

Alpha-gal Syndrome: The Red Meat Allergy

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Scientific publications describing alpha-gal or α -gal Syndrome (AGS) started to appear in the early 2000s. Multiple case histories of individuals in the United States (US) demonstrated delayed allergy symptoms after eating red meat. Although AGS is still a relatively new condition, ongoing research continues to enhance our understanding of its development and management. Case histories of those with AGS suggest that individuals who have multiple tick bites are more likely to develop AGS. Since its identification, the syndrome has been described in other countries and linked to consumption of red meat after a known tick bite. Preventing tick bites is the best way to reduce the risk of developing AGS or contracting a tick-borne disease.

Allergy Development

The compound, galactose- α -1,3- galactose (α -gal or alpha-gal), is a carbohydrate produced by all mammals except old-world primates, including humans. In most cases it is not known to be produced by or found in birds or seafood, including fish or arthropods. Several tick species have been found to have α -gal in their saliva or midgut. Some species have α -gal in their saliva even after feeding on blood that does not contain α -gal. This suggests that ticks can produce α -gal, and during the active feeding stage, α -gal, pathogens, and other compounds are secreted into humans. Current research suggests that the duration of tick feeding and the process of feeding produces a sensitization event in the human host. In some individuals, multiple tick feedings result in those individuals becoming sensitized to α -gal in red meat. Individuals who are sensitized to α -gal may have an immune response, thus becoming allergic to α -gal. The response involves the release of immunoglobulin E, IgE, into the body, and an allergic reaction occurs which can include symptoms such as a rash, vomiting and/or asphyxiation (difficulty breathing). All allergic reactions can potentially be life-threatening depending on the individual's response and the speed at which medical assistance is obtained.

Tick Life Cycle and Biology



Figure 1: Left, adult female, lone star tick, *Amblyomma americanum*, dorsal view (Photo Credit, Lauren Bishop, CDC). Right, adult female, black-legged tick, *I. scapularis*, lateral view (Photo Credit, CDC).

Ticks are arthropods and are closely related to spiders. They have four different life stages. All ticks start out as an egg (laid by the adult female tick) and progress into a six-legged larva, eight-legged nymph and eight-legged adult. All stages, except the egg, require at least one blood meal before developing into the next stage. Ticks often have different hosts at different stages of their lives. The larva and nymph usually feed on smaller animals such as mice, rats, birds and other small mammals. The nymph and adult may feed on larger animals such as deer, cattle and humans. Ticks cannot fly, as they do not have wings. They can walk and crawl and often hitchhike on their host to get from one area to another. Ticks are often found in taller grass and under trees, leaf litter and other vegetation. They are at risk of dehydration, drying out, and tend to avoid areas with direct sunlight and little to no grass vegetation or debris.

In the US, the lone star tick, *Amblyomma americanum* (Figure 1, left), is thought to be the primary tick that results in the sensitization to α-gal during feeding. The black-legged tick, *Ixodes scapularis* (Figure 1, right), previously thought of as the deer tick, has been found to have the α-gal compound in its saliva. Both tick species can be found in wooded and tall-grassy areas in Tennessee. In the state, lone star ticks are primarily active during the spring and summer, while black-legged ticks are active during the fall and winter.

The Western blacklegged tick, *I. pacificus*, was recently implicated in an AGS case in Washington state. While the Western blacklegged tick is not found in Tennessee, this finding indicates a need to prevent tick bites when traveling inside and outside the state to reduce the risk of developing AGS or acquiring a tick-borne disease pathogen.

Geographical Areas Where AGS Has Been Reported

In the US, the majority of AGS cases are reported in the South, Eastern and Central states, where lone star ticks are abundant. However, recent reports have identified individuals in Maine and Washington states with AGS. Central America, Australia, Europe, Japan and South Korea have also reported cases of AGS. Since this is still considered an emerging condition, other countries may have similar risks for AGS which have not yet been identified and/or reported. Currently, AGS is not a nationally reportable condition; thus, reporting to state public health departments, Centers for Disease Control (CDC) or international health departments is voluntary in many states. This means that the number of cases is likely higher than reported, and some cases may go undetected for a period of days to months. The Tennessee General Assembly passed a bill to make AGS reportable to the state health department, and this went into effect on July 1, 2025.

Signs and Symptoms of AGS

Unlike food and other allergies, AGS symptoms do not occur immediately and may take as long as two to six hours after eating red meat or swallowing certain medications that use red meat byproducts. Often AGS symptoms will occur weeks to a month after a known tick bite. Typical symptoms include:

- Hives or itchy rash
 - Swelling of the eyelids, lips and/or tongue
 - Dizziness or faintness
- Severe stomach pain
 - Shortness of breath
 - Difficulty breathing

In some cases, an individual may have a delayed reaction with one or more of the above symptoms at the same time, which is anaphylaxis also called anaphylactic reaction. This often occurs in the middle of the night and results in a trip to the emergency room. This is a life-threatening medical emergency, and medical assistance should be obtained immediately.

Individuals with more than one tick bite are more likely to develop AGS. There are some people who develop AGS without a known tick bite. This is likely because the larva and nymph can be very small, often smaller than a poppyseed, and may be missed in regular body inspections for ticks.

