Published in final edited form as:

J Allergy Clin Immunol. 2013 March ; 131(3): 923–925. doi:10.1016/j.jaci.2012.12.665.

Initial Description of Pork-Cat Syndrome in the United States

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Keywords

cat serum albumin; food allergy; pork

To the Editor

Despite meat being an important source of protein in western diets, development of meat allergy is uncommon¹. For mammalian meat, the extensive homology of proteins across mammalian species decreases the likelihood of creating a specific IgE response^{2,3}. In fact, when clinically relevant reactivity to meats has been demonstrated the results point to cross-reactivity (e.g., serum albumin (SA), actin) and not to a sensitization with meat-specific epitopes⁴. In keeping with this cross-reactivity, reports of IgE antibodies that bind various mammalian albumins do exist: notably, pork-cat syndrome^{5,6}. In this uncommon syndrome, patients develop an IgE Ab response specific for cat SA that cross-reacts with porcine albumin and can lead to severe or even fatal allergic reactions on occasions when pork is consumed^{5–7}. Interestingly, the reported cases of pork-cat syndrome are largely European. We have recently evaluated numerous patients with suspected “meat allergy”; in so doing we have found and report here for the first time eight cases of pork-cat syndrome in the US. Representative clinical history and evaluation of 2 patients are described, including detailed IgE specificity and a clinical response to elimination diet, both of which strongly suggested the diagnosis. Confirmatory food challenges, however, were not performed in any of the eight patients.

Published data regarding pork-cat syndrome have suggested that sensitization to cat SA represents the primary event in the development of the cross-reactive IgE⁶. In that investigation of sera from young patients in Luxembourg, it was shown that anti-cat serum albumin IgE reactivity completely contained the anti-pork reactivity while the reverse was

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None of the other authors report conflicts relevant to these studies.

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not true⁶. The patients in that report were all selected on the basis of being highly allergic to cat, whereas the 8 subjects reported here each presented for evaluation of suspected meat allergy.

Patient E364 (Table I) reported symptoms of abdominal cramping, nausea, itching and hives beginning 20 minutes after a meal of pork tenderloin, potatoes and green beans. His abdominal symptoms worsened, he reported lightheadedness and was taken to the local emergency department where he was treated for anaphylaxis. Given the proximity of his symptoms to the meal, a role for IgE Ab to alpha-gal seemed unlikely. Positive immunoassay results to cat, dog and pork, without concomitant sensitization to beef or lamb, prompted further investigation with serum albumins and gelatin (Table I). Positive results were obtained for cat and dog SA (Re220 and Re221, respectively), while bovine SA (Re204) was negative (Table I). Taken together, the results suggested that the anaphylactic reaction was triggered by pork due to cross-reacting IgE, consistent with pork-cat syndrome. The patient was advised to avoid eating pork, and has been followed for 2 years without additional reactions.

A second illustrative case is that of patient T559, a 14 year old female. She presented with recurrent bouts of abdominal pain 30–45 minutes after a meal. The pain occurred 3–5 times a month over the course of 14 months and would resolve without treatment in 45–60 minutes. There was no associated nausea, vomiting or diarrhea, and no noticed changes in bowel movements. No association was made with a particular food or drink. On some occasions, the abdominal pain was accompanied by urticaria. Our work-up revealed the presence of sIgE to cat and dog albumin and pork as shown in Table I (case 4) plus a negative result for sIgE Ab to alpha-gal. She was advised to remove pork from her diet but allowed to continue to eat beef. After 9 month follow-up no additional episodes of abdominal pain or urticaria were reported.

As Table I illustrates, this uncommon syndrome is similar to other food allergies in that a range of presentations are seen and the clinical symptoms are not consistently predicted by the titer of IgE to the allergen, cat SA. Assessment of binding specificity was performed as described⁸ on sera from three patients where sufficient quantity existed (Table II). The IgE response to cat SA and pork was significantly reduced by pre-incubation with cat albumin, whereas pork albumin and human albumin did not show significant inhibition of the cat SA response (Table II; N.B. – porcine SA and human SA share 82% and 76% protein homology with cat SA, respectively⁶). The IgE response of the patients reported here shows similar specificity to published data and is also consistent with cat SA as the primary sensitizing antigen⁶.

There are four notable aspects to pork-cat syndrome that merit discussion. First, the sensitivity to pork does not arise early in life: most reported patients are older than age 8 with the majority being adults or teens^{5–7}. It appears that the sensitization to cat SA develops over time and, therefore, onset of a “new” food allergy in an older child or adult may prompt consideration of pork-cat syndrome.

