The effectiveness of key lime (*Citrus aurantifolia*) inhalation aromatherapy as an adjunct in alleviating dizziness among hemodialysis patients: A randomized controlled trial

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Abstract

Introduction Dizziness is a common symptom experienced by patients undergoing hemodialysis. There have been some studies that show inhalation aromatherapy to be a simple and non-invasive way in reducing several symptoms including nausea and vomiting. This study aimed to determine if the use of key lime oil inhalation aromatherapy is effective as an adjunct to nursing interventions in reducing the duration of dizziness experienced by patients during hemodialysis.

Methods This was a randomized, placebo-controlled trial which assessed the efficacy of key lime oil inhalation aromatherapy in the relief of dizziness. The participants were asked to rate their dizziness using the Modified Borg Rating Scale for Dizziness before and after intervention and were timed until the dizziness was completely relieved.

Results The key lime inhalation aromatherapy and control groups were comparable, including their baseline dizziness ratings. Key lime inhalation aromatherapy alleviated dizziness in a significantly shorter time (4.8 vs 22.7 minutes, $p = 0.03$).

Conclusion Key lime inhalation aromatherapy is effective as an adjunct treatment for dizziness experienced by patients during hemodialysis.

Key words: Key oil, inhalation aromatherapy, dizziness, hemodialysis patients

Each year, an estimated 120 per million Filipinos develop kidney failure, meaning that approximately 10,000 Filipinos need to undergo various kidney treatments each year, including hemodialysis.[1] Hemodialysis is the most common procedure in treating patients with renal failure.[2] It is a form of replacement therapy that involves removing wastes from the blood via ultrafiltration from an external source.[3] However, hemodialysis is associated with complications and discomfort to the patients, with dizziness being the most common.[4] Intradialytic hypotension is a major cause of dizziness, requiring nursing interventions such as

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elevation of the patient's lower extremities, adjustment of the hemodialysis ultrafiltration rate, and/or administration of intravenous fluids.[5]

To help address this problem of dizziness during hemodialysis, the use of inhalation aromatherapy was investigated in this study. Aromatherapy is a complementary therapy that is purported to help patients cope with various symptoms including nausea, vomiting, and pain.[6] However, experimental studies on inhalation aromatherapy using citrus fruits such as lemon have not addressed the symptom of dizziness.[7] Furthermore, these studies have not explored the potential of key lime as an inhalation aromatherapy intervention. Key lime, locally known as dayap, is very abundant in the Philippines and has been anecdotally used to alleviate nausea.[8] Its peel contains a volatile oil with limonene, which is also found in lemon, as one of the main components.[9] This study aimed to determine 1) if there was a significant decrease in the duration of dizziness experienced by patients undergoing hemodialysis and 2) if the use of key lime oil inhalation aromatherapy was beneficial as an adjunct to nursing interventions in reducing the duration of dizziness of patients undergoing hemodialysis.

Methods

This was a double-blind randomized placebo-controlled trial to determine the efficacy of key lime inhalation aromatherapy in alleviating dizziness among patients undergoing hemodialysis in several centers in Quezon City from April to August 2015. The Modified Borg Rating Scale for Dizziness was used to measure dizziness before and after treatment.[10] The time it took to relieve dizziness was compared between the key lime aromatherapy and placebo groups. The study was approved by the Ethics Review Committee of the medical center.

Male or female patients aged 21 to 65 years, with a history of dizziness while undergoing dialysis, were recruited. Patients were excluded if they were 1) disoriented or having language barrier problems, 2) diagnosed by a doctor to have vertigo and/or cranial nerve VIII lesion, 3) diagnosed by a doctor to have anosmia and/or cranial nerve I lesion, 3) planning to transfer to another dialysis center during the duration of the study, 4) pregnant, 5) on their first three months of dialysis treatment, 6) diagnosed with asthma or having complaints of nasal discharge, nasal congestion, and the like during the onset of dizziness. Patients who agreed to participate in the study completed a preliminary survey form with the assistance of the researchers to check if they fit the inclusion and exclusion criteria. Eligible patients who consented were randomly assigned to either treatment group or control group using Microsoft Excel. A sample size of six participants per group was computed based on a standard deviation of 2.33, difference of 3, 95% confidence and 20% drop out.[7] Subjects were chosen from among the patients through purposive sampling. Patients were given instructions on what to do when they experienced dizziness during hemodialysis including how to rate their dizziness before and after the intervention using the Modified Borg Rating Scale for Dizziness (MBRSD) with 0, being the lowest and 10, the highest.[10] The first six subjects under treatment group and the first six subjects under control group to report dizziness during hemodialysis were included in this study.

