Analysis of Mushroom Exposures in Texas Requiring Hospitalization, 2005–2006

George A. Barbee, DScPA-EM, PA-C[a], Cristóbal S. Berry-Cabán, PhD[b], James D. Barry, MD[c], Douglas J. Borys, PharmD[d], John A. Ward, PhD[c], Steven W. Salyer, PA-C[c]

[a]Department of Emergency Medicine, Womack Army Medical Center, Fort Bragg, NC

[b]Information Management Division, Clinical Data Services, Womack Army Medical Center, Fort Bragg, NC

[c]Brooke Army Medical Center, Fort Sam Houston, TX

[d]Central Texas Poison Center, Scott & White Memorial Hospital, Temple, TX

ABSTRACT

Introduction: Texas has approximately 200 species of wild mushrooms, including toxic and hallucinogenic varieties. Mushroom ingestions in Texas were studied for 2005–2006.

Methods: Data was obtained via Texas Poison Control Centers and retrospectively reviewed. Case notes were reviewed individually regarding initial reporting, age, signs and symptoms, toxic effect, management, and patient outcomes.

Results: A total of 742 exposures occurred during the study period. All exposures were acute and intentional. Of these exposures, 59 (7.9%) were admitted to the hospital, with 17 (28.8% of admissions) requiring admission to a critical care unit. Four cases required inpatient psychiatric admission. The average age of admitted exposures was 20.5 years, with a male-to-female predominance of 3.3:1. Eleven (22.9%) of the admitted exposures were identified, with Psilocybin being the most common agent (n = 10, 91%). Among the admissions, co-ingestions were identified with the mushroom ingestion in eleven patients (40.7%). The most common symptoms in admitted patients were vomiting (n = 34, 57.6%), nausea (n = 19, 32.2%), altered mental status (n = 17, 28.8%), abdominal pain (n = 13, 22%), and diarrhea (n = 10, 16.9%).

Conclusions: All mushroom exposures examined were acute and intentional. Major toxic reactions were uncommon, and no deaths were reported. Serious poisoning from mushroom ingestion is rare in Texas; however, there is greater need for information dissemination on morbidity.

Keywords: mycetismus, mushroom, mushroom ingestion, Texas, Amanita

Notes: The opinions or assertions contained herein are the private views of the author and not to be construed as official or as reflecting the views of the U.S. Army Medical Department, Department of the Army, or the Department of Defense. Citation of commercial organizations and trade names in this manuscript do not constitute any official Department of the Army or Department of the Defense endorsement or approval of the products or services of these organizations.

All data produced from the American Association of Poison Control Centers databases during the year in which the exposures occur is considered preliminary. Changes occur in only a small number of cases each year. This is because it is possible that a poison center may update a case any time during that year if new data is obtained. In February of each year, the data for the previous year is locked and no changes are permitted. At that time, the data for a year is considered closed.

There was no outside funding of any kind used for this study.

Corresponding author: George A. Barbee, CPT, SP, DScPA-EM, PA-C, Department of Emergency Medicine, Womack Army Medical Center, 2817 Reilly Road, Fort Bragg, NC 28310. *Email: george.a.barbee@us.army.mil*

INTRODUCTION

Mycetismus (ICD-9, 988.1), also known as mushroom poisoning, refers to deleterious effects from ingestion of toxic substances present in a mushroom [1]. These symptoms can range from slight gastrointestinal malaise to death. The toxins present are secondary metabolites produced in specific biochemical pathways in the fungal cells. Mycetismus is usually the result of ingestion of wild mushrooms after misidentification of a toxic mushroom as an edible species. The most common reason for this misidentification is close resemblance in terms of color and general morphology of the toxic mushrooms species with edible species [2].

Of the 2000 known species of mushrooms in the world, only 32 have been associated with fatalities and an additional 52 have been identified as containing significant toxins [3]. By far the majority of mushroom poisonings are not fatal [4]. In the United States, mushrooms of the genera *Amanita* and *Galerina* produce amanitins and phallotoxins that are common causes of mycetismus. The most feared fungi are those that produce amanitin, which include the "deathcap," *A phalloides*. Ingestion of *A phalloides* may account for approximately 90% of deaths attributable to mushroom ingestion worldwide; the proportion of cases of mycetismus attributable to *A phalloides* in the United States is unknown [5].

Most cases of wild mushroom poisoning occur in late summer and early fall. Nontoxic mushrooms grow in the same area with toxic species, and even trained mycologists often confuse toxic varieties with edible ones because of the extensive variations among species. There are no simple tests to identify poisonous mushrooms and no safe ways to detoxify the poisonous varieties [2].

Identification of implicated mushrooms may be difficult if specimens have been prepared and cooked. Since a variety of mushrooms may have been ingested in most poisoning situations, reliance cannot be placed on the initial symptoms. Gastric contents as well as stool and mushroom samples may be assayed for toxins by radioimmunoassay [6,7].

