

Educational
& Teaching Material

Case Report



A novel Australian tick *Ixodes (Endopalpiger) australiensis* inducing mammalian meat allergy after tick bite

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ABSTRACT

Tick-induced mammalian meat allergy has become an emergent allergy world-wide after van Nunen et al. first described the association between tick bites and the development of mammalian meat allergy in 2007. Cases of mammalian meat allergy have now been reported on all 6 continents where humans are bitten by ticks, in 17 countries - Australia, United States of America (USA), Europe (France, Spain, Germany, Belgium, Switzerland, Sweden, United Kingdom, Italy, and Norway), Asia (Korea and Japan), Central America (Panama), South America (Brazil), and Africa (South Africa and Ivory Coast). To date, in each of these countries, bites from only a single tick species have been linked to the development of mammalian meat allergy: *Ixodes holocyclus* (Australia), *Amblyomma americanum* (USA), *Ixodes ricinus* (Europe), and *Ixodes cajennense* (Panama) are confirmed as culprits, and *Ixodes nipponensis* (Japan and Korea), *Amblyomma sculptum* (Brazil), *Amblyomma variegatum* (Ivory Coast), and *Haemaphysalis longicornis* (Japan) suspected of provoking mammalian meat allergy after tick bite. Other tick species remain to be formally identified (South Africa). Identification of tick species associated with development of mammalian meat allergy is crucial to the uptake of public health measures to prevent tick bites from culprit tick species, for both individuals living in these tick-endemic areas and those who choose to visit these regions. We report a tick associated with the enhancement of mammalian meat anaphylaxis after tick bite which is novel for both Australia and the world and establishes *Ixodes (Endopalpiger) australiensis* as a second tick species associated with mammalian meat allergy in Australia.

Keywords: Anaphylaxis; Ticks; Mammalian meat allergy; Alpha gal; Galactose-alpha 1,3-galactose

INTRODUCTION

In 2007, van Nunen et al. [1] first described the association between tick bites and the development of mammalian meat allergy. In 2009, Commings et al. [2] confirmed this association and discovered the epitope likely responsible for such allergic reactions, galactose-alpha 1,3-galactose (alpha gal).

Cases of mammalian meat allergy have now been reported on all 6 continents where humans are bitten by ticks, in 17 countries - Australia, United States of America (USA), Europe

(France, Spain, Germany, Belgium, Switzerland, Sweden, United Kingdom, Italy, and Norway), Asia (Korea and Japan), Central America (Panama), South America (Brazil), and Africa (South Africa and Ivory Coast) [3, 4].

To date, in each of these countries, the bites from only a single tick species have been linked to the development of mammalian meat allergy, with *Ixodes holocyclus* (Australia), *Amblyomma americanum* (USA), *Ixodes ricinus* (Europe), and *Ixodes cajennense* (Panama) confirmed as culprits. Other tick species suspected of provoking mammalian meat allergy after tick bite includes *Ixodes nipponensis* (Japan and Korea), *Amblyomma sculptum* (Brazil), *Amblyomma variegatum* (Ivory Coast), and *Haemaphysalis longicornis* (Japan), whilst other ticks remain to be formally identified (South Africa) [4].

The locations of previous reports of mammalian meat allergy after tick bite in Australia have correlated with the distribution of *I. holocyclus* and around 50% of Australians are potentially exposed to bites from this species [5]. *I. holocyclus* is responsible for 95% of the tick bites in humans in Australia [5]. Prevalence estimations of mammalian meat allergy indicate Australian tick-endemic regions have the highest prevalence world-wide [6].

Recently, infestation of an adult male by the hard tick *Ixodes australiensis*, a tick not hitherto known to bite humans, was confirmed in Australia [7, 8].

We report the novel association between an Australian tick species *Ixodes* (*Endopalpiger*) *australiensis* and the enhancement of mammalian meat allergy following human infestation.

CASE REPORT

In October 2016, a case of mammalian meat allergy was diagnosed in Western Australia in a Caucasian male, aged 52, a retired metal fabricator, who had not been bitten by a tick where he had lived previously (United Kingdom) and who had not travelled overseas or travelled or lived in the eastern states of Australia where *I. holocyclus* is endemic, for over 27 years. His first tick bite in 2013 was a recreational exposure and occurred in Denmark, Western Australia, a coastal town 423 km SSE of Perth, Western Australia. Unfortunately, in this case the tick specimen was not retained to allow for identification. However, it is interesting to note that *I. holocyclus* has a sister species, *Ixodes myrmecobii*, which has a catholic feeding habit, is endemic to Western Australia, and has a distribution including Denmark, Western Australia [9].

