Ricin

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Overview

Ricin is a potential bioterrorism weapon. If you suspect that you are dealing with a bioterrorism situation, immediately contact your Senior Epidemiology Specialist for the District, or the Department of Health and Senior Service's Situation Room (DSR) at 800-392-0272.

Ricin is a toxin that can be made from the waste left over from processing castor beans into castor oil. It would take a deliberate act to make ricin and poison people. Accidental exposure to ricin is highly unlikely, except by ingestion of castor beans.

Ricin can be prepared in liquid or crystalline form, or it can be processed to make a dry powder. It can be disseminated as an aerosol, injected into a target, or used to contaminate food or water. Whether ingested, injected or inhaled, ricin is highly toxic. The average amount needed to cause death (LD50) can be as little as 3 micrograms per kilogram (mcg/kg) when inhaled or injected into the body or 30 mcg/kg when ingested. [(3)] For example, the inhalational dose for a 180 pound man (82 kg) would be about 245 micrograms, an amount roughly equivalent to 2 grains of table salt.

Case Definitions

Ricin Ingestion

Clinical Description

Signs and symptoms from oral exposure to purified ricin are presumed to be similar to reports of illness after castor bean mastication and ingestion.

Some or all of the following symptoms may be manifest:

- Profuse vomiting
- Profuse diarrhea (bloody or nonbloody)
- Severe dehydration
- Weakness
- Influenza-like symptoms: fever, myalgia, and arthralgia
- Hallucinations
- Seizures
- Hematuria
- Hypotension
- Hypovolemic shock, and multiple system organ failure may occur, leading to death.

Ricin Inhalation

Clinical Description

Data on inhalation exposure to ricin in humans are limited. Some or all of the following symptoms may manifest:

- Cough, respiratory distress, bronchoconstriction
- Pulmonary edema
- Cyanosis
- Nausea
- Excessive diaphoresis
- Weakness
- Influenza-like symptoms: fever, myalgia, and arthralgia
- Hypotension, respiratory failure and multisystem organ failure may occur
- Death may occur within 36 to 72 hours due to acute respiratory distress syndrome (ARDS) and respiratory failure.

Ricin Injection (data are limited):

Clinical Description

- In a single human trial of low doses of intravenous ricin, influenza-like symptoms of fatigue and myalgias occurred.

A case in which a person injected castor bean extract subcutaneously resulted in hospitalization 36 hours after the injection. Clinical manifestations included:

- Complaints of nausea, weakness, dizziness, and myalgias.
- Anuria and hypotension developed.
- Hepatic failure, renal failure, cardiorespiratory failure, and death 18 hours following admission.

In a case in which a dissident was thought to have been assassinated with a ricin injection, clinical manifestations included:

- Pain at injection site, which developed immediately.
- Weakness developed within 5 hours.
- Fever and vomiting developed within 24 hours, followed by shock and multi-organ failure, and death within 3 days.

Diagnosis and Laboratory Criteria

- Nonspecific laboratory findings in ricin poisoning:
  - Metabolic acidosis
  - Increased liver function tests
  - Increased renal function tests
  - Hematuria
  - Leukocytosis (two- to five-fold higher than normal value).
- The presence of leukocytosis and/or abnormal liver and renal function tests may suggest ricin-associated illness in the correct clinical context but are not very specific.
- There are no specific clinically validated assays for detection of ricin that can be performed by the hospital/healthcare facility clinical laboratory.
- No methods are available for the detection of ricin in biologic fluids.
- Tests for ricinine, an alkaloidal component of the castor bean plant are being developed.
- The potential uses of tests for either ricin or ricinine in human biological samples would primarily be for purposes of confirming exposure or assessing the prevalence of exposure rather than diagnostic use.

Laboratory criteria for diagnosis include detection of ricin in environmental samples.

