

Sean Patrick Nordt

University College
Dublin
School of Medicine
Dublin, Ireland

Anthony Manoguerra
Richard F Clark

California Poison
Control System, San
Diego Division
Division of Medical
Toxicology and
Department of
Emergency Medicine
University of California,
San Diego, Medical
Center

Correspondence to:

Dr Nordt
47 Wilfield Ave
Sandymount
Dublin 4, Ireland
sean.nordt@excite.com

Competing interests:

None declared

West J Med
2000;173:314-317

5-Year analysis of mushroom exposures in California

ABSTRACT ● **Objective** To evaluate outcomes following toxic mushroom ingestions. ● **Design** Retrospective data analysis. ● **Methods** We analyzed American Association of Poison Control Center data for California from 1993 through 1997. ● **Results** A total of 6,317 exposures occurred during the study period. Most (n = 6,299 [99.7%]) were acute exposures, and the rest (0.3%) were chronic; 87.6% (n = 5,536) were unintentional. Most (n = 4,235 [67.0%]) were in children younger than 6 years, and of these, only 6.0% experienced any clinical effects. The most common symptoms in patients aged 6 years and older were vomiting in 588 patients (28.2%), nausea in 307 patients (14.7%), diarrhea in 263 patients (12.6%), and abdominal pain in 221 patients (10.6%). No effects were seen in 3,131 (49.6% of all patients). Major effects were seen in only 17 patients (0.3%). Only 61 patients (1.0%) were admitted to a critical care unit. Death occurred in a 32-year-old adult who ate foraged mushrooms. Of all patients, 1,375 (21.8%) received no therapy or were observed only. ● **Conclusions** Most mushroom exposures were acute and unintentional and occurred in children younger than 6 years. Major toxic reactions or death was uncommon.

INTRODUCTION

Foraging for wild mushrooms is popular in the United States. California has a large number of species of mushrooms, including toxic species. One of the limitations in

assessing possible wild mushroom poisoning is the lack of outcome data following ingestions. We performed this study to evaluate outcomes following foraged mushroom ingestions.

METHODS

The American Association of Poison Control Centers (AAPCC) comprehensive poisoning surveillance database, Toxic Exposure Surveillance System (TESS), was retrospectively analyzed for the years 1993 through 1997 for the entire state of California. These data were collected by poison control centers in the state by telephone hotlines. Reports to poison centers included in TESS originate from the public and from health care professionals and include both patients managed at home or at the site of the exposure and those managed in hospitals, emergency departments, or other health care facilities. The TESS data for each case of poisoning include the substances implicated (mushroom), patient age, outcome, clinical effects, exposure route, whether acute or chronic ingestion, and the level of health care intervention used.¹

The following fields were extracted from the data set: patient age, management site, decontamination therapy, related symptoms, site of exposure, and patient outcomes. The outcome definitions were those used by the AAPCC²:

- no effect: no symptoms developed as a result of the exposure;
- minor effect: the patient exhibited some symptoms as a result of the exposure, but they were minimally bothersome;
- moderate effect: the patient exhibited symptoms that were more pronounced, more prolonged, or more systemic as a result of the exposure, and the symptoms were not life-threatening, but usually some treatment was indicated;
- major effect: the patient exhibited some symptoms as a result of the exposure, which were either life-threatening or resulted in substantial toxic effects; and
- death: the cause of death was determined to be probably or undoubtedly related to the exposure.

All results are reported as descriptive statistics.

RESULTS

A total of 6,317 exposures were reported to California poison control centers during the 5-year study period. Most (99.7%) of the exposures (n = 6,299) were single, acute poisonings, and the rest (n = 16 [0.3%]) resulted from long-term ingestions. In all, 87.6% of all exposures (n = 5,536) were unintentional. In 4,235 of the incidents of exposure, the patients were younger than 6 years; 541 occurred in 6- to 12-year-olds, 667 occurred in 13- to 19-year-olds, and 865 occurred in patients 20 years of age or older. The age was unrecorded in 9 reports.

The most common geographic site of exposure (n = 5,798 [91.8%]) was a residence, followed by a school (n = 223 [3.5%]). The mushroom was the single substance involved in 6,201 exposures (98.2%). The species of mushroom ingested was identified in only 334 cases (5.3%), and in these, it was usually (n = 254) a psilocybin-containing variety. Most psilocybin (“magic mushroom”) ingestions (n = 251 [98.8%]) were intentional and occurred mainly in adolescents and young adults (mean [±SD] age, 18.9 [±6.4] years; median age, 18 years; and range, 1–42 years). The number of psilocybin ingestions has increased annually, from 16 in 1993 to 29 in 1994, 43 in 1995, 69 in 1996, and 97 in 1997.

