Toxicon 56 (2010) 273–281

Contents lists available at ScienceDirect

Toxicon

journal homepage: www.elsevier.com/locate/toxicon

Review

A review of the natural history, toxinology, diagnosis and clinical management of *Nerium oleander* (common oleander) and *Thevetia peruviana* (yellow oleander) poisoning

Veronika Bandara [a,*], Scott A. Weinstein [a], Julian White [a], Michael Eddleston [b]

[a] Department of Toxinology, Women's and Children's Hospital, 72 King William Road, North Adelaide, SA 5006, Australia
[b] National Poisons Information Service - Edinburgh, Royal Infirmary of Edinburgh, and Clinical Pharmacology Unit, University of Edinburgh, Edinburgh, UK

ARTICLE INFO

Article history:
Received 2 September 2009
Received in revised form 2 March 2010
Accepted 21 March 2010
Available online 8 May 2010

Keywords:
Oleander
Plant poisoning
Yellow oleander
Thevetia peruviana
Nerium oleander

ABSTRACT

Nerium oleander (common oleander) and *Thevetia peruviana* (yellow oleander) are potentially lethal plants after ingestion. Poisoning by these plants is a common toxicological emergency in tropical and subtropical parts of the world and intentional self-harm using *T. peruviana* is prevalent in South Asian countries, especially India and Sri Lanka. All parts of these plants are toxic, and contain a variety of cardiac glycosides including neriifolin, thevetin A, thevetin B, and oleandrin. Ingestion of either oleander results in nausea, vomiting, abdominal pain, diarrhoea, dysrhythmias, and hyperkalemia. In most cases, clinical management of poisoning by either *N. oleander* or *T. peruviana* involves administration of activated charcoal and supportive care. Digoxin specific Fab fragments are an effective treatment of acute intoxication by either species. However, where limited economic resources restrict the use of such Fab fragments, treatment of severely poisoned patients is difficult. Data from case reports and clinical studies were reviewed to identify treatments supported by evidence for the management of poisoning by *N. oleander* and *T. peruviana*.

1. Introduction

1.1. Taxonomy and distribution

The two common species *Nerium oleander* Linn (common, white, or pink oleander) and *Thevetia peruviana* Juss (yellow oleander) belong to the Dogbane family, Apocynaceae. *N. oleander* is native to Mediterranean regions of Africa and Europe, and *T. peruviana* to tropical America (Shepherd, 2004). Both species have been cultivated as ornamental shrubs throughout the tropical and subtropical parts of the world. However, in some parts of the world they are considered noxious weeds (Shepherd, 2004).

1.2. Descriptions

N. oleander (Fig. 1) is an evergreen shrub or small tree. Leaves are linear, leathery and dark green to grey green, with distinct light yellowish veins. Flowers are in clusters at the tip of twigs. Flowers are white to pink to deep red, with 5 spreading petals. The fruit is a narrow pod and contains many silky-haired seeds. The sap is thick, gummy and clear (Shepherd, 2004).

T. peruviana (Fig. 2) is a shrub or a tree, with a diffusely branched and dense crown. Leaves are dark green, glossy and linear. Flowers are in small clusters at the tip of twigs. Flowers are yellow to dull orange or peach, tubular, with 5 petal lobes. The fruit is a fleshy, triangular drupe, green

* Corresponding author. Department of Toxinology, Women's and Children's Hospital, 72 King William Road, North Adelaide, SA 5006, Australia. Tel.: +61 8 8161 7000; fax: +61 8 8161 8024.
E-mail address: veronika.bandara@adelaide.edu.au (V. Bandara).

0041-0101/$ – see front matter © 2010 Elsevier Ltd. All rights reserved.
doi:10.1016/j.toxicon.2010.03.026

Fig. 1. *Nerium oleander* (common oleander). Photograph by Julian White.

turning yellow, and then black and contain two seeds. The sap is milky white (Shepherd, 2004).