Texas has approximately 200 species of wild mushrooms, including toxic and hallucinogenic species. One of the major limitations in assessing wild mushroom poisoning is the lack of outcome data following ingestions. The following study describes the frequency with which patients admitted to hospitals with a mushroom ingestion develop significant toxicity. We hypothesized that significant toxicity from mushroom exposure is rare.

MATERIALS AND METHODS

This protocol was reviewed and approved by the Institutional Review Board at Brooke Army Medical Center, Fort Sam Houston, TX.

The American Association of Poison Control Centers (www.aapcc.org) maintains the national database of information logged by US Poison Control Centers (PCCs). A retrospective descriptive study was designed using the American Association of Poison Control Centers (AAPCC) comprehensive poisoning surveillance database—called the Toxic Exposure Surveillance System (TESS).

Data for Texas were analyzed retrospectively for the years 2005 and 2006. TESS data is compiled from poison control centers across Texas by using Poison Control Center telephone hotlines. Reports to poison centers originate from the public and from health-care professionals, and include both patients managed at home or at the site of exposure and those managed in hospitals, emergency departments, or other health-care facilities. TESS data for each case of poisoning include the substances implicated (mushroom), patient age, outcome, clinical effects, exposure route, whether acute or chronic ingestion, co-ingestions, and the level of health-care provided [8]. Each call is generated into a case note.

Exposures accounted for in the database do not necessarily represent a poisoning or overdose. The AAPCC is not able to completely verify the accuracy of every report made to member centers. Additional exposures may go unreported to PCCs and data referenced from the AAPCC should not be construed to represent the complete incidence of exposures to any substance(s).

Case notes were reviewed individually regarding initial reporting, age, signs and symptoms, toxic effect, management, and patient outcomes. Mushrooms and co-ingestions were identified by history, patient presentation, or visual verification of the substance ingested. Data was extracted from the TESS and entered into a detailed multiple-variable database containing information about the type of mushroom, season and place of poisoning, sex, age, poisoning latent period, clinical and laboratory findings, therapeutic interventions, duration of hospitalization, and outcome of patients. Mycetismus was identified according to the claim of the patient or his/her relatives together with clinical findings.

The outcome definitions for all events described are those used by the AAPCC [8]:

- No effect: The patient did not develop any signs or symptoms as a result of the exposure.
- Minor effect: The patient developed some signs or symptoms as a result of the exposure.
- Moderate effect: The patient exhibited signs or symptoms as a result of the exposure that were more pronounced, more prolonged, or more systemic in nature than minor symptoms.
- Major effect: The patient exhibited signs or symptoms as a result of the exposure that were life-threatening or resulted in significant residual disability or disfigurement.
- Death: The patient died as a result of the exposure or as a direct complication of the exposure.

All data were analyzed with SPSS software, version 16, SPSS Inc., Chicago, IL. Statistical comparisons were carried out using Student's *t* test. Pearson product-moment correlation coefficient was used to evaluate correlation among variables and analysis of vari-

ance used to explore simple logistic regression. *P* values = 0.05 were considered statistically significant.

RESULTS

A total of 742 mushroom-related exposures were reported between 2005 and 2006. All exposures were acute and intentional. Of these exposures, 389 (52.4%) occurred in children < 5 years; 69 (9.3%) occurred in children ages 6–12 years; 125 (16.8%) occurred in youth ages 13–19 years, and 146 (19.5%) occurred in persons 20 years and older. Seven persons (0.9%) had unknown or unrecorded age.

Among all 742 cases, 258 (34.7%) cases were found with no effect, 155 (15.5%) cases with minor effect, 76 (10.2%) cases with moderate effect, and 8 (1.1%) cases with major effect. No follow-up was noted in 26 (3.5%) of nontoxic cases, 138 (18.6%) of minimally-toxic cases, and 107 (14.42%) of potentially-toxic cases. There were 7 (0.9%) confirmed nonexposures. The effects totals refer to the levels unique to TESS.

Fourteen co-ingestions were reported with 7 different toxins identified. These included marijuana, 5 (0.7%); lysergic acid diethylamide (LSD), 1 (0.1%); methamphetamine, 1 (0.1%); ethyl alcohol, 2 (0.3%); alprazolam, 1 (0.1%); *Salvia splendens,* 1 (0.1%); and methylenedioxymethamphetamine, 3 (0.4%).

A total of 59 (7.9%) mycetismus exposures were admitted. Among admissions, 9 (15.3%) occurred in children < 5 years, 5 (8.5%) occurred in children ages 6–12 years, 24 (40.7%) occurred in youth ages 13–19 years, and 21 (35.6%) occurred in persons 20 years and older.

The average age of exposures requiring admission was 20.9 years (ranging from 1 to 80 years), with a male-to-female predominance of 2.7:1 (males = 43, females = 16). Of these exposures, 17 (2.3%) required admission to a critical care unit, 38 (5.1%) exposures required hospitalization, and 4 (0.5%) required an inpatient psychiatric admission.

