36%). There was no significant correlation between mucosal lesions in maxillary sinuses and age.

was  $15.59 \pm 30.69\%$  in atopic, and  $17.61 \pm 10.50\%$  in non-atopic patients. There were no significant differences between the two types (Fig. 2.). Mean nasal mucosal thickening was 5.03 mm in subjects with steroid-dependent intractable asthma (SDIA), and 4.38 mm in those without SDIA. No significant differences were observed between the two types. Maxillary mucosal lesions were more extensive in subjects with SDIA than the lesions in those without SDIA (21.78% in SDIA and 7.71% in non-SDIA). However, the differences in occupancy rate were not significant between two groups (Fig. 3.). No significant differences in nasal mucosa were observed between subjects with and without AIA. In subjects with AIA, maxillary mucosa lesion were more extensive than that in those without AIA. However, no significant differences were shown between the two groups (Fig. 4.). In subjects whose amount of expectoration on per day during asthma attacks was less than 50 ml/day (group A), mean nasal thickening

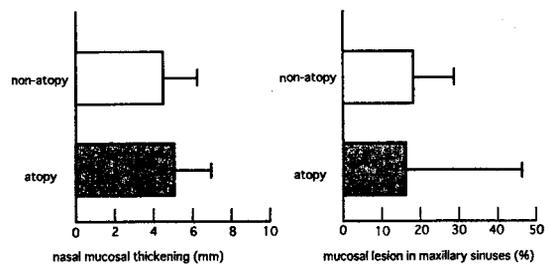


Fig. 2. No significant differences in nasal mucosal thickenings were observed between atopic ( $5.03 \pm 1.63$  mm) and non-atopic subjects ( $4.37 \pm 1.66$  mm). Mucosal occupancy rate in maxillary sinuses was  $15.59 \pm 30.69\%$  in atopic, and  $17.61 \pm 10.50\%$  in non-atopic subjects. There were no significant differences between the two groups.

was 4.36 mm and mean occupancy rate of maxillary mucosal lesion was 6.89%. In subjects whose amount of expectoration was between 50 ml/day and 99 ml/day (group B), mean nasal thickening was 4.57 mm and mean occupancy rate was 6.543%. In subjects with large amount of expectoration more than 100 ml/day (group C), mean nasal thickening was 5.71 mm and mean occupancy rate was 42.44%. Significant differences in maxillary sinus lesion were observed between in group A and group B, and between in group B and group C. No significant differences in nasal mucosal lesion were observed among three groups (Fig. 5.).

## Discussion

It is well accepted that asthma is accompanied with sinus disease<sup>3,9)</sup>. Sinusitis was more common in allergic individuals than in control subjects<sup>10,11,12)</sup>. More than 90% of asthmatics in St. Louis University Medical Center had a history indicating that their sinusitis

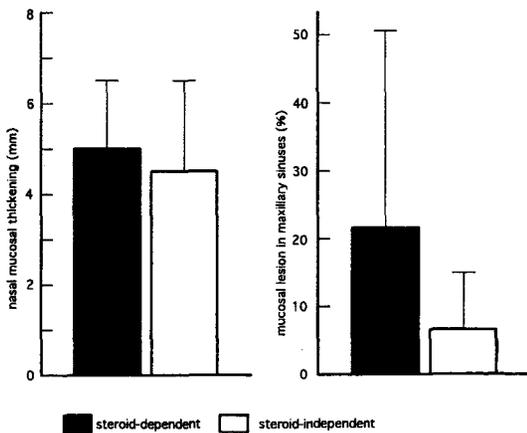


Fig. 3. No significant differences in nasal mucosal thickenings were observed between in subjects with and without SDIA. Maxillary mucosal lesions were more extensive in subjects with SDIA than in those without SDIA, but the difference was not significant.

preceded the development of asthma symptoms<sup>9</sup>). Sinusitis may play important roles in the pathogenesis of asthma.

In this study, a correlation between the extent of nasal-sinus lesion and clinical feature of asthma was discussed. Slavin reported that characteristics of patients with sinus disease and asthma were as follows. Two thirds were non-atopic based on history and skin test. More than half were aspirin sensitive. More than 90% received corticosteroids<sup>9</sup>). However, in our study, 16 of 26 subjects were atopic, and AIA cases were little (5/16), and 73.4% of subjects were steroid-dependent. No significant differences were observed in the extent of nasal or maxillary mucosal lesion between atopic and non-atopic subjects, between subjects with and without AIA, and between subjects with and without SDIA in our study. Subjects in our

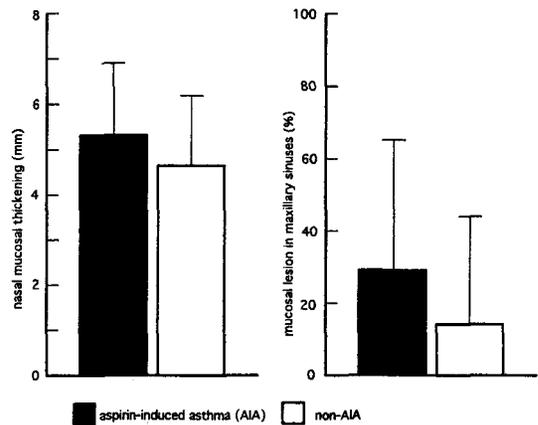


Fig. 4. In subjects with AIA, maxillary mucosal lesion was more extensive than the lesion in those without AIA. However, no significant difference was present. Nasal mucosal lesion showed no significant differences between the two groups.

study were asthmatics (with or without naso-sinus diseases), and subjects in Slavin's study were confined to asthmatics with sinus disease. Thus, differences in clinical features might occur between the studies. In another study for patients with chronic sinusitis using computed tomographic scans, the group showing extensive sinus lesion was associated with asthma, specific IgE antibody and eosinophilia, but not with total IgE level<sup>13</sup>). Further examinations for clinical features of asthmatics with sinus disease are needed.

