

Received 7 September 2015

Received in revised form 17 November 2015

Accepted 21 November 2015

Available online 31 December 2015

Toxic Plants: The Dangers of Returning to Nature

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Abstract In France, the plants are involved in about 5% of cases resulting in a call to a poison control center and toxicity (CAPTV). Poisoning plants are mainly children and are usually benign. In adults, they are rare and occur either suicidal context or by confusion with an edible plant or by use of the plant in an addictive or therapeutic purposes. Such poisoning can be serious and be life threatening. This article presents the plants where severe poisoning or death have been reported and whose toxicity is mainly cardiac and / or neurological. After a brief description of each of the following plants: aconite, belladonna, colchicum, datura, foxglove, yew, oleander, redoul and hellebore, the clinical, therapeutic and analytical corresponding poisoning will be treated.

Keywords: Plants toxic poisoning, Alkaloids antidote, Forensic science.

1 Introduction

In France, the plants are involved in about 5% of cases resulting in a call to a poison control center and toxicity (CAPTV) ^[1,2]. Poisoning plants are mainly children and are usually benign. In adults, they are rare and occur either suicidal context or by confusion with an edible plant or by use of the plant in an addictive or therapeutic purposes. Such poisoning can be serious and be life threatening.

In this article, we present a dozen toxic plants, in alphabetical order of vernacular name for which severe poisoning or death have been reported. These are mainly plants in cardiac toxicity and / or neurological. After a brief description of the plant ^[3], we discuss the clinical, therapeutic and analytical.

2 Aconite (*Aconitum napellus* L., Fig. 1)

The aconite, also called helmet of Jupiter, Wolfsbane, Venus chariot or peacekeeper (wolfsbane or monkshood, in English) is a perennial herb belonging to the family Ranunculaceae. It is a plant from 50 to 180 cm high that grows mainly in mountainous areas of Western Europe. It blooms from June to August; the flowers are purplish blue, grouped in clusters. The root is napiforme, pointed, often surmounted by a radical of the rod.

All organs of the plant, but especially the roots and seeds contain diterpene alkaloids, the main one aconitine. The aconitine acts at the level of voltage-gated sodium channels infarction, nerves and muscles. It causes persistent activation of these channels thus making them refractory

to repolarization, with the consequence, premature excitation. The aconitine is exciting and paralyzing nerve centers of the medulla and peripheral nerve endings. Its toxic action resulting in neurological and cardiac disorders. ^[4]

Poisonings are rare in Europe. They may be suicidal ^[5], consecutive to a consumption of herbal preparations or confusion with root vegetables (turnip, horseradish, celery) and exceptionally criminal. ^[6] Poisonings are common in Asia due to the use of aconitine in Chinese medicine for its antirheumatic properties and antineuralgic ^[7]. Severe poisoning can occur after ingestion of 1 mg aconitine or 2 to 4 g of fresh roots.

The symptoms appear soon after ingestion (from ten minutes to two hours) and are characterized by paresthesia oral, pharyngeal and labial and extremities, gastrointestinal disturbances (salivation, nausea,

vomiting, sometimes diarrhea), dizziness and asthenia. In severe cases occur in cardiac disorders (ventricular tachycardia, ventricular fibrillation, cardiac dysrhythmias) and a respiratory paralysis. The paresthesia association with muscle weakness and heart problems is characteristic of poisoning by aconite.

Aconite swallowed requires hospitalization in an intensive care unit with ECG and blood pressure monitoring. Digestive evacuation by vomiting, gastric lavage may be recommended if a short time (less than one hour). The indication of this digestive evacuation will depend on the assumed dose ingested, symptoms and delay. Treatment is mainly symptomatic. There is no consensus on the best treatment for ventricular arrhythmia, amiodarone, flecainide, mexiletine and magnesium sulphate^[8,9] have been used with variable success depending on the case. Lidocaine was generally ineffective. In animal studies, rats, are flecainide and beta-blockers that have proven to be most effective.^[10] In case of ventricular arrhythmias and refractory shock, it should be quickly put in place circulatory support.

The aconitine can be assayed in the blood or urine. The analytical method that now seems most effective for the determination of aconitine is liquid chromatography coupled with tandem mass spectrometry (LC-MS / MS). A blood concentration of 3.6 g / l can be considered lethal in the absence of treatment^[9]. In a case of severe intoxication with a plasma concentration at 1.75 mg / l at the seventh hour, the calculated half-life of aconitine was three hours^[11].