- Testing for ricin in environmental samples will most likely not be immediately available to assist in clinical decision making.
- Environmental testing may document the potential for exposure or affirm the exposure circumstances.
- Tests performed on ricin-suspicious samples include:
  - Time-resolved fluorescence immunoassay: antibody binds to ricin
  - Polymerase chain reaction: locates and makes copies of parts of the DNA contained in the castor bean plant. The search specifically identifies the DNA of the gene that produces the ricin protein.

Case Classifications

Confirmed: A clinically compatible case in which laboratory tests have confirmed exposure.
Probable: A clinically compatible case in which a high index of suspicion (credible threat or patient history regarding location and time) exists for ricin exposure, or an epidemiologic link exists between this case and a laboratory-confirmed case.
Suspected: A case in which a potentially exposed person is being evaluated by health-care workers or public health officials for poisoning by a particular chemical agent, but no specific credible threat exists.

The case can be confirmed if laboratory testing was not performed because either a predominant amount of clinical and nonspecific laboratory evidence of a particular chemical was present or a 100% certainty of the etiology of the agent is known.
Note: A case should not be considered ricin or abrin poisoning if another confirmed diagnosis exists to explain the signs and symptoms.

Information Needed for Investigation:

Verify the diagnosis. What are the patient's clinical signs and symptoms? What laboratory tests were conducted? What were the results?

Establish the extent of illness. Are there other individuals with similar signs/symptoms (includes household and other close contacts)? Characterize information by person, place, and time. Information may be obtained by talking with patients, health care workers, and emergency workers, etc.

Determine the form of the illness as soon as possible.

- Acute onset, with fever and coughing, chest tightness, dyspnea, and arthralgias occurs 4 to 8 hours, or more after inhalational exposure.
- Acute onset of fever, with nausea, vomiting, and abdominal pain can occur in a few hours or less. Internal bleeding in the stomach and intestines. Vomiting blood and bloody stools, after ingestion or injection of ricin.
- With injection you may also observe muscle and lymph node soreness near an injection site.

Determine the source of the exposure to prevent other cases.

- Assist patients with identifying possible exposure sources. (Inhalation, Ingestion or Injection).
- If the patient exhibits inhalational form of exposure, determine the recent locations that the patient has visited.
- If ingestion of ricin is indicated as the source of exposure, obtain a history of food and water consumption; if available, obtain samples of the suspected food or water source.
- If injection is suspected as the source of exposure, find out where and when the injection was given and by whom.
- Have there been other cases linked by time, place or person?

Notification and Control Measures:

- Contact the District Communicable Disease Coordinator, or the Senior Epidemiology Specialist, or the Department of Health and Senior Services' Situation Room (DSR) at 800-392-0272 (24/7) immediately upon learning of a suspected case of ricin.
- Contact the Bureau of Environmental Health Services at (573) 751-6095 and the Section for Child Care Regulation at (573) 751-2450, if the case is associated with a child care center.
- Contact the Section for Long Term Care Regulation at (573) 526-8524, if the case is associated with a long term-care facility.
- Contact the Bureau of Health Services Regulation at (573) 751-6303, if the case is associated with a hospital, hospital-based long-term care facility, or ambulatory surgical center.

Control Measures

- See USAMRIID's Medical Management of Biological Casualties Handbook, 6th Edition, 2005 (The Blue Book) 93-96.
- There are currently no vaccines or prophylactic antitoxin available for ricin. Management of exposures should be supportive care that may include treatment for pulmonary edema. Gastric lavage and cathartics are indicated for ingestion of ricin.
- Ricin is not person to person transmissible. It is non-volatile, and secondary aerosols are not expected to be a danger to healthcare providers.
- Decontaminate with soap and water. A hypochlorite solution of 0.1% sodium hypochlorite can inactivate ricin. (2)

  You may contact the regional poison control center for additional clinical guidance. (800)-222-1222.