The pathophysiology of chronic asthma is characterized by an eosinophil-rich inflammation of the airway mucosa. Paranasal eosinophil infiltration and extracellular deposition of major basic protein have also been shown to correlate with mucosal damage in patients with chronic sinusitis, suggesting that eosinophils may act as effector cells in

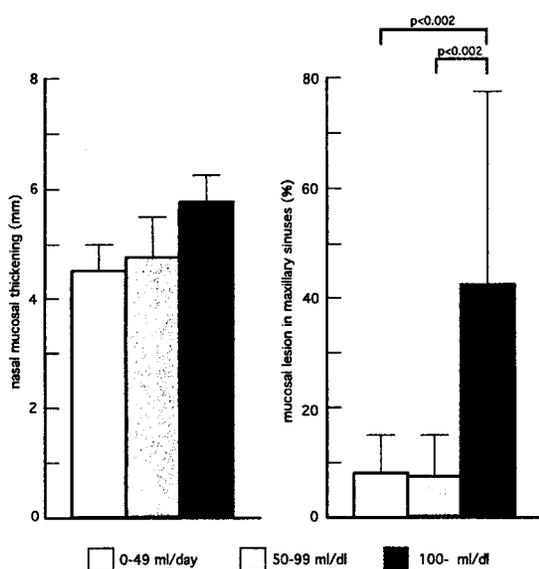


Fig. 5. Showed no significant differences were found in nasal mucosal thickenings among subjects with less (expectoration  $< 50 \text{ ml/day}$ ), moderate ( $50 \text{ ml} - 99 \text{ ml/day}$ ) and large amount of expectoration group ( $100 \text{ ml/day} \leq$ ). Significant differences in maxillary sinus lesion were observed between subjects with less and large amount of expectoration, and between subjects with moderate and large amount expectoration.

bronchial asthma and initiate allergic inflammation of bronchial mucosa<sup>10</sup>. Regarding pulmonary function, some studies have shown decrease of lower airway function in asthmatics after nasal challenge. However, provocation of allergen resulted in no changes in pulmonary functions<sup>2,15,16,17,18</sup>. In regard to bronchial reactivity, nasal allergen challenge showed both immediate and late increases in bronchial reactivity<sup>19,20</sup>, and nasal corticosteroids resulted in a significant improvement in seasonal asthma symptoms<sup>21</sup>. These

data may show that nasal mucosal lesion and/or sinus lesion influence the pathophysiology of asthma. Our study showed that the amount of expectoration was closely related to the extent of maxillary mucosal lesion. In subjects with large amount of expectoration more than  $100 \text{ ml/day}$ , maxillary mucosal lesion showed significantly more swelling comparing to the lesion in those with less amount of expectoration. Nasal discharge may affect sputum production in subjects with expectoration more than  $100 \text{ ml/day}$ . Huxley et al reported that nasopharyngeal secretions gain access to the lung in 50% of normal subjects and 70% of ill patients because of relaxation of the sleep<sup>22</sup>. Therefore, in subjects with expectoration more than  $100 \text{ ml/day}$ , eosinophils or inflammatory mediators in aspirated discharge from sinuses may exacerbate asthma symptoms. In asthmatics with large amount of expectoration, sinus disease may exacerbate asthma status. Therefore these asthmatics should have therapy for sinus disease to improve asthmatic status.

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### 気管支喘息症例における臨床的特徴と鼻腔・副鼻腔のCT所見の関連について

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気管支喘息26症例において喘息の臨床的特徴と、鼻腔・上顎洞のCT所見の関連について検討を加えた。1. 鼻腔粘膜肥厚はアトピー症例、非アトピー症例間で有意な差は認められなかった。上顎洞における粘膜肥厚比率(1 slice上の上顎洞面積に対し、上顎洞粘膜が占める割合)も、アトピー・

非アトピーで差は認められなかった。2. ステロイド依存群・非依存群においても、鼻腔粘膜肥厚・上顎洞粘膜肥厚に有意な差は認められなかった。3. アスピリン喘息症例においては、非アスピリン喘息症例に比べ、上顎洞粘膜肥厚が顕著であったが有意ではなかった。鼻腔粘膜肥厚は2群間で差は認められなかった。4. 発作時の一日喀痰量との関連では一日喀痰量が100ml以上の症例群では、喀痰量が50ml以下の群・50-100mlの群に比較して有意に上顎洞粘膜肥厚比率が高値を示した。鼻腔粘膜比率に関しては3群間で有意な差を認めなかった。以上の結果から、喀痰量の多い気管支喘息症例では、その病態に副鼻腔病変が影響を及ぼしている可能性が考えられ、副鼻腔病変に対する治療により、気管支喘息が改善する可能性が考えられた。