After his first tick bite, the patient continued to eat mammalian meat 2–3 times weekly. Three months following the first tick bite, however, he consumed kangaroo meat between 6–7 PM and at 1 AM awakened with paresthesiae of the hands and feet, and then within another 20 minutes developed generalised pruritus, generalised urticaria and dyspnoea. There was no tongue swelling, impending loss of consciousness, loss of consciousness or angioedema and the symptoms resolved spontaneously within 2 hours. Eight similar reactions occurred with symptoms such as those listed above as well as nausea, vomiting, and diarrhoea, in some instances, and 2 episodes required the use of an adrenaline auto-injector (Epipen, Pfizer Meridian Medical Technologies for Mylan Inc, Brentwood, CA, USA). An increased amount of the allergen and the cofactor alcohol were operative in several episodes [10]. For example, he noted that he tolerated a single lamb chop (approximately 120 g of fatty lamb on a bone usually including a small amount of bone marrow), but the ingestion of 2 lamb chops would

Table 1. Serology results

Date	Test	kU _A /L	Reference range
27.10.16	Mutton ImmunoCAP Specific IgE	12.90	<0.10 kU _A /L
	Pork ImmunoCAP Specific IgE	19.50	<0.10 kU _A /L
	Beef ImmunoCAP Specific IgE	27.60	<0.10 kU _A /L
	Galactose- α -1,3-Galactose ImmunoCAP Specific IgE (bovine thyroglobulin)	>100.00	<0.10 kU _A /L
	Total IgE	1,399	<26 kU/L
19.10.16	ImmunoCAP Tryptase	-	<11.4 μ g/L
Tick bites from <i>Ixodes australiensis</i> in late 2017			
12.02.18	Mutton ImmunoCAP Specific IgE	28.70	<0.10 kU _A /L
	Beef ImmunoCAP Specific IgE	56.10	<0.10 kU _A /L
	Lamb ImmunoCAP Specific IgE	41.00	<0.10 kU _A /L
	Total IgE	2,973	<26 kU/L

ImmunoCAP (Thermo Fisher Scientific Inc., Phadia AB, Uppsala, Sweden).

**Fig. 1.** One of the adult female specimens of *Ixodes australiensis* taken from the patient.

occasion an anaphylaxis. Ingestion of beef mince occasioned the most severe allergic reaction and all mammalian meat was ceased after this episode in early 2017, as adrenaline use was again required. Cow's milk products have continued to be tolerated and mammalian gelatine is tolerated orally. There was no history of other allergic disease.

The clinical diagnosis of mammalian meat anaphylaxis after tick bite was confirmed serologically and these results are tabulated below (**Table 1**). The convalescent tryptase level was normal (**Table 1**).

Three further tick bites were sustained by the patient, 1 in September 2017 and 2 in October 2017. The ticks which caused these bites were retained and sent to one of the authors (MLK) and identified as *I. australiensis* (**Fig. 1**). Following these bites, specific IgE and total IgE results reflected the recharging effect of these further tick bites and suggested that the bite of *I. australiensis* enhances the immunological effects of tick-induced mammalian meat allergy.

DISCUSSION

Tick-induced mammalian meat allergy is an emergent allergy world-wide [4, 10]. The identification of tick species associated with its development is crucial to appropriate public health measures being put in place to prevent tick bites from culprit tick species, for both

individuals living in these tick-endemic areas and for those who choose to visit these regions. We report a tick associated with the enhancement of mammalian meat anaphylaxis following a tick bite which is novel for both Australia and the world and establishes *I. (Endopalpiger) australiensis* as a second tick species associated with mammalian meat allergy in Australia. Although Kwak [7] provided a list of all known anthropophagic Australian tick species, there remains much to be discovered about tick-host dynamics and their relation to tick-induced mammalian meat allergy. With a more extensive knowledge of tick species which infest humans in Australia, and globally, we feel a better picture may be constructed of the risk factors associated with this condition in specific regions.

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