3 Belladonna (*Atropa belladonna*

L., Fig. 2)

Belladonna also called beautiful lady, black button or mandrake baccifère (deadly nightshade, English) is a herbaceous plant belonging to the Solanaceae family. Present in Europe, it grows in clearings, preferably limestone terrain. It bears fruit in August / September and produces globular berries, about the size of a cherry, embedded at the center of a star chalice.

Poisoning can be consecutive to accidental ingestion in children^[12,13] or confusion with edible berries in adults.^[14] They rarely occur in a context suicidal or addictive.

All parts of the plant contain tropane alkaloids, including atropine, hyoscyamine (levorotatory isomer of atropine) and scopolamine. These three alkaloids have a parasympatholytic share; they inhibit competitively and reversibly binding of acetylcholine at peripheral and central muscarinic receptors, resulting sympathomimetic effects (or anticholinergic or antimuscarinic).

Symptoms appear 30 minutes to 2 hours after ingestion and include, depending on the amount ingested, one or more of the following clinical signs: vomiting, dry mouth, mydriasis, tachycardia, hyperthermia, confusion, delirium, convulsions, coma and respiratory depression.

Treatment is mainly symptomatic. Physostigmine (or eserine), reversible acetylcholinesterase inhibitor, increases the level of acetylcholine in the synaptic cleft and allows the stimulation of muscarinic and nicotinic receptors. Thanks to its tertiary amine structure, physostigmine pass the blood brain barrier and acts on both central

anticholinergic symptoms and devices. It is available in France under the name of Anticholium® and is subject to the status of temporary authorization to use registered (ATU 2007). The drug, unwieldy due to its side effects, can



Figure 1. Aconit



Figure 2. Belladone



Figure 3. Colchique

be used in cases of severe poisoning resistant to symptomatic measures. It is to be administered at a rate of 1 to 2 mg i.v. slow in adults after verifying the absence of contraindications for its use. Physostigmine is between the 5th and 20th minute after injection, and the effect persists for 45 to 60 minutes ^[15-17].

4 Colchique (*Colchicum autumnale* L., Fig. 3)

Colchicum also called meadow saffron (meadow saffron or autumn crocus, English) is a herbaceous perennial flowering from August to November. Fruits and leaves appear in the spring of the following year. The fruit is a large green capsule with three compartments, each containing 60-80 seeds. The main compound is crocus



Figure 4. *Datura*



Figure 5. *Digitalis*

colchicine that inhibits microtubule formation by binding to tubulin with the consequence, a blocking mitosis at the stage of metaphase.

Poisonings occur mostly in spring, by confusion leaves with those of wild garlic ^[18,19] or wild leek; they rarely occur in children by consumption of seeds or adults in a suicidal frame. ^[20]

Colchicum poisonings are serious and bring life-threatening. The first signs are gastrointestinal and occur after a delay of several hours (vomiting and profuse diarrhea quickly responsible for dehydration). In severe cases, there is the appearance in the first 24 hours of acute circulatory failure. By the third day appears myelosuppression that will last two to six days and whose risk is infection and bleeding. By the tenth day occurs alopecia. The blood test colchicine to confirm the diagnosis.

Regarding the therapeutic management: the digestive evacuation is rarely performed because of the typically long delay between ingestion and hospital admission. The administration of activated charcoal repeated doses may be effective but is generally not feasible because of severe vomiting. The volume of distribution of colchicine renders illusory the renal replacement methods. The anticolchicine antibodies are not, to date not available. Treatment is mainly supportive, guided by daily monitoring of electrolytes, blood counts and prothrombin.

5 *Datura* (*Datura stramonium* L., Fig. 4)

The genus *Datura* comprises about twenty species of which the most common is *Datura stramonium* L., also called Jimson weed, grass of the devil,

thorn apple, grass to the moles (jimson weed, English). It is a herbaceous plant belonging to the Solanaceae family, abundant in Europe where she likes wasteland and roadsides; it is widely grown for its decorative appearance. It blooms from July to October (large white flowers trumpet-shaped). Its fruit is a large thorny ovoid capsule containing many seeds.

All parts of the plant contain alkaloids including hyoscyamine (principal alkaloid), scopolamine and atropine; these alkaloids are peripheral and central competitive antagonists of acetylcholine. *Datura* causes, such as belladonna, a parasympatholytic effect but whose intensity is stronger.