Of the 4,235 exposed children younger than 6 years, 3,980 (94.0%) experienced no effect following the exposure, minor effects were seen in 216 (5.1%), moderate in 34 (0.8%), and major in 1 (0.02%). The most common symptoms in patients aged 6 years and older were vomiting in 588 (28.2%), nausea in 307 (14.7%), diarrhea in 263 (12.6%), abdominal pain in 221 (10.6%), and hallucinations in 149 (7.2%). No death occurred in patients younger than 20 years. Elevated hepatic aminotransferase levels, defined as serum aspartate aminotransferase (previously SGOT) or serum alanine aminotransferase (previously SGPT) levels of greater than 100 U/L, were seen in 32 patients (0.5%), of whom only 4 were younger than 6 years. Only 1 of these children had serum hepatic aminotransferase levels greater than 1,000 U/L.

A total of 3,657 patients (57.9%) were treated on site, whereas 1,808 (28.6%) were treated and released from a health care facility. Of children younger than 6 years, 2,957 (69.8%) were treated at a non-health care facility (home or other residence). An additional 974 (23.0%) were treated and released from a health care facility (such as an emergency department, urgent care facility, or physician’s office). Only 31 children younger than 6 years (0.7%) were admitted to a hospital.

The following data give the clinical outcome of all exposures studied: no effect (n = 3,131 [49.6%]), minor (n = 636 [10.1%]), moderate (n = 264 [4.2%]), major (n = 17 [0.3%]), and 1 death (0.02%). Follow-up to a “known” outcome (according to TESS criteria) was not performed in 2,058 cases (32.6%). However, in most cases of exposure (n = 1,044 [16.5%]), follow-up to a known outcome was not performed because the exposures were thought to be either “nontoxic” (n = 341 [5.4%]) or “minimally toxic” (n = 703 [11.1%])—that is, resulting in mild, self-limiting symptoms. In 1,014 cases (16.1%), the exposure was thought to be potentially toxic but could not be followed up because of insufficient patient data (for example, either no phone number or an incorrect phone number given).

Only 61 (1.0%) patients were admitted to a critical care unit, and 94 (1.5%) were admitted to a non-critical



Amanita muscaria, the most recognizable of the *Amanita* family

care unit. Only 1 death was reported during the study period, and this occurred in a 32-year-old adult who ate foraged mushrooms. A total of 1,375 patients (21.8%) received no therapy or observation only. Of those who were treated, 2,215 (35.1%) received ipecac syrup, 975 (15.4%) received a single dose of activated charcoal, 77 (1.2%) underwent gastric lavage, and 41 (0.6%) received multiple doses of activated charcoal.

DISCUSSION

The exact identification of mushroom species can be difficult.³ Substantial morphologic variations can occur in the same mushroom species depending on the season, geographic location, and maturity of the fungus. Fortunately, most mushrooms ingested are either nontoxic or gastrointestinal irritants, resulting in mild to moderate toxic effects.³ Toxic species of mushrooms can be divided into 8 broad categories: cyclopeptides, orellanine, monomethyl hydrazine, *Coprinus* species, ibotenic acid, muscarinic, *Psilocybe*, and gastrointestinal irritants.^{4,5} Of these, cyclopeptide or amatoxin-containing species represent the greatest danger. Members of this group include *Amanita* and *Gallerina* species and have the common names of “death cap” (*Amanita phalloides*) or “destroying angel” (*Amanita ocreata*).^{6,7}

The clinical presentation following a cyclopeptide mushroom ingestion can include severe centrilobular hepatic necrosis clinically indistinguishable from acetaminophen poisoning. Although rare, this type of toxic reaction accounts for 95% of mushroom-related deaths in North America.⁵ The only death reported in our series resulted from the ingestion of foraged cyclopeptide mushrooms.

