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Clinical presentation and diagnosis of meat allergy in Switzerland and southern Germany

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Summary

Study/principles: The aim of this study was to investigate the clinical characteristics of meat allergy, to validate the routine diagnostic tools and to compare our results with data from the literature.

Methods: We recruited within the framework of the EU-project REDALL adult patients and children with a positive case history of meat allergy. Definitive inclusion criteria were either a history of an anaphylactic reaction to meat or a positive titrated double-blind placebo-controlled food challenge with the incriminated meat. Sensitisation to meat was assessed in all patients by skinprick-testing with meat extracts and in vitro determination of specific IgE to pork, beef and chicken (CAP-FEIA).

Results: Between 3/2003 to 6/2005 we identified thirteen patients with a positive case history of a meat allergy to either chicken (n = 6), beef (n = 5) or pork (n = 2), respectively. Meat allergy associated symptoms as reported by the patients ranged from contact urticaria of the oral mucosa (oral allergy syndrome, OAS) to anaphylactic reactions. Skin testing with the responsible meat was positive in nine patients, and in vitro determination of specific IgE in four patients. Under DBPCFC one patient responded with nausea and dysphagia after 10.2 g of chicken and two patients either with urticaria or nausea, diarrhoea, emesis and abdominal pain at 0.102 g and 34 g of beef, respectively.

Conclusion: Meat allergy seems to be an uncommon food allergy in Central Europe. Meat induced symptoms range from OAS to severe anaphylactic reactions. The routine-diagnostic tools, i.e., skin testing and in vitro determination of specific IgE had a low sensitivity among our patients.

Key words: meat allergy; chicken; pork; beef; diagnosis; DBPCFC

Introduction

The prevalence of food allergy in Europe is not known since prospective studies providing validated data on the epidemiology of food allergy are virtually non-existent. Most data available are based on interviews and questionnaires but in those studies reported food allergies were mostly not confirmed by food challenges, which are the gold standard for diagnosing this allergic disease. It is estimated that about 4% of adults and 8% of children suffer from food allergy [1–4]. However, much more patients believe that they are food allergic.

For instance, the self-reported lifetime prevalence of any adverse reaction to food in the Berlin population (mean age 41 years) was recorded to be 34.9%. Out of the investigated population, 814 individuals were more extensively investigated, e.g., using food challenges. The point prevalence of adverse reactions to food confirmed by food challenge tests in the Berlin population including all age groups was 3.6% (95% confidence interval [3.0–4.2%]) [1].

The type of food leading to allergic reactions is partly age dependent. Thus, in children food allergy to egg and milk is most prevalent. For instance in the Danish population 2.2% of all children develop a cow's milk allergy during the first year of life, and 1.6% of all children suffer from a hen's egg allergy up to the age of three years [5]. In adult patients from central and northern Europe, however, pollen related food allergy to plant foods such as fruits and vegetables is most frequently observed whereas food allergy to animal derived foods are comparatively rarely reported. Within the German KORA study including subjects with a median age of 50 years, based on questionnaires and determination of food specific IgE and not on food challenges, 25% of adult

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subjects who thought they had a food allergy were indeed sensitised to at least one allergenic food. Sensitisation to hazelnut, celeriac and peanuts were most frequently observed (11–18%) whereas sensitisation to meat was reported in just 3% [6]. In a Spanish study investigating the type of food allergy among 355 children with a mean age of 4.5 years and a confirmed IgE mediated food allergy [7] egg, milk and fish accounted for 24–34% of food allergies whereas meat allergy was observed in just 3% of food allergic children. Among 402 mainly adult patients with an IgE mediated food allergy visiting the Allergy Unit at the University Hospital Zürich between 1978 and 1987 just 28 patients (7%) were identified with either a chicken, pork or a beef allergy [8]. Also in a follow-up study covering the years 1990 to 1994 among 383 adult patients food allergy was dominated in those subjects by allergic reactions to hazelnut, apple, celeriac or carrots (25–37%) and just 3% of the investigated patients were allergic to beef [9]. Taken together, meat allergy seems to be a rare phenomenon in Switzerland, but also in other European countries.

The EU-funded project "REDALL – Reduced Allergenicity of Processed Foods Containing Animal Allergens" lasting from 2002 to 2006 investigated food products containing allergens of animal origin such as milk, egg and meat. The project involved 13 partners from 7 countries. The work plan was divided into seven work packages comprising in particular an epidemiological part and a clinical evaluation of patients affected with food allergy to animal derived products, but also determination of allergens in processed foods, prevention strategies of allergen contamination in food processing and development of less allergenic food products (hypoallergenic foods).