The most common method of intoxication for the consumption of this plant in a goal addictive form of decoction, ingestion of seeds or use of cigarettes made from dried leaves. ^[21]

The poisoning causes anticholinergic syndrome primarily neuropsychiatric symptoms with psychomotor excitement, incoherent, visual hallucinations, disorientation, aggressiveness. Among the peripheral anticholinergic signs, we note the presence of a bilateral mydriasis while other anticholinergic signs are more fickle: dry mouth, sinus tachycardia, hyperthermia, vomiting and urinary retention. In severe cases, there may be convulsions and coma. Evolution is generally favorable in 24 to 48 hours. The diagnosis can be confirmed by blood and urine assay of alkaloids by liquid chromatography coupled to a dual-mass spectrometry (LC-MS / MS). ^[22]

Treatment is symptomatic. Physostigmine, available in France under the name of Anticholium® and subjected to a nominative ATU,

can be used in severe poisoning (see Belladonna).

6 Digitalis (Fig. 5)

The genus *Digitalis* includes twenty species. This is a herbaceous plant belonging to the family of Scrophulariaceae and blooming from May to September as a long unilateral cluster. In France there are three wild species: foxglove (*Digitalis purpurea* L.) or purple foxglove in English, yellow digitalis (*Digitalis lutea* L.) and *Digitalis grandiflora* (*Digitalis grandiflora* L.).

The plant contains many compounds which qualitatively and quantitatively variable cardiac glycosides (digitoxin, gitoxin, lanatoside C digitoxigenin). These cardenolides act by inhibiting the Na⁺ / K⁺ + ATPase membrane. They have a positive inotropic, chronotropic and dromotropic negative. They also a vasoconstrictor, diuretic and a central effect.

Poisoning can be a result of a confusion with borage leaves used to prepare salads or teas, or voluntary ingestion with suicidal intent. Accidental poisoning in children are rare.

Symptoms involve: gastrointestinal disorders (nausea, vomiting), neurosensory disorders (confusion, confusion, color blindness), heart problems with conduction disturbances and / or automatism (sinus bradycardia, atrioventricular block grade 1, 2 or 3, sinus or junctional tachycardia, tachycardia or ventricular fibrillation). These disorders may be associated with hyperkalemia, this intoxication gravity factor. Because of cross-reactions when cardenolides assays immunoassay,

the dosage of digoxin that is usually used to assess the severity of the poisoning; However, given the low correlation clinicobiological^[23], should be preferred clinical signs for evaluating the severity and determine the therapeutic management. A measurement of specific glycosides would be helpful if the laboratory has the appropriate techniques^[24]. Regarding treatment, indicating a digestive evacuation is to discuss on the time, the amount ingested and symptoms. Repeated administration of activated charcoal may be useful^[23]. Treatment involves the careful correction of hypokalaemia and administration of atropine in case of bradycardia. Specific treatment by antidigitalis antibodies (DIGIBIND[®]) is the treatment of choice for severe poisoning.

7 If (*Taxus baccata* L., Fig. 6)

This is a tree (yew, English) from 4 to 15 m high evergreen, often planted in parks and gardens. The fruit, falsely called "bay", is formed by a red aril sacciforme surrounding an ellipsoidal seed.

Except the aril, all parts of the plant are poisonous and contain a mixture of alkaloids and complex structure pseudoalcaloïdes. The main cardiotoxic substances are taxines A and especially B taxines, diterpene taxane core substances that are antagonists of the calcium and sodium channels and whose properties are similar to those of the class of antiarrhythmic 1. One gram of redwoods contain approximately 5 mg of taxines. Taxol (paclitaxel), antimicrotubuline cytotoxic agent originally isolated from the bark of *Taxus brevifolia* Nutt., Are present in

very small quantities (0.01%).

Severe poisoning are mainly observed in adults and may be secondary to ingestion of leaves and seeds with suicidal intent or accidental ingestion in a context of herbal treatment. In children, accidental poisoning are usually benign due to the ingestion of non-toxic fleshy part of the "bay" or ingesting a small amount of "bays" with a non-mache core.

The clinical signs appear two to three hours after ingestion and include digestive, neurological signs (coma, convulsions) and heart (ventricular conduction disorders, arrhythmias, ventricular fibrillation). The dosage of the alkaloids in biological fluids can be performed in a laboratory with the correct technique^[25,26].

