Mushroom poisoning in Canada:
Report of a fatal case

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Summary: At least 150 cases of mushroom poisoning occur in Canada each year, 75% in the Province of Ontario. Eighty per cent of the total are in children under the age of 9, and most do not require hospitalization. Amanita virosa *poisoning is a potentially fatal medical emergency which presents as an acute gastroenteritis, progressing to hepatorenal failure. Treatment consists of elimination of undigested mushrooms, rapid rehydration, management of acute liver and renal failure, and prevention of infection during the recovery phase.*

The practice of picking and eating wild mushrooms is not as prevalent in North America as it is in Europe and, as a result, mushroom poisoning is uncommon in Canada. Nevertheless the Department of National Health and Welfare reported 113 cases of mushroom poisoning in 1964, 130 in 1965 and 151 in 1966. None was fatal. Three hundred and sixteen of these 394 cases were in children under the age of 9 years. In 1967, the latest year for which statistics are available, there were 183 cases, 11 of which required hospitalization.

Amanita virosa, which is easily mistaken for the edible *Lepiota procera,* is responsible for most fatal cases of mushroom poisoning on this continent.[1, 2] Amanita poisoning usually presents as an acute gastroenteritis which may progress to hepatorenal failure.[3] The management of this medical emergency is illustrated by the following case report.

On August 7, 1967, a 28-year-old man was admitted to the Montreal General Hospital 36 hours after eating about eight mushrooms while on a fishing trip. He complained of persistent severe vomiting and diarrhea, present for 12 hours, associated with generalized crampy abdominal pain. He had passed no urine in the preceding 24 hours.

On physical examination he was lethargic and severely dehydrated, with peripheral cyanosis and vasodilatation. The temperature was 99° F., pulse 100 per minute, respirations 20 per minute, and blood pressure 80/50. The heart and lungs were normal. There was tenderness in the right upper abdominal quadrant but the liver and spleen were not palpable.

On admission the hematocrit was 61%, blood urea nitrogen (BUN) 36 mg. per 100 ml., potassium 3.3 mEq., sodium 143 mEq., CO_2 15 mEq., and chloride 95 mEq. per litre. The stool and vomitus were positive for occult blood. On the second day the BUN was 60 mg., bilirubin 1.3 mg. per 100 ml., LDH 480 units and SGOT 300 units. Some of the mushroom stew had been kept by his wife, and thin-layer chromatography of mushroom extracts identified the toxins as consistent with those of *Amanita virosa.*[8]

The patient was hemodialyzed for 12 hours with stabilization of vital signs and an initial urine output in response to mannitol and massive fluid and electrolyte replacement. On the third day he became obviously jaundiced. The total bilirubin was 11.7 mg. per 100 ml. and the SGOT had risen to 1600 units. The liver was now palpable 3 cm. below the right costal margin. On the sixth day the SGOT was 410 units and bilirubin 16 mg. per 100 ml. The patient lapsed into coma, presumably hepatic in origin, although a consultant neurologist suggested that cerebral edema could be a contributing factor. Fluid and electrolyte replacement was continued, along with intravenous hypertonic glucose, and neomycin was instilled through a Levin tube.

An initial exchange transfusion of seven units of blood (3130 ml.) was carried out on the seventh day with no apparent effect on the level of consciousness. Two subsequent exchange transfusions, employing 10 (4780 ml.) and 11 units (5350 ml.) of blood respectively, on the eighth and twelfth days, likewise were of no avail.

His subsequent course was complicated by thrombocytopenia with gastrointestinal bleeding, laboratory evidence of continuing liver-cell necrosis, and a rising BUN and creatinine with oliguria. Peritoneal dialysis on the 10th and 15th days and hemodialysis on the 22nd and 30th days achieved a temporary reduction in the BUN and creatinine.

The serum bilirubin rose progressively to a peak value of 30 mg. per 100 ml. and the alkaline phosphatase to 23.6 King-Armstrong units. The level of consciousness improved somewhat, but the patient remained oliguric and died 33 days after admission.

