**Biological Agents: Ricin**

*Ricinus communis*

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**Ricin toxin**
- Biological toxin derived from the castor bean plant
- Over 1 million tons of castor beans are processed annually to make castor oil
- Ricin is a glycoprotein lectin inhibiting protein synthesis
- Other potential mechanisms are cellular membrane damage, stimulation apoptosis and inflammation promotion.
- Ricin is under review for therapeutic use in bone marrow transplants and cancer chemotherapy
- Roots, leaves and seeds of the castor plant are used in folk remedies

**Routes of Infection**
- **Ingestion** of castor bean meal or powder and/or through addition to food or water.
- **Inhalation** of toxin during industrial operations or aerosol release
- **Injection** of toxin
  - Georgi Markov
    - Bulgarian exile injected with ricin in the tip of an umbrella

**Clinical Presentation**
- **Ingestion**
  - Mild poisoning: nausea, vomiting, diarrhea, and abdominal pain
  - Moderate – severe poisoning: gastrointestinal tract symptoms progressing (4-36 hours) to hypotension, liver dysfunction, and death
- **Inhalation**
  - Within 8 hours: cough, dyspnea, arthralgias, and fever progressing to respiratory distress and death
- **Injection**
  - Under 6 hours: generalized weakness and myalgias
  - 24-36 hours: vomiting, fever, hypotension, multi-organ failure and death
- Death in 3 to 5 days regardless of route of infection

- Inhalation and injection are the primary routes for the use of ricin as a bioweapon
  - 500 micrograms is lethal dose
- Can be in the form of a powder, mist, pellet, or dissolved in water or weak acid
- Stable substance, unaffected by extreme cold or heat
- Worldwide availability in massive quantities as industrial byproduct
- Weaponized in World War II

**Castor Plant**

*Ricinus communis*

**Ricin as a Bioweapon**

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Clinical Presentation
- Ricin poisoning can have a presentation similar to gastroenteritis or respiratory illnesses
- Not absorbed well dermally
- Ricin is not transmitted person-to-person

Patient Decontamination
- **Dermal**
  - Remove contaminated clothes and jewelry
  - Wash skin with soap and deluge-volume water
  - Double bag and label contaminated clothing
- **Ingestion**
  - Single dose of activated charcoal if no vomiting
  - Gastric lavage if within one hour of ingestion
- **Inhalation**
  - Remove patient from exposure
- **Environmental Contamination**
  - Clean surfaces and clothing with a 0.1% sodium hypochlorite solution for 30 minutes

Personal Protective Equipment for Ricin Poisonings
- Decontaminate patients away from site of ricin release and outside the hospital
- Level B PPE with self-contained breathing apparatus
- Disposable Tyvek suit coated with penetration-preventative chemical
- Air-purifying respirator with P-100 filter
- Eye and face protection
- Universal precautions are adequate once patients are decontaminated

Laboratory Testing
- There are no clinically validated methods for detecting ricin in the body
- Only analytic methods are available
- Blood and urine tests are available through USAMRIID and the CDC
- CDC and the Laboratory Response Network conduct tests to identify ricin in the environment

Treatment
- **Supportive care**
  - Intravenous fluid and vasopressors for hypotension
  - Activated charcoal and gastric lavage for ingestion
  - If ricin is ingested, do not induce vomiting or give fluids to drink
- **No vaccines are available**
  - Immunization is protective in lab animals, but not necessarily in humans
- **Any suspected case of ricin should be reported to the local and state health departments, as well as to the regional poison control center.**
  - Regional Poison Control Center: 1-800-222-1222

Sources
Biological Agents: Ricin
Pacific EMPRINTS

Course Transcript

Slide 1: “Biological Agents: Ricin”
Welcome to the Biological Agents: Ricin tutorial designed by the Pacific Emergency Management, Preparedness and Response Information Network and Training Services at the University of Hawaii at Manoa.

Slide 2: “Ricin toxin”
Ricinus communis is the castor bean from which Category B biological agents, ricin toxin, is made. Castor beans are most commonly used to make castor oil which is used in paints, varnishes, lubricating oils for jet engines, high speed automobiles and industrial machinery. In addition, castor oil is used as a purgative. Over 1 million tons of castor beans are also processed annually to make castor oil, which does not, after processing, contain ricin. However, the bean pulp remaining after the oil is separated from the castor bean contains approximately 1 to 5% ricin.

Ricin, a glycoprotein lectin, is known to be toxic because it inhibits protein synthesis. Other potential mechanisms include cellular membrane damage, stimulation apoptosis and inflammation promotion. Ricin is also under review for its potential therapeutic uses in bone marrow transplants and cancer chemotherapy. The roots, leaves and seeds of the castor plants are found in folk remedies throughout the world, but the medicinal use of the castor bean is not well studied.

Slide 3: “Castor Plant (Ricinus communis)”
This is the castor plant, the beans from which are processed to make both castor oil and the ricin toxin.