Secondly, patients do not report reactions with each instance of eating pork. Both in the 3 patients described by Hilger *et al*⁶ and in the 8 patients reported here, fresh meat or dried and smoked pork (i.e., barbecue) were more consistent provocateurs of allergic reactions. Well-cooked meat, however, was associated with fewer reactions.

Thirdly, reactions to pork begin soon after eating the meat. In many ways, the timing of these reactions is most helpful in differentiating pork-cat syndrome from delayed anaphylaxis due to IgE to alpha-gal⁸. Both food allergies are IgE-mediated, involve mammalian meat and can show similar responses with certain skin tests and immunoassays;

however, symptoms from pork-cat syndrome can occur rapidly and may initially present with oral pruritus during the meal. In general, reactions to pork begin within 30–45 minutes of consumption, often with GI symptoms such as abdominal cramping.

Fourthly, the natural history of pork-cat syndrome is not well-established but it appears that the sIgE to cat SA may slowly decrease over time⁹. Perhaps continued exposure to cat is important for maintaining the sensitization and this may explain why certain patients can eventually consume pork again safely. In fact, existing data indicate that of appropriately sensitized patients approximately 30% experience allergic symptoms in relation to pork consumption⁶.

Interestingly, whereas patients with IgE Ab to alpha-gal show positive immunoassay results to beef and pork, the cross-reactivity to bovine albumin in pork-cat syndrome is variable. Thus, certain patients with pork-cat syndrome report being able to tolerate beef while others cannot⁶ and we have not advised beef avoidance unless patients report symptoms associated with eating beef. In the present group of subjects, only one (E710) specifically noted symptoms after eating beef and she was advised to avoid both pork and beef.

If a careful history reveals the possibility that mammalian meat could be associated with episodes we suggest performing immunoassay testing for sIgE to pork, beef, cat serum albumin and alpha-gal. Further investigations may be required but this simple panel would identify patients whose symptoms were most likely to be explained by pork-cat syndrome. In summary, this represents the first report of patients identified in the US with pork-cat syndrome where sensitization to cat SA, which cross-reacts with pork albumin, can produce symptoms rapidly after the consumption of pork.

Acknowledgments

These studies are primarily funded by NIH grants: AI-20565, U19-AI-070364, R21-AI-087985, and K08-AI-1085190. Dr. Platts-Mills has a patent on the use of streptavidin solid phase to evaluate IgE antibodies to recombinant molecules and is a consultant to Viracor/IBT.

Abbreviations

alpha-gal	galactose- α -1,3-galactose
SA	serum albumin

References Cited

1. Ayuso R, Lehrer SB, Tanaka L, Ibanez MD, Pascual C, Burks AW, et al. IgE antibody response to vertebrate meat proteins including tropomyosin. *Ann Allergy Asthma Immunol.* 1999; 83:399–405. [PubMed: 10582720]
2. Jenkins JA, Breiteneder H, Mills EN. Evolutionary distance from human homologs reflects allergenicity of animal food proteins. *J Allergy Clin Immunol.* 2007; 120:1399–405. [PubMed: 17935767]
3. Spitzauer S. Allergy to mammalian proteins: at the borderline between foreign and self? *Int Arch Allergy Immunol.* 1999; 120:259–69. [PubMed: 10640909]
4. Restani P, Fiocchi A, Beretta B, Velonà T, Giovannini M, Galli CL. Meat allergy: III--Proteins involved and cross-reactivity between different animal species. *J Am Coll Nutr.* 1997; 16:383–9. [PubMed: 9263189]
5. Drouet M, Sabbah A. The pork/cat syndrome or crossed reactivity between cat epithelia and pork meat. *Monogr Allergy.* 1996; 32:164–73. [PubMed: 8813195]
6. Hilger C, Kohnen M, Grigioni F, Lehnert C, Hentges F. Allergic cross-reactions between cat and pig serum albumin. Study at the protein and DNA levels *Allergy.* 1997; 52:179–87.

