

CASE REPORT

Intoxication by ingestion of castor beans

P. de Haan¹, L.M. Reidinga-Saenen², J.A. Korporaal-Heijman¹

Departments of ¹Clinical Pharmacy, ²Anesthesiology and Intensive Care, Tjongerschans Hospital, Heerenveen, the Netherlands

Correspondence

P. de Haan - pimdehaan@live.nl

Keywords - intoxication, castor beans, ricin, suicide attempt, toxicology

Abstract

A 77-year-old woman was brought to the emergency room and subsequently admitted to the ICU for treatment of a mixed intoxication including 15 crushed castor beans, which she obtained from a reform store and ingested in a suicide attempt. The patient suffered from severe vomiting and diarrhoea, complicated by renal dysfunction and aspiration pneumonia. Symptomatic treatment of the pneumonia with antibiotics, nebulised bronchodilators and oxygen supply allowed the patient to recover somatically. After three days in the ICU, she was discharged to the department of internal medicine, and agreed to be admitted to the psychiatric department another three days later. No symptoms of the intoxication remained at that time. Castor beans are the seeds of the castor bean plant, containing the highly toxic compound ricin. If an intoxication with castor beans is suspected, it can only be treated symptomatically since no antidote is available. Treatment should focus on gastrointestinal effects and possible mid-term hepatic damage.

Introduction

The castor bean plant (*Ricinus communis* L., Dutch: 'wonderboom') is a common decorative plant in Europe, available both as plant and seeds in most Dutch garden centres. Although in use as a decorative plant, the seeds of the castor bean plant contain the highly toxic compound ricin, one of the deadliest naturally occurring toxins.^[1] Because of the easy access to the castor bean plant and the relatively simple work-up of ricin by extraction, ricin is considered a potential biochemical weapon.^[2] Notorious examples of ricin usage include recent threats to of American politicians including President Obama and the homicide of Bulgarian dissident Georgi Markov in 1978. Markov was killed in what is known as the 'umbrella murder': it is hypothesised that a ricin-containing metal projectile was fired from the end of an umbrella, hitting the man in his thigh. He became seriously ill the next day and was admitted to hospital. During his stay in the hospital, he suffered from hypothermia,

sweating, dizziness and haematemesis, dying only a few days later of a cardiac arrest.^[1]

Case description

A 77-year-old woman with a history of depression was referred to the emergency room by the general practitioner, after her partner found her confused and aphasic at home. She had suffered from extensive vomiting and diarrhoea overnight. In the emergency room, she admitted to have ingested several substances in a suicide attempt the day before. She reportedly ingested ten tablets of oxazepam 10 mg, ten tablets of an unknown hypnotic, two units of an unknown opiate, four units of port wine and 15 castor beans. She had purchased these beans from a reform store (i.e. a store selling 'natural products,' based on anthroposophical principles), and had crushed the beans before ingesting them. In the emergency room, the patient felt reasonable but cold and she was very thirsty. Her clinical condition was stable, based on neurological testing scores and measurements of heart rate, blood pressure, respiratory rate and oxygen saturation levels. However, her laboratory values at ICU admission showed elevated levels of potassium, urea, creatinine and C-reactive protein; no deviation in hepatic enzymes (aspartate transaminase (ASAT), alanine aminotransferase (ALAT), gamma glutamyltransferase) was observed (*table 1*). The patient was admitted to the ICU for observation, especially to observe the mid-term toxic effects of the ingested castor beans.

Since the patient had ingested the beans the day before, no beneficial effect was to be expected by the use of activated charcoal to reduce gastrointestinal absorption. Also, most of the 15 crushed castor beans had probably been expelled from her gastrointestinal tract by severe vomiting and diarrhoea. Throughout her stay in the ICU, the patient was haemodynamically stable. Hepatic enzymes were monitored, as

hepatotoxicity could be expected based on the known literature^[1,3] However, no increase in hepatic enzymes or clinical symptoms was found (*table 1*). Serum creatinine was elevated during the first day of her stay in the ICU, possibly related to the severe vomiting and fluid loss.

