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ROCKY MOUNTAIN SPOTTED FEVER (RMSF)

H. Goldlin Jebaselvi, Tutor

Department of medical surgical nursing Sree Balaji college of nursing

Bharat institute of higher education and research (BIHER)

Chennai, (India)

ABSTRACT:

Rocky Mountain spotted fever (RMSF) is a tick-borne disease which is caused by an organism *Rickettsia rickettsii*. Although RMSF can be lethal, it is curable. RMSF is the most common rickettsial infection. The organism is endemic in parts of North, Central, and South America, especially in the southeastern and south-central United States.

Rocky Mountain spotted fever (RMSF) is a bacterial disease spread by ticks. It typically begins with a fever and headache, and a few days later followed by the development of a rash. The rash is generally made up of small spots of bleeding and starts on the wrists and ankles. Other symptoms may include muscle pains and vomiting. Long-term complications following recovery may include loss of hearing or loss of part of an arm or leg. The disease is caused by *Rickettsia rickettsii*, a type of bacteria that is primarily spread to humans by American dog ticks, Rocky Mountain wood ticks, and brown dog ticks. Rarely the disease is spread by blood transfusions.

Fewer than 5,000 cases are reported a year in the United States, most often in June and July. It has been diagnosed throughout the contiguous United States, Western Canada, and parts of Central and South America. Rocky Mountain spotted fever was first identified in the 1800s in the Rocky Mountains.

Key Words: tick-borne disease, ticks, spotted fever.

ROCKY MOUNTAIN SPOTTED FEVER:

Rocky Mountain spotted fever is a bacterial infection transmitted by a tick. Without prompt treatment, Rocky Mountain spotted fever can cause serious damage to internal organs, such as your kidneys and heart.

Early signs and symptoms of Rocky Mountain spotted fever include a severe headache and high fever. A few days later, a rash usually appears on the wrists and ankles. Rocky Mountain spotted fever responds well to prompt treatment with antibiotics.



SYMPTOMS

Although many people become ill within the first week after infection, signs and symptoms may not appear for up to 14 days. Initial signs and symptoms of Rocky Mountain spotted fever often are nonspecific and can mimic those of other illnesses:

- High fever
- Chills
- Severe headache
- Muscle aches
- Nausea and vomiting
- Confusion or other neurological changes

Rash is distinctive

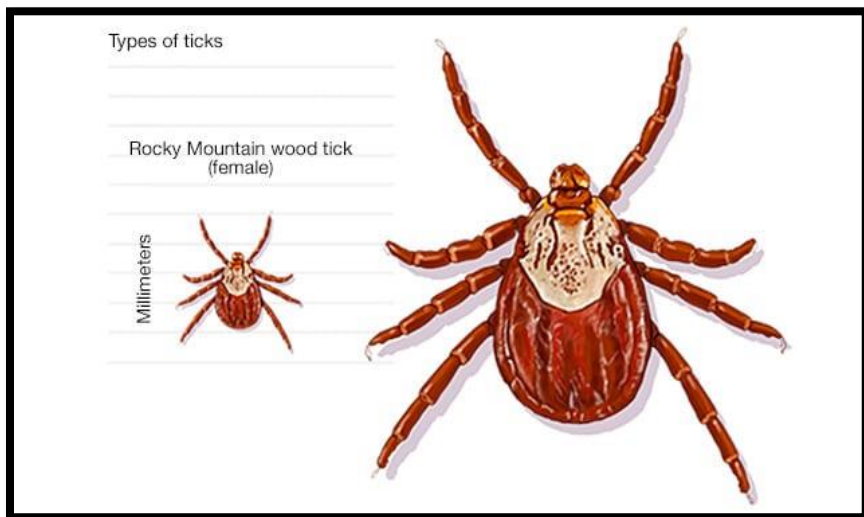
The red, non itchy rash associated with Rocky Mountain spotted fever typically appears three to five days after the initial signs and symptoms begin. The rash usually appears first on your wrists and ankles, and can spread in both directions — down into the palms of your hands and the soles of your feet, and up your arms and legs to your torso.

People who are infected with Rocky Mountain spotted fever don't ever develop a rash, which makes diagnosis much more difficult.

