

Catherine PECQUET

Dermatologie-Allergologie, Hôpital Tenon,
AP-HP,
4 rue de la Chine,
75970 Paris cedex 20,
France

Reprints: C. Pecquet
<catherine.pecquet@tnn.aphp.fr>

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New pets and allergies

This review focuses on the various symptoms of allergy induced by new pets, the new pets themselves, and some of the identified allergens.

Key words: new pets, hypersensitivity, allergy

Besides the classic dog and cat, numerous other non-traditional animals are more and more present in households. In addition to the problems of feral animals, these non-traditional animals can cause problems to their owners such as infections (zoonoses), trauma (more or less venomous bites and scratches) as well as respiratory allergic reactions and more rarely, cutaneous manifestations, of which some are shown here.

Some definitions

A pet is defined by the European Convention for the protection of Pet Animals: "By pet animal is meant any animal kept or intended to be kept by man in particular in his household for private enjoyment and companionship". The definition described in Art L.21 of the French rural code is "any animal kept or intended to be kept by man in particular in his household for private enjoyment". Animals bred for food production, wool, pelts, fur and other agricultural uses, animals living in zoos and circuses for entertainment purposes and animals kept for experimental or other scientific purposes are excluded from this definition. Some wild animals may become pets (for example peccaries or agoutis for the indigenous Amazonian hunting tribes). Animals that have been domesticated for a long time have more recently become household pets (ferrets, rabbits...).

New pets [1-6]

At the beginning of the 1980s, veterinarians who were seeing this type of animal more frequently apparently introduced the term "new companion animals" instead of "exotic animals". This term includes unconventional animals used as pets. The trend to have new domestic companions began in the 1970s. The motivation behind this trend was quite varied: exoticism, novelty, and singularity because aestheticism and exchanges with humans are not characteristic of certain species...

It is impossible to provide an exhaustive list of non-traditional domestic animals. We will cite but a few examples in the table below (*table 1*). They are estimated to be present in 5% of French households with more than 18 million specimens. Most often, they do not legally qualify as domestic animals. Their origin is varied: illicit capture of

wild animals, specialized breeding, relocation of domestic animals...

With these animals, the risk of allergies is less serious than the risk of infection (zoonoses) and envenomation from bites and scratches. These allergies can develop in the owners (children or adults), breeders, care givers...

Clinical aspects of allergies to new companion animals

The published observations (non-exhaustive bibliography) are regrouped in *table 2* [7-46].

Respiratory manifestations are most commonly reported: new onset or worsening of rhinitis, rhino-conjunctivitis or asthma, sometimes even severe bronchospasms in either non-atopic or atopic subjects [9-15, 17, 22-24, 26, 27, 29, 30, 32-37, 43, 44]. In the latter cases, the clinical picture is characterized by an aggravation of symptoms, ineffectiveness of the usual treatments, or appearance of the discomfort in a new context. These symptoms most often regress with removal of the animal.

Cutaneous manifestations [10, 15, 16, 21, 24, 25, 28, 31] refers to:

- contact urticaria on areas exposed to the saliva or skin appendages of the animal;
- eczematous dermatitis less commonly, allergic or protein contact dermatitis, or papules at the bite/sting site.

These cutaneous signs must be differentiated from infections due to transmission of zoonotic parasites or bacteria. General manifestations: anaphylactic reactions occur most often after an animal bite [7, 12, 18-20, 23, 39-42, 45, 46]. Reaction time from the first contact with the new pet and the first clinical appearance of allergic symptoms varies widely. It is also very difficult to recognize all possible contact situations, in particular exposure by proxy - from family members or close relations directly or indirectly exposed, for example by working with the animals [36, 47].

The triggers also include:

- indirect contact through airborne contamination [48];
- direct contact with the animal, without wound or infection;
- allergen introduction due to a bite or scratch. In these cases, anaphylactic reactions are the most frequent.

The origins of the allergens vary with the responsible animal: dander proteins, salivary proteins, urinary proteins.

Table 1. New companion animals: a few examples.