2. Toxicology

N. oleander and *T. peruviana* are well known for their toxicity. All parts of the plants contain cardiac glycosides (Table 1) including: stems, leaves, young shoots, flowers, nectar, sap and products induced by combustion (Langford and Boor, 1996; Oji and Okafor, 2000). Karawya et al. (1973) reported that seeds and roots of *N. oleander* contained the highest percentage of cardiac glycosides followed by fruits and leaves. The total cardiac glycoside content was higher in plants producing red flowers than in plants producing white flowers at all stages of growth, with the highest concentration in the flowering stage (Karawya et al., 1973). All parts of *T. peruviana* contain cardiac glycosides with the highest concentration in the kernel of seeds, followed by leaves, fruit and sap (Kyerematen et al., 1985; Saravanapavananthan and Ganeshamoorthy, 1988). These cardiac glycosides are structurally similar to digitoxin of the foxglove plant (Langford and Boor, 1996).

Fig. 2. *Thevetia peruviana* (yellow oleander). Photograph by Julian White.

Table 1
Cardiac glycosides found in oleander species (Langford and Boor, 1996; Kyerematen et al., 1985; Yamauchi et al., 1983; Karawya et al., 1973).

Common oleander (*N. oleander*)	Yellow oleander (*T. peruviana*)
Oleandrin	Thevetin A
Folineriin	Thevetin B
Adynerin	Thevetoxin
Digitoxigenin	Neriifolin
	Peruvoside
	Ruvoside

In spite of their toxicity *N. oleander* and *T. peruviana* have been used as abortifacients, as well as therapeutics for heart failure, leprosy, malaria, ringworm and indigestion (Osterloh et al., 1982). In the early 1930s the therapeutic value of the cardiac glycoside in *T. peruviana* was studied. It was found to promote diuresis in patients with heart failure and slow ventricular response in patients with atrial fibrillation. However it is no longer used as a therapeutic due to its substantial adverse gastrointestinal side effects (Middleton and Chen, 1936). Several researchers have reported their potential as insecticides, molluscides, rodenticides and antibacterial agents (Obasi and Igoboechi, 1991; Oji and Okafor, 2000; Osterloh et al., 1982). The potential of oleander extract as a chemotherapeutic agent has been studied (Nasua et al., 2002; Newman et al., 2007).

2.1. Toxic dose

Ingestion of 5–15 *N. oleander* leaves has resulted in a fatal poisoning (Osterloh et al., 1982). Other fatalities after ingestion of unknown amounts of *N. oleander* have been reported (Wasfi et al., 2008; Blum and Rieders, 1987; Haynes et al., 1985). Shaw and Pearn (1979) suggested that even one leaf of *N. oleander* could be toxic to children. However, they also reviewed the case of a seven-year-old child who ingested three *N. oleander* leaves and only had mild poisoning and recovered without complications. Several more nonfatal cases have been reported with different levels of toxicity after ingesting varying amounts of *N. oleander* leaves, leaf extract, flowers, and root extract (Pietsch et al., 2005; Le Couteur and Fisher, 2002; Monzani et al., 1997; Durakovic et al., 1996; Driggers et al., 1989; Shumaik et al., 1988). Tracqui et al. (1998) reported a case of moderate toxicity in an adult female after ingestion of five handfuls of *N. oleander* leaves in a suicide attempt, but the patient recovered completely after symptomatic care. Therefore, it is difficult to determine the lethal dose for *N. oleander* poisoning as there are few published case reports that contain data sufficient to assess specific quantities/ingested doses. The toxic dose will vary depending on several factors; such as the amount, plant part, and toxin concentration in the plant part ingested, and age and health of the patient at the time of ingestion.

Ingestion of 8–10 *T. peruviana* seeds can be fatal to adults (Saravanapavananthan, 1985). However, Eddleston et al. (1999) reported that the number of *T. peruviana*