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Case reports of aconite poisoning in mainland China from 2004 to 2015: A retrospective analysis

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ABSTRACT

Aconitum species have long been used in key traditional medicines in China, but cases of fatal aconite poisoning have also been reported. This paper presents a review of 40 single and multi-person cases of fatal aconite poisoning. The cases involved 53 victims in mainland China described in 27 case reports published between January 2004 and September 2015. We summarize the details of the case reports in order to highlight the features of fatal aconite-poisoning cases in China, including victims' sex and age, route of intoxication, clinical symptoms, medicolegal autopsy findings, and results of toxicological analysis. Our results indicate a need for legal medical experts encountering cases of fatal aconite poisoning to pay increased attention to the methods used for collecting biological samples. In addition, prevention strategies should focus on increasing public awareness regarding the potential toxicity of *Aconitum*, harm caused by medicinal liquors containing aconitine, and possibility of *Aconitum* alkaloids accumulating in the body.

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1. Introduction

Aconitum species have long played an important role in traditional Chinese medicine (TCM). “Caowu” (the root of *Aconitum kusnezoffii* REICHB), “chuanwu” (the main root of *Aconitum carmichaeli* DEB), and “fuzi” (the daughter root of *A. carmichaeli* DEB) have been regarded as indispensable aconite-derived medicines in TCM. The tubers and roots of *Aconitum* (Ranunculaceae) are commonly used for treating diverse ailments such as syncope, rheumatic fever, painful joints, gastroenteritis, diarrhea, edema, bronchial asthma, various tumors, and certain endocrine disorders such as irregular menstruation.¹ In certain regions of China, aconite roots (roots or root tubers of the *Aconitum* species) are consumed as root vegetables and used for preparing herbal soups and meals, primarily for the health benefits they offer.² Moreover, people in China drink medicinal liquors containing *Aconitum* alkaloids to fortify their health.

Aconitum alkaloids are widely recognized to contain a series of diester diterpene alkaloids such as aconitine, mesaconitine, and

hyaconitine. The alkaloids include cardiotoxins and neurotoxins; therefore, nearly all cases of aconite poisoning result in neurological and cardiovascular symptoms. The cardiotoxicity and neurotoxicity of aconitine and related alkaloids are caused by their actions on the state of voltage-sensitive sodium channels at Site 2 in the cell membrane; exposure renders these sodium channels refractory to excitation.³ Traditional Chinese processing (“paozhi”) includes methods such as soaking and boiling for several hours in order to convert *Aconitum* alkaloids to comparatively less toxic or nontoxic derivatives.¹ Nevertheless, a few cases of fatal aconite poisoning are reported every year in China. Here, fatal aconite poisoning cases published over the past 11 years in mainland China are characterized by reviewing the relevant case reports.

2. Methods

China Academic Journals Full-text Database, which includes the China National Knowledge Infrastructure, VIP Journals of Chinese Science, and WANFANG Database, along with English-language databases such as PubMed and Web of Science, were used to search for reports on fatal aconite poisoning in China (from January 2004 to September 2015) published in Chinese or English. The keywords used in the search were Chinese and English terms,

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including aconite, aconitine, “caowu,” “chuanwu,” “fuzi,” aconite poisoning, *Aconitum* alkaloid poisoning, and poisoning leading to death. The present article focused on the accurate analysis of fatal aconite poisonings; therefore, reports without a relevant history or forensic toxicology findings were excluded. Overall, this study included 27 case reports of *Aconitum* alkaloid poisoning.^{4–30} Most of the selected case reports were published in Chinese. Table 1 presents a summary of 9 typical cases of fatal aconite poisoning.

3. Results

3.1. Sex and age

This study reviewed 40 case studies of aconite poisoning in mainland China involving 53 fatalities that were reported in 27 papers from January 2004 to September 2015. The victims ranged from 3 to 65 years in age; 39 of them were men and 6 were women. The gender of the remaining 8 victims was not mentioned in the respective reports.

3.2. Regional distribution (Fig. 1)

Cases of fatal aconite poisoning between 2004 and 2015 were reported in 17 provinces of mainland China including Heilongjiang, Jilin, Beijing, Hebei, Beijing, Shandong, Shaanxi, Chongqing, Hubei, Jiangsu, Shanghai, Zhejiang, Jiangxi, Hunan, Guizhou, Yunnan and Guangdong Province. Specifically, 18 and 35 victims of fatal aconite poisoning were reported from 7 northern (Heilongjiang, Jilin,

Beijing, Hebei, Beijing, Shandong and Shaanxi Province) and 10 southern provinces (Chongqing, Hubei, Jiangsu, Shanghai, Zhejiang, Jiangxi, Hunan, Guizhou, Yunnan and Guangdong Province) of China, respectively. The largest number of reported victims from a single province was 10 (from Yunnan province located in southern China).

