

Incidence of Herb-Induced Aconitine Poisoning in Hong Kong

Impact of Publicity Measures to Promote Awareness Among the Herbalists and the Public

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Abstract

Background: In Hong Kong 'chuanwu' (the main root of *Aconitum carmichaeli*) and 'caowu' (the root of *Aconitum kusnezoffii*) are used by herbalists to treat patients with various musculoskeletal disorders. These aconite roots contain aconitine, mesaconitine and hypaconitine, which are neurotoxins and cardiotoxins. During 1989 to 1991, 31 patients were treated in public hospitals because of poisoning by aconite roots and there were two deaths from ventricular arrhythmias. In late 1991, healthcare officials together with cardiologists held a press conference to warn the public, healthcare professionals and herbalists of the potential toxicity of aconite roots. The risk of ventricular arrhythmias and the need for urgent medical attention were highlighted. An information leaflet was also sent to hospital doctors. Since 1992, the topic was covered periodically in the local newspapers, medical journals and continuing medical education programmes.

Objective: The objective of this study was to assess the impact of these publicity measures on the incidence of herb-induced aconitine poisoning in the New Territories East, based on the number of admissions to the Prince of Wales Hospital.

Methods: During 1989 to 1993 and 1996 to 1998, all patients admitted to our medical wards because of herb-induced aconitine poisoning were identified by on-going surveillance of medical patients, searching our computerised medical record system and reviewing reports received by the 24-hour Drug and Poisons Information Bureau.

Results: The number of hospitalisations due to aconitine poisoning markedly decreased from four to six per year in 1989 to 1991 to one to two per year in 1992 to 1993. The annual incidence of aconitine poisoning showed a marked decrease from 0.49 to 0.69 [overall 0.60, 95% confidence intervals (CI) 0.34 to 0.99] to 0.10 to 0.22 (overall 0.16, 95% CI 0.03 to 0.46) per 100 000 population ($p = 0.024$). During 1996 to 1998, herb-induced aconitine poisoning remained uncommon, with zero to two hospital admissions per year or an annual incidence of zero to 0.33 (overall 0.17, 95% CI 0.05 to 0.43) per 100 000 population ($p = 0.016$).

Discussion: It is possible that the herbalists could have used smaller doses of 'chuanwu' and 'caowu' than before. Patients could be more compliant with the instructions on how to prepare the herbal decoction at home. However, our ex-

perience suggested that publicity measures to promote awareness, among the herbalists and the public, may reduce the incidence of poisoning due to toxic herbs such as aconite roots.

Background

Aconite roots (the roots or root tubers of the plant *Aconitum* sp.) continue to be used in traditional medicine as anti-inflammatory, analgesic and cardiotonic agents.^[1] The principal active (toxic) ingredients in aconite tubers are C₁₉-diterpenoid alkaloids, including aconitine, mesaconitine and hypaconitine.^[2] These alkaloids are known neurotoxins and cardiotoxins, which act on the voltage-sensitive sodium channels of the excitable membranes.^[3] In patients with aconitine poisoning, a combination of sensory and motor features are seen, including paraesthesia and weakness of the four limbs.^[4] Palpitations and hypotension are common. A variety of abnormalities in cardiac rhythm and conduction have also been reported, especially in serious poisoning. Gastrointestinal features such as nausea and vomiting are also common. Death usually results from refractory ventricular arrhythmias,^[5] which are most likely to occur in the first 24 hours. The management of herb-induced aconitine poisoning is essentially supportive.^[4]

