Original Article

Clinical Outcomes of Oleander Seed Poisoning Based on Biochemical and Cardiac Parameters

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Abstract

Background: Oleander seed poisoning is common in Villupuram district of Tamil Nadu, India, and its neighbouring districts.

Objectives: To assess the clinical outcomes of oleander seed poisoning based on biochemical and cardiac parameters. We also analysed the clinical course of patients with oleander seed poisoning with reference to clinical profile, ECG changes, echocardiographic changes, and electrolytic changes.

Methods: This was a single centre nonrandomized prospective observational study conducted in the Department of General Medicine, Government Villupuram Medical College, Villupuram, Tamil Nadu, India between November 2019, and December 2021. The study included hundred consecutive patients (18 to 60 years of age and admitted within 24 hours of consumption) of oleander seed poisoning. The patients were followed up with electrocardiography, echocardiography, and specified laboratory investigations.

Results: Majority (96.0%) of the patients had complete recovery, whereas two patients were referred to higher institution and two patients died. Nearly half (48.0%) the patients developed cardiotoxicity following Oleander seed consumption (34.0% had mild and 14.0% had severe cardiotoxicity). The highest incidence of cardiotoxicity was on day 1 and 2. The most common abnormal findings were bradycardia (40.0%); 10.0% patients had SA nodal exit block and 30.0% had sinus bradycardia. Cardiotoxicity was higher among patients consuming yellow Oleander seeds (95.8%), crushing the seeds before swallowing (87.8%), consumption in empty stomach (60.9%), not given first aid (64.3%), and among patients presenting to hospital beyond five hours of consuming Oleander seeds (71.4%). Patient outcome (recovery or death or referral) correlated with the number of seeds consumed. It was found that 75.0% of those who consumed more than five seeds developed severe cardiotoxicity. More than half (54.0%) the patients had GI manifestations; vomiting was the commonest symptom reported by 41.0%. The most common non-GI symptom reported was giddiness (37.0%). In echocardiography, 7 patients had features suggestive of toxic myocarditis including global hypokinesia and decreased LV systolic function.

Conclusion: Oleander seed poisoning is a significant healthcare concern in rural south India. Cardiotoxicity is the prominent feature of Oleander seed poisoning. It is the need of the hour to explore the sociological and psychiatric aspects of oleander seed poisoning. Alongside, better, early diagnostic facilities and medical treatments (overall, a holistic strategy) should be developed.

Keywords: Oleander seed poisoning, cardiac outcomes, arrythmias, cardiotoxicity, toxic myocarditis

INTRODUCTION

Poisoning is a common mode of suicidal attempt and is very common in South India.[1] Younger age group is commonly involved, and this has a significant negative impact on the productive years of life.[2, 3] Also, poisoning is associated with mortality, morbidity, and major health care expenses. More than two third Indians are associated with agriculture, and organic poisons are easily accessible to this group.[4] Easy accessibility and knowledge of the toxic nature of different vegetative poisons makes it a choice for the widespread use of these poisons as a mode of suicidal attempt among Indian population.

Organic poisons are predominantly vegetative poisons. Based on their systemic actions they can be local irritants (Calotropis, Castor) and neurotoxins (including convulsant like Strychnine, sedatives like Opium and alkaloids, deliriants like Atropa belladonna and Datura stramonium, cardiotoxins like Aconite, Oleander and Digitalis).[5] Oleander is a plant that commonly grows in the wild and is also grown as an ornamental plant.[6] The flowers are in shades of yellow and purple and their prolific growth in wide variety of environmental conditions and their ability to survive with less water makes them a popular choice of shrub for landscaping. Based on the colour of the flower they are of two major types – pink/purple Oleander (Nerium Oleander) and yellow oleander (Thevetia peruviana).[7]