Small mammals		
Chinchillidae	Chinchilla (<i>Chinchilla lanigera</i>)	Rodent herbivore
Caviidae	Guinea Pig (<i>Cavia porcellus</i>)	Rodent herbivore
Octodontidae	Degu (<i>Octodon degus</i>)	Rodent herbivore
Muridae	Mongolian Gerbil (<i>Meriones unguiculatus</i>)	Rodent omnivore
	Hamsters (<i>Mesocricetus auratus</i> , <i>Phodopus sungorus</i> , <i>Phodopus roborowskii</i> , <i>Crietulus griseus</i>)	Rodent omnivore
	Domestic Rat (<i>Rattus norvegicus</i>)	Rodent omnivore
	Mice (<i>Mus musculus</i>)	Rodent omnivore
	Typical Striped Grass Mouse (<i>Lemniscomys striatus</i>)	Rodent omnivore
Dipodidae	Greater Egyptian Jerboa (<i>Jaculus orientalis</i>)	Rodent omnivore
Sciuridae	Eastern chipmunk (<i>Tamia striatus</i>)	Pellets, seeds, nuts, fruit
Mustelidae	Ferret (<i>Mustela putorius</i>)	Carnivore
Leporidae	Common rabbit (<i>Oryctolagus cuniculus</i>), miniature rabbits	Strict herbivore
Suidae	Miniature pig (<i>Sus scrofa</i>)	
Lizards		
Agamidae	Aquatic Agamid (<i>Physignathus cocincinus</i> , <i>Pogona vitticeps</i>)	Omnivore
	Spiny-tailed lizard (<i>Uromastyx acanthinurus</i>)	Insectivore and vegetarian
Iguanidae	Green Iguana (<i>Iguana iguana</i>)	Folivore, frugivore
	Carolina Anole (<i>Anolis carolinensis</i>)	Insectivore
Chamaeleonidae	Veiled chameleon (<i>Chamaeleo calyptatus</i>)	Insectivore, plants, fruit
	Panther Chameleon (<i>Chamaelo pardalis</i>)	Insects, young mice
Gekkonidae	Leopard Gecko (<i>Eublepharis macularius</i>)	Insectivore, herbivore
	Tokay Gecko (<i>Gekko gekko</i>)	Insects, young mice, fruit
	Day Gecko (<i>Phelsuma sp</i>)	Insects, plants, small prey
Scincidae	Eastern Blue-tongued lizard (<i>Tiliqua scincoides</i>)	Omnivore, live prey
	Fire skink (<i>Riopa fernandi</i>)	Insectivore
Teiidae	Tegu (<i>Tupinambis sp</i>)	Omnivore
Varanidae	Savannah monitor (<i>Varanus exanthematicus</i>)	Insects/small rodents
Snakes		
Boidae	Boa constrictor (<i>Boa constrictor</i>)	Young mice, rabbits
	Indian Python (<i>Python molurus</i>)	Mice/rats/rabbit/ chicken
	Royal Python (<i>Python regius</i>)	Young mice,mice, rats, gerbils, live chicks
	Green tree python (<i>Morelia viridis</i>)	Small mammals
Pythonidae	Carpet python (<i>Morelia spilota variegata</i>)	Rodents, chicks
Colubridae	Corn snake (<i>Elaphe guttata</i>)	Stunned prey
	Common garter snake (<i>Thamnophis sirtalis</i>)	Live fish, young mice
	Red-tailed green rat snake (<i>Elaphe oxycephala</i>)	Mice, rats, birds
	Black snake (<i>Elaphe obsoletta</i>)	Stunned rodents
	King snake (<i>Lampropeltis sp</i>)	Ophiophagy, small rodents
Turtles		
Geoemydidae		Omnivores, herbivores and frugivores (Spiny turtle)
Pelomedusidae		Omnivore, worms, fish, meat, molluscs
Chelidae	Australian Snake-necked Turtles	Omnivore or carnivore
Emydidae		Omnivore carnivore tendencies (Florida box turtle)
Chelydridae		Fish, frogs, young mice
Trochoidea		Fish, shellfish, meat, insects, plants
Kinosternidae		Omnivores with carnivore tendencies
Testudinidae	Hermann's tortoise	Vegetarian

Table 1. (Continued)