In Hong Kong, ‘chuanwu’ (the root tuber of *Aconitum carmichaeli* Debx.) and ‘caowu’ (the root tuber of *Aconitum kusnezoffii* Reichb.) are the most commonly used *Aconitum* sp. in Chinese materia medica. The alkaloid components and amounts in these herbs can vary, depending on the species, place of origin, time of harvest and method of processing.^[6] Raw aconite tubers are generally very

toxic and must be ‘processed’ before use. Processing may reduce their alkaloid content by up to 90%.^[4] The aconitine content in some samples of processed ‘chuanwu’ and ‘caowu’ was 0.0041 to 0.021% and 0.0084 to 0.034%, respectively.^[7] Soaking and boiling during processing and domestic decoction preparation will also hydrolyse aconite alkaloids into the less toxic benzyllaconine and aconine derivatives.^[4,7] However, decoction preparation by the patient at home may be rather variable. Patients with aconitine poisoning were often prescribed 7 to 11g each of processed ‘chuanwu’ and ‘caowu’.^[4] This dose was considerably higher than the recommended value of 1.5 to 3g.^[8] During 1989 to 1993, 18 patients with herb-induced aconitine poisoning were admitted to the Prince of Wales Hospital and there was one death from refractory ventricular arrhythmias (see Results section and table I).^[4] During 1989 to 1991, 16 patients were admitted to other public hospitals in Hong Kong and there was one death from refractory ventricular arrhythmias.^[5] In late 1991, health officials together with the cardiologists held a press conference to warn the public, healthcare professionals and herbalists of the potential toxicity associated with the use of aconite roots. The risk of ventricular arrhythmias and the need for urgent medical attention were highlighted. The need for proper decoction preparation at home was mentioned. There was excellent coverage by television, radio and all local newspapers. An information

Table I. The number of hospital admissions to the Prince of Wales Hospital and the incidence (per 100 000 population) of herb-induced aconitine poisonings in the New Territories East of Hong Kong before and after publicity measures in 1991

	1989	1990	1991	1992	1993	1996	1997	1998
Number of admissions	5	4	6	2	1	2	0	2
Size of catchment population (thousands)	806.5	823.2	867.8	922.0	968.5	1142.3	606.0 ^a	612.2 ^a
Incidence	0.62	0.49	0.69	0.22	0.10	0.18	0	0.33

a Two other general hospitals were opened during 1997 to 1998.

leaflet outlining the clinical features and management of aconitine poisoning was also sent to hospital doctors. Since 1992, articles on the topic appeared periodically in the local newspapers and medical journals. Herb-induced aconitine poisoning has also been covered in continuing education seminars for both hospital doctors and family physicians.

The main objective of this retrospective study was to determine the impact of these publicity measures to promote awareness on the incidence of herb-induced acute aconitine poisoning in the New Territories East of Hong Kong.

Subjects and Methods

Until December 1996, the Prince of Wales Hospital was the sole general teaching hospital for the New Territories East of Hong Kong and served approximately 20% of the population in Hong Kong. The New Territories East region consists of the Shatin District, the Tai Po District and the North District. With the opening of a smaller general hospital in phases in the Tai Po District in January 1997 and in the North District in February 1998, the Prince of Wales Hospital then became the sole general teaching hospital for the Shatin District. However, the Prince of Wales Hospital remained the tertiary referral centre for cardiac and poisoning cases in the region and other parts of Hong Kong. The clinical pharmacologists based at the Prince of Wales Hospital provide expert advice on the management of poisoning to the whole of Hong Kong.

During 1989 to 1993 and 1996 to 1998, all patients admitted to our medical wards in the Prince of Wales Hospital because of herb-induced aconitine poisoning were identified by on-going surveillance of medical patients,^[9] searching our computerised medical record system^[10] and reviewing reports received by the 24-hour Drug and Poisons Information Bureau (DPIB).^[11] In our medical unit, patients' demographic data, main diagnoses with International Classification of Diseases (ICD) codes and discharge summaries were stored on computer.^[10] Patients with ICD codes 960-979

(medicinal poisonings) or 980-989 (non-medicinal poisonings) were screened and those with aconitine poisoning were identified. Our DPIB provides drug and poison information service to the whole of Hong Kong and serves as the drug and herbal medicine monitoring centre.^[11]

The case notes of patients suspected of having herb-induced aconitine poisoning were reviewed. As in our previous study,^[12] the diagnosis was based on the following criteria:

- patients became unwell only after taking herbs for the treatment of musculoskeletal disorders
- the neurological, cardiovascular, gastrointestinal and other features were typical of aconitine poisoning (see Background section)^[4]
- based on patient's history and clinical features and/or a review of the prescription, exposure to aconite roots could be verified.