The oleander is a plant grown for its aesthetic appeal. It is grown commonly in homes and gardens. The plant contains cardiac glycosides (including neriifolin, thevetin A, thevetin B, and oleandrin) that are poisonous to cardiac muscle and clinically produces a picture similar to digoxin toxicity.[8, 9] Every part of the Oleander plant is toxic.[10] Gastrointestinal symptoms are the earliest to develop and most frequently reported. They are nonspecific, including nausea, vomiting, diarrhoea and abdominal pain. Bradycardia with AV block, dysrhythmias, hyperkalaemia, hypotension, lethargy, confusion, dizziness, drowsiness, weakness, visual disturbances, and mydriasis are more serious manifestations of toxicity.[11] The vagotonic effects are due to inhibition of Na^+-K^+-ATPase.[12, 13] Most patients also experience numbness with a burning sensation of the mouth initially on chewing the seeds.[14] Regarding fatal dose, the general consensus is that eight to ten seeds are fatal.[15] The perineal availability of oleander seeds, the easy accessibility due to its local availability and the common knowledge among the population about its toxicity and the ability to acquire it without any cost makes it an ideal choice as a suicidal poison.

Though global evidence highlights that Oleander poisoning constitutes 10.0% of the total poisonings,[12] such data for Indian population has not been estimated. Oleander seed poisoning is common in Villupuram district of Tamil Nadu, India, and its neighbouring districts. Against this background the primary objective of the study were to assess the clinical outcomes of oleander seed poisoning based on biochemical and cardiac parameters. The secondary objective was to analyse the clinical course of patients with oleander seed poisoning with reference to clinical profile, ECG changes, echocardiographic changes, and electrolytic changes.

MATERIALS AND METHODS

This was a single centre nonrandomized prospective observational study conducted in the Department of General Medicine, Government Villupuram Medical College, Villupuram, Tamil Nadu, India between November 2019, and December 2021. The study included hundred consecutive patients of oleander seed poisoning admitted in Government Villupuram Medical College, conveniently, provided the cases were between 18 and 60 years of age and admitted within 24 hours of consumption. However, patients with known history of cardiovascular diseases, dyselectrolytemias, underlying severe renal or hepatic disease, patients on cardiac drugs (including Digoxin, Diuretics, Verapamil, Diltiazem, Beta blockers, ACE inhibitors, Amiodarone), patients on calcium and potassium supplements, patients who had ingested plant parts other than seed, and with cardiac pacemakers were excluded from the study.

The study was approved by Institute Ethics Committee, Government Villupuram Medical College, Villupuram, Tamil Nadu, India. The content of Participant Information Sheet (PIS) in local language was provided to the study subjects and contents were read to them in their own language to their satisfaction. The study subjects were enrolled in the study after obtaining written informed consent. A detailed clinical history and examination was done. All the cases were kept in close follow up till clinical recovery or death. We collected basic socio-demographic details, details regarding the source and events related to poisoning such as colour of the plant flower (yellow or pink), number of seeds ingested, form of consumption (crushed before swallowing or swallowed as a whole), taken in empty stomach or with food, time interval between poisoning and hospitalization and details of first aid given. Patients were followed up with ECG (on admission, twice on day two and once daily until discharge or death), echocardiography (on day two of admission) and laboratory investigations (including random blood sugar, blood urea, serum creatinine, liver function tests, serum potassium, serum sodium and serum calcium).

Regarding the course of treatment, all the patients were initially treated with gastric lavage using normal saline and was kept nil per oral for 12 hours. The patients were treated with IV fluids under monitoring. If sinus bradycardia was present Orciprenaline was started and given until bradycardia resolved. If there was severe bradycardia with heart rate less than 40 beats per minute, the patients were kept in ICU with cardiac monitoring. They were treated with small bolus doses of Atropine. Temporary Cardiac pacing and digoxin specific antibodies were not available in the hospital and hence could not be administered.

The data were entered in Microsoft Excel datasheet and analysed using the STATA 16.0 version [Statistical Software: Release 14. College Station, TX: Stata Corp LP]. Descriptive analysis was precented using numbers (frequencies), percentages, measures of central tendency (mean) and dispersion (standard deviation). Tables and graphs were made as appropriate. Tests of association was performed using univariate and multivariate analysis and p value less than 0.05 was considered statistically significant.