Autopsy Findings

The pertinent findings at postmortem examination were in the liver, kidneys and brain. The liver weighed 1450 g. and had a mottled granular surface. Microscopically there was severe centrilobular liver-cell necrosis with early post-necrotic cirrhosis (Fig. 1). Bile stasis was evident in bile ducts and canaliculi, with pseudoduct formation by parenchymal cells about bile lakes in areas of liver cell regeneration and associated with a mild chronic inflammatory reaction. Renal

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tubules were dilated and contained bile casts. Calcium deposits were found sprinkled through the renal parenchyma, and there was a mild and diffuse lymphocytic infiltration. In the central nervous system, foci of acute demyelinization were found in the cervical spinal cord, midbrain and cerebral hemispheres, associated with reactive astroglial changes. There were also many areas of perivenous lymphocytic cuffing and demyelination. Alzheimer type II astrocytic changes, usually associated with liver failure, were also present.[4]

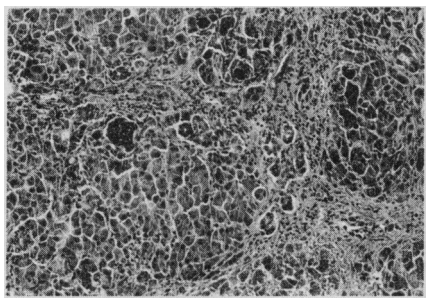

FIG. 1—Post-necrotic cirrhosis as a result of *Amanita virosa* mushroom poisoning (× 300).

Types of Mushroom Poisoning in Canada (after Groves[1])

MUSHROOM	TOXINS
A. *Amanita virosa*	Amatoxins and phallotoxins
B. Others	
1. *Amanita muscaria*	Mycoatrophine
2. (a) *Clitocybe dealbata*	Muscarine
(b) Inocybe species	Muscarine
3. Miscellaneous group	
(a) *Entoloma lividum*	
Russula	
Lactarius	
(b) *Gyromitra esculenta*	Helvellic acid
(c) Coprinus species	

A. *Amanita virosa*

The truly poisonous mushrooms belong to the genus Amanita, which is said to cause 95% of all fatalities. *Amanita phalloides* is not found in North America, but the related *Amanita virosa* contains the same toxic peptides.[5] Groves[1] points out the folly of the superstition that mushrooms which peel are safe to eat; *Amanita virosa* peels readily. This pure white mushroom grows in deciduous forests from July to October. Cooking does not alter the lethal property of the toxins.

Amanita mushrooms contain five phallotoxins with a common cyclic hepta-peptide and six amatoxins with a common cyclic octo-peptide skeleton.[5] Phalloidin has a marked affinity for the microsomal (endoplasmic reticulum) fraction of the liver cell. Electron microscopic observations on livers of rats[6] and humans[7] have shown dilatation of the endoplasmic reticulum with focal cytoplasmic degradation, fat droplet deposition and paracrystalline striations in some mitochondria. Phalloidin is active only in an intact liver and it has been suggested that it may not be toxic itself but is converted to a toxic compound by the drug-metabolizing enzymes of the liver.[8] Drugs which inhibit metabolizing enzymes seem to provide some protection from the effects of the poison in animals.

The amatoxins affect the liver-cell nuclei primarily;[5] nuclear fragmentation is evident 15 hours after administration of alpha amanitin. Cytoplasmic lesions develop later and are thought to be a consequence of the nuclear changes.

B. 1. *Amanita muscaria*

Amanita muscaria is an orange or reddish mushroom, sprinkled with wart-like excrescences, found in open woods from July to October. It is the cause of many poisonings in Canada but is seldom fatal.[1] Nervous excitement, hallucinations and behaviour suggesting alcoholic intoxication occur one to four hours after ingestion and are believed to be due to stimulation of the central nervous system by mycoatrophine. Peripheral anticholinergic manifestations are attributed to the small amounts of muscarine present.

