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BRIEF RESEARCH REPORT

Neurology

Essential oil–related status epilepticus: A small case series study

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Abstract

Objective: Essential oils are plant-derived oils and are widely used as an over-the-counter remedy for common ailments. Many essential oils are found to have proconvulsant effects. Here we report a small case series of 3 adults with eseential oil-related status epilepticus.

Methods: This was an observational study conducted in a tertiary care hospital in south India from January 2018 to December 2019. We collected the demographic, clinical, and imaging features of all cases of status epilepticus resulting from exposure to essential oils. Cases of status epilepticus secondary to all other causes were excluded.

Results: There were 3 young adults with essential oil-related status epilepticus. Two had de novo generalized tonic–clonic status epilepticus, and 1 with posttraumatic occipital lobe epilepsy had focal-impaired awareness status epilepticus. The first 2 cases presented with histories of ingestion of eucalyptus oil. The third case had focal-impaired awareness status epilepticus after topical application of various balms containing eucalyptus and camphor.

Conclusions: Proconvulsant essential oils of eucalyptus and camphor can cause both generalized and focal status epilepticus. Physicians dealing with patients of status epilepticus should enquire about the exposure to proconvulsant essential oils.

KEYWORDS
camphor, essential oil, eucalyptus, seizure, status epilepticus

1 | INTRODUCTION

Essential oils are plant-derived oils and are widely used as an over-the-counter remedy for common ailments such as headache, common cold, cough, and backache. Commonly used essential oils in south India are eucalyptus and camphor. The exact prevalence of their use is not known, but most households have these essential oils for managing common and simple ailments and for the purpose of religious

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prayers and rituals. Many essential oils are found to have proconvulsant effects and can trigger seizures. In 2017, we published a small case series of patients from 3 tertiary care hospitals who had eucalyptus oil inhalation–induced seizures.[1] Similar to eucalyptus oil, camphor also has proconvulsant properties. Camphor is a terpenoid obtained from the wood of camphor laurel and has been known for more than 500 years to have convulsant properties.[2] Camphor has been implicated in many cases of acute symptomatic seizures not only in the pediatric age group but also in adults.[3-5] Status epilepticus can have varied etiology, but essential oil-related status epilepticus has received less attention in the literature. Here we report a small case series of 3 adults with essential oil-related status epilepticus.

2 | CASE 1

A 24-year-old young man was admitted to the critical care ICU in our hospital with status epilepticus of unknown cause. History was clarified by the father who narrated the incident. He (the father) had brought a bottle of eucalyptus oil home a few weeks previous. As the bottle was leaking, he transferred the contents from the eucalyptus bottle to another empty cough syrup bottle. His son, who was apparently healthy, came home in the afternoon and drank 1 teaspoon (5 mL) of the liquid (eucalyptus oil) from the cough syrup bottle as he was having cough and cold symptoms since that morning. Five minutes after drinking the syrup, he had an episode of generalized tonic–clonic seizure and had multiple episodes after that. He was taken to a nearby hospital for initial treatment. He was given intravenous lorazepam 4 mg and after 15 minutes was transferred to our hospital. He did not undergo any investigations at this primary care center. He was brought to our emergency department (ED) within 30 minutes. When he arrived, he was in an unconscious state and had 2 more episodes of generalized tonic–clonic seizures. He was intubated with rapid sequence induction and was treated for status epilepticus with intravenous lorazepam 4 mg for 2 minutes and intravenous phenytoin 1000 mg for 20 minutes. He was shifted to the critical care ICU where he had few more generalized tonic–clonic seizures and was hence loaded with intravenous levetiracetam 1 g and was started on midazolam infusion (0.2 mg/kg bolus and then 0.2 mg/kg/h). His brain computed tomography showed diffuse cerebral edema (Figure 1), and electroencephalogram showed diffuse slowing in the delta range. His blood sugar in the ED was 140 mg% (7.8 mmol/L), serum sodium 141 mEq/L, and serum calcium 9 mg/dL (2.25 mmol/L).

His other hematological and biochemical tests were within normal limits. His blood cultures, urine cultures, and chest X-ray did not show any abnormalities. He had a recurrence of a generalized tonic–clonic seizure on tapering midazolam after 24 hours, and hence midazolam was continued. Intravenous lacosamide 100 mg twice a day was added to phenytoin (100 mg three times a day) and levetiracetam (1 g twice a day). He developed multiorgan dysfunction and died on the fifth day of admission. He had no history of prior seizures, stroke, febrile seizures, head trauma, or family history of seizures.

