Renal failure after eating "magic" mushrooms

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The spectrum of acute renal failure has shifted: there are fewer traumatic and surgical cases and more drug-induced ones, both iatrogenic and intoxicant-related.[1] In many instances the cause of acute renal failure remains obscure.

Mushrooms are gathered as a valuable and delectable food, particularly in Eastern Europe and Scandinavia but less so in North America. Thousands of years of tradition dictate the use of certain mushrooms, particularly *Amanita muscaria* and *Psilocybe* species, which are used for religious or hallucinogenic purposes.[2] The ingestion of these "magic" mushrooms has been revived recently as a way to get a "cheap high."

The inadvertent ingestion of toxic mushrooms may lead to acute renal failure. *Amanita phalloides* is well known in both North America and Europe to cause catastrophic illness with liver and renal failure. In addition, the European literature describes many cases of renal failure after ingestion of mushrooms of the *Cortinarius* species. The symptoms vary from mild, transient renal failure to irreversible total acute renal failure that necessitates continual dialysis.[3,4] Although *Cortinarius* mushrooms exist in North America there have been no reports of this intoxication here.

We describe a woman who had acute renal failure after eating magic mushrooms.

Case report

A 20-year-old woman was admitted to hospital because of nausea, vomiting and abdominal pain. Her symptoms had begun 5 days earlier, 8 hours after eating what she believed to be magic mushrooms. The patient was very secretive about where she had obtained the mushrooms, but she said that she had requested magic mushrooms (*A. muscaria* or *Psilocybe* species), both of which are similar to *Cortinarius*. She experienced none of the expected hallucinations or mood alterations; instead, a constant, severe pain developed in her entire abdomen, radiated to both flanks and prevented sleep. The pain was accompanied by flatulence, nausea and vomiting, and diarrhea. She denied any urinary symptoms.

Two days after eating the mushrooms the patient visited her family physician, who diagnosed urinary tract infection and prescribed trimethoprim–sulfamethoxazole. After 2 days of no improvement the patient was seen in our emergency department. Her blood pressure was 130/100 mm Hg. She was given three doses of ampicillin intravenously and sent home.

The patient returned the next day with worsening symptoms. Her serum potassium level was 5.3 mmol/L, but other electrolyte levels were normal. Her serum urea level was 10.1 mmol/L. There was mild proteinuria, pyuria and hematuria. The blood pressure was 160/100 mm Hg and the jugular venous pressure 10 cm H_2O. The patient's abdomen and flanks were tender on deep palpation. Hematologic, gastrointestinal and liver function tests showed normal results. Ova, parasites, *Shigella*, *Salmonella*, *Campylobacter*, *Yersinia* and *Aeromonas* were not present in the feces. Transient leukocytosis and a moderately low serum iron level (8 mmol/L) were found. The prothrombin and partial thromboplastin times were normal.

Tests for fluorescent antinuclear antibodies, cryoglobulin, titres of antistreptolysin O and anti-DNase-B, hepatitis B surface antigen, hepatitis C virus antibodies, and complement components C3 and C4 yielded normal results.

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Ultrasonography at the time of admission showed symmetric hypoechoic areas in the two renal cortices. Urinary cytopathologic investigaton then and 2 days later showed mild ischemic necrosis, renal fragments and 12 collecting-tubule and 4 necrotic tubular cells per 10 high-power fields. There were no viral inclusion cells. The lesion was compatible with ischemic tubular necrosis; no evidence of glomerular damage was seen (Fig. 1). No organisms were cultured from the urine. The total serum protein and albumin levels were normal: protein electrophoresis showed mild decreases in the concentration of albumin, α_1 globulin and γ globulin. Repeat urinalysis showed a decrease in the proteinuria, pyuria and hematuria.

The patient was uremic when admitted: the serum creatinine level was 356 μmol/L and the serum urea level 10.1 mmol/L. The serum electrolyte levels returned to normal after therapy with sodium polystyrene sulfonate.

Over the next week the patient's diuresis increased, and the serum creatinine and urea levels fell to 99 μmol/L and 6.0 mmol/L respectively. Her body weight decreased by 4 kg, and she became normotensive without dialysis or hemoperfusion. The patient was discharged with normal renal function and mild proteinuria. She did not return for follow-up.