Long-term Health Problems

- RMSF does not result in chronic or persistent infections.
- Patients who recover from severe RMSF may be left with permanent damage, including amputation of arms, legs, fingers, or toes (from damage to blood vessels in these areas); hearing loss; paralysis; or mental disability. Any permanent damage is caused by the acute illness and does not result from a chronic infection.

CAUSES:



Types of ticks:

Rocky Mountain spotted fever is caused by infection with the organism *Rickettsia rickettsii*. Ticks carrying *R. rickettsii* are the most common source of infection.

If an infected tick attaches itself to your skin and feeds on your blood for six to 10 hours, you may pick up the infection. But you may never see the tick on you.

Rocky Mountain spotted fever primarily occurs when ticks are most active and during warm weather when people tend to spend more time outdoors. Rocky Mountain spotted fever cannot be spread from person to person.

Rickettsiae are transmitted through saliva injected while a tick is feeding. Unlike Lyme disease and other tick-borne pathogens that require a prolonged attachment period to establish infection, a person can become infected with *R. rickettsii* in a feeding time as short as 2 hours. In general, about 1-3% of the tick population carries *R. rickettsii*, even in areas where the majority of human cases are reported. Therefore, the risk of exposure to a tick carrying *R. rickettsii* is low

RISK FACTORS

Factors that may increase your risk of contracting Rocky Mountain spotted fever include:

- Living in an area where the disease is common
- The time of year — infections are more common in the spring and early summer
- How much time you spend in grassy or wooded areas
- Whether you have a dog or spend time with dogs

If an infected tick attaches to your skin, you can contract Rocky Mountain spotted fever when you remove it, as fluid from the tick can enter your body through an opening such as the bite site.

You can reduce your risk of infection by taking steps to prevent exposure to ticks and tick fluids. When removing a tick from your skin:

- Use a tweezers to grasp the tick near its head or mouth and remove it carefully
- Treat the tick as if it's contaminated; soak it in alcohol or flush it down the toilet
- Clean the bite area with antiseptic
- Wash your hands thoroughly

PATHOPHYSIOLOGY

Entry into host

Rickettsia rickettsii can be transmitted to human hosts through the bite of an infected tick. As with other bacterium transmitted via ticks, the process generally requires a period of attachment of 4 to 6 hours. However, in some cases a *Rickettsia rickettsii* infection has been contracted by contact with tick tissues or fluids. Then, the bacteria induce their internalization into host cells via a receptor-mediated invasion mechanism.

Exit from host cell

The cytosol of the host cell contains nutrients, adenosine triphosphate (ATP), amino acids, and nucleotides which are used by the bacteria for growth. For this reason, as well as to avoid phagolysosomal fusion and death, rickettsiae must escape from the phagosome. To escape from the phagosome, the bacteria secrete phospholipase D and hemolysin C. This causes disruption of the phagosomal membrane and allows the bacteria to escape. Following generation time in the cytoplasm of the host cells, the bacteria utilizes actin based motility to move through the cytosol.

RickA, expressed on the rickettsial surface, activates Arp2/3 and causes actin polymerization. The rickettsiae use the actin to propel themselves throughout the cytosol to the surface of the host cell. This causes the host cell membrane to protrude outward and invaginate the membrane of an adjacent cell. The bacteria are then taken up by

the neighboring cell in a double membrane vacuole that the bacteria can subsequently lyse, enabling spread from cell to cell without exposure to the extracellular environment.

Consequences of infection

Rickettsia rickettsii initially infect blood vessel endothelial cells, but eventually migrate to vital organs such as the brain, skin, and the heart via the blood stream. Bacterial replication in host cells causes endothelial cell proliferation and inflammation, resulting in mononuclear cell infiltration into blood vessels and subsequent red blood cell leakage into surrounding tissues. The characteristic rash observed in Rocky Mountain spotted fever is the direct result of this localized replication of rickettsia in blood vessel endothelial cells

DIAGNOSIS:

This disease can be diagnosed by a doctor with and without the use of lab testing. Lab tests are not always relied upon because treatment may be necessary before the results are returned.^[23]

Abnormal laboratory findings seen in patients with Rocky Mountain spotted fever may include a low platelet count, low blood sodium concentration, or elevated liver enzyme levels. Serology testing and skin biopsy are considered to be the best methods of diagnosis. Although immune fluorescent antibody assays are considered some of the best serology tests available, most antibodies that fight against *R. rickettsii* are undetectable on serology tests during the first seven days after infection.

