

Eucalyptus oil inhalation–induced seizure: A novel, underrecognized, preventable cause of acute symptomatic seizure

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Epilepsia Open, 2(3):350–354, 2017

doi: 10.1002/epi4.12065



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SUMMARY

Eucalyptus oil (EO) is an essential oil that is widely used across the globe as an over-the-counter remedy for common ailments. **EO-induced seizure (EOIS)** has not been recognized as an entity, and physicians rarely ask the history of exposure to eucalyptus oil when seeing a patient with first episode of seizure. Here we report 10 cases of EO inhalation–induced seizures seen over the past 2 years in three tertiary care hospitals. Eight patients had GTCS and two had CPS. We aim to raise awareness of seizures induced by exposure to eucalyptus oil.

KEY WORDS: Epilepsy, Essential oils, Eucalyptus oil, Seizure.

Accepted May 28, 2017.

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Eucalyptus oil (EO) is an essential oil that has a history of wide application for purposes ranging from pharmaceutical to industrial. Owing to its easy availability in the market, it is commonly used as an over-the-counter remedy for treating common colds and sinusitis. EO, being a plant derivative, is generally thought to be safe, though plant-derived oils are known to have epileptogenic properties.¹ In recent times, there have been reports and open discussions in the literature and on social media concerning the safety of using plant-derived essential oils owing to their association with seizures. It is easily conceivable that, given the scarcity of published data, there is a lack of awareness among health-care professionals of the potential seizure risk caused by EO ingestion.

Objective

Through this retrospective study, we seek to describe clinical features, neuroimaging, and electroencephalographic findings in patients with EO-induced seizures.

MATERIALS AND METHODS

Our retrospective study was carried out over a period of two years from January 2015 to December 2016 across three tertiary care hospitals. The principal author saw the index and the following case. When he discussed these cases at a local neurological society meeting, similar encounters by other physicians were noted. A cohort of 10 patients was identified from three epilepsy centers. The respective physicians attending to the cases collected the details of individual patients. Case records were reviewed for demographic data, mode of exposure to EO, temporal relation to seizure, nature and number of attacks of seizure, previous and family history of seizure, neuroimaging and electroencephalograph (EEG) findings, antiepileptic treatment received, and recurrence of seizures. The collected data were entered into a tabulated form, and descriptive statistical methods were used where applicable.

This study is a retrospective observational study, and we have not revealed the identity of any patients nor have we included any pictures or images. We explained the study, its nature and purpose, to the patients and relatives and collected signed informed consent forms from the patients. We collected the consent of minors from their parents. All our patients were more than willing to participate in this study and wanted to spread the awareness among the general public.

RESULTS

During the period of two years from January 2015 to December 2016, there were 10 cases of EO-induced seizure (EOIS) identified by five neurologists in three tertiary care hospitals. Among 350 cases of acute symptomatic seizures per year, EOIS was seen in 5 patients, giving an annual incidence of 1.4%. The mean age of the cohort was 22.3 years (range 2–45 years). All patients were males. Eight out of 10 patients inhaled steam of water mixed with EO, 1 patient used EO as intranasal drops, and 1 patient used EO as massage oil. Seizures developed at an average of 4.1 min (range 2–10 min) after exposure to EO. Eight patients had generalized tonic-clonic seizure, and 2 had complex partial seizure. Ictal phase lasted for a few seconds to a few minutes. The mean duration of the postictal phase was 45 minutes (range 10–300 min). Nine patients had a first episode of seizure, and 1 had a breakthrough seizure. MRI of the brain was normal in all patients. EEG done after the event was normal in all except 3. Two patients had frontal slowing: bifrontal in 1, right frontal in another, and 1 had generalized spike and slow-wave discharges. Six patients were treated with antiepileptic medications, and 4 were closely monitored. The antiepileptic drugs were tapered and stopped over a period of 2 weeks

to 1 month. Patients were advised not to inhale EO again. All patients were followed up for a period of 3 months up to 24 months. None had recurrence of seizure.

We have described below the index case and the following case. Cases 3–10 are summarized in Table 1.