3.3. Mode of aconitum consumption (Fig. 2)

The raw aconite roots or plants of *Aconitum* species were described as having been used as vegetables for cooking in 3 reports.^{9,12,13} Additionally, 6 victims were stated to have cooked and consumed raw aconite roots or plants for health purposes in two of the reports.^{8,13} A case of accidental aconite poisoning caused by consumption of an *Aconitum* species of plant that was mistaken for wild celery, resulting in 6 deaths, was also reported.¹² This *Aconitum* species of plant was considered to be one of *Aconitum soon-garicum* Stapf, *Aconitum anthoroideum* and *Aconitum smirnovii* by botanists and in shape similar to several species of wild celery such as *Lepidium apetalum*, *Oenanthe hookeri*, *Ostericum sieboldii* and so on.

In addition to consumption as food, *Aconitum* species are used as a key ingredient in Chinese herbal medicines to treat various illnesses. Here, we describe consumption of Chinese herbal medicines resulting in 8 deaths that were reported in 7 papers.^{6,8,14–18} Doctors took full responsibility for the poisoning cases. Additional reports presented cases in which Chinese herbal medicines containing excess “caowu” and “chuanwu” were prescribed that

Table 1
Fatal aconite poisoning in China: 9 typical cases.

Case	Age	Sex	Deaths	Province	Ingested matter	Symptoms	Forensic medical	Reference
1.	Unrecorded	Male	Two	Chongqing	Drank 25 ml homemade medicinal liquor containing aconitine	Numbness, dizziness, vomiting, and weakness	The remaining liquor was found to contain 48 µg/mL aconitine.	4
2.	38	Male	One	Guangdong	Drank a medicinal liquor containing aconitine as a beverage by accident	Umbness in the tongue and limbs, abdominal pain, and vomiting	Cyanosis of the lips and nail beds, traces of drooling around the mouth, and scattered bleeding points in the surface of the heart and lungs were found. The tracheal cavity was found to contain foamy liquid. Aconitine was present in the remaining liquor, plant roots, the contents of the stomach, and blood taken from the heart.	5
3.	35	Female	One	Jilin	Took an herbal medicine that included processed <i>Radix Aconitum Kusnezoffii</i> 10 g and processed <i>Radix Aconitum carmichaeli</i> 10 g	Numbness, chest distress, nausea, vomiting, and diarrhea	Scattered petechiae on the inside of the legs, pulmonary congestion, and pulmonary edema. The liver, lung, spleen, pancreas, and the gastrointestinal mucosal tissue were all infiltrated by eosinophilic granulocytes.	6
4.	Unrecorded	Male	One	Hebei	Drank the medicinal liquor containing aconitine twice	Numbness and convulsions	Aconitine was present in the blood, liver, and remaining medicinal liquor.	7
5.	40	Male	One	Jiangsu	Took an herbal medicine including <i>Radix Aconiti</i> (3 g) in warm water for 7 days	Numbness, weakness, vomiting, and dizziness	Aconitine (20.4 ng/mL), mesaconitine, and hypaconitine were present in the blood.	8
6.	39	Female	One	Yunnan	Drank 200–250 ml of the herbal soup	Unconscious	Nail beds were found to be canosed, the tracheal cavity was found to contain a pink foamy liquid. Acute pulmonary edema and pulmonary congestion were identified microscopically. Aconitine was detected in the stomach, and the contents of the stomach and liver.	9
7.	38	Male	One	Jiangxi	Drugs including <i>Radix Aconiti Aconiti</i> , <i>Kusnezoffii</i> 8 g and <i>Radix</i> 8 g on damaged skin for 3 days	Unrecorded	Aconitine was detected in blood taken from the heart.	10
8.	65	Female	One	Guangdong	Drank 10 ml of the homemade liquor twice daily for 8 days	Numbness, weakness, respiratory distress, vomiting and dysphoria	Unrecorded	11
9.	21–44	Male	Six	Xinjiang	Picked what they assumed to be wild celery to be consumed during a meal	Numbness, weakness, and vomiting	Aconitine was detected in blood and vomit sample, The average blood concentration of aconitine was 0.30 µg/mL.	12

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