

Occupational rhinitis, asthma, and contact urticaria from IgE-mediated allergy to pork

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We describe four cases of slaughterhouse workers with occupational immediate allergy to raw pork allergens, confirmed by positive skin prick testing and specific immunoglobulin E (IgE) antibodies. Our first patient was diagnosed with occupational asthma from raw pork allergens. Two patients were diagnosed with occupational rhinitis caused by raw pork allergens, which was confirmed by a nasal provocation test. One of these also had occupational contact urticaria caused by raw pork meat. We were unable to diagnose an occupational respiratory or skin disease in the fourth patient, despite signs of immediate sensitization to raw pork meat from occupational exposure. Based on proper diagnoses, measures to prevent allergen exposure were taken, which led to the improvement of symptoms in these four patients. The present patient cases highlight the importance of recognition of early signs of occupational allergy and identification of causative allergens in order to allow avoidance of allergens, with the aim of preventing persistence and worsening of symptoms.

KEYWORDS

immediate allergy, nasal provocation test, pork meat, skin prick test, slaughterhouse work

1 | INTRODUCTION

Occupational rhinitis, occupational asthma, contact urticaria, and protein contact dermatitis caused by the processing of raw pork meat have been infrequently reported.^{1–4} Cutting and handling meat may cause the release of aerosolized allergens into the breathing zone of a worker, and the skin may be exposed to fluids and splashes. Occupations at risk include slaughterhouse workers and other food industry workers, butchers,⁴ and cooks. In patients with symptoms after ingesting meat, porcine serum albumin, and galactose- α -1,3-galactose have been identified as potential allergens. Cross-reactivity between albumins from various animal species is possible.⁵ Less is known of pork meat and increment allergens in patients with symptoms caused by occupational exposure to raw pork meat. In swine breeders, IgE-mediated sensitization to pig dander has been reported.⁶

We report four cases of occupational IgE-mediated allergy to pork allergens examined at our clinic; one of these was diagnosed with occupational asthma, two with occupational rhinitis, and one with occupational contact urticaria. None of the patients had a history of symptoms associated with the ingestion of pork meat. All four patients worked in a single slaughterhouse which exclusively processed pork. They worked in turns in three different sections, cutting and packing pigs' entrails (liver, kidney, lung, heart, or tongue), or intestines. In the intestine section, the pig's stomach is separated from the intestine; the intestine is then turned out and washed. Here, stomach acid contents may be splashed.

None of our patients had been using respiratory protection masks, or protective goggles at work. All of them used protective gloves either of nitrile or of natural rubber latex. Two of the patients reported that while working in the intestine section where it was warm, they used a short-sleeved work coat which left the upper forearm skin bare. When cutting and packing the entrails, protective rubber gloves, plastic sleeve protectors, and plastic aprons were used. Despite the sleeve

protectors, the sleeves of the work coat were splashed with blood and secretions.

2 | CASE REPORTS

Table 1 summarizes the results of the clinical examinations.

Patient A, a 35-year-old smoking female slaughterhouse worker, presented with a history of 14 years of recurrent watery rhinitis, eye irritation, cough, and dyspnea, associated with handling raw pork meat. She had worked in various positions at the slaughterhouse including the intestine section. Asthma had been diagnosed 13 years ago.

Skin prick test revealed dermatographism, which affected the interpretation of the skin prick test results. The skin prick test with raw pork meat and pork kidney (prick-prick method), and pig dander (diluted with potassium phosphate buffer) samples from the patient's workplace were positive. The serum-specific IgE antibodies (ImmunoCAP®, Phadia AB, Uppsala, Sweden) with pig urine protein were elevated. A specific inhalation challenge test was performed for 45 min on the patient who minced raw pork meat and kidney. We noted a slightly increased bronchial hyperresponsiveness. The dose of histamine that caused a 15% decrease in forced expiratory volume in one second (FEV₁) (PD₁₅ FEV₁) was 1.129 mg after the challenge test. We observed no changes in fractional exhaled nitric oxide, peak expiratory flow (PEF), or FEV₁. No findings were consistent with occupational rhinitis. The control specific inhalation challenge test of the patient handling iceberg lettuce was negative.