Amphibians		
Ambystomatidae	Axolotl (<i>Ambystoma mexicanum</i>) Tiger salamander (<i>Ambystoma tigrinum</i>)	Silt worms, aquatic larvae Insects, worms, slugs
Discoglossidae	Oriental Fire-bellied Toad (<i>Bombina orientalis</i>)	Insects, earthworms, slugs
Dendrobatidae	Green and black poison dart frog (<i>Dendrobates aureatus</i>)	Drosophila, crickets
Leptodactylidae	Argentine Horned Frog (<i>Ceratophrys ornata</i>)	Cockroaches, mice, grasshoppers, meat, fish
Ranidae	Golden Mangella (<i>Mantella aurantiaca</i>)	Drosophila, aphids, crickets
Hylidae	Red-eyed Treefrog (<i>Agalychnys callidryas</i>)	Flies, crickets, grasshoppers
	Australian Green Tree Frog (<i>Litoria caerulea</i>)	Live prey
	American green tree frog (<i>Hyla cinerea</i>)	Live prey
	White-lipped Tree Frog (<i>Litoria infrafrenata</i>)	Live insects
Pipidae	African clawed frog (<i>Xenopus laevis</i>)	Silt worms, aquatic larvae, mosquitoes
Invertebrates		
Mygalomorphae	Mexican Red-kneed Tarantula (<i>Brachypelma smithi</i>) which has projectible urticating hairs from abdomen	Prey (crickets. . .)
	<i>Phryxotrichus auratus</i>	Worms, crickets, cockroaches
	Goliath bird-eater Spider (<i>Theraphosa blondi</i>)	Cockroaches, mice, grasshoppers
Praying Mantis		Flies, grasshoppers, butterflies
Centipede		Fresh fruit and vegetables
Scorpion		Crickets, worms, cockroaches, grasshoppers
Phasmatodea		Brambles, rose bushes, ivy
Primates	Sunda Slow loris (<i>Nycticebus coucang</i>)	Insects, leaves, seeds, tiny lizards or bird eggs
	Barbary Macaque (<i>Macaca sylvanus</i>)	Herbivore and insects
	Tufted capuchin (<i>Cebus apella</i>)	Herbivore and insects
Birds		
Psittaciformes (Parrots)	Lovebird, budgerigat parrot, ara	Granivores and frugivores
Passeriformes	Mainate (<i>Gracula religiosa</i>), Gouldian finch, canary	Granivores, insectivores, frugivores

Causative new pets

All new pets can cause hypersensitivity reactions. The references contained in *table 2* are incomplete and numerous cases are not published. We have not included allergies only related to exposure in a professional context.

Rodents are most often implicated, but they are also the most common new pets. The popularity of rabbits and hares seems to be on the rise.

Snakes, lizards, certain monkeys and spiders cause local and general signs of envenomation that are sometimes difficult to differentiate from true immediate hypersensitivity reactions [46, 49]. Both types of manifestation can be associated in certain cases. The published reports of reactions to these animals are only rarely linked to contact as a new pet, but it would be surprising if contact with certain pet spiders, for example, does not provoke urticarial reactions [7, 48].

It is imperative to be aware that administered treatments, such as anti-venoms, can themselves cause anaphylactic reactions [50, 51].

Allergic investigations

These must be adapted to the manifestation at hand. Commercial extracts are almost always insufficient. It is often necessary to collect animal proteins (scales, saliva, urine, secretions. . .) to perform tests, but one must be aware of the risk of systemic reactions with non-standardized substances as well as the risk of possible infection [29, 43, 44]. The test for specific IgE is only possible for a limited number of species. Identification of the responsible proteins by different immunological techniques and the study of cross-reactions are very interesting but can only be carried out in specialized research facilities.

Table 2. Reactions after exposure to different NCA.