TREATMENT:

Appropriate antibiotic treatment should be started immediately when there is a suspicion of Rocky Mountain spotted fever. Treatment should not be delayed for laboratory confirmation of disease as early initiation of treatment of Rocky Mountain spotted fever is associated with lower mortality. Failure to respond to a tetracycline argues against a diagnosis of Rocky Mountain spotted fever. Severely ill people may require longer periods before their fever resolves, especially if they have experienced damage to multiple organ systems. Preventive therapy in healthy people who have had recent tick bites is not recommended and may only delay the onset of disease.

Doxycycline (a tetracycline) is the drug of choice for patients with Rocky Mountain spotted fever. According to the CDC, "Doctors often avoid prescribing doxycycline to young children because of a warning that tooth staining may occur when used in children less than 8 years old. ..Misperceptions about the use of doxycycline for children prevent kids from getting lifesaving treatment" of rickettsial diseases. "Delay in treatment of rickettsial diseases may lead to severe illness or death. Children are five times more likely than adults to die from RMSF." Treatment typically consists of 100 milligrams every 12 hours, or for children under 45 kg (99 lb) at 4 mg/kg of body weight per day in two divided doses. Treatment should be continued for at least three days after the fever subsides, and until there is unequivocal evidence of clinical improvement. This will be generally for a minimum time of five to ten days. Severe or complicated outbreaks may require longer treatment courses. Chloramphenicol is an alternative

drug that can be used to treat Rocky Mountain spotted fever, specifically in pregnancy. However, this drug may be associated with a wide range of side effects, and careful monitoring of blood levels is required.

PREVENTION:

- There is no vaccine to prevent RMSF. Prevent illness by preventing ticks on your pets and preventing ticks in your yard
- Ticks live in grassy, brushy, or wooded areas, or even on animals, so spending time outside camping, gardening, or hunting will bring you in close contact with ticks. Protect yourself, your family, and your pets. Here's how:

Before You Go Outdoors

- **Know where to expect ticks.** Ticks live in grassy, brushy, or wooded areas, or even on animals. Spending time outside walking your dog, camping, gardening, or hunting could bring you in close contact with ticks. Many people get ticks in their own yard or neighborhood.
- **Treat clothing and gear** with products containing 0.5% permethrin. Permethrin can be used to treat boots, clothing and camping gear and remain protective through several washings. Alternatively, you can buy permethrin-treated clothing and gear.
- **Use environmental repellants** containing DEET, picaridin, IR3535, Oil of Lemon Eucalyptus (OLE), para-menthane-diol (PMD), or 2-undecanone
- **Avoid Contact with Ticks**
 - Avoid wooded and brushy areas with high grass and leaf litter.
 - Walk in the center of trails.

After You Come Indoors

Check your clothing for ticks. Ticks may be carried into the house on clothing. Any ticks that are found should be removed. Tumble dry clothes in a dryer on high heat for 10 minutes to kill ticks on dry clothing after you come indoors. If the clothes are damp, additional time may be needed. If the clothes require washing first, hot water is recommended. Cold and medium temperature water will not kill ticks.

Examine gear and pets. Ticks can ride into the home on clothing and pets, then attach to a person later, so carefully examine pets, coats, and daypacks.

Shower soon after being outdoors. Showering within two hours of coming indoors has been shown to reduce your risk of getting Lyme disease and may be effective in reducing the risk of other tick-borne diseases. Showering may help wash off unattached ticks and it is a good opportunity to do a tick check.

Check your body for ticks after being outdoors. Conduct a full body check upon return from potentially tick-infested areas, including your own backyard. Use a hand-held or full-length mirror to view all parts of your body. Check these parts of your body and your child's body for ticks:

- Under the arms
- In and around the ears
- Inside belly button
- Back of the knees
- In and around the hair
- Between the legs
- Around the waist

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