Le traitement des troubles cardiaques reste mal codifié : lidocaïne, phénytoïne, anticorps antidigitaliques, assistance circulatoire et perfusion de

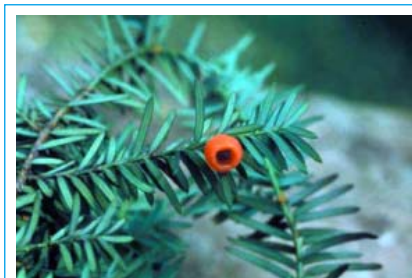


Figure 6. If



Figure 7. Laurier rose

solutés alcalins ont été utilisés avec des succès variables ^[27].

8 Laurier rose (*Nerium oleander* L., Fig. 7)

This is a shrub (oleander, English) from 2 to 3 m high belonging to the family Apocynaceae. The leaves are evergreen and flowers, pink, red or white, are present from June to September. All parts of the plant contain glycosides, the main one being the oleandrine, whose structure is similar to that of digitalis. Poisonings occur most often in adults with suicidal context ^[28,29].

The symptoms of poisoning are those of digitalis intoxication with: digestive disorders (nausea, vomiting), neurosensory disorders (agitation, confusion, color vision disorders), cardiac disorders related to inhibition of the Na⁺ / K⁺ ATPase membrane (bradycardia, conduction disorders and / or automatism). These disorders may be associated with hyperkalemia, gravity factor of this poisoning. ^[30] The dosage of oleandrine not being made in current practice, the dosage of digoxin which is generally used to assess the severity of the poisoning even

though there is no strict correlation between the measured concentration and the severity of the poisoning. The effectiveness of the activated carbon is likely, although there is no consensus on the mode of administration (single dose versus multiple doses) ^[31,32].

Treatment includes, besides the If atropine in bradycardia and careful correction of ionic abnormalities, administration of antibody antidigitalis whose indication is based on clinical, electrocardiographic and laboratory (serum potassium).

9 Redo (*Coriaria myrtifolia* L.)

This is a common shrub of Mediterranean regions whose fruit roughly resemble blackberries. All parts of the plant contain a sesquiterpene lactone (coriamyrtine) having a structural similarity with the picotixine and anisatin. The most common cause of poisoning is ingestion of fruit, especially in children.

The symptoms usually occur between 30 minutes and 2 hours of ingestion and associate: digestive (gastrointestinal pain, vomiting), neurological disorders (in order of frequency: convulsions, confusion, hypertension and muscle cramps, fainting, coma, disorientation, lockjaw and opisthotonos, headache, agitation) and breathing problems (rapid breathing, apnea). Treatment is symptomatic ^[33,34].

10 Vératre (*Veratrum album* L., Fig. 8)

The white hellebore (known in Europe), also known as white hellebore (white hellebore or poison lilly, English), belongs to lafamille Liliaceae.

It is a perennial herb of the mountainous regions of Europe. The flowers form a long white cluster to the end of the rod. The fruits are in the form of a brown ovoid capsule containing seeds. The plant contains many alkaloids including protovératrine A and B ^[35]. The main pathophysiological mechanism of poisoning is related to the increase in the permeability of sodium channels ^[36]. Poisonings occur mainly in adults by confusion with gentian (*Gentiana lutea* L.) in the liqueur crafted from the roots, the two species share the same habitat. Symptoms appear after 30 minutes to 3 hours and are characterized by digestive disorders (nausea, vomiting, abdominal pain), cardiovascular disorders (bradycardia, hypotension, conduction disorders) and neurological disorders (visual disturbances, dizziness, paresthesia, confusion) ^[37,38]. Symptoms usually resolve within 24 to 48 hours. Treatment is symptomatic. Atropine is effective bradycardia.

11 Conclusion

A number of plants contain cardiotoxic and neurotoxic alkaloids. Their use can cause serious intoxications whose diagnosis may be disregarded in the absence of accurate history. It is therefore appropriate for every patient in a context of digestive disorders with cardiovascular disorders and / or neurological symptoms (paraesthesia, confusion, convulsions) to discuss the hypothesis of plant poisoning. A blood sample is to allow the admission, if any, to provide a measurement of specific alkaloids in order to confirm the diagnosis and to advance in the study of a clinicopathologic correlation for cases of poisoning infrequent, and caused



Figure 8. Redoul

serious by agents in our immediate environment.

Conflict of interest

The authors declare that no conflict of interest.

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