RESULTS

The present study included hundred patients of oleander seed poisoning. The mean (SD) age of the patients was 29.2 years (9.88), ranging between 19 and 58 years. Majority of the patients were between 18 and 30 years of age (65.0%) with preponderance of females across all age groups. Overall, majority (60.0%) of the patients were females with a ratio of 1.5:1. Almost all (94.0%) of the patients consumed yellow Oleander seeds and 6.0% consumed pink Oleander seeds. Patients consumed Oleander seeds either by swallowing the seed as a whole (33.0%), chewing (34.0%) or by crushing the seeds before consuming (33.0%). Regarding the timing of consumption, nearly two third (64.0%) patients consumed the poison in an empty stomach, whereas the remaining 36.0% consumed after food intake. Suicidal intention was behind 86.0% of patients who consumed Oleander seeds. There were no cases of homicidal or accidental poisonings in our study.

We found that the total number of seeds consumed in the group with suicidal intention was higher than their counterparts. Also, patients with suicidal intention either crushed or chewed the seeds before consumption.

In the present study, 44.0% of the patients were given first aid in the form of induced vomiting using salt water or tamarind water or soap water locally immediately after identifying intake of Oleander seeds. Nearly two third patients (64.3%) who were not given first aid initially developed some form of cardiotoxicity ($p<0.05$). The mean delay in getting to Government Villupuram Medical College after consumption of poison was 1 hour and 18 minutes, ranging between 15 minutes to 18 hours. Of the 14 patients who presented to hospital beyond five hours of consumption of Oleander seed poisoning, 71.4% developed cardiotoxicity. On the other hand, only 5.2% patients developed severe cardiotoxicity among those who presented to hospital in less than 1 hour ($p<0.05$).

It was observed that the outcome correlated with the number of seeds consumed. There was no history of adverse outcome in those who consumed up to two seeds and this represented a major proportion of our study population (68.0%). Importantly, it was found that 75.0% of those who consumed more than five seeds developed severe cardiotoxicity; of which one patient was referred for pacing and two patients died.

Symptomatology of the poisoning: Gastrointestinal symptoms were the most common. More than half (54.0%) the patients had GI manifestations. Vomiting was the commonest symptom reported by 41.0%, followed by 30.0% patients reporting abdominal pain, and 23.0% reporting loose stools. More than one in three (36.0%) patients reported oral numbness – common among patients who chewed the Oleander seeds or consumed crushed seeds. The most common non-GI symptom reported was giddiness (37.0%).

Vital signs and biochemical parameters: The range, mean and standard deviation values of pulse rate, blood pressure and biochemical parameters are presented in Table 5. The mean values of all these measured parameters were within normal limits. One in ten patients (11.0%) had irregular pulse rate on admission. Hypotension was present in two cases at admission.

Cardiotoxicity In Oleander seed Poisoning: The study results show that 48.0% patients developed cardiotoxicity following Oleander seed consumption. Two patients were referred to higher institution (tertiary care referral centre) for cardiac pacing and further management, whereas two patients died (96 patients were discharged following complete recovery). The most common abnormal findings observed in patients with oleander seed poisoning was bradycardia (40.0%); 10.0% patients had SA nodal exit block and 30.0% had sinus bradycardia. Digoxin effect and associated ST-T changes were observed in 25 cases. Many patients had a combination of ECG changes like sinus bradycardia with Digoxin Effect. Patients with Digoxin effect mainly had down sloping ST depression**,** flattened, inverted, or biphasic T waves or shortened QT interval. The patients who did not develop arrhythmias were predominantly those who swallowed the seed as a whole or consumed small number of seeds. The highest incidence of cardiotoxicity was on day 1 and 2 following which there was a significant reduction in the incidence of arrhythmias in the study. The follow up ECGs showed a gradual resolution of cardiotoxicity on subsequent days wherein 63.0% of patients recovered from cardiotoxicity on day 2, 80.0% recovered on day 3 and 90.0% recovered on day 4. Echocardiography was normal in 93 patients whereas 7 patients had features suggestive of toxic myocarditis including global hypokinesia and decreased LV systolic function.

