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journal or publication title	Tokyo Women's Medical University Journal
volume	4
page range	77-80
year	2020-12-25
URL	<a href="http://hdl.handle.net/10470/00032749">http://hdl.handle.net/10470/00032749</a>

## A Case of Anaphylaxis due to Salmon Roe Diagnosed by Skin Prick Test

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(Accepted November 22, 2019)

(Advance Publication by J-STAGE January 29, 2020)

In recent years, salmon roe allergies have become common among young children. Conventionally, the diagnosis of a salmon roe allergy has been confirmed by a positive specific immunoglobulin E (IgE) antibody test. We encountered a case of anaphylaxis caused by salmon roe in a child aged 2 years and 10 months. The total amount of IgE antibody was low, thus, the salmon roe-specific IgE antibody test was negative. However, the skin prick test showed positive results, and thus, the diagnosis was confirmed. The skin prick test was found to be useful for confirming an anaphylaxis due to salmon roe in young children with low specific IgE antibody levels.

**Key Words:** food allergy, salmon roe allergy, skin prick test, specific IgE antibody test

### Introduction

In Japan, ingestion of fish roe is a common culinary tradition. In particular, salmon roe is widely considered a favorite product in conveyor belt sushi. As it is used in many dishes as a garnish, there are several opportunities for children to eat it.

An epidemiological survey in the Japanese Pediatric Guidelines for Food Allergy (2016)<sup>1</sup> found that fish roe was the fifth most common cause of food allergies (3.7%). Moreover, as a food associated with new allergy onset, it was the second most common cause of onset by 1 year of age (12.9%) and the first by 2-3 years of age (20.2%).

A previous report suggested that the salmon roe-specific immunoglobulin E (IgE) is positive in most cases of salmon roe allergy.<sup>2</sup> However, the subjects in

this report were around 6 years of age, and were different from younger children with a high initial age. Furthermore, the case of a 3-year-old boy with a salmon roe allergy who tested negative for the salmon roe-specific IgE has also been reported. However, no prick test was performed.<sup>3</sup>

The prick test is convenient, safe, and useful for confirming the allergy diagnosis of infants with low specific IgE antibody levels. Here, we encountered the case of a boy aged 2 years and 10 months who experienced anaphylaxis after eating chirashi sushi. He was diagnosed with a salmon roe allergy using a prick test. We report this case alongside a literature review.

### Case Report

**Patient:** Boy aged 2years and 10 months.

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doi: 10.24488/twmuj.2019008

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**Table 1** Blood test findings (at visit).

WBC	11,700 / $\mu$ L	Alb	4.4 g/dL
Neut.	60.1 %	CRP	0.06 mg/dL
Eos.	0.7 %	AST	28 IU/L
Baso.	0.4 %	ALT	13 IU/L
Mono.	6.4 %	LDH	251 IU/L
Lym.	32.4 %	BUN	11.9 mg/dL
RBC	448 $\times$ 10 <sup>4</sup> / $\mu$ L	Creat.	0.24 mg/dL
Hb.	11.6 g/dL	Na	139 mEq/L
Ht.	35.8 %	K	3.6 mEq/L
Plat.	32.7 $\times$ 10 <sup>4</sup> / $\mu$ L	Cl	109 mEq/L

**Chief complaint:** Facial edema, hoarseness.

**History of past illness:** None noted.

**Family history:** Parents had hay fever.

**History of present illness:** At 18:15 on Hina Matsuri Day, immediately after eating 3-4 mouthfuls of home-made sushi, the patient exhibited sneezing and facial swelling with inspiratory wheezing. He visited the Holiday Clinic at 19:25. Due to the severity of his symptoms and by recommendation of the doctor, his mother requested emergency care and he was transferred to our department. Adrenaline (0.1 mg) was injected intramuscularly before the ambulance arrived. At 20:04, he was admitted to our hospital.

His acute status and findings at visit were as follows. The blood pressure was 138/68 mmHg, heart rate was 130/minute, oxygen saturation was 99% in room air, and body temperature was 38.2°C. Breath sound and heart sounds showed no abnormalities. His pharynx was no swelling or redness. Skin findings showed mild wheal and slight facial swelling.