So far, data concerning perceived food allergy in children have been analysed and published [10]. In that part of the project, a representative sample of the general population was contacted by a randomised telephone survey in Austria, Belgium, Denmark, Finland, Germany, Greece, Italy, Poland, Slovenia and Switzerland. A standardised questionnaire was used and considered parentally perceived food allergy reports, symptoms, foods and medical service use by their live-in children. 40 246 adults were polled, yielding data on 8825 children. Parentally perceived food allergy prevalence was 4.7% (90% CI 4.2–5.2%). The most affected age group was 2- to 3-year olds (7.2%). Single-country incidence ranged between 1.7% (Austria) to 11.7% (Finland). Milk (38.5%), fruits (29.5%), eggs (19.0%) and vegetables (13.5%) were most often implicated, although with significant age-linked variations.

In Switzerland 4017 subjects have been contacted by telephone. The incidence of children with reported food allergy was 3.1%. Fish (17.4%), eggs (21.7%), milk (34.8%) and fruits (26.1%) were the most frequently reported elicitors of allergic symptoms whereas meat was only mentioned in 8.7%. In general, the incidence of allergic reactions to meat among children ranged from 0% (Austria) to 15.2% (Italy).

In parallel to the epidemiological part of the REDALL-project patients with allergy to animal derived foods routinely attending the allergy clinics were investigated by detailed interview, skin testing, in vitro determination of specific IgE to the investigated foods and a titrated double-blind placebo-controlled food challenge. We present here the data of meat allergic patients that have been recruited in Switzerland and Germany.

Methods

Patients

Patients with a history of an allergic reaction to meat as a primary inclusion criterion were recruited at the Allergy Unit of the University Hospital Zurich and the Clinic of Dermatology and Allergology "am Biederstein", Munich, in the context of the EU-project REDALL (Reduced Allergenicity in processed Foods) from March 2002 to June 2005. The secondary inclusion criterion was a confirmed food allergy to meat, i.e., a case history of an anaphylactic reaction after meat consumption or a positive food provocation with the respective meat. Pregnancy, history of a severe life-threatening reaction after meat consumption, significant concurrent disease or intake of glucocorticosteroids, H1-receptor antagonists, angiotensin-converting enzyme inhibitor, or β-blocking agents were exclusion criteria for the food provocation. All patients were interviewed in regard to their meat allergy, i.e., type and preparation (raw versus cooked) of meat leading to allergic reactions, meat induced symptoms and date of the last reaction to meat as well as other atopic diseases.

Ethical considerations

The study was reviewed and approved by the local ethical committees. All subjects provided written informed consent before enrolment into the study.

Skin tests

SPTs were performed on the flexor aspect of the forearm with a standardized needle (Stallerpoint, Stallergènes). Histamine dihydrochloride (10 mg/ml) was used as a positive control, and the glycerol diluent of the prick solution (Soluprick, ALK) was used as a negative control. Patients were tested with commercial extracts from cow's milk (Teomed AG, Greifensee ZH, Switzerland), egg-yolk, egg-white and from chicken-, beef- and pork-meat (Alyostal Stallergenes SA, Antony, France). Reactions were recorded after 15 minutes. An SPT result was considered positive if it produced a wheal with a diameter of at least 3 mm.

Table 1

Recipe for DBPCFCs with meat.

Meal with meat (active meal)*	
210 ml	water
40 g	Sinlac® (containing rice flour and carob flour; Nestlé, Vevey, Switzerland)
½ spoon	peppermint flavour
50 g	spinach (colouring)
50 g	meat (beef, pork or chicken) minced and cooked at 96 °C during 5 minutes
Meal without meat (placebo meal)*	
210 ml	water
50 g	Sinlac®
½ spoonful	peppermint- or orange flavour
50 g	spinach (colouring)
30 g	rice/wholewheat flakes

* All ingredients were mixed in a blender.

In vitro diagnosis

Specific serum IgE to pork, beef and chicken were measured by Immuno- CAP-technique (Phadia, Uppsala, Sweden). Specific IgE concentration of more than 0.35 kU/l was considered positive.

Double-blind placebo-controlled food challenge (DBPCFC) with meat

In patients with positive case histories of allergic reactions to meat a double-blind placebo-controlled food challenge (DBPCFC) was performed.