In the present study, 34.0% patients had mild cardiotoxicity and 14.0% had severe cardiotoxicity. Of the 48 patients who developed cardiotoxicity, 46 (95.8%) had consumed yellow Oleander seeds and two (4.2) had consumed pink Oleander seeds. None of the patients who consumed the seeds of pink oleander developed severe cardiotoxicity, whereas 18.1% patients who consumed yellow oleander developed severe cardiotoxicity. The incidence of cardiotoxicity was highest (87.8%) among patients who crushed the seeds before swallowing ($n=29$); there was 26.6 times increased risk of cardiotoxicity in patients who consumed Oleander seeds after crushing the seeds ($p<0.05$). A higher incidence of cardiotoxicity was observed among those patients who consumed Oleander seeds in empty stomach ($n = 39$, 60.9%) compared to those who consumed the poison after food intake ($p<0.05$).

DISCUSSION

Oleander plant is common in Tamil Nadu – it grows in wild as well grown as an ornamental plant.[1] Literature evidence shows that there are multiples reports of Oleander poisoning, attributed to both accidental and suicidal causes.[16-18] Poisoning is a common modality of self-harm and because oleander is an easily accessible poisonous seed, that is available free of cost and the common knowledge of its toxic potential makes it an ideal choice for those with suicidal intention – for which rural agricultural community of Tamil Nadu is a vulnerable subgroup. Against this background the present study assessed the clinical outcomes of oleander seed poisoning based on biochemical and cardiac parameters. The study also analysed the clinical course of patients with oleander seed poisoning with reference to clinical profile, ECG changes, echocardiographic changes and electrolytic changes.

Seeds of Oleander are the most toxic parts of the plant and lethal dose is largely variable depending upon the number of seed intake, the mode of consumption and delay in seeking healthcare. Oleander seeds contain highly active cardiac glycosides like oleandrin, nerin, thevetin, digitoxigenin, and olinerin of which oleandrin is the principal toxin.[19-21] The main toxicity of concern that develops with Oleander is its characteristic cardiotoxicity, which is similar to that of digoxin

toxicity.[22] The increased amounts of intracellular calcium can result in spontaneous depolarisations and enhanced arrhythmogenicity. They can cause lethal brady and tachyarrhythmias including asystole and ventricular fibrillation.[23] In the present study, the mean age of cases who consumed Oleander seeds was 29.19 years. This was similar to the mean age reported by similar other studies from India and Sri Lanka.[17, 24] Yellow oleander was the predominant species consumed when compared to pink oleander (6.0%). Previous studies have also identified similar pattern of preference of yellow oleander to pink oleander for suicidal consumption.[1] None of the patients who consumed the seeds of pink oleander developed cardiotoxicity, whereas 18.1% cases which consumed yellow oleander developed severe cardiotoxicity. More than half (54.0%) the patients in the present study had gastrointestinal manifestations including vomiting, oral numbness, diarrhoea, and abdominal pain. These findings corroborated with that reported in a previous study conducted by Gopalakrishnan et al. in Villupuram district.[1] It was found that 54.5% patients had vomiting, 21.8% had giddiness, 10.9% had abdominal pain and 8.9% had diarrhoea.

It was identified in the present that the incidence of cardiotoxicity was higher among patients who ingested higher number of seeds even though the correlation was nonlinear. Similarly, Gopalakrishnan et al. reported that the incidence of cardiotoxicity was higher among those who consumed more than three seeds.[1] However, in contrast to the findings of both the studies, Eddleston et al. reported that the incidence of cardiotoxicity did not increase proportionately with the number of Oleander seeds ingested.[24] The variation in study findings may be attributed to the fact that the studies did not mention the mode and form of ingestion of Oleander seeds.