On the basis of the positive skin prick test, the workplace peak expiratory flow measurement in which lower peak expiratory flow values were documented at work, and the changes in bronchial hyperresponsiveness after the specific inhalation challenge test, Patient A was diagnosed with occupational asthma caused by raw pork meat and kidney.

Patient B, a 32-year-old smoking male slaughterhouse worker with pollen allergy, presented with a history of 2 years of recurrent watery rhinitis and urticaria on the forearms when handling raw pork meat and removing pig hair from carcasses.

The skin prick tests with raw pork and pig dander from the patient's workplace were positive, whereas a commercial pig dander test solution (Allergopharma GmbH & Co. KG, Reinbek, Germany, Cat. No 319) was negative. The specific IgE antibodies for pork meat, pig dander, and urine protein were elevated. Nasal provocation test was performed with potassium phosphate buffer control and 10% weight/volume raw pork meat extract in buffer by dropping 0.1 mL of the solution bilaterally on nasal mucosa. The control test was negative, whereas the nasal provocation test with meat extract gave a positive reaction, with rhinorrhea and sneezing. Anterior rhinoscopy, rhinomanometry (inspiratory resistance) and acoustic rhinometry (change of nasal volume within the distance of 2-5 cm from the nostrils) measurement showed no increase of blockage. Open skin application test for a pork meat sample from the worksite was performed on the patient's healthy forearm skin. After a follow-up of 20 min, the pork meat application was repeated on the same skin site and the follow-up

continued for 40 min, then up to 60 min after the repeated application of pork meat. An open skin application test is considered positive if urticarial wheals appear on the test area during the follow-up period. In Patient B, the open skin application test was negative.

Nevertheless, occupational contact urticaria was diagnosed based on the presence of IgE-mediated allergy to pork meat and a typical history of contact urticaria that appeared at the worksite when the patient was in contact with raw pork meat and carcasses, and on the lack of clinical signs and history indicative of other causes of urticaria. The patient had no symptoms or findings suggestive of asthma. Patient B was diagnosed with occupational allergic rhinitis and occupational allergic contact urticaria caused by raw pork meat.

Patient C, a 50-year-old previously healthy smoking female slaughterhouse worker, presented with a 1-year history of dermatitis on the forearms associated with working in the intestine section.

Skin prick test with pig heart, tongue, kidney, liver, and stomach from the patient's workplace were positive, whereas skin prick test with pigtail and common aeroallergens were negative. The specific IgE antibodies for pork meat, pig dander, and urine protein were elevated. Open skin application tests with pig heart and tongue were negative. The IgE-mediated allergies to pork meat, pig's internal organs, dander, and urine proteins were considered occupational.

The patient had no symptoms or findings suggestive of asthma or rhinitis. Her forearm dermatitis was suspected to be consistent with occupational protein contact dermatitis caused by pork meat. However, we were unable to confirm this diagnosis since the patient's forearm dermatitis was absent during our examinations and had not been previously documented by a physician, so the clinical characteristics of the dermatitis were undefined. She did not contact us for further examinations or visits.

Patient D, a 33-year-old non-smoking male slaughterhouse worker with childhood asthma, presented with a history of 3 years of recurrent watery rhinitis associated with handling raw pork meat.

Skin prick test with a sample of raw pork meat from the workplace gave a negative result. Specific IgE antibodies were elevated for pig dander, but negative for pork meat. Due to nasal polyposis and initial nasal hyperreactivity, nasal provocation test was performed after oral steroid treatment. Nasal provocation test with potassium phosphate buffer control was negative. Bilateral nasal provocation test with 0.2 mL raw pork meat extract (10% weight/volume in buffer) for 30 min resulted in rhinorrhea, and additional pork meat extract (20% weight/volume in buffer) provocation confirmed an allergic reaction, with rhinorrhea, sneezing, and nasal congestion in both rhinomanometry and acoustic rhinometry measurements.