Two different meals (table 1) were prepared for the DBPCFCs (i.e., an active meal [with meat] and a placebo meal [without meat]). They were of identical color, consistency and taste. Apart from meat, all ingredients were known to be tolerated by each patient. The DBPCFC was performed randomised on two different days. The provocation was performed double-blind; neither the patient nor the physician knew, which substance was given to the patient.

The test meals were administered at intervals of 30 minutes in increasing dosage – i.e. 0.2 ml, 0.6 ml, 2 ml, 6 ml, 20 ml, 60 ml, 200 ml with a meat content of 0.034 g, 0.102 g, 0.34 g, 1.02 g, 3.4 g, 10.2 g, 34 g, respectively, in the active meal. Doses were increased until the first objective sign of an allergic reaction occurred or intake of the whole test meal. Thus, a cumulative meat consumption of 50 g (corresponding approximately to 10 g of protein) was achieved in an asymptomatic patient at the end of the active provocation. The patient was observed for two hours after the last provocation dose. If asymptomatic, patients were discharged from hospital with emergency drugs (i.e., 100 mg Prednisone and 20 mg Levocetirizine). Patients with a history of a severe life-threatening allergic reaction (anaphylaxis) were not challenged due to ethical reasons and as suggested in the position paper on food challenges published by an expert group of the European Academy of Allergy and Clinical Immunology [11]. Patients with a case history of an anaphylactic reaction to meat were included into the study as patients with confirmed food allergy to meat.

Results

Patients

Thirteen patients (7 females, 6 males) aged 34.3 ± 16.5 (2–60) years with a positive case history of allergic reaction to chicken (n = 6), beef (n = 5), or pork (n = 2) entered the study. One patient each mentioned an additional allergy to cow's milk and egg. Six patients suffered from atopic diseases as summarised in table 2. Twelve patients were recruited in Zurich and one patient (patient number 13) in Munich.

The symptoms in cases of meat allergy ranged from contact urticaria of the oral mucosa (oral allergy syndrome; OAS) to anaphylactic reactions and are summarised in more detail in table 3.

Table 2

Case histories in regard to atopic diseases and allergies to other foods, age and gender of included patients (n = 13).

Patient	Age	Gender	rhinoconjunctivitis pollinosa	atopic dermatitis	other food-allergies
1	54	f	Yes	No	No
2	55	f	No	No	No
3	44	m	No	No	Walnuts, poppy seed
4	22	m	Yes	No	Walnuts, tomato, spinach, celeriac, fish, apple, peas
5	28	m	Yes	No	Milk, hazelnut, walnut, almond, brazil nut, carrot, pea, pear, lentil, apple
6	27	m	No	No	Walnuts
7	29	f	No	No	No
8	27	f	Yes	No	Crustaceans
9	2	m	No	No	Egg
10	60	f	No	No	No
11	25	f	Yes	No	No
12	47	m	Yes	Yes	Apple, cherry, strawberry, kiwi, apricot, walnut
13	26	f	Yes	Yes	Apple, cherry, walnuts

Confirmed food allergy in six patients

Three patients (patient number 2, 3, 7) were definitively included in the study on the basis of an anaphylactic reaction to pork (n = 1), chicken (n = 1) and beef (n = 1), respectively. These patients responded with life threatening allergic reactions consisting of skin symptoms associated with a drop in blood pressure leading to unconsciousness in patient 2 and 7, respectively, and skin symptoms, dyspnoea and life threatening laryngeal oedema in patient 3. The symptoms that occurred after the ingestion of the respective meats are summarised in table 3. For ethical reasons, these patients did not undergo food provocation. The other ten patients did not experience life threatening symptoms upon exposure to meat and were therefore challenged by DBPCFC with the incriminated foods. In seven patients the challenge was negative. Three patients responded with allergic symptoms to the meal containing meat but not to the placebo meal. One patient de-

veloped nausea and dyspnoea after ingestion of 10.2 g chicken, and two other patients urticaria, nausea, abdominal pain and diarrhoea, respectively, after 102 mg and 34 g of beef.