Case 1 (Index case)

A 29-year-old man presented with single episode of generalized tonic-clonic seizure. On physical examination, he was normal except for a lateral tongue bite. He had a common cold on the same day and was inhaling EO immediately prior to the seizure. As per his wife, he had put three drops of eucalyptus oil in a bowl of water and was inhaling the steam for about 5 minutes. He fell down and had tonic posturing of all four limbs followed by clonic movements for 1 min. He had postictal confusion for 15 min. He had had no seizures in the past. There was no history of febrile seizures in childhood or any family history of seizures. He had never inhaled EO in the past. His brain MRI was normal. EEG showed slowing in the right frontal region. He was given levetiracetam 500 mg twice daily for 2 weeks. After 3 months of follow-up, he was found to be doing well with no recurrence of seizures.

Case 2

A 45-year-old man with a history of common cold and exposure to EO through inhalation for the first time presented to us with one episode of loss of consciousness and scald injury on the face due to fall into the bowl of hot water. He was unconscious for a period of 5 min and recovered from a drowsy state over 20 min. His wife noticed generalized tonic posturing of all four limbs followed by clonic movements. He had a lateral tongue bite. He was brought to the emergency room, where he received intravenous levetiracetam 1,000 mg. His brain MRI was normal. His EEG done on the second day of seizure was normal. There was no history of seizures in the past, myoclonic jerks, absence seizures, or family history of seizures. He was discharged on levetiracetam 500 mg twice daily. After 1 month of follow-up, he was found to be asymptomatic.

DISCUSSION

EO is an essential oil that is used all over the world for its therapeutic properties. It is used to treat ailments like the common cold and to relieve sinus congestion in both young and old. It is the distilled volatile aromatic constituent of the leaf of *Eucalyptus*, a genus of the plant family Myrtaceae. All eucalyptus oils are composed of complex mixtures of volatile organic compounds. The main group of constituents of EO is monoterpenes, and the principal constituent of pharmaceutical-grade EO is 1, 8-cineole (eucalyptol), which must comprise at least 70% of the contents.

Table 1. Profile of patients with eucalyptus oil-induced seizures

Age of patient (years)	Sex	Mode of inhalation	Time to seizure (min)	Duration of seizure (min)	Type of seizure	Postictal drowsiness (min)	H/O febrile seizure	Past H/O seizure	Family H/O seizure	H/O previous use of eucalyptus oil	MRI	EEG	AED/Duration of treatment (weeks)	F/u (months)	Recurrence
29	M	Inhalation	5	15	GTCS	15	No	No	No	No	Normal	Right frontal slowing	Levetiracetam (2 weeks)	4	No
45	M	Inhalation	5	5	GTCS	20	No	No	No	No	Normal	Normal	Levetiracetam	3	No
30	M	Inhalation	2	5	GTCS	20	No	No	No	No	Normal	Normal	Levetiracetam (4 weeks)	3	No
2	M	Intranasal drops	2	3	GTCS	15	No	No	No	No	Normal	Normal	No treatment	3	No
30	M	Inhalation	5	3	GTCS	30	No	No	No	No	Normal	Normal	No treatment	12	No
11	M	Inhalation	3	3	GTCS	30	No	No	No	No	Normal	Bifrontal and temporal slowing	Levetiracetam (4 weeks)	4	No
8	M	Massage	10	8	CPS (patient was in a state of altered sensorium for 10 min)	10	No	No	No	No	NA	NA	No treatment	2	No
13	M	Inhalation	5	3	GTCS	20	No	Yes	No	No	Normal	Normal	Previous topiramate continued	12	No
39	M	Inhalation	2	1	CPS (patient was in a state of altered sensorium for 10 min)	10	No	No	No	No	Normal	Normal	No treatment	24	No
16	M	Inhalation	2	3	GTCS	10	No	No	No	No	Normal	Generalized spike and wave discharges	Levetiracetam (2 weeks)	6	No

AED, antiepileptic drug; CPS, complex partial seizures; EEG, electroencephalogram; F/u, follow-up; GTCS, generalized tonic-clonic seizures; H/O, history; NA, not available.