The number and annual incidence (per 100 000 population) of hospital admissions because of herb-induced aconitine poisonings before (1989 to 1991) and immediately after (1992 to 1993) the publicity measures in 1991 were determined. Particular attention was given to the occurrence of ventricular arrhythmias, the main cause of deaths in these patients. Since the impact from publicity measures could wear off, the occurrence of aconitine poisonings during 1996 to 1998 was also determined. In calculating the incidence of aconitine poisoning, the total number of subjects of all ages was used because age distribution figures in the catchment areas of the Prince of Wales Hospital were available only in 1991 and since 1996. The aconite roots and other potent herbs are not used in children. Our DPIB has never received any report of herb-induced aconitine poisoning in children. Hence, all subjects with aconitine poisoning requiring admission to the Prince of Wales Hospital would have been included in this study. The population size in the catchment areas of the Prince of Wales Hospital during these periods was provided by the Census and Statistics Department.

The overall incidence and 95% confidence intervals (CI) for the mean were calculated for 1989 to 1991, 1992 to 1993 and 1996 to 1998. Tests of

comparison of Poisson rates were performed by using Statgraphics version 2.0.

Results

During the three study periods, a total of 22 patients were admitted to the Prince of Wales Hospital because of herb-induced aconitine poisoning. All the herbs were said to have been prescribed by the herbalists. As can be seen in table I, the number of admissions markedly decreased from four to six per year in 1989 to 1991 to one to two per year in 1992 to 1993. The annual incidence of herb-induced aconitine poisoning showed a marked decrease from 0.49 to 0.69 (overall 0.60, 95% CI 0.34 to 0.99) to 0.10 to 0.22 (overall 0.16, 95% CI 0.03 to 0.46) per 100 000 population ($p = 0.024$). During 1996 to 1998, herb-induced aconitine poisoning was still less common than 1989 to 1991, with zero to two hospital admissions per year or an annual incidence of zero to 0.33 (overall 0.17, 95% CI 0.05 to 0.43) per 100 000 population ($p = 0.016$).

A comparison of the demographics and clinical characteristics of patients admitted during 1989 to 1991, 1992 to 1993 and 1996 to 1998 is shown in table II. Patients admitted during 1989 to 1991 and 1992 to 1993 have been described in detail elsewhere.^[4] Fortunately, there were only one to two cases of aconite-induced ventricular arrhythmias every 2 to 3 years. There was only one death from refractory ventricular arrhythmias and asystole.

During 1989 to 1991, four out of the 15 patients had provided the written prescriptions for inspection. ‘Chuanwu’ and ‘caowu’ were used alone ($n = 1$) or together ($n = 3$), amounting to a total of 7.5 to 22.5g per decoction. The only patient who died from aconitine poisoning was the subject of a coroners investigation and hydrolysed aconitine was present in her stomach contents. During 1992 to 1993, the written prescription was available for inspection in all three patients. The quantities ingested were documented in the case notes of two patients, amounting to a total of 7.5 to 22.5g of ‘chuanwu’ and ‘caowu’ per decoction. During 1996 to 1998, all four patients had provided the prescriptions for inspection. ‘Chuanwu’ and ‘caowu’ were used alone ($n = 1$) or together ($n = 3$). The amounts that were prescribed were not documented in the records.

Discussion

Until December 1996, the Prince of Wales Hospital served approximately 20% of the population in Hong Kong. Based on our experience at the Prince of Wales Hospital during 1989 to 1993, we estimated that ‘chuanwu’, ‘caowu’ and other aconite roots accounted for 60% of herbal medicine-induced accidental poisonings requiring hospital admissions in Hong Kong.^[12] Cardiotoxicity is commonly seen in aconitine poisoning (table II) and patients with severe poisoning may die from

Table II. Clinical details of patients with herb-induced aconitine poisoning admitted before and after publicity measures to promote awareness in 1991