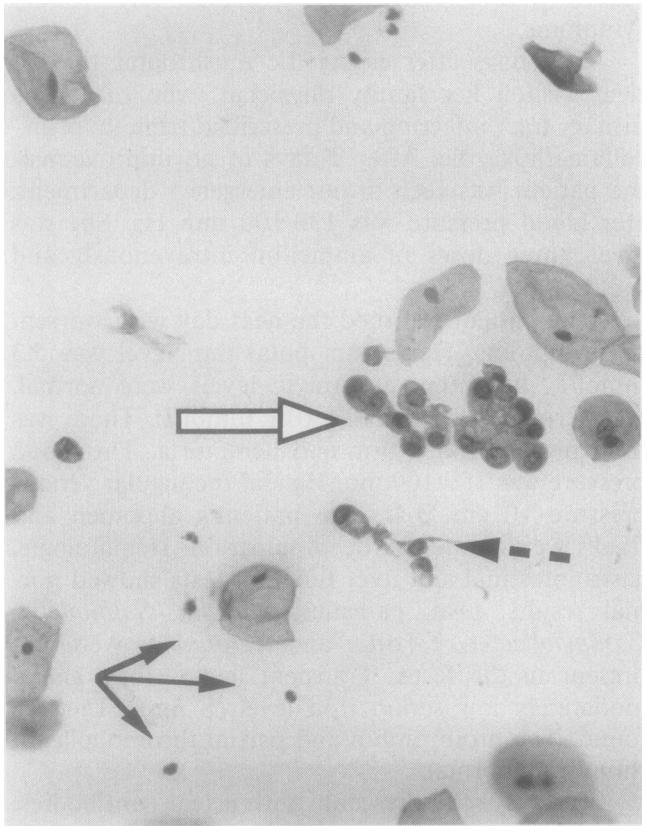

Fig. 1: Urinary cytopathology stain by Papanicolaou technique. Note large renal fragment (white arrow), large number of tubular cells, some necrotic (broken arrow), and neutrophils (black arrows). Magnification × 350. The cells are similar to those seen in animals given orellanine and in patients with renal failure from *Cortinarius* intoxication. Photo courtesy of Dr. Niels Marcussen, Cytopathology Laboratory, University of Alberta Hospitals, Edmonton, Alta.

Comments

The patient described here had transient severe acute renal failure after eating magic mushrooms. The supplier of the mushrooms may have thought *Cortinarius* mushrooms were *A. muscaria* or *Psilocybe* species. The timing, the symptoms, the absence of the expected "high," the urinary cytopathologic findings, the clinical course and the absence of other factors known to cause acute renal failure all point to the mushroom ingestion as the cause.

The first case of acute renal failure after ingestion of *Cortinarius* mushrooms was reported in Poland in 1957.[3] Similar cases have since been described, most recently in a report from France on 12 previously healthy young men with various degrees of acute renal failure after eating mushroom soup.[5] The mushrooms reportedly associated with renal failure have usually been eaten as part of a meal or soup.[4,5] Our case may be the first in which *Cortinarius* mushrooms masqueraded as magic mushrooms.

Renal failure as a result of intoxication from *Cortinarius* mushrooms typically develops insidiously. Patients experience nausea, vomiting and abdominal pain, and within 5 to 12 days after ingestion renal failure, which is usually oliguric, occurs. However, the symptoms and outcome vary.[3-8] One case of sudden death, presumably due to hyperkalemia, has been described: a postmortem blood sample from a previously healthy young woman showed uremia.[8] In some patients the renal failure is mild and transient, as in our patient; in others it is irreversible and necessitates chronic dialysis or transplantation.[4-7]

Biopsy or autopsy findings show normal glomeruli and interstitial nephritis, swelling and necrosis of tubular cells, particularly in the medullary region (by light microscopy), and epithelial-cell organelles (by electron microscopy).[4,5,7,8] We did not perform a renal biopsy, because our patient's condition resolved spontaneously. However, urinary cytopathologic investigation showed severely damaged collecting tubule cells, renal fragments and neutrophils. These findings are compatible with ischemic or toxic tubular necrosis.[9] Such lesions are similar to those found in patients and experimental animals after injection of orellanine, the nephrotoxic principle of *Cortinarius* mushrooms.[10-13]

Cortinarius mushrooms, specifically *C. orellanus* and *C. speciosissimus*, have been the subject of careful toxicologic investigation.[10-13] Orellanine, a

bipyridyl skeleton containing two hydroxyl groups in each structure, is the active toxic principle. The molecule resembles paraquat, a well-known nephrotoxin. On the basis of animal studies the lethal dose in a 70-kg person would be approximately 7.5 mg per kilogram of body weight, which would be present in about 70 g of dried mushrooms or 700 g of fresh mushrooms. The exact action of orellanine is uncertain, but likely unstable radicals produced by reduction of the molecule act on a cellular target. This target must be ubiquitous, since the toxin affects the cells of microorganisms, plants and animals. In one study, proximal tubular cells in rats lost their brush border within 12 hours after exposure to orellanine, and necrotic and postnecrotic cells were found in all nephron segments of the renal cortex within 48 hours after ingestion.[13] The time from ingestion of orellanine to death from renal failure in laboratory animals has varied inversely with the dosage.[13] A similar relation would be expected in humans, but for obvious reasons such dose-response data are not available.

Steroids have been used to counteract the toxic effects of orellanine; as well, the toxin has been removed by hemodialysis or hemoperfusion.[8] No clear data exist on the efficacy of these interventions, because the number of patients with this condition has been small, the patients present late, and a controlled trial is not feasible.

The problem with mushrooms is the difficulty in identifying the toxic ones. Hardly anyone would mistake the startling, handsome, red and white European *A. muscaria*; however, the yellow American form of this species and *Psilocybe* mushrooms are difficult to distinguish from the many similar *Cortinarius* species.[14-16] Both a botanist and a mycologist have died after eating *Cortinarius* mushrooms.[6] Over 500 species of *Cortinarius* exist. They have a pleasant smell and taste and a wide range of toxicity.[14,15] Several species exist in North America; *C. rainierensis* and *C. gentilis* grow freely along the Pacific coast (Randy Currah, PhD: personal communication, 1992), but their toxicity is unknown.

We believe that this is the first case in North America of acute renal failure resulting from the ingestion of *Cortinarius* mushrooms, a condition that is becoming increasingly prevalent in Europe. More cases will likely appear in North America as the search for a cheap high intensifies. In the event of unexplained acute renal failure queries about mushroom ingestion should be made and knowledge about magic mushrooms broadcast.

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