Table 3

Case histories in respect to meat allergy and results of the DBPCFC with meat.

patient	meat	Time since last reported reaction	symptoms by history	symptoms under DBPCFC	amount of meat eliciting reaction
1	Beef	2 years	U	No symptoms	–
2	Pork	4 years	F, P, R, Co, N, E, Di, BP, UC	nd	nd
3	Chicken	1 year	AE lips, OAS, D, LE	nd	nd
4	Chicken	<1 year	OAS, Diz	No symptoms	–
5	Chicken	<1 year	OAS, AE lips, U, R, E, C	N, Dy	10.2 g
6	Beef	<1 year	P	No symptoms	–
7	Beef	6 years	F, U, D, N, Di, UC	nd	nd
8	Beef	7 years	OAS, D, P, CD, AE lips	U	0.102 g
9	Chicken	<1 year	P, F, PCD	No symptoms	–
10	Pork	<1 year	F, U	No symptoms	–
11	Chicken	<1 year	OAS, D, F, U	No symptoms	–
12	Chicken	<1 year	OAS, D	No symptoms	–
13	Beef	<1 year	N, Di, E, AP	N, Di, AP	34 g

Nd = not done due to case history of an anaphylactic reaction to meat; U = urticaria; F = flush; P = pruritus; Co = cough; N = nausea; E = emesis; Di = diarrhea; BP = drop of blood pressure; UC = unconciousness; AE = angio-oedema; LE = larynx oedema; D = dyspnoea; OAS = oral allergy syndrome; Diz = dizziness; R = rhinitis; C = conjunctivitis; PCD = protein contact dermatitis; AP = abdominal pain

Skin testing and in vitro determination of specific IgE

In four out of six patients with confirmed food allergy, i.e., the three patients with a positive food challenge and the three patients with meat induced anaphylaxis, skin testing with the respective meats was positive (sensitivity 66%). Skin test results of all patients are summarised in table 4. Specific IgE to the allergenic meats, however, were just elevated in two patients (sensitivity 33%). Furthermore, the patient with the anaphylactic reaction to pork was skin test positive to cat epithelia, a phenomenon that has been described in the past as pork-cat-syndrome [12–19]. In addition, one of the beef allergic patients was sensitised to cow's milk without suffering, however, from a milk allergy.

In patients with a negative food challenge sensitisation to the incriminated food was detected by skin testing in five out of seven patients and by in vitro determination of specific IgE in two out of the seven patients. These results are indicative for the fact that determination of specific IgE in vitro or by skin testing does not discriminate between true food allergic patients and patients with a clinically not relevant sensitisation to meat as often observed in food allergy.

Discussion

In the present study, we performed within the framework of the EU-Project REDALL a detailed allergy work-up in 13 patients with a convincing history of allergic reaction to meat to investigate the clinical characteristics and to validate the currently used diagnostic tools.

Taking into account the difficulties we had in recruiting patients in Switzerland, which were even more pronounced in the Munich area, and the paucity of published studies about meat allergy, we conclude that meat is a rare cause of food allergy both in adulthood and childhood.

Table 4

Skin-Prick-Test results with extracts from cow's milk, egg-yolk, egg-white, cat, chicken-, beef-, pork-meat and CAP determination of specific serum IgE to chicken, beef and pork meet.

Patient	SPT Cow's milk	SPT Egg-yolk	SPT Egg-white	SPT Cat	SPT Chicken	SPT Beef	SPT Pork	CAP Chicken (kU/l)	CAP Beef (kU/l)	CAP Pork (kU/l)
1	–	–	–	+	+	++	–	<0,35	<0,35	<0,35
2	–	–	–	+	–	+	+	<0,35	<0,35	3,05
3	–	–	–	–	–	+	nd	<0,35	<0,35	<0,35
4	+	–	–	+	++	+	nd	2,03	2,01	0,59
5	–	–	–	–	+++	–	nd	4,68	<0,35	<0,35
6	–	–	–	–	+++	+++	+++	<0,35	<0,35	<0,35
7	+	–	–	–	+	++	nd	<0,35	1,43	0,84
8	–	–	–	–	–	–	–	<0,35	<0,35	<0,35
9	–	+	+	nd	–	–	nd	<0,35	<0,35	<0,35
10	–	–	–	–	–	–	–	<0,35	10,6	3,61
11	+	–	–	–	+	–	nd	<0,35	<0,35	<0,35
12	–	–	–	+	+	–	nd	<0,35	<0,35	<0,35
13	–	–	–	–	–	+	nd	<0,35	<0,35	<0,35

Nd = not done

This is astonishing taking into account the high meat consumption in industrialised countries. For instance in the United States 65 pounds of beef are ingested per person and year [20].