Animal	Means of contact/lesions	Patient profile	Clinical manifestations	Explorations and allergens	Ref.
Spiders (Sparassidae)	Accidental skin contact on forearm. (non NCA)	Male age 55	Anaphylactic shock		[7]
Chameleleon (Chamaeleo calyptratus)	Contact with animal	Male age 31, atopic	Contact urticaria	Allergy to latex and Ficus benjamina present on the claws of the iguana	[8]
Prairie Dog	Bite to finger	Male age 26	Severe asthma		In [9]
Prairie Dog	Exposure to animal and contact with animal's bedding	Male age 41	Worsening asthma and rhinitis, conjunctivitis	IgE + extract of skin appendage, faeces and urine (proteins 21, 17 et 18 kDa = lipocalines)	[9]
Chinchilla (Chinchilla lanigera)	Exposure to animal	Female age 43	Contact urticaria, asthma, rhinitis and conjunctivitis	Prick-tests + chinchilla epithelium IgE + chinchilla urine, fur (lipocaline)	[10]
Chinchilla (Chinchilla lanigera)	Exposure to animal	2 children age 5 & 10 4 adults (20-30)	Rhinitis, conjunctivitis and asthma	Prick-tests + chinchilla epithelium	[11]
Guinea Pig	1/ Contact with animal 2/ Cage cleaning	1/ Female age 11 2/ Female age 24	1/ Anaphylactic shock 2/ Anaphylaxis Dyspnoea, sensation of imminent death	IgE / prick-tests + extract of guinea pig epithelium	[12]
Ferret (Mustela putorius furo)		5 patients	IgE hypersensitivity	Prick-tests and IgE + dander and urine extracts faeces, bedding (protein 66 kDa)	[13]
Ferret (Mustela putorius furo)	Exposure at residence	Male age 29, atopic	Worsening of asthma, rhinitis	Prick-tests and IgE + dander and urine extracts (protein 17 kDa)	[14]
Ferret (Mustela putorius furo)	Bathing ferret, contact with animal	Male age 41	Severe Asthma, contact urticaria	Prick-tests and IgE + extract of ferret fur, male and female ferret urine (proteins 14.8, 28.8, 81,103 kDa for urine and 81 kDa for fur)	[15, 16]
Gerbil (Meriones unguiculatus)	Exposure to animal	Females age 15 & 42 Male age 44, Non-atopic	Asthma, cough, rhinitis and conjunctivitis	Skin tests + and IgE + Gerbil serum and dander	[17]
Gerbil	Bite to right index finger	Female age 25 atopic	Anaphylactic shock	Prick-tests + cat and rat dander Tests + with extract of gerbil and hamster hair IgE + mice, cat, hamster, rat	[18]
Gerbil	Bite to hand and foot	Female, age 13	Oedema and respiratory discomfort		[19]
Hamster	Bite to hand	Female age 36	Anaphylactic shock	Prick-tests + hamster saliva	[20]
Hamster	Bites from Ornithonyssus bacoti, parasitic acarions from hamster	Female age 48	Pruriginous papules on wrists		[21]
European Hamster (Cricetus cricetus)	Exposure to animal	Female age 64 non atopic	Rhinitis, conjunctivitis, asthma	Prick-test et IgE + European hamster epithelium	[22]

Table 2. (Continued)