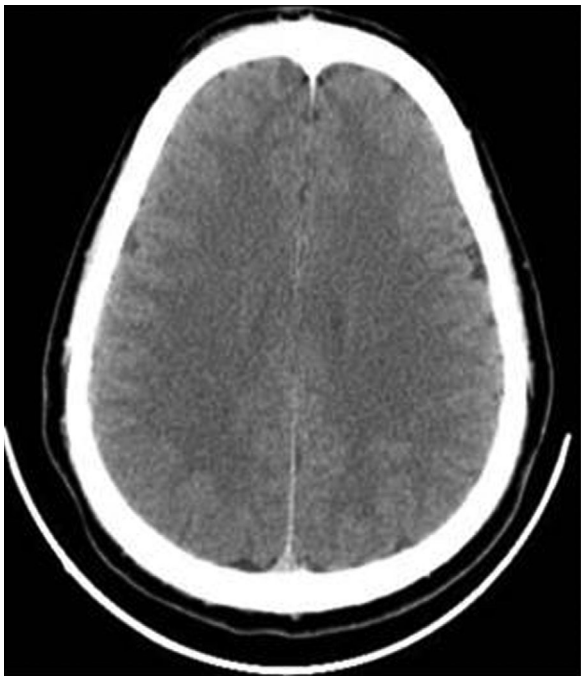

FIGURE 1 Computed tomography image of the brain showing mild diffuse cerebral edema

3 | CASE 2

A 31-year-old male presented to us with generalized tonic–clonic status lasting 60 minutes, witnessed by his wife. He used to take few drops of eucalyptus oil mixed with water occasionally for abdominal pain for the past 3 years. He drank 2 to 3 teaspoonfuls (10–15 mL) of eucalyptus oil for abdominal pain on that day and had multiple episodes of generalized tonic–clonic seizures 20 minutes after the ingestion. He was taken to the ED at a nearby hospital in a drowsy state and was admitted to the critical care unit. There was no history of prior seizures, stroke, febrile seizures, head trauma, or family history of seizures. His blood sugar in the emergency was 120 mg% (6.7 mmol/L), serum sodium 138 mEq/L, and serum calcium 9.2 mg/dL (2.3 mmol/L). His hematological, biochemical, and neurological investigations including brain magnetic resonance imaging and electroencephalogram were unremarkable. He was treated with intravenous lorazepam 4 mg and was loaded with intravenous levetiracetam 1 g followed by maintenance of 500 mg twice a day. His sensorium improved over 6 hours, and he was transferred to the neurology ward. He was discharged after 5 days on levetiracetam 500 mg orally twice a day. At 1-month follow-up he had no recurrence of seizures, and his levetiracetam was stopped.

4 | CASE 3

A 38-year-old male was a case of post-traumatic occipital lobe epilepsy for the past 6 years and was well controlled on phenytoin 300 mg orally per day. He had a headache and cold for 3 days for which he

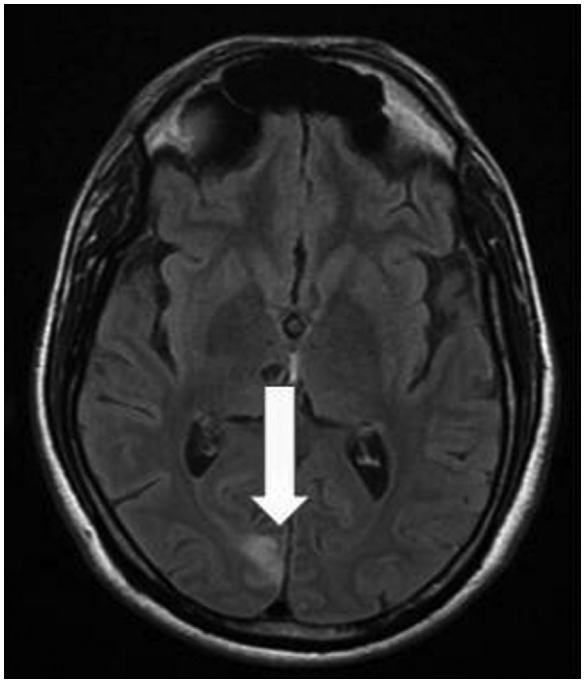

FIGURE 2 Brain magnetic resonance imaging axial fluid attenuated inversion recovery image showing right occipital gliosis (white arrow)

applied various balms and oils containing eucalyptus and camphor and had multiple episodes of visual aura in the form of flashes of light with altered sensorium lasting for hours, suggestive of a complex partial status (focal seizures with impaired awareness status). He had no fever, vomiting, or ear discharge. He was not on any quinolone antibiotics or tramadol. His brain magnetic resonance imaging showed right occipital gliosis (Figure 2), and the electroencephalogram showed slowing from the occipital regions. His blood sugar in the ED was 90 mg% (5 mmol/L), serum sodium 140 mEq/L, and serum calcium 8.9 mg/dL (2.22 mmol/L). His other hematological and biochemical investigations were normal. He was treated with intravenous fosphenytoin 750 mg loading dose followed by 150 mg every 8 hours. After 12 hours, his visual auras decreased but were still persistent. Intravenous levetiracetam was added to the current treatment (1 g loading followed by 500 mg every 12 hours). His attacks completely subsided after 24 hours. He was discharged after 2 days with the advice to avoid these essential oils, which provoke seizures. On follow-up he was continued on the same dose of phenytoin 300 mg, and his levetiracetam was tapered and stopped after 2 weeks.