Table 1. Clinical parameters after the ingestion of castor beans and other agents

	Unit	Reference	Day 1 11:20	Day 1 19:00	Day 2 06:30	Day 3 06:30	Day 4 06:30	Day 6 07:00
Sodium	mM	135-145	140	143	138	133	133	137
Potassium	mM	3.5-5.0	5.2	4.2	4.1	4.0	3.5	3.5
Urea	mM	2.5-7.5	10.0	10.2	8.5	5.0	1.5	2.0
Creatinine	μM	50-90	167	96	67	51	42	54
ALP	U/l	<120	119	76	68	ND	64	ND
Gamma-GT	U/l	<40	16	10	8	ND	8	ND
ASAT	U/l	<40	35	32	37	ND	20	ND
ALAT	U/l	<35	30	22	20	ND	13	ND
CRP	mg/l	<5	32	75	135	161	70	38

ALAT = alanine aminotransferase; ALP = alkaline phosphatase, ASAT = aspartate transaminase; CRP = C-reactive protein; GT = glutamyltransferase; ND = not determined

Renal function recovered quickly and remained stable for the remainder of her stay in the ICU. C-reactive protein was already elevated at the time of admission, and increased to a maximum on the third day in the ICU (*table 1*). This can be related to the development of an aspiration pneumonia, with fever, hypoxia and coughing. An infiltrate in the base of the right lung was visible on chest X-rays (*figure 1*). The pneumonia was treated with amoxicillin with clavulanic acid and the patient was supported with oxygen suppletion and nebulised salbutamol and ipratropium. After three days in the ICU, the patient had somatically recovered and was discharged to the department of internal medicine. Three days later, the oxygen supply

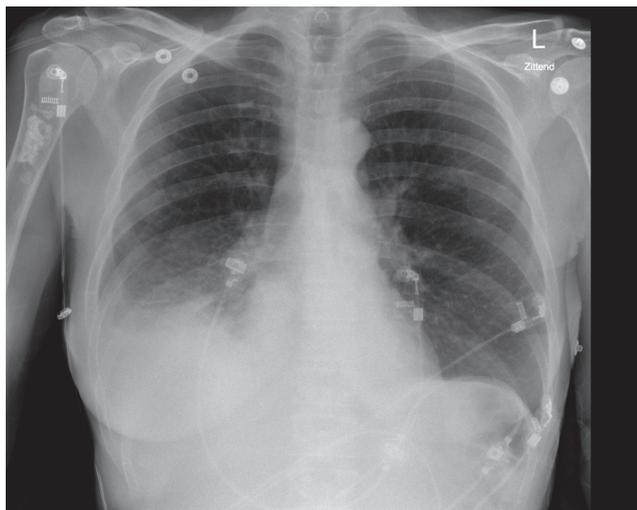


Figure 1. Chest radiograph (sitting), recorded on day 2, showing an infiltrate in the right lung base

could be stopped and the patient was voluntarily transferred to the department of psychiatry. No somatic symptoms of the intoxication remained at the time of discharge.

Discussion

The castor bean plant originates from the tropics, and is kept as a houseplant throughout the world. The plant is not only used as decoration, but it also provides materials for traditional medicine.^[4] Castor oil may be extracted from the seeds of the castor bean plant and is used as a laxative. The United States Food and Drug Administration (FDA) classifies the use of castor oil as a laxative as Generally Recognised As Safe and Effective (GRASE) and it is widely available for this purpose.^[5] However, castor beans contain the highly toxic compound ricin, a 66 kDa heterodimeric protein, which very effectively inhibits intracellular ribosomal functioning after ingestion or inhalation. Ricin enters the human cells by invagination, after which the vesicle containing ricin is transported to the endoplasmic reticulum. The ricin dimer is split in the endoplasmic reticulum, and the ricin A chain translocates to the cytosol.^[6] Cytosolic ribosomal RNAs are chemically modified by the enzymatic function of the ricin A chain, leading to an inhibited protein synthesis and eventually cell death.^[1]