Medical Testing and Treatment of AGS

Medical professionals will ask questions regarding skin and other medical reactions and activities such as travel and/or known tick bites to identify the potential for AGS. A blood test may be performed to look at increased levels of IgE which indicates an immune response. A combination of medical assessment of risks and an IgE test will be considered as the IgE test can have false-positive and false-negative results. This makes the information about known tick bites and time spent outdoors in areas where encounters with ticks are likely a critical part of the medical professional’s assessment.

Treatment of AGS may include over-the-counter or prescribed steroids, diet changes and/or prevention of further tick bites. Avoiding foods made with red meat, red meat byproducts and/or medications that contain mammalian byproducts will help prevent further allergic reactions to red meat (Table 1). Flounder roe, eggs and carageen, a food thickener or stabilizer extracted from edible red seaweeds, should also be avoided as they have also been implicated in the development of AGS after a tick bite and consuming foods containing them. Some individuals may find it helpful to join an AGS support group to learn what other individuals are doing to reduce their risks and manage AGS.

Table 1. Examples of red meat foods, byproducts and medications made from mammalian byproducts which may be avoided to reduce AGS allergic reactions. This is not a complete list. Consult with a medical professional if AGS is diagnosed or suspected.

Red-Meat Foods and Byproducts	Mammalian-Based Medications
1. Mammalian meat including beef, pork, lamb, venison, and/or rabbit 2. Meat stock, broth, gravy, etc. 3. Mammalian fat such as bacon grease 4. Dairy products 5. Products that contain gelatin such as jellybeans, marshmallows and Jello	1. Gel capsules 2. Vaccines that contain gelatin such as measles, mumps, and rubella (MMR) 3. Thyroid hormone supplements derived from cows or pigs 4. Heparin 5. Snake antivenom made from horses or sheep

Some case histories of individuals with AGS have indicated that by changing one’s diet and preventing further tick bites, they can eventually be able to eat red meat again. This is not true for all AGS cases and should be discussed with a medical doctor before diet changes are made.

Steps to Prevent Tick Bites

There are no medicines available to prevent AGS. The best strategy to reduce the risk of contracting AGS is to prevent tick bites. Because ticks can stay on a host's body, animals including humans, for several hours or days, tick bite prevention is in two phases: what you do before you go outside and what you do when you go inside after being outside in areas where you may encounter ticks.

Before you go outside, you need to prepare yourself, any gear you are taking with you, and/or your animal companion.

- If possible, avoid areas where ticks are likely to be such as grassy and wooded areas.
- Wear protective clothing such as light-colored long-sleeved shirts and long pants when outdoors.
- If possible, treat your clothing and gear with permethrin. Note that cats are sensitive to permethrin and should not be in areas where clothing and gear are being treated or stored.
- Use EPA-approved repellent and reapply if necessary and as directed on the label.
- Talk to your veterinarian about the best tick and mosquito products for your companion animals.

The longer a tick is on your body, the more likely it is to attach to you, feed, and potentially the α -gal compound and/or other tick-borne pathogens are transferred during the active feeding process. The sooner you find and remove the tick, the less risk you have.

While outdoors and when you return inside from the outdoors, there are several things you should do to prevent tick bites.

- Complete a thorough inspection of your body (hair, body creases and folds such as under armpits, behind knees and between toes), shoes, gear and companion animals for ticks.
- Shower within two hours after returning inside. This will remove any ticks that you may miss during your tick inspection and help you with your inspection.
- Wash and dry your clothing and washable gear to kill and ticks on those items.

If you find a tick attached to you, remove it as soon as possible. Simple tweezers can be used to safely remove the tick and its mouthparts. You do not want to yank the tick out, as the mouth parts may stay attached inside your body. Instead, grab ahold of the tick with tweezers as close to the skin and attachment site as possible. Remove the tick by pulling out against the direction it is attached, like removing a bee stinger. Be careful not to break the tick or push on the back end as this pressure may cause the tick to release more compounds into you. The CDC has a tick bite bot to help you determine the next steps for a tick bite. If you develop a fever or infection, immediately seek medical attention.

Control Measures for Ticks

There are several acaracides, pesticides that include ticks on the label, available for use to control ticks in residential or commercial yards. Make sure to follow any local, state, and federal laws when applying and using pesticides.

Most yards can be easily landscaped to create a less tick-friendly environment. Reducing tall grass and opening the yard so that more sunlight can reach the ground will help reduce the risk of ticks. There are several other landscaping options that can help make your yard attractive as well as reducing the potential for ticks.

- Create a 3-foot, walking border made of rock, gravel, wood mulch and other materials between desired wooded and tall grassy areas.
- Discourage unwanted animals such as deer and stray dogs by installing and maintaining fences.
- Rodents can be discouraged by stacking firewood, quickly removing produce from gardens and fruit-bearing trees and removing trash such as mattresses from the yard.
- Keep decks, patios, playground equipment and storage sheds away from property edges where tall grasses and wooded areas may be located.
- Reduce tick habitat by preventing the buildup of leaf litter.

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