Eleven (18.6%) of the admitted exposures were identified, with *Psilocybe* (n=11, 16.9%) being the most common agent. Among admissions, co-ingestions were also identified with the primary mushroom ingestion (n= 11, 18.6%). Co-ingestions included marijuana, MDMA, LSD, *S splendens*, and alprazolam.

The most common symptoms in admitted patients were vomiting in 34 (57.6%), nausea in 19 (32.2%), altered mental status in 17 (28.8%), abdominal pain in 13 (22%), and diarrhea in 10 (16.9%).

Major effects were seen in 6 (10.2%) hospitalized patients; moderate effects were seen in 20 (33.9%) hospitalized patients, and minor effects were seen in 223 (37.3%) hospitalized patients. No effects were seen in 11 (18.6%) hospitalized patients. No mortality or long-term sequelae were reported. The distribution of effects was: none = 11, minor = 22, moderate = 20 and major = 6.

Frequency of effects noted in the 59 admitted patients were major, 5.1 % (n = 3); moderate, 33.9% (n = 20); minor, 37.3% (n = 22); and no effects, 18.6% (n = 11). Ventilator support was required in 6 (10.1%) of the exposures. In 2 (33.3%) of the exposures requiring ventilator support, the mushroom ingested was identified as psilocybin, and in 3 (50%) patients a co-ingestion was identified. No deaths occurred.

DISCUSSION

Our study examined Toxic Exposure Surveillance System data for Texas during a 2-year study period between 2005 and 2006. Limitations of this study are the lack of follow-up data regarding the patients not admitted, bias introduced by the Texas Poison Control Center system, and the wide variety of mushroom species in Texas.

All mushroom exposures examined were acute and intentional. Major toxic reactions were uncommon, and no deaths were reported. The outcome of poisoning greatly depends on the time between the onset of poisoning and hospital admission, the efficiency of medical interventions, and the type of poisonous mushroom.

The mainstay of treatment was supportive care. Ingestions associated with illicit-drug co-ingestions had a higher propensity for presenting acutely ill initially and required more supportive care. Although initial ventilator support is common with co-ingestions, there was no reported change in mortality or long-term sequelae.

Nonlethal mushrooms generally cause symptoms within 6 hours. The point is that patients often ingest more than one type of mushroom, so that symptom onset within 6 hours does not rule out a co-ingestion of a potentially lethal variety.

A number of conditions are associated with mycetismus. Many adults seem unaware of the risks of eating wild mushrooms. Inexperienced mushroom hunters may mistake the identity of a mushroom; immigrants may come from areas where edible look-alikes exist. Unsupervised infants, persons looking for hallucinogenic drugs, and families who are told by others that the mushrooms are edible may also become poisoned.

Serious poisoning from mushroom ingestion is rare in Texas. Substantial morphological variations often occur in the same mushroom species depending on the season, geographical location, and maturity of the fungus. Thus, identification of mushroom species is often difficult.

Because mushroom species vary widely with regard to the toxins they contain and because identifying mushrooms is difficult, a clinical system of classification is more useful than a taxonomic system. In many cases, management, prognosis, and outcome can be determined with a high degree of confidence from the history and initial symptoms.

To help healthcare providers in the management of mushroom poisoning, complete guidelines have been developed by the International Program on Chemical Safety (IPCS) team. According to their recommendations, the mainstays of treating poisoning are decontamination, symptomatic and/or supportive therapy, clinical observation, and good nursing care. If the mushrooms are available and the diagnosis is still unclear, it is important to have

a mycologist analyze them. However, treatment should be initiated if serious poisoning is suspected.

The authors have no potential financial conflicts of interest to report.

REFERENCES

1. Berger KJ, Guss DA. Mycotoxins revisited: Part I. *J Emerg Med*, 2005;28(1):53–62.

2. Metzler S, Metzler V. *Texas mushrooms: a field guide*. 1st ed. Austin: University of Texas Press; 1992.

3. Ford MD. Clinical toxicology. Philadelphia: W. B. Saunders. 2001.

4. Gussow L. The optimal management of mushroom poisoning remains undetermined. *West J Med* 2000;173(5): 317–318.

5. Centers for Disease Control and Prevention. Amanita phalloides Mushroom Poisoning—Northern California, January 1997. MMWR Morb Mortal Wkly Rep 1997;46(22): 489–492.

6. Faulstich H. Mushroom poisoning. *Lancet* 1980;2(8198): 794–795.

7. Weber T. Mushroom poisoning. *Lancet* 1980;2(8195 pt 1): 640.

8. Bronstein AC, et al. 2006 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS). *Clin Toxicol (Phila)* 2007;45(8):815–917.

BRIEF TOXICOLOGY COMMUNICATIONS

What Signs and Symptoms Would Be Expected after Ingestion of this Plant?

See continuation on page 90