The patient had no symptoms and we made no findings suggestive of asthma. Patient D was diagnosed with occupational allergic rhinitis caused by raw pork allergens.

3 | DISCUSSION

IgE-mediated allergy to foodstuffs may cause allergic rhinitis, asthma, contact urticaria, and protein contact dermatitis in food handlers.⁷⁻¹¹

TABLE 1 Symptoms at workplace and results of blood tests, skin prick tests, open skin application tests, lung function tests, specific inhalation challenge tests, and nasal provocation tests

	Patient A (female)	Patient B (male)	Patient C (female)	Patient D (male)
Working history in the slaughterhouse (years)	17	7	13	8
Symptoms at work	Recurrent cough, dyspnea, watery rhinitis for 14 years	Recurrent watery rhinitis and urticaria on the forearms for 2 years	History of dermatitis on the forearms and hoarseness for 1 year	Recurrent watery rhinitis for 3 years
Specific IgE tests (IU/l)				
Positive work-related IgE antibodies (negative <0.35 IU/l)	Pig urine protein 1.58	Pork meat 1.5, pig dander 0.90, pig urine protein 0.83	Pork meat 4.3, pig dander 0.72, pig urine protein 2.7	Pig dander 0.67
Skin prick tests (wheal diameter in mm)				
Histamine 10 mg/mL	8	6	6	6
Diluent control	3	Negative	Negative	Negative
Common aeroallergens	Birch 4, alder 4, meadow fescue 5, timothy 6, mugwort 6, horse 4, dog 5, cat 6, cow dander 4, Alternaria alternata 4, house dust mite 5	Birch 7, meadow fescue 7, horse 7, alder 6, timothy 6, dog 6, cat 5	Negative	Birch 4, mugwort 3, alder 6, timothy 6, dog 5, cat 8, house dust mites 3-4, Cladosporium herbarum 6, Alternaria alternata 5
Commercial allergens	Not tested	Pig dander negative	Wheat flour negative	Not tested
Patient's own materials from the workplace	Pork meat 6, pig dander 6, kidney 9	Pork meat 5, pig dander 5	Pork liver 3, heart 5, tongue 5, stomach 3, kidney 4, pigtail negative	Pork meat negative
Open skin application test				
Pork meat	Not tested	Negative	Not tested	Not tested
Pig heart and tongue	Not tested	Not tested	Negative	Not tested
Nasal provocation test (0.1 ml on both sides)				
Diluent control	Not tested	Negative; no relevant rhinometric changes	Not tested	Negative; no relevant rhinometric changes
Raw pork meat extract 10-20% weight/volume	Not tested	10% positive: sneezing, rhinorrhoea 2.20 g, no relevant rhinometric changes	Not tested	20% positive: rhinorrhea 1.37 g, nasal volume decrease 54%, nasal inspiratory resistance increase 58%
Lung function tests				
PEF (l/min) monitoring at workplace	At work 290-380, on rest days 320-390, declining when handling intestines	Not tested	Not tested	Not tested
Fractional exhaled nitric oxide (normal limit 30 ppb)	5.4 ppb	30.5 ppb	5.5 ppb	44.8 ppb
Histamine challenge	>1.6 mg	>1.6 mg	>1.6 mg	Not tested

(Continues)

TABLE 1 (Continued)