Because of the inability of accurate mushroom identification, the onset of clinical symptoms has been suggested as a good biomarker for the likelihood of the ingestion of an amatoxin-containing species.⁴ *Amanita* mushrooms generally manifest gastrointestinal symptoms, but effects are delayed for more than 6 hours following ingestion. Persons who ingest typical gastrointestinal irritant mushrooms such as *Chlorophyllum* species generally have symptoms within 30 minutes to a few hours following ingestion.^{4,5} One caveat to this rule of thumb is that the ingestion of foraged mushrooms often includes several species, thereby giving a misleading clinical course if gastrointestinal symptoms are seen within the first few hours of ingestion. The 6-hour rule may be more helpful when a child accidentally ingests a single species of mushroom.

Because of the inability to identify mushrooms and the lack of an effective antidote for amatoxin-containing species, much attention has been focused on gastrointestinal decontamination in cases of exposure to these species. The use of ipecac syrup, once a mainstay of poisoning treatment of mushroom ingestions, has been questioned.⁸ Specifically, problems with ipecac include its inability to effectively empty the stomach, its contraindications of decreased mental status and risk of seizures, and most important, the loss of the gastrointestinal monitoring variable, particularly in children ingesting a single species of mushroom. More recently, attention has been focused on home and prehospital administration of activated charcoal in these cases. Prehospital administration of activated charcoal appears to be a promising decontamination technique, but its efficacy is dependent on the dose administered, patient acceptability, and availability for home use.⁹

Our results demonstrated that most mushroom exposures in California from 1993 through 1997 were acute, unintentional exposures in children younger than 6. No effects were seen in 94% of these children, suggesting that major toxic reactions or death may be uncommon following acute, nonintentional mushroom ingestions in these patients. Consistent with previous reports, the only death seen in this study occurred in an adult who ate foraged mushrooms with a meal. Possibly, young children would rarely, if ever, ingest enough *amanita* mushrooms to lead to hepatic damage. This is consistent with the lack of such cases in poison center records and the recent medical literature. However, it is still prudent to consider the possibility of hepatotoxic mushroom ingestion in children who present with delayed symptoms after eating mushrooms or where identification is not possible.

Our study is one of the first to evaluate a possible difference between toxic reactions encountered with foraged mushrooms as opposed to accidental pediatric exposure. Although our numbers are large compared with

other toxin and drug poisonings reported to California poison control centers, morbidity and mortality are rare with most of these cases. How many years of exposures would be required to generate enough experience to generalize our findings into management recommendations is difficult to estimate because comfort levels with treatment of these cases would likely vary among health care providers. It may be of benefit to health care providers to develop a sense of the rarity of the occurrence of major toxic reactions and death in most unintentional childhood mushroom ingestions.

Our study is also limited by the number of cases unavailable for follow-up and the possibility that our data do not include unreported cases of pediatric mushroom poisoning with hepatotoxic effects or other severe outcomes. Future research in this area should focus on prospectively collecting data and pooling results among several centers to obtain more meaningful numbers.

References

- 1 Litovitz T. The TESS database: use in product safety assessment. *Drug Saf* 1998;18:9-19.
- 2 Litovitz TL, Klein-Schwartz W, Dyer KS, Shannon M, Lee S, Powers M. 1997 annual report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. *Am J Emerg Med* 1998;16:443-497.
- 3 Trestrail JH III. Mushroom poisoning in the United States: an analysis of 1989 United States Poison Center data. *J Toxicol Clin Toxicol* 1991;29:459-465.
- 4 McPartland JM, Vilgalys RJ, Cubeta MA. Mushroom poisoning. *Am Fam Physician* 1997;55:1797-1800, 1805-1809, 1811-1812.
- 5 Goldfrank LR. Mushrooms: toxic and hallucinogenic. In: Goldfrank LR, ed. *Goldfrank's Toxicologic Emergencies*. Norwalk, CT: Appleton & Lange; 1998:1205-1219.
- 6 O'Brien BL, Khuu L. A fatal Sunday brunch: Amanita mushroom poisoning in a Gulf Coast family. *Am J Gastroenterol* 1996;91:581-583.
- 7 Parish RC, Doering PL. Treatment of Amanita mushroom poisoning: a review. *Vet Hum Toxicol* 1986;28:318-322.
- 8 Manoguerra AS. Gastrointestinal decontamination after poisoning: where is the science? *Crit Care Clin* 1997;13:709-725.
- 9 Lamminpaa A, Vilksa J, Hoppu K. Medical charcoal for a child's poisoning at home: availability and success of administration in Finland. *Hum Exp Toxicol* 1993;12:29-32.