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## Food allergy to meat and milk in adults

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meat allergy; milk allergy.

Food allergy caused by milk or meat is rare in adults, despite prevalence of combined milk and meat allergy in children (1). Little information is available on combined milk and meat allergy in adults, although bovine serum albumin (BSA) is known as a causative allergen of them (2). Here, we report the clinical features and immunological findings of ten patients with food allergy to both milk and meat that developed in adulthood.

We enrolled 10 adults with the history of recurrent food allergy symptoms on exposure to milk and meat. All patients were interviewed to identify the causal relation of milk and meat with their food allergy symptoms. Skin prick tests (SPTs) were performed with commercial milk, beef, pork and chicken meat extracts (Bencard, Bradford, UK) and considered positive if they produced a wheal with a diameter  $\geq 3$  mm. Serum total and specific IgE levels to milk, pork, beef and chicken were measured using the ImmunoCAP system (Phadia, Uppsala, Sweden). A specific IgE level  $> 0.35$  KU/l was considered positive.

**Food allergy to both meat and milk can be found in adults.**

BSA-specific IgE levels were measured by ELISA using a previously described method (3). The positive cut-off value for a high serum BSA-specific IgE antibody level was defined as the mean  $\pm 3$  standard deviations of the absorbance value for nonatopic healthy controls.

A summary of the 10 cases is provided in Table 1. All of the patients developed food allergies to meat and milk in adulthood (median onset age 33.2 years, range 20–58 years) with no history of any allergic symptoms as children. The most common symptoms developing after meat and milk ingestion were skin symptoms (70%), followed by gastrointestinal symptoms (40%). All patients experienced these symptoms after exposure via an oral route, but not in response to contact or inhalational exposure. The SPT results for beef, pork, chicken meat and milk extracts were negative in all patients, whereas nine patients had high serum-specific IgE to meat or milk by CAP, and four patients (40%) had high specific IgE to BSA by ELISA.

Several findings of this study can be highlighted. Previous studies reported that the major symptoms in child patients with meat and milk allergy were atopic dermatitis with highly atopic status (1). By contrast, our patients had various clinical features, such as anaphylaxis, respiratory symptoms and urticaria, and less commonly atopic dermatitis. Among three kinds of meat, patients with beef and pork allergy more commonly had milk allergy than did those with chicken allergy, which may result from the antigenic similarity of the serum albumins. Previous studies reported that the percentage of sequence identity between BSA and pig, sheep and chicken serum albumin was 80.0, 92.4 and 44.7%, respectively (4, 5).

In this study, we could not perform a confirmative oral challenge test. However, all of the patients had clinical history of repeated hospital visits because of allergy symptoms after meat and milk ingestion. Furthermore, measuring the serum food-specific IgE level is known to be useful for diagnosing food allergy (6). In this study, the serum-specific IgE levels to milk and each meat were measured, and the results were correlated with the causative meat and milk reported in each patient's history. To evaluate the diagnostic role of the serum BSA-specific IgE level in combined milk and meat allergy in adults, we measured the serum-specific IgE level to BSA using ELISA. Although the results suggest that this is insufficient for use in diagnosing food allergy caused by both milk and meat alone, a high BSA-specific IgE level could help to suspect milk or meat allergy.

In conclusion, our study shows that food allergy to both meat and milk could occur in adults with various clinical manifestations, and it should be considered about the possibility of co-existence of milk and meat allergy. We also recommend the measurement of serum-specific IgE to BSA, as well as each meat and milk allergen for the diagnosis of meat and milk allergy in adult.

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**Table 1** Clinical features and immunological findings of the study subjects

| Pt | Sex | Age | Atopy | Total IgE<br>(IU/ml) | Associated allergic<br>diseases | Onset<br>age | Evoked symptoms to |          |          |           | Specific IgE to |                 |                    |                 |     |
|----|-----|-----|-------|----------------------|---------------------------------|--------------|--------------------|----------|----------|-----------|-----------------|-----------------|--------------------|-----------------|-----|
|    |     |     |       |                      |                                 |              | Beef               | Pork     | Chicken  | Milk      | Beef<br>(IU/ml) | Pork<br>(IU/ml) | Chicken<br>(IU/ml) | Milk<br>(IU/ml) | BSA |
| 1  | M   | 59  | +     | 1298                 | AR, FA (seafood)                | 58           | AN, A, U           | AN, A, U | -        | AP        | 15.6            | 10.1            | 0                  | 3.49            | P   |
| 2  | F   | 46  | +     | 1138                 | BA, AR, AC                      | 46           | A, U, AP           | A, U, AP | A, U, AP | A, U, AP  | 9.26            | 4.58            | 0                  | 3.04            | P   |
| 3  | M   | 47  | +     | 650                  | CU, FA (seafood)                | 44           | U                  | -        | U        | AP, D     | 3.02            | 0               | 1.36               | 0               | N   |
| 4  | F   | 24  | +     | 83                   | CU                              | 24           | U                  | U        | U        | U         | 0.71            | 0.35            | 0.36               | 21.9            | N   |
| 5  | F   | 23  | +     | 118                  | BA, AR, FA (seafood)            | 21           | U                  | U        | U        | U         | 0.42            | 0               | 0                  | 4.52            | N   |
| 6  | M   | 37  | +     | >5000                | AD                              | 35           | Ez                 | Ez       | Ez       | Ez        | 0.39            | 0               | 1.19               | 0.41            | N   |
| 7  | M   | 25  | +     | 366                  | BA, AR                          | 25           | OAS                | -        | -        | LS, AP, D | 0               | 0               | 0                  | 14.6            | P   |
| 8  | F   | 27  | +     | 300                  | AD                              | 23           | Ez                 | Ez       | -        | Ez        | 0.51            | 0               | 0                  | 0.85            | N   |
| 9  | F   | 22  | +     | 132                  | BA, AR, drug allergy            | 20           | Pr                 | U        | U        | Pr        | 0               | 0.93            | 0                  | 0               | N   |
| 10 | F   | 37  | +     | 53                   | Bee venom allergy               | 36           | Pr                 | Pr       | Pr       | Pr        | 0               | 0               | 0                  | 0               | P   |

Beef-, pork-, chicken- and milk-specific IgE levels were measured using ImmunoCAP, and BSA-specific IgE levels were measured using ELISA. The positive cut-off value (line) for a high level of serum-specific IgE antibody was defined as the mean  $\pm$  3 standard deviations of the absorbance value for 12 nonatopic healthy controls.

Pt, patient; M, male; F, female; +, present; -, absent; FA, food allergy; BA, bronchial asthma; AR, allergic rhinitis; AC, allergic conjunctivitis; AD, atopic dermatitis; CU, chronic urticaria; OAS, oral allergy syndrome; AN, anaphylaxis; A, asthma; R, rhinitis; U, urticaria; AE, angio-oedema; Ez, eczema; Pr, pruritus; AP, abdominal pain; D, diarrhoea; V, vomiting; P, positive; N, negative.

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