Eucalyptus kochii and *Eucalyptus polybractea* have the highest cineole content, ranging from 80% to 95%. Global production is dominated by *Eucalyptus globulus*. The composition of the extracted oil can change depending on the storage conditions of the raw material and the technique employed to extract the oil.¹

Plant-derived essential oils such as EO have been known to have epileptogenic properties when they have been used for therapeutic purposes.² Our article describes 10 cases of patients who had exposure to EO mainly in the form of inhalation and developed seizures. Eight out of the 10 patients had generalized tonic-clonic seizures; 2 had complex partial seizures. The patients with complex partial seizures had altered mental status for 10 min, during which they were unable to communicate or respond to commands.

The temporal relation between the time of exposure and onset of seizure confirms the pro-convulsive properties of EO. There have been a few reported cases in literature of children and adults who developed acute symptomatic seizure following exposure to various other essential oils in different forms.² In children with EO toxicity, the main mode of exposure was ingestion and seizures developed after 30 min to 4 h.³ In a study from Canada, seizures due to EO ingestion were reported in children from 11 months of age to 3 years. The time of onset of seizure after EO ingestion ranged from 10 min to 2 h.⁴ Seizure has been reported 9 hours after ingestion in a 4-year-old child.⁵ A case of status epilepticus has been documented after 10 min of ingestion of 10 ml of EO in a 6-year-old boy.⁶ Occurrence of seizures after dermal application of an EO head lice preparation in a 4-year-old girl has also been recently reported.⁷ However, in our cohort we had mostly adult patients, and the mode of exposure was inhalation, and seizures developed after 2–5 min. Unlike ingestion, inhalation results in faster onset of central nervous system (CNS) symptoms because inhaled volatile oils are known to reach the brain directly and stimulate the neurons. Although there have been no explicit studies outlining the mechanism by which essential oils/eucalyptus oils can precipitate seizures, studies on rat models show it may be secondary to loss of tissue sodium/potassium gradient leading to increased cellular hyperexcitability.⁸

All patients described in this study were exposed to EO for the first time. But it is logical to presume that even patients who have been exposed in the past on a regular basis may get an episode of seizure if a higher quantity of EO is used. Occasionally, we have seen patients who had ingested EO earlier without any complications develop seizure secondary to ingestion of a higher quantity. EOIS may be reported so rarely in the literature because of lack of awareness among patients, caregivers, and healthcare providers and missed identification of the link between EO and seizures. Given the widespread use of EO in many forms, regardless of whether the real risk of EO-related seizure is

low or not, EO use must be evaluated by large epidemiological studies.

Unfortunately, advice regarding the amount of EO to use and precautions for the general population is lacking on packaging labels of EO, available both locally and on the Internet. It is critical that history of exposure to EO and other essential oils should be sought in every patient, irrespective of age, who presents with a first episode of seizure or a breakthrough seizure. Patients and relatives may not reveal the history, and there is also a chance that the treating physician may ignore the history because most health professionals are unaware of the epileptogenic potential of these essential oils. This may result in falsely labeling the seizure as “idiopathic,” and the patient may be given long-term antiepileptic drugs unnecessarily. We also suggest providers inquire about the exposure of EO or any other essential oils in any form in patients with epilepsy, because preparations containing these essential oils are available in almost every home and may be a factor provoking breakthrough seizures. Therefore, the knowledge that EO can induce seizure must be disseminated among healthcare professionals and the public so that such practices as consuming, applying, or inhaling EO in any form may be avoided. The relationship of EO and seizures needs to be further explored in future studies.

AUTHOR CONTRIBUTIONS

Thomas Mathew: concept, identified the cases, review of literature, preparation of manuscript. Vikram Kamath: identified and contributed cases. Shiva Kumar: identified and contributed cases. Meghana Srinivas: review of literature, preparation and editing of the manuscript. Prarthana Har-eesh: collection of data, preparation and editing of data. Rakesh Jadav: identified and contributed cases. Sreekanta Swamy: identified and contributed cases.

DISCLOSURES

We have read and understand the Journal’s policy on declaration of interests and declare that we have no competing interests. All authors have completed the ICMJE uniform disclosure form and declare no support from any organization for the submitted work; no financial relationships with any organizations that might have an interest in the submitted work in the previous three years; no other relationships or activities that could appear to have influenced the submitted work. We confirm that we have read the Journal’s position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

FINANCIAL DISCLOSURE

None.

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