The administration of the key lime and the placebo was done by the researchers, following a standard procedure developed for the study which included concealment and randomization. Similar containers were used for the key lime oil and the placebo. Additionally, every researcher assigned to a participating hemodialysis center was instructed not to wear any perfume to minimize confounding scents. During the course of the hemodialysis treatment, once a patient reported dizziness of any cause to the assigned researcher for the day, the patient was asked to rate his dizziness using MBRSD. With gloved hands, the researcher prepared a cotton ball in a small white plastic container with 3 drops of key lime oil if the patient belonged to the treatment group or 3 drops of distilled water if the patient belonged to the control group. The patient was then instructed to inhale deeply from the prepared cotton ball up to 1 minute while the researcher held the small white plastic container with the cotton ball 1-2 cm away from the patient's nose. After inhalation, the patient was instructed to rate his or her dizziness every two minutes until he or she did not feel any dizziness with a rating of MBRSD of 0. Cotton balls were discarded after 1 hour and a new one was provided for each patient if the need arose. The duration of dizziness was recorded with a stopwatch by the researcher from the onset of the first cotton ball inhalation up to the time the patient reported a

rating of MBRSD 0. The patient's baseline blood pressure at the start of hemodialysis and the hemodialysis ultrafiltration volume noted from the hemodialysis machine were recorded by the researcher in a monitoring sheet along with the specific nursing interventions provided by the hemodialysis staff, MBRSD rating, and time it took for the dizziness to be alleviated.

There was no available locally-produced key lime oil in the Philippines when the study was conducted. The key lime oil used in this study was prepared from the key lime peel by Edens Garden in San Clemente, California, USA and was purchased and shipped through Amazon in sealed bottles. The key lime oil product for the treatment group was colorless; hence distilled water was used as a placebo control.

The demographics of the population were compared using descriptive statistics. An independent t-test was conducted to determine if the key lime inhalation aromatherapy and placebo groups were comparable in terms of pre-intervention dizziness rating, blood pressure, and ultrafiltration volume. A one-tailed t-test was used to determine whether there was sufficient evidence to conclude that there was a significant difference between the control and treatment group in terms of the time it took for the alleviation of dizziness. Finally, Shapiro-Wilk Test was employed to check normality assumption. Data analysis was done using SPSS.

Results

Of the 10 dialysis centers invited, two responded. There were 39 hemodialysis patients who qualified for the trial after a preliminary survey and who were randomly allocated into key lime inhalation aromatherapy group or control group in both dialysis centers. The first 12 subjects who reported dizziness during hemodialysis (6 subjects in the treatment group and 6 subjects in the control group) were included in the study. There were no subjects who reported dizziness at same time in the same hemodialysis center. There was no dropout or loss to follow-up or voluntary exit among the participants. The study intervention was administered to all the 12 subjects simultaneous with the nursing interventions provided by the hemodialysis staff; this included elevating the lower extremities in 11 subjects, adjusting the hemodialysis ultrafiltration rate in one subject, and allowing two subjects to eat. No subject needed intravenous fluid replacement or medications to relieve the dizziness.

Table 1 shows that there were no significant differences in the baseline characteristics, including the dizziness ratings, of the key lime inhalation aromatherapy and control groups. All 12 subjects had anemia in addition to chronic renal failure. It took an average of 4.8 minutes to relieve dizziness in the key lime inhalation aromatherapy group compared with 22.7 minutes in the control group. The difference was significant (mean difference = 17.9 min, $p = 0.03$, 95% CI <0.01, 35.8). The Shapiro-Wilk test showed that the assumption of normality for a non-parametric test was not violated. There were no adverse effects reported from both the key lime inhalation aromatherapy and control groups.

Table 1. Comparison of baseline characteristics of key lime aromatherapy and control groups.