	1989-1991 (n = 15) ^[4]	1992-1993 (n = 3) ^[4]	1996-1998 (n = 4)
Males : females	11 : 4	0 : 3	3 : 1
Age in years (mean and ranges)	45 (24-71)	59 (21-81)	44 (32-61)
Cardiovascular features ^a	13	3	4
Ventricular arrhythmias	2	1	1
Neurological features ^b	14	2	4
Gastrointestinal features ^c	10	2	3
Other features ^d	14	2	4
Death	1	0	0

a Cardiovascular features included palpitations, chest pain, hypotension, supraventricular or ventricular ectopics, supraventricular tachycardia and junctional rhythm.
b Neurological features included muscle weakness and numbness/paraesthesia of the four limbs and perioral/facial areas.
c Gastrointestinal features included nausea, vomiting, abdominal pain and diarrhoea.
d Other features included hyperventilation, respiratory alkalosis, ‘difficulty in breathing’, dizziness, sweating, confusion and headache.

refractory ventricular arrhythmias.^[5] Therefore, extra caution in the use and domestic processing of the aconite roots could have prevented much of the severe poisoning due to herbal medicines in Hong Kong. Publicity measures to promote awareness among herbalists and the public about the cardiotoxicity of the aconite roots might achieve this purpose. However, until the present study was performed, it was not known if publicity ('education') measures targeting the subject groups concerned (herbalists and the patients) could reduce the incidence of accidental poisonings due to toxic herbs such as aconite roots.

As can be seen in table I, the annual incidence of herb-induced aconitine poisoning in the New Territories East was markedly reduced after the publicity measures, from 0.49 to 0.69 (overall 0.60) in 1989 to 1991 to 0.10 to 0.22 (overall 0.16) per 100 000 population in 1992 to 1993. This decrease in annual incidence was still seen, several years later, in 1996 to 1998 (0 to 0.33, overall 0.17 per 100 000 population). These observations suggested that these publicity measures were effective and sustained.

There could be several reasons for the decreased incidence of herb-induced aconitine poisoning in the New Territories East. As suggested by some experts,^[8] herbalists in Hong Kong had since used smaller dosages of 'chuanwu' and 'caowu'. Only patients who had been given large doses of aconite roots (e.g. up to 110g)^[13] were now admitted to hospital because of aconitine poisoning. Confirmation was possible only if the prescriptions were available for inspection in all patients. The herbalists could have put emphasis on the importance of proper domestic processing in reducing the toxicity of aconite roots. Having been warned of the potential toxicity of 'chuanwu' and 'caowu' by herbalists and the mass media, patients were more compliant with the instructions how to prepare the herbal decoction at home. The wholesalers had only imported aconite roots from few selected sources. Then, the processing of these herbs had been more stringent and their alkaloid components and amounts were more 'predict-

able'.^[6] Since traditional Chinese medicine remains popular in Hong Kong,^[14] it was unlikely that patients with musculoskeletal disorders consulted herbalists less frequently than before. The decreased use of 'chuanwu' and 'caowu' as anti-inflammatory, analgesic agents was rather unlikely since there were few, if any, alternatives among the commonly used herbs.^[2] Unfortunately, the sales figures of these aconite roots for 1989 to 1991 and since 1992 were not available.

When the actual prescriptions were not available, diagnosis of herb-induced aconitine poisoning should ideally be confirmed by toxicological analysis of herbal residues and urine or blood samples. An assay to measure aconitine and related compounds became available in a public hospital in Hong Kong since 2000. Few patients could have been admitted to other public hospitals. Death from ventricular arrhythmias might have occurred in the community. To accurately document the incidence of fatal and non-fatal aconitine poisoning in the whole of Hong Kong, it is necessary to review patients admitted to other hospitals and cases that have been seen by a coroner. Information on the actual amounts of aconite roots prescribed was not available in most of the patients in this study. It was not possible to tell if the doses used had decreased since 1992. It was also not known if patients had better knowledge of the toxic effects of 'chuanwu' and 'caowu' than before.

Our experience in the New Territories East indicated that herb-induced aconitine poisoning had become much less common in Hong Kong since 1992. This marked decrease in incidence appeared to be sudden and occurred after the measures to promote awareness of the toxicity of aconite roots among the herbalists and the public.

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