Animal	Means of contact/lesions	Patient profile	Clinical manifestations	Explorations and allergens	Ref.
Djungarian hamster (Phodopus sungorus)	1/ bite to finger 2/ Bite to thumb	Female age 23 Female age 45	Anaphylactic shock Worsening asthma Anaphylactic shock if cage cleaning	IgE common hamster class 2 IgE common hamster negative; IgE class 4 epithelium Phodopus sungorus	[23]
Djungarian hamster (Phodopus sungorus)	Bites	2 atopic children	Urticaria, angioedema, respiratory discomfort	Prick-tests and IgE negative for commercial hamster extract, IgE positive for hamster saliva (protein 21 kDa)	[24]
Djungarian hamster (Phodopus sungorus)	Bite to right index finger	Female age 25	Widespread urticaria conjunctivitis, asthma	Prick-test and IgE + saliva Djungarian hamster (protein 18 kDa)	[25]
Djungarian hamster (Phodopus sungorus)	Exposure to animal	6 patients of whom 4 females age 19 - 44	Unstable asthma with treatment	Prick-tests + dwarf hamster dander IgE + extract (proteins 18 et 32 kDa). No reaction with common hamster	[26]
Hamster	Exposure at residence and to animal	4 patients : age 39 – 42; 2 males et 2 females, non-atopic	Asthma	Intra-dermal tests + with hamster skin appendages	[27]
Hedgehog	Stung by quills	Male age 11 and his mother Female age 48	Wheals if contact with quills	Skin tests + epithelium and saliva recovered by brushing quills	[28]
Four-toed hedgehog (Atelerix albiventris)	Contact with hedgehog	Male age 54 : atopic	Exacerbation asthma	Prick-tests + extract quill and hedgehog dander	[29]
Iguana	Worsening at her residence and if cleaning iguana's room	Female age 38 non-atopic	Asthma, rhinitis	Prick-tests + iguana scales, IgE + extract of scales, urine and faeces.	[30]
Iguana	Bites to wrists	Male, age 13	Crusty pruriginous papules at the bite site and at distance on fingers	Histology : perivascular and periannexial lichenoid infiltration: « hypersensitivity reaction »	[31]
Iguana	1/ Exposure to animal at his residence 2/ Exposure to animal particularly to male	1/Male age 32 2/ Male	1/ Asthma, rhinitis, conjunctivitis 2/ Asthma, rhinitis, conjunctivitis	1/ Prick-tests + with extract of iguana scales IgE + extract of iguana scales (proteins 40 et 80 kDa) 2/ IgE + extract of pore secretion	[32]
Iguana	Only at her residence (son's iguana)	Female age 42	Asthma, rhinitis and conjunctivitis	Prick-tests and IgE + extract of iguana scales (proteins 40 et 50 kDa)	[33]
Iguana	Exposure to animal	Male age 20 non-atopic	Allergic rhinitis	Prick-tests + extract of iguana scales	[29]
Rabbit	Exposure to animal	Female age 20 Female age 37 Male age 33	Asthma, Rhinitis, asthma conjunctivitis, Allergic rhinitis, asthma	IgE + extract of epithelium (protein 17kDa)	[34]
Rabbit (Oryctolagus cuniculus)	Exposure to animal	Female age 10, atopic	Rhinitis, conjunctivitis, laryngeal oedema	Prick tests et IgE + rabbit epithelium	[35]

Table 2. (Continued)

Animal	Means of contact/lesions	Patient profile	Clinical manifestations	Explorations and allergens	Ref.
Rabbit	Exposure to animal. Indirect contact	Female age 18	Severe respiratory allergy Sensitization by indirect contact	IgE + rabbit urine and epithelia	[36]
Hare (Lepus europaeus)	Exposure to animal	Female age 46 , atopic	Rhinitis, conjunctivitis and asthma	Prick-tests and IgE + extract of hare and rabbit epithelium Inhibition to rabbit by hare (proteins from 14 to 70 kDa, of which 19 kDa)	[37]
Lizard (Egernia cunninghami)	Exposure to lizard	Male age 23	Asthma	Prick-tests + lizard squames	[38]
Lizard : Gila monster (Heloderma suspectum)	Bite to forearm	Male, age 40, non- atopic	Oedema of lips, tongue, face, hypotension, respiratory distress without urticaria	Not done Toxic mechanism????	[39]
Lizard : Gila Monster (Heloderma suspectum)	Bite to hand	Male age 20, non- atopic	Oedema, dyspnoea, abnormalities of the ventricular repolarisation	Not done Toxic mechanism????	[40]
Beaded Lizard (Heloderma horridum)	Bite to hand	Male, age 40, non- atopic	Oedema of hand, lips, tongue, respiratory distress	Not done Toxic mechanism????	[41]
Primate : Slow Loris (Nycticebus coucang)	Bite to wrist	Male age 43, non- atopic	Anaphylactic shock		[42]
Tamarin Monkey	Exposure	2 patients	Asthma	IgE + monkey urine and dander. Crossed reaction with cotton top	[43]
Macaque Monkey	Exposure to animal	Male age 49 , atopic	Rhinitis, conjunctivitis, asthma	IgE + extract of monkey dander	[44]
Macaque Monkey	Exposure to animals	Male age 49, atopic	Rhinitis, conjunctivitis and asthma	IgE + extract skin appendage and monkey skin	[29]
White mouse	Bite to finger	Boy age 9	Anaphylactic shock	Prick test and IgE + mouse epithelia	[45]
Reptile: Crotalus	Accidental bite to leg: (Non NCA)	Male age 22, non- atopic	Widespread urticaria, dyspnoea, hypotension	Not done	[46]

Table 3. Examples of allergic reactions to NCA food.