5 | DISCUSSION

Essential oils are plant-derived oils that contain the "essence" of the plant or its parts. The term "essence" is a misnomer as these oils are not essential to any living organism. As they have a fragrance they are used in perfumes, cosmetics, and food additives. They are claimed to have antibactericidal and antiviral properties in in vitro studies.[6] People use these essential oil-containing products as over-the-counter remedies to treat many common ailments such as the common cold, cough, headache, and so on. During the current coronavirus 2019 pandemic, many companies are selling essential oils for the prevention and treatment of coronavirus 2019 infection, claiming that they have an effect against severe acute respiratory syndrome coronavirus 2 but without any evidence.[7] Hence there is high chance of use and abuse of these potentially proconvulsant essential oils during the current coronavirus 2019 pandemic. Physicians are unaware of the side effects of these essential oils as they are not systematically studied. Many of the side effects go unnoticed as physicians rarely ask the history of essential oil exposure and are unaware of the chemical nature and adverse effects of these essential oils.

Essential oils such as eucalyptus and camphor have proconvulsant potentials that are rarely recognized by the public. These essential oils are kept in houses in easily accessible areas and within the reach of everyone, including toddlers, as they are generally perceived as safe. Here we described 3 cases of essential oil-related status epilepticus in 3 young adults. The first 2 cases presented with histories of the ingestion of eucalyptus oil. The first young man who expired following status epilepticus and multiorgan dysfunction had consumed it accidentally. The second case had ingested eucalyptus oil for abdominal pain and had multiple episodes of generalized tonic–clonic seizures. The third case had complex partial status epilepticus (focal-impaired awareness status epilepticus) after topical application of various balms containing eucalyptus and camphor. Ingestion of eucalyptus and camphor is well known to trigger seizures, but topical application is generally perceived as safe.[8,9] In epileptic patients, the use of the topical application of essential oils are found to precipitate seizures.[10] The dermal application of eucalyptus for head lice treatment resulted in a tonic–clonic seizure in an otherwise healthy 4-year-old child.[11] Studies have shown that camphor is also readily absorbed from all sites of administration after inhalation, ingestion, or dermal exposure. In the case of dermal application, the volume of the absorption is relatively low, but the speed of the process is very fast.[12] Essential oils such as eucalyptus, camphor, and rosemary contain aromatic monoterpene 1,8-cineole.[13,14] 1,8-Cineole has a mechanism of action similar to the known proconvulsant pentylenetetrazole.[11,15] 1,8-Cineole in animal models was found to induce seizures at a dosage of 0.5 mL/kg.[16] Although there have been no explicit studies outlining the mechanism by which eucalyptus oils can precipitate seizures, studies on rat models show it may be secondary to the loss of tissue sodium/potassium gradient leading to increased cellular hyperexcitability.[1,11] The effects of eucalyptol (1,8-cineole) studied on the central neurons of the land snail *Caucasotachea atrolabiata* found that the excitatory and epileptogenic action of eucalyptol is most likely mediated through the direct inhibitory action on potassium channels.[17] Another study in snail neurons with camphor showed that its excitatory and epileptogenic action is also mediated through the blockade of K^+ channels and upregulation of the Ca^{2+} inward currents.[18] Although the epileptogenic properties of plant-derived essential oils have been known for centuries, both the public and physicians are equally ignorant of these serious

complications. The essential oils that are epileptogenic are those of eucalyptus, camphor, rosemary, thuja, sage, spike lavender, and turpentine.[2,3] The route of exposure, type of essential oil, amount taken, and genetic susceptibility may be important in causing these complications. The essential oils of eucalyptus and camphor are the those that are commonly used and abused.[19] In cases of so called de novo status, epilepticus exposure to essential oils need to be sought. The public and physicians should be made aware of the epileptogenic potential of these essential oils.

6 | CONCLUSION

The proconvulsant essential oils of eucalyptus and camphor can cause both generalized and focal status epilepticus. Physicians dealing with patients of status epilepticus should enquire about exposure to essential oils.

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