7. Drouet M, Sabbah A, Le Sellin J, Bonneau JC, Gay G, Dubois-Gosnet C. Fatal anaphylaxis after eating wild boar meat in a patient with pork-cat syndrome. *Allerg Immunol (Paris)*. 2001; 33:163–5. [PubMed: 11434195]
8. Commins SP, Satinover SM, Hosen J, Mozena J, Borish L, Lewis BD, et al. Delayed anaphylaxis, angioedema, or urticaria after consumption of red meat in patients with IgE antibodies specific for galactose-alpha-1,3-galactose. *J Allergy Clin Immunol*. 2009; 123:426–33. [PubMed: 19070355]
9. Savi E, Rossi A, Incorvaia C. Cat-pork syndrome: a case report with a three years follow-up. *Eur Ann Allergy Clin Immunol*. 2006; 38:366–8. [PubMed: 17274523]

Table 1

Eight cases of pork-cat syndrome: subject characteristics and relevant sIgE profiles

Subject#	E364	E533	E572	T559	E584	T625	E710	E724
Sex	M	F	F	F	F	M	F	F
Age (yr)	52	34	21	14	44	11	13	41
Symptoms with Meat *	ANA	OA/URT	OA/GI	URT	ANA	OA	ANA	OA/GI
Avoidance Diet Results	No episodes at 2 yrs	No episodes at 1.5 yrs	No episodes at 15 mo	No episodes at 9 mo	No episodes at 13 mo	Fewer episodes [§]	No episodes at 1 yr	Fewer episodes [§]
Symptoms with Cat or Dog exposure [‡]	No	R	R, C, U	A	No	Yes	R, C	R
Animal Exposure [‡]	Cat	Cat, Dog	Dog, Horse	No	Cat, Dog, Guinea Pig	Dog	Cat, Dog	Cat
SPT Dog Dander [#]	+	+	-	-	-	+	ND	ND
SPT Cat Dander [#]	+	-	+	+	+	+	ND	ND
SPT Pork [#]	+	+	+	+	+	+	ND	ND
Total IgE (IU/ml)	83.4	252	328	791	42.3	1860	2619	133
Specific IgE (IU/ml) to:								
Cat Albumin	2.28	98.8	12.3	9.96	4.18	2.33	130	26.8
Dog Albumin	2.59	65.0	15.2	6.53	4.87	1.71	110	10.8
Bovine Albumin	<0.35	6.79	1.92	4.76	<0.35	3.56	6.31	<0.35
Cat Dander	3.74	33.8	5.71	121	3.87	23.6	155	17.7
Fel d 1	1.58	1.94	2.16	103	<0.35	ND	90.1	0.81
Alpha-Gal	<0.35	<0.35	1.41	<0.35	<0.35	<0.35	<0.35	<0.35
Pork	0.65	13.2	7.10	7.96	0.53	42.8	43.8	3.40
Beef	<0.35	2.22	1.10	4.45	<0.35	0.91	2.62	<0.35

ND: Not Done

* ANA: anaphylaxis; OA: oropharyngeal itching; URT: urticaria; GI: gastrointestinal symptoms

[‡] A: asthma; C: conjunctivitis; R: rhinitis; U: urticaria

[§] Defined as consistent exposure at home, work or regular activity (e.g., horseback riding); NB – subject T559 had to limit animal exposure due to symptoms

[#] SPT positive (+) defined as >4mm wheal with flare present; (-) = <4mm wheal

§ Each subject reported symptoms when choosing to consume pork but denied episodes when following an avoidance diet

Table II

Absorption of sera from pork-cat subjects using different mammalian albumins

Subject [#]	Specific IgE (IU/ml)	* Sepharose Beads Used for Absorption:			
		Control	Cat	Pork	Dog Human
E533	Cat Albumin [†]	24.9	0.69	20.6	6.65 31.9
	Pork Meat	6.37	0.36	0.39	<0.35 6.65
	Pork Albumin	6.09	<0.35	<0.35	<0.35 6.09
E710	Cat Albumin	51.3	1.58	30.2	6.05 47.3
	Pork Meat	12.8	1.38	1.43	1.24 12.7
	Pork Albumin	9.8	0.51	0.43	0.45 9.32
E724	Cat Albumin	13.1	0.53	8.76	5.04 12.1
	Pork Meat	1.65	<0.35	<0.35	<0.35 1.51
	Pork Albumin	1.56	<0.35	<0.35	<0.35 1.34

* Each serum was diluted 1:2 or 1:4, and then 200 microliters was absorbed for 4 hours with 40 microliters of either Sepharose beads coated with the relevant albumin or uncoated blank beads. Sera were then assayed for specific IgE to cat albumin (Re220), pork meat (f26), and pork albumin (e222) using ImmunoCAP as described⁸.

[†]Pre-incubation with alpha-gal or bovine gelatin did not affect the response to cat serum albumin.