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## Clinical evaluation of MAST system in the measurement of specific IgE antibodies in patients with bronchial asthma

Fumihito MITSUNOBU, Hikaru KITANI, Takashi MIFUNE, Kazuhiro KAJIMOTO, Satoshi YOKOTA, Ichiro TAKADA and Yoshiro TANIZAKI

Division of Medicine, Misasa Medical Branch,  
Okayama University Medical School

**Abstract :** The serum levels of specific IgE antibodies to food allergens and inhalant allergens were evaluated in ninety five patients with bronchial asthma using the MAST system, which can measure specific IgE antibodies against sixteen different allergens with a single sample. 1. Higher positivities of specific IgE antibodies were found in inhaled allergens than in food allergens. Specific IgE antibodies against several allergens were detected in individuals more frequently in inhaled allergens than in food allergens. 2. Positivities of specific IgE antibodies against food allergens did not correlate to patients' age and patients' age at onset. In inhaled allergens, positive results in MAST system were frequently observed in patients under age of 50 and under age at onset of 60. 3. In subjects with high serum IgE levels, high positivities of specific IgE antibodies against inhaled allergens and food allergen were found. 4. The MAST system is suggested to be clinically more useful than RAST.

**Key words :** bronchial asthma, specific IgE antibodies MAST system

### Intodution

IgE-mediated immediate allergic reaction plays a major role in atopic diseases including bronchial asthma<sup>1)-3)</sup>. It is clinically important to measure the specific IgE antibodies to individual allergens. The commercially available radioallergosorbent test (RAST) (as Phadebas RAST) supplied a

widely used diagnostic tool for allergic diseases<sup>4)</sup>. Nevertheless, RAST still presents some disadvantages ; e.g. it is less sensitive than *in vivo* tests<sup>5)</sup>, and in atopic patients with low-grade allergy RAST was less sensitive than specific provocation test for several inhalant allergens. Although various modifications of the RAST technology have been proposed and tested, an increase of

sensitivity resulted in a loss of specificity<sup>6,7,7)</sup>.

Recently, new *in vitro* tests, e.g. CAP System (Pharmacia) and MAST system (MAST Immunosystems)<sup>8)-10)</sup>, have been proposed to measure IgE antibodies in a quantitative way. The CAP system is based on a porous hydrophilic carrier polymer encased in a capsule, while the MAST system is based on cellulose fiber in a sort of pipette. In the MAST system, the carrier can bind many kinds of allergens in the CNBr (cyanogen bromide) activated form compared to the RAST paper disc, and the internal standardization and the stable chemiluminescence reaction achieved improvements to determine a small amount of specific IgE antibodies without any loss of accuracy<sup>10)</sup>.

In present study, we examined serum levels of specific IgE antibodies against food allergens and inhalant allergens in ninety five subjects with bronchial asthma by means of the MAST system.

### Subjects and Methods

#### Subjects

We studied ninety five subjects with bronchial asthma (57 females, 38 males, mean 52.5 years, range 7-88 years). The subjects were divided into 6 groups, according to age or age at onset: 0-20, 21-30, 31-40, 41-50, 51-60, 60+ years. Mean level of serum IgE was 509.9 IU/ml (2.2-2676.6 IU/ml). The subjects were also classified into 5 groups, according to serum IgE levels: 0-100, 101-300, 301-500, 501-1000, 1001+ IU/ml.

#### *In vitro* tests

The MAST system (food allergens set, inhalant allergens set) was employed as follows: undiluted sera were incubated with an allergen-coated solid phase consisting of cellulose fiber in a sort of pipette. After

incubation and washing, a peroxidase labelled anti-human IgE goat serum was added, following incubation and washing. After the substrates were added, the chemiluminescence was obtained. This strength was measured and expressed in V, ranging 0.06 to 3.50 V.

The food allergens set consists of house dust, mite, Japanese cedar, cat danger, egg white, milk, Cheddar cheese, beef, chicken, shrimp, crab, tuna, salmon, wheat, rice and soybean. The inhalant allergens set consists of house dust, mite, egg white, soybean, ragweed, mugwort, spring grass, timothy grass, Penicillium, Cladosporium, Candida, Alternaria, Aspergillus, cat danger and dog danger.

The specific IgE antibodies against sixteen different allergens were measured simultaneously.

#### Assessments of results

Results were classified into 5 classes: 3 (3.50<), 2 (1.90-3.50), 1 (0.67-1.90), 1/0 (0.06-0.67), 0 (<0.05). Classes of more than 1 were defined as positive.