The reported mortality in the present study is 2.0%. Both were females and had consumed five crushed seeds. One of the cases arrived at the hospital after 12 hours of poison consumption. Females have a higher likelihood of adverse outcomes and higher incidence of development of cardiotoxicity probably because of lesser body mass index than their male counterparts resulting in more significant amount of toxins per kilogram bodyweight. These findings were similar to that described by Gopalakrishnan et al.[1]

Patients in the present study reported wide range of cardiac manifestations including sinus bradycardia, atrial ectopics, ST-T changes and first-degree heart block. Severe cardiotoxicity was characterised by exit blocks, junctional rhythm, second degree heart block, third degree heart block and AV dissociation. Cardiotoxicity was seen in 48.0% of patients, of which 14.0% had severe cardiotoxicity. These findings corroborated with that reported by Zamani et al.[20] We found higher toxicity profile in patients consuming Oleander seeds in empty stomach (60.9%) compared to those who consumed the poison after a meal (25.0%) – a statistically significant finding ($p<0.05$). This is because consumption of Oleander seed in an empty stomach mostly results in a greater amount of systemic absorption of toxin thereby resulting in higher incidence of cardiotoxicity in this group.

The consumption of dried crushed or chewed seeds (87.9%) of yellow oleander had a much higher toxicity profile than those who swallowed the seed as a whole (3.3%). Crushing seeds releases greater amounts of active components which are mainly cardiac glycosides and thereby resulting in a greater toxicity.[25]

In the present study, majority of the patients had normal potassium levels. The likelihood of developing severe cardiotoxicity was 5.9 times higher among patients with hyperkalaemia ($p<0.05$) compared to a patient with normal potassium levels. The blockade of sarcolemmal Na^+-K^+-ATPase pump can result in hyperkalaemia along with increased intracellular calcium concentrations that predispose to arrhythmias.[26] However, we did not find any association between the Oleander seed consumption and other biochemical parameters like serum sodium, serum calcium and random blood sugar with development of cardiotoxicity and adverse outcomes. The mean duration of hospital stay was 5.5 days, ranging between two and ten days. This was similar to other studies published from the region.[17, 22, 24] Those who developed significant cardiotoxicity had a longer duration of hospital stay and required longer supportive care due to obvious reasons.
The present study is not without limitations. Firstly, the estimation of blood cardiac glycoside levels was not done. Secondly, anti-digoxin Fab fragments were not administered and temporary pacemaker insertion for AV blocks were not done.[27] These were primarily due to nonavailability of tests and treatment; and financial constraints.

It is the need of the hour to explore the sociological and psychiatric aspects of oleander seed poisoning. Alongside, better, early diagnostic facilities and medical treatments (overall, a holistic strategy) should be developed. The presence of various cardiac glycosides in Oleander seeds may delay the development of an antidote formulation. However, the therapeutic efficacy, effectiveness and economic feasibility of Digoxin antibodies and cardiac pacing should be investigated.

CONCLUSION

To conclude, Oleander seed poisoning is a significant healthcare concern in rural south India. Cardiotoxicity is the prominent feature of Oleander seed poisoning. Consumption of larger number of seeds in the crushed or chewed form, consumption of seeds in an empty stomach, delayed presentation to hospital and female gender predisposed to cardiotoxicity and adverse outcomes. The range of cardiac manifestations included sinus bradycardia, atrial ectopics, ST-T changes and first-degree heart block. Severe cardiotoxicity was characterised by exit blocks, junctional rhythm, second

degree heart block, third degree heart block and AV dissociation. Hyperkalaemia and presence of cardiogenic shock were harbingers of adverse outcomes.