In food allergy, an accurate diagnosis is extremely important in particular to prevent patients from unnecessary and even potentially health threatening diets.

Measurement of food-specific IgE antibodies by *in-vitro* assays or skin testing tries to link the clinical reaction with the IgE mediated pathophysiology of the reaction.

Unfortunately and in contrast to inhalant allergies, almost no standardised extracts in regard to total protein content, content of single allergens or biological activity are available for use in the diagnosis of food allergy. Therefore, often poor correlations are observed between the clinical history or the outcome of a controlled food challenge and skin test results or in vitro determination of food specific IgE. The high rate of false negative reactions may be explained by the fact that allergen extracts produced from natural source materials are heterogeneous products containing not only the allergenic proteins but also non allergenic proteins or enzymes that may interact with allergens and cause their degradation [21–23]. Moreover, even with well prepared extracts, false positive SPT or elevated food specific IgE do occur due to clinically silent or insignificant sensitisation or cross-reaction, respectively, which explains the overall observed low specificity and low positive predictive value of SPT or in vitro testing for specific IgE in food allergy. These are often below 50%, particularly in children with atopic dermatitis [24–26]. In adults, however, this figure is higher, at about 80% [22, 23, 27–29].

Thus, positive diagnostic tests indicate the presence of food specific IgE antibodies, but they do not establish the diagnosis of food allergy and negative diagnostic tests might be the consequence of the unavailability of standardised meat extracts. Therefore, the final proof of the clinical relevance of the reported history and the detected food specific IgE can only be provided by a positive controlled food challenge. A double-blind placebo-controlled food challenge (DBPCFC) has proven to be the most accurate means of diagnosing food allergy at the present time. These general experiences when managing patients with a case history of a food allergy hold true also in regard to meat allergy.

Seven patients included on the basis of a positive case history failed DBPCFC, i.e., they were completely asymptomatic under ingestion of the suspected meat. This confirms the fact that many more patients believe to have a food allergy than can be proven in a solid diagnostic work up. For safety reasons we used well cooked meat for the oral provocation. Whereas chicken and pork are usually consumed in this form, beef is often eaten medium, rare or even raw. This might lead to negative challenges in beef allergic patients responding only to raw beef if well cooked meat is used for provocation. However, all apart from one patient reported their past reactions after ingestion of well cooked meat. Despite of this limitation, 70% of our meat allergic patients were under an unnecessary dietary restriction at least to well cooked meat.

Two of the patients with a negative challenge showed elevated specific IgE to the incriminated foods in vitro reflecting a state of silent sensitisation. However, just one out of three patients with a positive food challenge was IgE positive by means of CAP determination. Even worse was the situation when analysing the skin test results. Skin testing with commercial extracts was not helpful at all in discriminating patients with a positive from those with a negative food challenge. Similar findings have been published elsewhere. For instance among 335 highly atopic children, 25% were skin test positive for beef, but just 12% of positive skin test correlated with a positive food challenge [20] reflecting the poor positive predictive value of a positive skin test to beef. Similar findings have been reported for other meats. Just 4% of challenges performed with pork and 14.8% with chicken in subjects with positive skin testing to either pork or chicken, were positive [30]. Furthermore, in an investigation from Turkey, just 2 out of 12 beef allergic patients were skin test positive with beef. In contrast to our results, however, all of the Turkish patients were IgE positive to beef in vitro [31]. Nevertheless, – based on our experiences and published data from other investigators – in food allergy to meat neither skin testing nor in vitro determination of meat specific IgE do facilitate the diagnosis of a true meat allergy.

Beef allergy is mainly reported in children with milk allergy

Published studies on beef allergy were mainly done in a population of highly atopic children suffering from atopic dermatitis and often concomitantly from milk allergy. The reported prevalence of beef allergy among children with atopic dermatitis is 1.8 to 6.5% and 13–20% in cases with concomitant milk allergy [32, 33].