**Inspection findings:** The blood test results from the visit were normal as shown in **Table 1**.

**Treatment course:** When they got to the hospital, inspiratory wheezing and hoarseness had reduced. The facial swelling improved after inhalation of adrenaline and dexamethasone. Since the general condition was stable, hydrocortisone sodium succinate (100 mg) and hydroxyzine pamoate (10 mg) were intravenously administered at 20:59. Facial swelling and cough were observed and the patient was admitted to the hospital for follow-up. He was discharged the same day.

**Cause search:** Before anaphylaxis development, homemade chirashi sushi had been consumed. The ingredients included rice, sushi vinegar, broiled egg, steamed

**Table 2** Results of specific IgE antibody tests.

Total IgE antibody level	19.7 IU/mL
Specific IgE antibody level	
Crab	<0.01 UA/mL (class 0)
Shrimp	<0.01 UA/mL (class 0)
Salmon	<0.01 UA/mL (class 0)
Salmon roe	0.22 UA/mL (class 0)
Clam	<0.01 UA/mL (class 0)
Egg white	<0.01 UA/mL (class 0)
Egg yolk	<0.01 UA/mL (class 0)
Ovomucoid	<0.01 UA/mL (class 0)

Specific IgE antibody level, class 0=<0.34 UA/mL.

shrimp, salmon roe, seaweed, crab, and grilled salmon. Clam soup was served to others in the room. Eggs were previously consumed, thus, shrimp, salmon roe, and crab were considered suspicious.

**Table 2** shows the blood results of the specific IgE antibody tests performed by the capsulated hydrophilic carrier polymer (CAP) method (Thermo Fisher Diagnostics) at the time of hospitalization. The total IgE antibody level was 19.7 IU/mL, an age-appropriate value. Crab, shrimp, salmon, salmon roe, clam, egg white, egg yolk, and ovomucoid were all class 0 negative.

Two weeks later, a skin-prick test was performed. A scratch solution manufactured by Torii Pharmaceutical, Tokyo, Japan, was used for the shrimp, crab, tuna, house dust, cedar, positive control, and negative control. The salmon roe test was administered using the prick by prick method in which raw salmon roe was stabbed directly with a bifurcated needle. The salmon roe reaction resulted in wheal diameter of 7  $\times$  10 mm and an erythema diameter of 12  $\times$  15 mm. The results were comparable to the histamine diameter and were judged to be positive (**Table 3** and **Figure 1**). Shrimp and crabs that were negative for both the prick test and the specific IgE antibody tests were subsequently ingested and showed no abnormalities. Therefore, this case was diagnosed as anaphylaxis due to salmon roe.

## Discussion

The positive rate of specific IgE antibody tests in patients with a salmon roe allergy is relatively high.<sup>2</sup> Two points were considered as reasons why the specific IgE antibody test was negative and the prick test was positive in this case. First, the patient was 2 years and 10 months old and

**Table 3** Result of skin prick test.

	Diameter of		
	wheal (mm)	/	erythema (mm)
Salmon roe	7 × 10	/	12 × 15
Shrimp	0 × 0	/	0 × 0
Crab	0 × 0	/	0 × 0
Tuna	0 × 0	/	0 × 0
House dust	0 × 0	/	0 × 0
Cedar	0 × 0	/	0 × 0
Positive control solution	5 × 5	/	15 × 15
Negative control solution	0 × 0	/	0 × 0

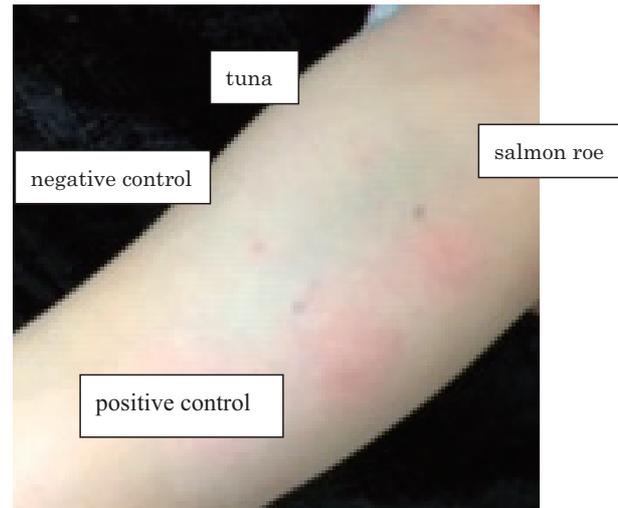
The skin prick test was performed using a bifurcated needle.