Slide 4: “Routes of Infection”
There are three main routes of infection for the ricin toxin: ingestion, inhalation and injection. Ingestion of castor bean meal, or powderized castor bean is possible, and has occurred, but is not very effective as a bioweapon. Inhalation of the organism is possible during industrial operations, such as the processing of castor beans for castor oil. However, inhalation is also the route of greatest concern through which ricin could be effectively used as a bioweapon. Injection of the ricin toxin has also occurred. In 1978, Georgi Markov, a Bulgarian exile living in London, was jabbed in the leg with the tip of an umbrella held by an espionage agent standing behind him. At the tip of the umbrella was a small pellet impregnated with ricin toxin. The pellet was implanted into Mr. Markov subcutaneously, and as the pellet released ricin toxin into his body, Georgi Markov sickened and died.

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Slide 5: “Ricin as a Bioweapon”
Inhalation and injection of ricin are considered to be the most lethal routes of exposure to ricin, as well as the primary routes for use of ricin as a bioweapon. It is estimated that 500 micrograms, or an amount the size of the head of a pin would be enough to kill someone. Although ricin is nearly 1,000 times less lethal than botulinum toxin or other Category A agents, its potential for use as a weapon of bioterrorism is increased by its heat and cold stability and its worldwide availability in massive quantities as an industrial byproduct. Ricin can be in the form of a powder, mist, pellet, or dissolved in water or weak acid. Ricin was identified as a toxin ripe for weaponization during World War I, based on its high toxicity and ease of production. It was weaponized in World War II as a bomb, but was never used. As mentioned before, ricin has already been used as a biological weapon in the assassination of Georgi Markov.

Slide 6: “Clinical Presentation”
Ingestion of ricin can cause mild, moderate or severe poisoning. With mild poisoning, there will be nausea, vomiting, diarrhea and abdominal pain, as with most types of food poisoning. Moderate to severe poisoning will also produce gastrointestinal tract symptoms progressing in 4 to 36 hours to hypotension, liver and renal dysfunction and possibly death. Inhalation of the ricin toxin or aerosol will take effect within 8 hours and symptoms will include cough, dyspnea, arthralgias, and fever, which progress to respiratory distress and death. In the first six hours after the injection of ricin subcutaneously, patients will show signs of generalized weakness and myalgias. In 24 to 36 hours, this will turn into vomiting, fever, hypotension and eventually multiorgan failure and death. Death from ricin poisoning from any of these three routes of infection will occur within 3 to 5 days. If the patient has not died in this time frame, it is likely that they will recover.

Slide 7: “Clinical Presentation”
Ricin poisoning often has a presentation similar to gastroenteritis or respiratory illnesses, so these are the main differential diagnoses for ricin. Fortunately, ricin is not an agent that is absorbed well dermally, nor is it an agent that can be transmitted from person-to-person.

Slide 8: “Patient Decontamination”
Although ricin is not generally absorbed through the skin, contaminated clothes and jewelry should nevertheless be removed and skin washed with soap and deluge amounts of water. Contaminated clothes should be double bagged and clearly labeled. For oral ingestion of ricin, a single dose of activated charcoal may be administered if the patient is not vomiting. Gastric lavage can be used within an hour of ingestion, but may not be especially effective.

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For inhalational ricin, the only thing to be done is to remove the patient from the source of the exposure. Oral decontamination is not necessary. Contamination of the environment with ricin can be cleaned with a 0.1% sodium hypochlorite solution for 30 minutes, which will inactivate more than 99% of ricin. Carpets should simply be removed.

**Slide 9: “Personal Protective Equipment for Ricin Poisonings”**
Patients should be decontaminated away from the site where ricin was released and outside the hospital. Responders should wear Level B PPE with self-contained breathing apparatus and the disposable Tyvek suits coated with penetration preventative chemicals. Use air-purifying respirator with P-100 filters, and protect eye and face at all times. Universal precautions are adequate once patients have been decontaminated.

**Slide 10: “Laboratory Testing”**
Currently, there are no clinically validated methods for detecting ricin in the body, but there are analytic methods available. Blood and urine may be tested in special reference laboratories, such as the ones at the U.S. Army Medical Research Institute for Infectious Diseases and the Centers for Disease Control and Prevention. The CDC and the Laboratory Response Network also conduct tests to identify ricin in the environment.

**Slide 11: “Treatment”**
Treatment for ricin toxin poisoning is entirely supportive. Intravenous fluids may be administered and vasopressors such as dopamine can be used to treat the hypotension. Activated charcoal can be given to patients who are suspected to have ingested ricin as long as vomiting has not yet begun. Gastric lavage can also be used if the ingestion occurred in an hour or less. Do not attempt to induce vomiting or give the patient fluids to drink. Otherwise, there are no known vaccines or antitoxins available, although immunization appears promising in animal models. Any and all suspected cases of ricin poisoning should be reported to local and state health departments, as well as the regional poison control center, who can aid in treatment and management options currently available. The regional poison control center can be reached by calling 1-800-222-1222.

**Slide 12: “Sources”**
The following sources were consulted in the development of this tutorial.

**Slide 13: “Pacific EMPRINTS”**
The Pacific Emergency Management, Preparedness, and Response Information Network and Training Systems is funded by the U.S. Department of Health and Human Services Health Resources and Services Administration Grant No. T01HP6427-0100.
References