	Patient A (female)	Patient B (male)	Patient C (female)	Patient D (male)
test PD ₁₅ FEV ₁				
Spirometry ^a	FVC 93%, FEV ₁ 76%; after bronchodilatation FVC change +7%, FEV ₁ change +12%	FVC 95%, FEV ₁ 90%; no relevant changes after bronchodilatation	FVC 108%, FEV ₁ 89%; no relevant changes after bronchodilatation	FVC 98%, FEV ₁ 96%; no relevant changes after bronchodilatation
Specific inhalation challenge test with pork meat and liver up to 45 min				
Nasal changes	Negative; no relevant rhinometric changes	Not tested	Not tested	Not tested
Lung function changes	Bronchial hyperresponsiveness increase after specific inhalation challenge, no relevant PEF or FEV ₁ changes	Not tested	Not tested	Not tested
Diagnosis	Occupational asthma	Occupational rhinitis and occupational contact urticaria	Occupational sensitization, no occupational disease	Occupational rhinitis

PEF = peak expiratory flow; PD₁₅ FEV₁ = the dose of histamine that caused a 15% decrease in forced expiratory volume in one second (threshold for positive test 1.6 mg); FEV₁ = forced expiratory volume in one second; FVC = forced vital capacity.

^aPercentage predicted; volume change after bronchodilatation.

Nasal provocation test has been established as an international standard for evaluating occupational rhinitis.^{12–14} It is noteworthy that occupational rhinitis seems to be more common than occupational asthma.^{15,16} Two cases of occupational asthma caused by pork meat confirmed by specific inhalation challenge test with nebulized pork meat antigen or monitoring FEV₁ at work have previously been reported.¹⁷ These two cases also showed symptoms of occupational rhinoconjunctivitis.

Food industry workers are known to be at risk of occupational contact urticaria caused by foods such as seafood, vegetables, fruits, and meat.¹⁸ Occupational protein contact dermatitis caused by pork meat in patients with skin prick test -confirmed immediate allergy to pork meat has previously been reported in a butcher and in a slaughterman.^{3,4}

As none of our patients had a history of symptoms associated with eating red meat, we did not need to examine them for galactose- α -1,3-galactose (" α -Gal") allergy. Tick bites may lead to sensitization to the carbohydrate galactose- α -1,3-galactose, and sensitized patients may later suffer from anaphylaxis after eating red meat.¹⁹ Pork meat and cat epithelium have been reported as cross-reacting. This so-called "pork-cat syndrome" has been associated with severe reactions after eating pork meat, but also after occupational contact. Porcine serum albumin was implicated as one of the possible allergens.^{20–22}

A limitation of our report is that we did not measure specific IgE for pig serum albumin, which is commercially available. Instead, we diagnosed the immediate allergy to pork meat and increments based on skin prick test and nasal provocation test and to specific IgE measurements to other pig allergens. Previously, a patient with a history of occupational inhalant allergy to pork and with allergic symptoms after ingestion of chicken was shown to have elevated IgE to chicken and pig serum albumin.²³

The slaughterhouse in which our patients worked had encountered problems with insufficient ventilation and air quality before the patients' symptoms appeared. Subsequently, industrial hygienic improvements to reduce allergen exposure were implemented at the workplace.

In slaughterhouses, respirators with particle filters for allergen protection are difficult to use due to food hygiene regulations, cold air, and humidity in the workplace. Patient A with occupational asthma continued working in another section of the slaughterhouse. She still had asthma symptoms, and further work task changes were planned. Patient B with occupational contact urticaria and occupational rhinitis changed worksites to the company's laundry section and has since been symptom-free. Patient C, who was diagnosed with occupational immediate allergy to pork meat and organs, continued working in the slaughterhouse but avoided the intestine section in which her symptoms had appeared. Patient D moved to another work environment.

In conclusion, allergic rhinitis and contact urticaria may serve as early signs of occupational immediate allergy. According to previous literature, occupational rhinitis may precede the development of occupational asthma.^{24,25} Timely diagnosis of occupational rhinitis and contact urticaria, and the identification of the causative allergen, are important because they enable measures to be taken to avoid contact to the allergen and to prevent persistent symptoms in sensitized patients.

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All authors participated in drafting the work or revising it critically for important intellectual content. All authors participated in the final approval of the version to be published.

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DISCLAIMER

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