General Information:

- By other routes of exposure, ricin is not a direct lung irritant; however, intravascular injection can cause minimal pulmonary perivascular edema due to vascular endothelial injury. Ingestion causes necrosis of the gastrointestinal epithelium, local hemorrhage, and hepatic, splenic, and renal necrosis. Intramuscular injection causes severe local necrosis of muscle and regional lymph nodes with moderate visceral organ involvement.
- An attack with aerosolized ricin would be primarily diagnosed by the clinical and epidemiological setting. Acute lung injury affecting a large number of geographically clustered cases should raise suspicion of an attack with a pulmonary irritant such as ricin, although other pulmonary pathogens could present with similar signs and symptoms. Other biological threats, such as SEB, Q fever, Tularemia, Plague, and some chemical warfare agents like phosgene, need to be included in the differential diagnosis.
- Ricin-induced pulmonary edema would be expected to occur much later (1-3 days post exposure) compared to that induced by SEB (about 12 hours post exposure) or phosgene (about 6 hours post exposure). Ricin intoxication would be expected to progress despite treatment with antibiotics, as opposed to an infectious process. There would be no mediastinitis as seen with inhalation anthrax. Ricin patients would not be expected to plateau clinically as occurs with SEB intoxication.

Laboratory Procedures

Specimens:

Contact the Missouri State Public Health Laboratory for instructions on collection and transport of specimens for ricin testing.

Specific ELISA and ECL testing on serum and respiratory secretions, or immunohistochemical stains of tissue may be used where available to confirm the diagnosis. Ricin is an extremely immunogenic toxin, and paired acute and convalescent sera should be obtained from survivors for measurement of antibody response. PCR can detect castor bean DNA in most ricin preparations. Additional supportive clinical or diagnostic features after aerosol exposure to ricin may include the following: bilateral infiltrates on chest radiographs, arterial hypoxemia, neutrophilic leukocytosis, and a bronchial aspirate rich in protein compared to plasma which is characteristic of high permeability pulmonary edema.[(2)]

WARNING: ***Ricin is highly toxic and persistent in the environment. Do not attempt to collect environmental samples unless you are trained and equipped to do so.*** See the NIOSH emergency response card for ricin, available at: http://www.bt.cdc.gov/agent/ricin/erc9009-86-3.asp. (March 17, 2011)

Reporting Requirements

Ricin is a Category 1(A) disease and shall be reported **immediately** to the local health authority or to the Missouri Department of Health and Senior Services by telephone, facsimile or other rapid communication.

1. For confirmed and probable cases, complete a "Disease Case Report" (CD-1).
2. Entry of the completed CD-1 into the WebSurv database negates the need for the paper CD-1 to be forwarded to the District Health Office.
3. All outbreaks or "suspected" outbreaks must be reported as soon as possible (by phone, fax, or e-mail) to the District Communicable Disease Coordinator. This can be accomplished by completing the Missouri Outbreak Surveillance Report (CD-51).
4. Within 90 days from the conclusion of an outbreak, submit the final outbreak report to the District Communicable Disease Coordinator.

References

1. Centers for Disease Control and Prevention (CDC). Public Health Emergency Preparedness & Response, " Facts About Ricin", http://emergency.cdc.gov/agent/ricin/facts.asp, 2008, (2/13)
2. USAMRIID'S Medical Management of Biological Casualties Handbook, 6th Edition, Fort Detrick, Frederick, Maryland, 2005. 93-96 http://www.usamriid.army.mil/education/bluebookpdf/USAMRIID%20BlueBook%206th%20Edition%20-%20Sep%202006.pdf (2/13).
3. Mirarchi, FL, "CBRNE – Ricin", eMedicine Journal, Jun 7, 2010 http://emedicine.com/emerg/topic889.htm (2/13)

Other Sources of Information

1. National institute for Occupational Safety and Health, The Emergency Response Safety and Health Database, "Ricin," (08/2008), 1-9. http://www.cdc.gov/NIOSH/ershdb/EmergencyResponseCard_29750002.html (2/13)
2. Franz, DR and NK Jaax, "Chapter 32 – Ricin Toxin" in Medical Aspects of Chemical and Biological Warfare.(6/09). (http://www.bordeninstitute.army.mil/published_volumes/chemBio/Ch32.pdf (2/13)