REFERENCES

1. S. K. Gopalakrishnan, S. Kandasamy, B. Isaac, C. Jayasankar, and C. Chandru, "Oleander Toxicity–the clinical spectrum and mortality predictors: an observational study," Internet Journal of Medical Update-EJOURNAL, vol. 12, no. 1, pp. 4-8, 2017.
2. D. Saikia, R. K. Sharma, and K. V. Janardhan, "Clinical profile of poisoning due to various poisons in children of age 0-12 years," (in eng), J Family Med Prim Care, vol. 9, no. 5, pp. 2291-2296, May 2020, doi: 10.4103/jfmpc.jfmpc_365_20.
3. C. Soman, S. Safraj, V. R. Kutty, K. Vijayakumar, and K. Ajayan, "Suicide in South India: a community-based study in Kerala," Indian journal of psychiatry, vol. 51, no. 4, p. 261, 2009.
4. T. Bonvoisin, L. Utyasheva, D. Knipe, D. Gunnell, and M. Eddleston, "Suicide by pesticide poisoning in India: a review of pesticide regulations and their impact on suicide trends," (in eng), BMC Public Health, vol. 20, no. 1, p. 251, Feb 19 2020, doi: 10.1186/s12889-020-8339-z.
5. S. Patel, M. K. Nag, S. Daharwal, M. R. Singh, and D. Singh, "Plant toxins: an overview," Research journal of Pharmacology and Pharmacodynamics, vol. 5, no. 5, p. II, 2013.
6. P. Gopalakrishnakone, C. R. Carlini, and R. Ligabue-Braun, Plant toxins. Springer, 2017.
7. V. Bandara, S. A. Weinstein, J. White, and M. Eddleston, "A review of the natural history, toxinology, diagnosis and clinical management of Nerium oleander (common oleander) and Thevetia peruviana (yellow oleander) poisoning," Toxicon, vol. 56, no. 3, pp. 273-281, 2010.
8. S. D. Langford and P. J. Boor, "Oleander toxicity: an examination of human and animal toxic exposures," (in eng), Toxicology, vol. 109, no. 1, pp. 1-13, May 3 1996, doi: 10.1016/0300-483x(95)03296-r.
9. T. Farkhondeh, M. Kianmehr, T. Kazemi, S. Samarghandian, and M. Khazdair, "Toxicity effects of Nerium oleander, basic and clinical evidence: A comprehensive review," Human & experimental toxicology, vol. 39, no. 6, pp. 773-784, 2020.
10. D. Shaw and J. Pearn, "Oleander poisoning," Medical journal of Australia, vol. 2, no. 5, pp. 267-269, 1979.
11. I. Khan, C. Kant, A. Sanwaria, and L. Meena, "Acute cardiac toxicity of nerium oleander/indicum poisoning (kaner) poisoning," (in eng), Heart Views, vol. 11, no. 3, pp. 115-6, Oct 2010, doi: 10.4103/1995-705x.76803.
12. V. V. Pillay and A. Sasidharan, "Oleander and datura poisoning: an update," Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine, vol. 23, no. Suppl 4, p. S250, 2019.
13. T. K. Bose, R. K. Basu, B. Biswas, J. N. De, B. C. Majumdar, and S. Datta, "Cardiovascular effects of yellow oleander ingestion," (in eng), J Indian Med Assoc, vol. 97, no. 10, pp. 407-10, Oct 1999.
14. M. K. Davies and A. J. Mayne, "Oleander poisoning," (in eng), Arch Dis Child, vol. 84, no. 1, p. 9, Jan 2001, doi: 10.1136/adc.84.1.9.
15. S. Rajapakse, "Management of yellow oleander poisoning," Clinical Toxicology, vol. 47, no. 3, pp. 206-212, 2009.
16. A. Carfora, R. Petrella, R. Borriello, L. Aventaggiato, R. Gagliano-Candela, and C. P. Campobasso, "Fatal poisoning by ingestion of a self-prepared oleander leaf infusion," Forensic Science, Medicine and Pathology, vol. 17, no. 1, pp. 120-125, 2021/03/01 2021, doi: 10.1007/s12024-020-00338-w.
17. L. Senarathna, S. F. Jayamanna, P. J. Kelly, N. A. Buckley, M. J. Dibley, and A. H. Dawson, "Changing epidemiologic patterns of deliberate self poisoning in a rural district of Sri Lanka," BMC Public Health, vol. 12, no. 1, p. 593, 2012/08/02 2012, doi: 10.1186/1471-2458-12-593.
18. S. Rubini et al., "A Probable Fatal Case of Oleander (Nerium oleander) Poisoning on a Cattle Farm: A New Method of Detection and Quantification of the Oleandrin Toxin in Rumen," (in eng), Toxins (Basel), vol. 11, no. 8, Jul 25 2019, doi: 10.3390/toxins11080442.
19. A. Kumar, T. De, A. Mishra, and A. K. Mishra, "Oleandrin: A cardiac glycosides with potent cytotoxicity," (in eng), Pharmacogn Rev, vol. 7, no. 14, pp. 131-9, Jul 2013, doi: 10.4103/0973-7847.120512.
20. J. Zamani and A. Aslani, "Cardiac findings in acute yellow oleander poisoning," (in eng), J Cardiovasc Dis Res, vol. 1, no. 1, pp. 27-8, Jan 2010, doi: 10.4103/0975-3583.59982.
21. S. Senthilkumaran, S. Saravanakumar, and P. Thirumalaikolundusubramanian, "Cutaneous absorption of Oleander: Fact or fiction," (in eng), J Emerg Trauma Shock, vol. 2, no. 1, pp. 43-5, Jan 2009, doi: 10.4103/0974-2700.44682.
22. D. Anandhi, K. N. J. Prakash Raju, M. H. Basha, and V. R. Pandit, "Acute myocardial infarction in yellow oleander poisoning," (in eng), J Postgrad Med, vol. 64, no. 2, pp. 123-126, Apr-Jun 2018, doi: 10.4103/jpgm.JPGM_141_17.
23. D. Anandhi, K. N. J. Prakash Raju, M. H. Basha, and V. R. Pandit, "Acute myocardial infarction in yellow oleander poisoning," (in eng), J Postgrad Med, vol. 64, no. 2, pp. 123-126, Apr-Jun 2018, doi: 10.4103/jpgm.JPGM_141_17.
24. G. Karthik et al., "Acute oleander poisoning: A study of clinical profile from a tertiary care center in South India," (in eng), J Family Med Prim Care, vol. 9, no. 1, pp. 136-140, Jan 2020, doi: 10.4103/jfmpc.jfmpc_632_19.
25. M. Eddleston et al., "Epidemic of self-poisoning with seeds of the yellow oleander tree (Thevetia peruviana) in northern Sri Lanka," (in eng), Trop Med Int Health, vol. 4, no. 4, pp. 266-73, Apr 1999, doi: 10.1046/j.1365-3156.1999.00397.x.
26. G. Indhumathi, "Analysis of Clinical Profile, Cardiac Arrhythmias and Electrolyte Disturbances in Patients with Acute Yellow Oleander Poisoning," Madras Medical College, Chennai, 2010.
27. J. N. Weiss, Z. Qu, and K. Shivkumar, "Electrophysiology of Hypokalemia and Hyperkalemia," (in eng), Circ Arrhythm Electrophysiol, vol. 10, no. 3, Mar 2017, doi: 10.1161/circep.116.004667.
28. G. M. Shumaik, A. W. Wu, and A. C. Ping, "Oleander poisoning: Treatment with digoxin-specific fab antibody fragments," Annals of Emergency Medicine, vol. 17, no. 7, pp. 732-735, 1988, doi: 10.1016/S0196-0644(88)80625-5.