Discussion

This patient presents the classical course of *Amanita virosa* poisoning characterized by an initial acute gastroenteritis with severe vomiting and diarrhea, developing 12 to 24 hours after ingestion. A false remission may then follow, after which signs of progressive liver cell necrosis become apparent, progressing to liver failure and renal insufficiency, anuria and convulsions or coma. The toxins act principally upon the liver cells and the renal impairment is secondary to hypovolemia and hypotension. Focal demyelination is an unusual finding and it is possible that the poisoning may have precipitated a latent multiple sclerosis in this particular case.

2. *Clitocybe dealbata* and Inocybe Species

Muscarine is found in large amounts in the *Clitocybe dealbata*[9] and some Inocybe species. Salivation, vomiting, diarrhea, tenesmus, miosis, bradycardia and dyspnea are due to the effect of muscarine upon the organs innervated by the post-ganglionic cholinergic fibres of the autonomic nervous system. Atropine is the antidote for muscarine poisoning.

3. *Miscellaneous group*

Entoloma lividum, species of Russula and of Lactarius, cause severe vomiting and diarrhea with abdominal pain. Poisoning by *Gyromitra esculenta* is said to be due to the presence of helvellic acid, particularly in over-mature or decomposed specimens. Coprinus species are said to potentiate the effects of alcohol, and this has been demonstrated in animals.[10]

When mushroom poisoning is suspected, it is of the utmost importance to establish whether the symptoms are caused by *Amanita virosa* or by one of the other much less toxic varieties. Uneaten remains of the stew or undigested mushrooms recovered from the vomitus should be preserved. The Plant Research Institute of the Department of Agriculture in Ottawa can be of help in mushroom identi-

fication. Phalloidin and amatoxin of *Amanita virosa* may be isolated and identified chromatographically from mushroom extracts, as was possible in the case reported.

Attempts to remove the toxins by gastric lavage and by dialysis are relatively ineffective because of the long latent period between ingestion and the subsequent toxic manifestations. Likewise, the suggested use of charcoal as an adsorbent is probably of little or no value. Immune horse serum against extracts of *Amanita phalloides* has been used by the Pasteur Institute in Paris. Wieland[5] points out that specific antibodies have not been identified in the French serum and the opportunity for early administration seldom arises in man. Amatoxin and phalloidin have molecular weights between 800 and 1100 and are known to be poorly dialyzed *in vitro;* nevertheless, useful amounts may be removed by dialysis, particularly in the early stages. The treatment is otherwise supportive and aimed at maintenance of fluid and electrolyte balance, and renal and hepatic function.

Exchange transfusions have been used as an adjuvant in the treatment of potentially reversible acute hepatic necrosis[11] but their efficacy remains to be established.[12] Our patient had three exchange transfusions without improvement in the level of consciousness or significant effect on the laboratory manifestations of his liver failure. Because of this failure of response, cross-circulation, although considered, was not carried out.

Despite antibiotic coverage, infection is a constant hazard. In this patient, *A. aerogenes* was isolated from throat swabs, peritoneal fluid and urine, and probably contributed to his demise.

Résumé

L'intoxication par champignons vénéneux au Canada: Présentation d'un cas fatal

Chaque année, on compte au moins 150 cas d'intoxication par champignons vénéneux au Canada, dont 75% dans la province d'Ontario seulement. Dans 80% du total des cas, il s'agit d'enfants de moins de 9 ans; la majorité ne doivent pas être hospitalisés. L'intoxication par l'ammanite vireuse risque d'être fatale et doit être considérée comme une urgence médicale. Elle se présente sous forme d'une gastro-entérite aiguë évoluant vers l'insuffisance hépatorénale. Le traitement consiste à évacuer les champignons non encore digérés, à réhydrater rapidement le malade, à traiter l'insuffisance hépatique et rénale et à prévenir l'infection pendant la convalescence.

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