### Results

Specific IgE antibodies in patients with bronchial asthma

Among ninety five asthmatics investigated, 37 (38.9%) had positive MAST results to inhaled allergens tested, whereas 8 (8.4%) had positive specific IgE antibodies to food allergens. The positivities of specific IgE antibodies against inhaled allergens and food allergens were presented in Table 1. In this study, house dust, mite, ragweed, mugwort, spring grass, timothy grass, Penicillium, Cladosporium, Candida, Alternaria, Aspergillus, cat danger and dog danger were considered as inhaled allergens. Egg white, milk, Cheddar cheese, beef, chicken, shrimp, crab,

tuna, salmon, wheat, rice and soybean were considered as food allergens. Higher positivities of specific IgE antibodies were found for inhaled allergens than for food allergens. Twenty of ninety five patients (21.1%) had specific IgE antibodies against

Table 1. Specific IgE antibodies in patients with bronchial asthma

Allergen		No. of MAST positive allergens							
		0	1	2	3	4	5	6	7
Inhalant	No. Pts	58	17	10	7	1	1	0	1
Food	No. Pts	87	5	3	0	0	0	0	0

Table 2. Positivities of specific IgE against each allergen

	MAST positivities
Mite	27/95(28.4%)
House Dust	19/95(20.0%)
Candida	2/95( 2.1%)
Japanese cedar	7/95( 7.4%)
Spring grass	11/95(11.6%)
Timothy grass	8/95( 8.4%)
Mugwort	7/95( 7.4%)
Cat danger	6/95( 6.3%)
Cladosporium	1/95( 1.1%)
Alternaria	1/95( 1.1%)
White egg	4/95( 4.2%)
Soybean	2/95( 2.1%)
Rice	2/48( 4.2%)
Crab	2/48( 4.2%)
Shrimp	2/48( 4.2%)

two or more inhaled allergens, whereas only three of ninety five subjects (3.2%) had them against food allergens. Seven of eight patients with positive MAST to food allergens showed positive MAST to inhaled allergens. Table 2 showed a positive trend in MAST system, indicating relatively high positivities in mite (28.4%), spring-grass (11.6%), timothy grass (8.4%), Japanese cedar (7.4%), mugwort (7.4%), cat danger (6.3%), egg white (4.2%).

#### Specific IgE antibodies and patients' age

As shown in Table 3, positivities of specific IgE antibodies against food allergens did not correlate to patients' age. In inhaled allergens, positive results in MAST system were frequently observed in groups under age of 50 (more than 50%). However, positivities of specific IgE decreased over the age of 51, especially over age of 61 years (17.9%).

Table 3. Specific IgE antibodies and patients' age

Patients' Age	MAST Positivities	
	Inhaled allergen	food allergen
0-20	7/10 (70.0%)	3/ 7 (42.9%)
21-30	3/ 5 (60.0%)	0/ 4 ( 0%)
31-40	4/ 7 (57.1%)	0/ 4 ( 0%)
41-50	9/15 (60.0%)	2/ 7 (28.6%)
51-60	6/19 (31.6%)	2/10 (20.0%)
61-	7/39 (17.9%)	1/16 ( 6.3%)

Specific IgE antibodies and patients' age at onset

As shown in Table 4, high positivities of

specific IgE antibodies against food allergens did not correlate to patients' age at onset. Positive reaction to inhaled allergens in the MAST system was frequently observed in patients under age at onset of 60 (more than 40%).

Table 4. Specific IgE antibodies and patients' age at onset

Patients' Age at onset	MAST Positivities	
	Inhaled Allergen	Food Allergen
0-20	9/14 (64.3%)	3/9 (33.3%)
21-30	4/9 (44.4%)	0/7 (0%)
31-40	9/16 (56.3%)	2/8 (25.0%)
41-50	6/14 (42.9%)	0/8 (0%)
51-60	5/20 (40.0%)	2/11 (18.1%)
61-	1/12 (8.3%)	0/3 (0%)

Serum IgE levels and specific IgE antibodies

The relationship between serum IgE levels and specific IgE antibodies was presented in Table 5. In subjects with high serum IgE levels ( $>500$  IU/ml), high positivities of specific IgE antibodies against inhaled allergens were found. The MAST system also gave

Table 5. Specific IgE antibodies and serum IgE levels

Serum IgE levels (IU/ml)	MAST Positivities	
	Inhaled Allergen	Food Allergen
0-100	3/19 (15.8%)	0/8 (0%)
101-300	6/20 (30.0%)	0/6 (0%)
301-500	5/14 (35.7%)	2/6 (33.3%)
501-1000	10/14 (71.4%)	1/6 (16.7%)
1001-	8/11 (72.7%)	4/6 (66.7%)

high positivities of specific IgE antibodies against food allergens in subjects with high serum IgE levels ( $>1000$  IU/ml).