Characteristic	Control*	Key lime aromatherapy*	Mean difference (SE)	p-value (95% CI)**
Age (yr)	49.2	53.3	-4.17±4.60	0.39 (-14.4, 06.1)
Sex distribution (M:F)	2:4	2:4		
MBRSD rating	5.3	4.7	0.67±1.27	0.61 (-2.17, 3.50)
Systolic pressure	143.0	136.7	6.33±7.49	0.42 (-10.4, 23.0)
Diastolic pressure	80.0	81. 7	-1.67±1.67	0.34 (-5.4, 2.0)
Ultrafiltration volume	2405.67	2316.00	89.67±997.60	0.93 (-2133.13, 2312.46)
No. of years since start of dialysis	5.8	4.8	1.00±2.16	0.65 (-3.8, 5.8)
No. w/ other illnesses	4	5		
No. w/ other medications	4	5		

* Means, unless indicated otherwise
**Independent t-test

Discussion

Dizziness is the most common symptom experienced by patients undergoing hemodialysis and may have several causes including hypotension, hypoglycemia, and anemia; the treatment is usually directed to the specific cause.[4] Eleven of the 12 subjects required elevation of the lower extremities and one subject needed adjustment of hemodialysis ultrafiltration rate and thus, it can be assumed that majority of the subjects had hypotension as the main cause of dizziness during hemodialysis. Hypoglycemia most likely contributed to the dizziness of two subjects who were allowed by the hemodialysis staff to eat. Moreover, all subjects had anemia, which could have contributed to the dizziness.

The results show a significant decrease in the duration of dizziness experienced by the patients undergoing hemodialysis following key lime oil inhalation aromatherapy. The exact mechanism of action of inhalation aromatherapy using key lime oil or other scents has not yet been fully studied. In general, however, it has been proposed that the effects of inhalation aromatherapy commence with the absorption of volatile molecules through the nasal mucosa which are transformed into chemical signals. These signals then move towards the olfactory bulb and the limbic system via the medial olfactory tract, releasing hormones that can cause physiological and psychological effects which may help calm a person leading to alleviation of dizziness.[7,11] This may explain the quicker relief of dizziness of the hemodialysis patients who had inhaled the cotton ball with key lime oil.

There are no available experimental studies on inhalation aromatherapy that specifically investigated key lime oil or other scents of aromatherapy as a treatment for dizziness to compare the results of this study. However, there are experimental studies which investigated the effect of other scents in relieving symptoms like nausea and vomiting but showed conflicting results. A double-blind randomized controlled clinical trial by Yavari on the effect of lemon inhalation aromatherapy among 100 pregnant women with nausea and vomiting demonstrated a significant improvement in the nausea and vomiting of the treatment groups, supporting lemon oil aromatherapy's anti-emetic properties.[7] However, this contradicts the findings of Pasha, who investigated the effect of mint oil aromatherapy among 60 pregnant women with nausea and vomiting for four nights and found no significant differences in the level of nausea and vomiting between the two groups.[12]

There are several limitations of this study. The research was done in only two outpatient dialysis centers in Quezon City. Since the sampling was purposive, the external validity of the study may have been affected. Additionally, variations in the standard treatment protocol for hypotension and other causes of dizziness during hemodialysis between the two hemodialysis centers and/or variation in the initiation of the said protocol among the hemodialysis staff in each of the hemodialysis center may have been different, which might have affected the time it took to alleviate the dizziness of each of the study participants. Moreover, the key lime oil used for this study was imported from another country and thus the exact posology of the product is undetermined. Finally, the participants in the control group, though blinded, may have suspected that the cotton ball presented to them was a placebo due to the absence of any scent.

Nevertheless, the results of this study suggest that key lime oil inhalation aromatherapy, when used properly, may be an adjunct non-pharmacologic treatment in the management of dizziness among hemodialysis patients. Since there is a lack of previous studies on the effects of aromatherapy on dizziness experienced by hemodialysis patients or other population groups, this paper may serve as a reference for future studies with the following recommendations: 1) focus on one outpatient hemodialysis center with multiple branches to avoid variations in the standard treatment protocol to be administered; 2) investigation of the effect of inhalation aromatherapy on other population groups with complaints of dizziness but without any chronic disease; 3) investigation of the short and long term effects of key lime oil inhalation aromatherapy; and 4) the use of locally produced key lime oil inhalation aromatherapy to promote the use of the abundant key lime in the Philippines.

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