Table 1: Distribution of patient characteristics and poisoning related variables

Variables		N = 100 n	Percent (%)
Age (in years)	18 to 30	65	65.0
	31 to 50	24	24.0
	51 to 60	11	11.0
Gender	Male	40	40.0
	Female	60	60.0
Type of Oleander	Yellow	94	94.0
	Pink	6	6.0
Mode of consumption	Swallowed	33	33.0
	Chewed	34	34.0
	Crushed	33	33.0
Timing of consumption	Empty stomach	64	64.0
	After food intake	36	36.0
Intention	Suicidal	86	86.0
	Parasuicidal*	14	14.0

*Intention was not of killing oneself but was meant as a threat to frighten the relatives or to leverage a situation for some personal gain or to resolve conflict

Table 2: Factors related to cardiotoxicity

Factors related to cardiotoxicity		Cardiotoxicity		Total n (%)
		No N = 52	Yes N = 48	
Manner of consumption	Swallowed	32 (61.5)	1 (2.1)	33 (33.0)
	Chewed	16 (30.8)	18 (37.5)	34 (34.0)
	Crushed	4 (7.7)	29 (60.4)	33 (33.0)
First aid	Given	16 (30.8)	18 (37.5)	34 (34.0)
	Not given	36 (69.2)	30 (62.5)	66 (66.0)
Admission interval (in hours)	<1	16 (30.8)	3 (6.3)	19 (19.0)
	1 to 5	32 (61.5)	35 (72.9)	67 (67.0)
	>5	4 (7.7)	10 (20.8)	14 (14.0)