Animal	Food	Patients	Manifestations	Testing	Ref.
Rabbit	Dandelion	Female, age 10, atopic dermatitis	Chronic eczema of the hands	Epicutaneous tests: + sesquiterpene lactone mix Improvement after stopping contact with dandelions.	[52]
Birds	Sunflower seeds	4 patients	(1) Asthma, (3) anaphylactic shock due to ingestion of sunflower seeds. Probable sensitization while feeding birds.	Prick tests and IgE + with sunflower seed extract	[53]
Birds	Millet seed	23 patients	7 with food allergy to millet, 16 others exposed with no allergy	Prick-test millet extract + 3/5 allergic patients, IgE +: 7/7 allergic patients 10/16 exposed without allergy (proteins 36, 70 and 90 kDa)	[54]
Birds (Budgerigar)	Millet seed	Female, age 37, allergic rhinitis	Anaphylactic shock after ingesting millet. Probable sensitization by inhalation while feeding bird.	Prick-tests and IgE + millet	[55]
Birds (Budgerigar)	Millet seed (<i>Panicum milliaceum</i>)	Female, age 51, non-atopic	Asthma while cleaning birdcage and anaphylaxis after ingesting food containing millet.	Prick-tests and IgE + millet	[57]
Birds (Parrot)	Pine nuts (<i>P. pinea</i>)	Female, age 54, allergic to eggs	Anaphylaxis after ingesting pine nuts (parrot food) and asthma while cleaning birdcage.	Prick tests + with pine nut extract (<i>P. pinea</i> and <i>P. cembra</i>) IgE + with pine nut extract, feather and parrot serum	[56]
Fish	Midge larvae (<i>Chironomus thummi thummi</i>)	Male, age 23, atopic	Rhinitis, conjunctivitis, frontal urticaria, cough, dyspnoea	Prick-test and IgE+ chironomidae extract (protein 13kDa)	[58]
Fish	Buzzer midge larvae (<i>Chironomus plumosus</i>)	Male, age 35, non-atopic	Contact urticaria, palpebral oedema and conjunctivitis if contact with larvae	Prick-tests and IgE + chironomidae extract	[59]
Fish	Bloodworm larvae (<i>Chironomus</i>)	Male, age 44, and girls, age 10 and 14	Asthma, rhinitis, urticaria when in contact with larvae	Prick-tests + with larvae (anaphylaxis)	[60]
Tropical fish and frogs belonging to his son	freeze-dried larvae (<i>Chironomus plumosus</i>)	1/female, age 34 2/ 2 others : fish food salesman and male age 33	1/Periorbital oedema and conjunctivitis for one week. 2/ contact urticaria and respiratory difficulty	1/Prick-tests + larvae with persistence 2 days; IgE + <i>Chironomus plumosus</i>	[61]
Turtle	Dried shrimp (<i>Gammarus</i>)	Female, age 25, atopic	Worsening rhinitis and conjunctivitis	Prick-tests et IgE + <i>Gammarus</i> extracts (proteins 25,32,40kDa). No reaction to shellfish	[62]

Treatment of allergies to new companion animals

This is based on the elimination of contact with the animal, sometimes difficult to obtain. Often, trials of withdrawal from the animal, bringing remissions followed by relapses upon re-exposure, are necessary to convince the patients or their family circle.

Other causes

Besides the animal, other possible causes for these allergic reactions must be considered.

– Food given to the animal (*table 3*) [52–62]: for example, chironomid larvae as in fish food, bird food seeds such as millet causing inhalation reactions when feeding birds and a risk of anaphylactic shock when ingesting millet.

– The animal's environment: allergy to ficus and latex for example [8].

Conclusion

Faced with the proliferation in number and species of these new pets, one must expect an increase in secondary allergic reactions in atopic, but also non-atopic patients, with clinical manifestations that go from the most benign to the most severe. ■

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