The severity of the ricin intoxication and the progression strongly depend on the dose and the route of administration. Injection of ricin or macerated castor beans is one of the most toxic routes of administration, with an estimated lethal dose (LD₅₀, the dose that is lethal to 50% of subjects, usually as mg/kg of body weight,) in mice of 5-10 μg/kg of body weight.^[6] It is difficult to state the number of castor beans this corresponds to, since the ricin content of the beans varies strongly. Symptoms may be absent for the first hours, as in Markov's case, and may include fever, headaches, anorexia, abdominal pain, elevated liver enzymes, renal failure and gastrointestinal bleeding.^[1] Inhalation of ricin induces serious toxicity as well, including symptoms of respiratory failure, hypotension, sweating, fever and eventually death. The estimated lethal ricin dose (LD₅₀) in mice by inhalation is 3-5 μg/kg;^[1] this is even more toxic than by injection. The toxicity of ricin by ingestion is significantly lower: the LD₅₀ in mice is around 30 mg/kg of bodyweight, with an estimated lethal dose in humans of 1-20 mg/kg of bodyweight.^[1] It has been reported that the toxicity of castor beans varies: fatal incidents of an ingestion of as few as two beans have been reported.^[1] A review focussing on both intentional and unintentional ingestions of castor bean seeds in California, USA, from 2001 till 2011, reports that none of the 84 cases included led to death, with a reported ingestion of 1-40 castor bean seeds. In 58% of the cases, it was reported that the patient had crushed or chewed the seeds before ingestion, thus increasing the availability of ricin. Most patients experienced gastrointestinal symptoms such as vomiting, nausea, diarrhoea

and abdominal pain, but all could be discharged eventually with few or no serious symptoms remaining.^[3] In one of the 13 patients whose liver parameters were determined, the hepatic enzymes ASAT and ALAT were mildly elevated in the first week after ingestion of castor beans, to 93 and 164 U/l, respectively (reference <40 and <35 U/l).^[3]

The National Intoxications Information Centre (Nationaal Vergiftigingen Informatie Centrum, University Medical Centre of Utrecht) states that they receive 'only a few reports a year' concerning people exposed to *Ricinus communis* material, and most do not report any serious symptoms. One case, however, developed serious symptoms after eating a home-made castor bean soup prepared according to a 'suicide recipe' from the internet, suffering from diarrhoea, melaena, vomiting and impaired renal and hepatic functioning. This patient recovered and was discharged after 16 days.^[7]

Conclusion

The easy availability of castor beans and the simple work-up procedure to obtain the toxic ricin impose a risk for suicidal patients, as for the woman in this case. Symptomatic treatment and supportive care for three days in the ICU was sufficient to discharge the patient somatically. No beneficial effect of bowel irrigation was expected because the ingestion had taken place the day before, and the patient had probably expelled most of the castor beans by vomiting and diarrhoea.

No specific treatment for ingested castor beans is available, but based on the literature and our experience, we recommend the following:

- Admit the patient to hospital and observe at least until 24 hours after the start of the intoxication.
- Determine hepatic parameters at the time of admission, after one day and after one week to monitor the development of hepatic damage.
- Consider bowel irrigation or the use of activated charcoal only if the ingestion took place within the past six hours.
- Provide supportive care, including compensation for severe fluid and/or electrolyte loss that may result from vomiting and diarrhoea.

Disclosures

All authors declare no conflict of interest. No funding or financial support was received.

References

- [1] Musshoff F, Madea B. Ricin poisoning and forensic toxicology. *Drug Test Anal.* 2009;1;184-91.
- [2] Convention on the prohibition of the development, production, stockpiling and use of chemical weapons and on their destruction: Organisation for the Prohibition of Chemical Weapons, 2005, p. 52. (Accessed June 17, 2015, at https://www.opcw.org/fileadmin/OPCW/CWC/CWC_en.pdf).
- [3] Thornton SL, Darracq M, Lo J, Cantrell FL. Castor bean seed ingestions: a state-wide poison control system's experience. *Clin Toxicol.* 2014;52;265-8.
- [4] Scarpa A, Guerci A. Various uses of the castor oil plant (*Ricinus communis* L.). A review. *J Ethnopharmacol.* 1982;5:117-37.
- [5] Listing of Over-the-Counter (OTC) Active Ingredients: Center for Drug Evaluation and Research of the United States Food and Drug Administration, 2010. (Accessed June 17, 2015, at <http://www.fda.gov/downloads/aboutfda/centersoffices/officeofmedicalproductsandtobacco/cder/ucm135688.pdf>).
- [6] Audi J, Belson M, Patel M, Schier J, Osterloh J. Ricin poisoning: a comprehensive review. *JAMA.* 2005;294:2342-51.
- [7] Van Velzen AG, van Sommeren-de Potter IC, den Dulk MO, van Riel AJHP, Meulenbelt J, de Vries I. Attempted suicide by ingestion of ricin soup. XXXV International Congress of the EAPCCT. *Clin Toxicol.* 2015;53:346.