Depending on the ECG changes, the cases of oleander poisoning were divided into no cardiotoxicity, mild cardiotoxicity and severe cardiotoxicity groups; No cardiotoxicity group – includes those presenting with sinus rhythm and sinus tachycardia; Mild cardiotoxicity – includes those with sinus bradycardia, atrial ectopics, ST-T changes and first degree heart block; Severe cardiotoxicity – includes exit blocks, junctional rhythm, second degree heart block, third degree heart block and AV dissociation

Table 3: Factors related to severe cardiotoxicity

Factors related to severe cardiotoxicity		Severe cardiotoxicity		Total n (%)
		No n = 86	Yes n = 14	
Serum potassium*	<3.5	0 (0.0)	0 (0.0)	0 (0.0)
	3.5 to 5	85 (98.8)	12 (85.7)	97 (97.0)
	>5	1 (1.2)	2 (14.3)	3 (3.0)
Serum sodium*	<135	20 (23.3)	4 (28.6)	24 (24.0)
	135 to 145	66 (76.7)	10 (71.4)	76 (76.0)
	>145	0 (0.0)	0 (0.0)	0 (0.0)
Serum calcium*	<8.5	9 (10.4)	2 (14.3)	11 (11.0)
	8.5 to 10.3	76 (88.4)	12 (85.7)	88 (88.0)
	>10.3	1 (1.2)	0 (0.0)	1 (1.0)

Depending on the ECG changes, the cases of oleander poisoning were divided into no cardiotoxicity, mild cardiotoxicity and severe cardiotoxicity groups; No cardiotoxicity group – includes those presenting with sinus rhythm and sinus tachycardia; Mild cardiotoxicity – includes those with sinus bradycardia, atrial ectopics, ST-T changes and first degree heart block; Severe cardiotoxicity – includes exit blocks, junctional rhythm, second degree heart block, third degree heart block and AV dissociation

*Statistically significant at $p<0.05$

Table 4: Factors related to patient outcomes

Factors related to patient outcomes		Outcome			Total n (%)
		Recovered n = 96	Expired n = 2	Referred n = 2	
Mode of consumption	Swallowed	33 (34.4)	0 (0.0)	0 (0.0)	33 (33.0)
	Chewed	33 (34.4)	0 (0.0)	1 (50.0)	34 (34.0)
	Crushed	30 (31.2)	2 (100)	1 (50.0)	33 (33.0)
Number of seeds consumed	1	31 (32.3)	0 (0.0)	0 (0.0)	31 (31.0)
	2	37 (38.5)	0 (0.0)	0 (0.0)	37 (37.0)
	3	18 (18.7)	0 (0.0)	1 (50.0)	19 (19.0)
	4	9 (9.4)	0 (0.0)	0 (0.0)	9 (9.0)
	5	1 (1.0)	2 (100)	0 (0.0)	3 (3.0)
	6	0 (0.0)	0 (0.0)	1 (50.0)	1 (1.0)

Table 5: Vital parameters and Biochemical profile

Parameter	Range	Mean	Standard Deviation
Pulse Rate on admission	38-124	76.8	22.4
Systolic Blood Pressure	68-156	114.4	16.1
Diastolic Blood Pressure	48-104	76.7	12.8
Random Blood Sugar	68-209	114.5	27.7
Blood Urea	12-52	22.4	9.1
Serum Creatinine	0.6-2.4	0.9	0.5

Serum Sodium	132-147	137.8	3.6
Serum Potassium	3.6-5.8	4.7	0.4
Serum Calcium	8-10.4	9.5	0.5

Table 6: ECG findings in Oleander seed poisoning

ECG findings	**Day 1**	**Day 2**	**Day3**	**Day 4**
Normal	52	63	80	90
Sinus Bradycardia	30	34	17	6
SA Nodal Exit Block	10	4	1	0
Digoxin Effect	25	16	6	0
Atrial Ectopics	3	1	0	0
1st degree AV Block	6	0	0	0
2nd degree AV Block	2	1	0	0
Complete Heart Block	2	1	0	0