Bovine serum albumin, a 67 kDA allergen called Bos d 6 (BSA) and gamma globulins (mainly bovine IgG), are the major beef allergens. Both are implicated in cross-reactivity to milk and other mammalian meats [30, 34–38]. In our study population one beef allergic subject was sensitised to milk, however, without suffering from allergic symptoms upon milk ingestion (clinically silent sensitisation or eventually cross-reaction). Other minor beef allergens are muscle proteins such as actin, myoglobin and tropomyosin. Heat treatment does reduce the allergenicity of beef, in particular BSA is partly heat-labile [20, 30, 39]. Since meat is predominantly consumed in processed and in cooked form, the partial heat lability of major beef allergens might contribute to the general low prevalence of beef allergy. Myoglobin, however, another beef protein, has been shown to

be heat resistant [40]. In our study population patient one reported that the last episode of a beef induced allergic reaction occurred after ingesting medium cooked meat and could not report tolerance to well done meat. All other patients reported allergic reactions after eating well cooked beef. The fact that our challenge meal consisted (for ethical reasons) of well cooked beef might have contributed to the negative outcome of the challenge in patient one.

In our study population we definitively identified three beef allergic patients, one with an anaphylactic reaction and two with a positive DBPCFC. The two patients with the positive DBPCFC reacted with urticaria after intake of 0,102 g of beef and nausea, diarrhoea and abdominal pain after 34 g of beef meat, respectively. That threshold doses, i.e., the minimal dose provoking an allergic reaction, exhibit high inter-individual variability, as shown for other foods too [28].

Pork meat allergy has been particularly seen after ingestion of kidney and gut

Published studies about pork meat allergy are rare. Several allergic and even anaphylactic reactions after consumption of pork meat, kidney and gut have been described as case reports [41, 42]. An anaphylactic reaction after consumption of pork gut and kidney has been reported in a patient who tolerated pork meat itself indicating that IgE reactivitiy might be directed to other allergens or different allergenic epitopes in pork meat and pork innards [43]. Furthermore cases with occupational asthma and contact dermatitis due to pork allergens have been described [44–46]. The prevalence of pork allergy among food allergic individuals ranges from 0.6% to 2.6% [47]. A cross-reaction between cat-epithelia and pork-meat has been reported in the literature as "pork-cat-syndrome" [12–19]. This cross-reactivity is induced by serum albumins.

In our study population, we could just identify one patient with a history of an anaphylactic reaction to pork. In another patient the case history of a pork allergy could not be confirmed by the food challenge. The patient with the anaphylactic reaction to pork was indeed sensitised to cat epithelium, however, without suffering from allergic symptoms upon cat contact (clinically silent sensitisation).

Chicken serum albumin is the major chicken meat allergen

Despite the popularity of poultry consumption there are just few reports of chicken meat allergies. The symptoms range from an oral allergy syndrome to anaphylactic reactions. In addition there are case reports of children with a chicken related enteropathy [48]. According to the reference lists of the Allergen Data Collections (mainly based on searches of Medline and Food Science and Technology Abstracts databases) the prevalence of allergy to chicken meat ranges from 0.6% to 5% among food allergic subjects [49].

This syndrome is defined as a concomitant respiratory allergy to bird feather or dander and a food allergy to egg yolk elicited by cross-reacting IgE-antibodies directed to chicken serum albumin, a 70 kDa allergen called α-Livetin or Gal d 5. Chicken serum albumin is also the major chicken meat allergen [53]. The partial heat lability of chicken serum albumin might explain that chicken meat, which is mostly consumed in a well cooked form, does rarely induce a food allergy [54]. Among 25 patients with a bird feather allergy described in the literature, just 3 suffered from a chicken meat allergy and there are only a handful of cases reported in the literature of egg allergic patients developing a chicken meat allergy [55]. Cross-reactivity between goose, duck, turkey and chicken meat has been demonstrated [56].

In our study, we have included two patients with a confirmed food allergy to chicken. Both did not report allergic reactions to other avian meet or hen's egg and both were not sensitised to egg-yolk or egg-white. The threshold dose inducing an allergic reaction in the patient who underwent DBPCFC was 10.2 g chicken meat.

In conclusion

Meat allergy is a rare phenomenon in our population. This might be the consequence of the partial heat lability of the major meat allergens described so far, i.e., chicken serum albumin and bovine serum albumin as well as bovine immunoglobulins and the fact that meat is most often ingested in cooked form. The similarity of the different animal serum albumins might lead to sensitisation to meat in patients with sensitisation or allergy to animal epithelia such as from cats or dogs. As shown in the literature and as well in our study population, sensitisation to meat is rarely clinically relevant [57, 58]. Symptoms of meat allergy range from oral itching, to anaphylactic reactions. The currently available diagnostic tests such as skin testing or in vitro determination of meat specific IgE do not facilitate the diagnosis of meat allergy. Such a history should be confirmed by DBPCFCs to prevent patients from needing to undertake unnecessary diets.

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