his total IgE antibody level was low (19.7 IU/mL). The level of specific IgE antibody may not have been detected in the blood. Second, it may be possible that reactions with other antigens besides the salmon roe antigen occurred in the specific IgE antibody test. The main antigen of salmon roe is  $\beta'$ -component (Onc k 5), a constituent of the egg yolk protein precursor vitellogenin (Vg). About 10% of cases are considered to respond to Lipovitellin and are not necessarily reactive to  $\beta'$ -component.<sup>4</sup>

The prick test checks for an immediate allergic reaction. It is highly appreciated in Western countries because of its safety and simplicity. However, the lack of reproducibility of the results is regarded as a problem. In recent years, this has been improved by using a bifurcated needle. In addition, antigen solutions can contain vasoactive substances causing unreliable results. This can be clarified by using a positive control solution such as the allergen scratch extract positive control drug (histamine di-hydrochloride) manufactured by Torii Pharmaceutical, Tokyo, Japan.

The prick test is considered to be more likely to cause a positive local reaction in infants with low specific IgE antibody levels in their bloodstream. Egg allergy<sup>5</sup> and milk allergy<sup>6</sup> studies also indicated that the prick test was positive in early infancy when the specific IgE antibody test was negative. Similar results were observed in a study that checked allergies to peanuts and sesame seeds.<sup>7</sup> Furthermore, aging has been associated with increased detection of specific IgE antibodies in the circulating bloodstream.<sup>5,6</sup>

It is speculated that the composition of the specific IgE antibody test antigen solution may be different from that



**Figure 1** Photo of the reaction after the prick test patient's right forearm.

of the skin test antigen solution. Recently, skin prick tests have been reported to be more accurate than specific IgE antibody tests in the diagnosis of buckwheat allergy.<sup>8</sup> Also, at the Annual Meeting of the Pediatric Allergy and Clinical Immunology held in November 2019, the usefulness of the prick test for salmon roe allergy was announced. The prick test showed 100% sensitivity, 100% specificity, 85% positive predictive value, and 100% negative predictive value for predicting salmon roe allergy and was reported to be superior to the specific IgE antibody test.<sup>9</sup>

The advantage of the prick test is that even low antibody levels can cause a reaction that can be detected in younger children. It is simple, less invasive than other tests, and very safe. In addition, the determination time is as short as 15 minutes and the results can be understood immediately. Furthermore, if the prick by prick test uses food itself, many antigens such as fruits, vegetables, and seafood can be tested. Moreover, allergens that are not included in the specific IgE test options can be tested this way.

A disadvantage of the test is that it uses a qualitative reaction that cannot be quantified. Furthermore, the allergen extract contains a vasoactive substance and may produce a false positive result. This can be improved by comparison with a positive control solution. In addition, taking antihistamines may cause false negative results and they should be discontinued 3 days prior to testing. In addition, the test cannot be performed if the condition

of the subject's skin is bad. The gold standard for diagnosing food allergies is the oral food challenge test. However, the prick test is safer because the risk is high when testing food orally in patients exhibiting anaphylaxis.

In the case reported, the patient was diagnosed with a salmon roe allergy. However, other fish roes also contain  $\beta'$ -component (Onc k 5) as a common antigen and salmon roe has cross-antigenicity with pollock, herring, capelin, and some other fish.<sup>10,11</sup> In this case, it may be necessary to conduct a specific IgE antibody test or prick test to examine the risk of ingesting other fish roe.

Salmon roe allergy accounts for a significant proportion of fish roe allergies and is ranked first in the new onset of allergies in infants. There are several cases in infants where specific IgE antibody tests show negative results. In these cases, the prick test as a diagnostic method, is more accurate and safer.

### Conclusion

We reported a case of anaphylaxis in a young boy caused by the ingestion of salmon roe which was diagnosed by a skin prick test. In younger children with low antibody levels, a prick test that can yield results is useful when the specific IgE antibody test is not positive.

**Conflicts of Interest:** The authors declare that they have no conflict of interest.

**Disclaimer:** Shigetaka Sugihara is one of the Associate Editors of Tokyo Women's Medical University Journal and on the journal's Editorial Board. He was not involved in the editorial evaluation or decision to accept this article for publication at all.

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