### Discussion

The IgE-mediated allergic reaction is considered to be one of the onset mechanism of bronchial asthma. The existence of IgE antibodies to specific allergens is a factor of great importance in patients with bronchial asthma and another allergic diseases. It is necessary to measure specific IgE antibodies to allergens for the clinical diagnosis.

Although RAST has been considered to be the standard of measuring specific IgE antibodies<sup>4)</sup>, it is generally reported that 10-25% of patients presenting a positive challenge test to specific allergens will give a negative RAST<sup>5)</sup>. Some of these may result from false-positive by non-specific reactivity of *in vivo* test, but another may be because of low sensitivity of *in vitro* test.

Several attempts have been done to improve the sensitivity to detect specific IgE antibodies. Recently, new *in vitro* methods have been developed to estimate specific IgE antibodies quantitatively, and one of those is the MAST system, which shows some advantages in comparison with RAST. Namely, using a single sample, it makes possible to measure a small amount of specific IgE antibodies to sixteen different kinds of allergens with no radioactive materials, no complicated manipulation and no loss of specificity.

In the present study, we investigate serum levels of specific IgE antibodies to food and inhalant allergens in ninety five patients with bronchial asthma to employ the MAST system.

Higher positivities of specific IgE antibodies were found in inhaled allergens than in

food allergens, suggesting that inhaled allergens may play a more important role in patients with bronchial asthma than food allergens. It is also consistent with the result that large number of patients present specific IgE antibodies to 2 or more inhaled allergens, but only a few patients showed them to food allergens. Seven patients present specific IgE antibodies to both inhaled and food allergens, and all of them suffer from another allergic diseases, particularly pollinosis. Moreover, they showed high serum IgE levels (mean level : 1435, 7 IU/ml), which was higher than those of total subjects tested, suggesting that a combination with food and inhalant allergens has a relationship to an allergic inheritance. It could be considered that there is a crossreactivity between pollen antigens and food antigens. In recent years, it was published that IgE to food allergens were highly prevalent in patients allergic to pollens, with and without symptoms of food allergy<sup>12)</sup>.

Positive incidence of specific IgE antibodies against food allergens did not correlate to patients' age and patients' age at onset, therefore food allergens might be a minor factor as a cause of bronchial asthma. In inhaled allergens, positive results in MAST system were frequently observed in relatively young subjects. In subjects with high serum IgE levels, high positivities of specific IgE antibodies against inhaled allergens and food allergens were found.

We applied the MAST system, one of new *in vitro* systems for measuring specific IgE antibodies, to patients with bronchial asthma. This assay was suggested to be useful for analysis of the relationship among individual allergens.

## Conclusions

The commercially available radioallergosorbent test (RAST) is still widely used as a good diagnostic tool for allergic diseases. Recently, new *in vitro* tests (CAP system and MAST system) were proposed to measure IgE antibodies in a quantitative manner. In this study, we examined serum levels of specific IgE antibodies to food allergens and inhalant allergens in ninety five patients with using the MAST system.

Higher positivities of specific IgE antibodies were found for inhaled allergens than for food allergens in the subjects studied. Although positivities of specific IgE antibodies against food allergens did not correlate to patients' age or age at onset, positive reaction to inhaled allergens in the MAST system was frequently observed in patients under age of 50 or in those under age at onset of 60. High positivities of specific IgE antibodies against both inhaled allergens and food allergens were found in asthmatics with high serum IgE levels. The MAST system, which can measure specific IgE antibodies against sixteen different allergens with a single sample, is suggested to identify a larger number of allergens than RAST.

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### MASTシステムによる気管支喘息患者の特異的IgE抗体の検討

光延文裕, 貴谷 光, 御船尚志, 梶本和宏,  
横田 聡, 高田一郎, 谷崎勝朗

岡山大学医学部附属病院三朝分院内科

気管支喘息95例を対象に, MASTシステムにより吸入抗原, 食餌抗原の陽性率を検討した。その結果, 吸入抗原の方が食餌抗原よりも陽性者が高率にみられ, さらに複数個の抗原に陽性の傾向が見られた。また8名の食餌抗原陽性者の内7名が吸入抗原陽性であった。MAST陽性率と年齢, 発症年齢には食餌抗原では明らかな相関は見られな

かったが, 吸入抗原では, 50才以下の症例に陽性率がやや高い傾向が, 発症年齢が60才以下の症例の陽性率が高い傾向が見られた。食餌抗原では血清IgE値が300IU/ml以上の症例で陽性者がみられ, 1001IU/ml以上の症例では66.7%と比較的高率であった。一方, 吸入抗原に対する陽性率は, 血清IgE値が500IU/ml以上の症例で高く70%以上の陽性率であった。以上の結果より1検体同時多項目(16項目)測定可能なMASTシステムは従来のRASTに比して臨床的に有用であると考えられた。

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