



Original Article

The Effect of Aromatherapy by Lavender Oil on Infant Vaccination Pain: a Double Blind Randomized Controlled Trial

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ABSTRACT

Introduction: Exposure to noxious stimuli can cause pain in infants. This study was conducted to evaluate the effects of the lavender oil inhalation on the pain resulting from the pentavalent vaccination.

Methods: This clinical trial consisted of two groups: the lavender oil group with 42 infants and the placebo group with 57 infants. The healthy infants without congenital abnormalities in need of pentavalent vaccine also participated in our study. The infants started the lavender oil or placebo aromatherapy one minute before injection. The pain was assessed three times, using the Neonatal Infant pain Scale (NIPS): before vaccination, 15 s, and 5 min after vaccination. Also, the duration of crying was measured in both groups.

Results: At baseline, the two groups were similar in relation to the NIPS scores. While, after 5 minutes, the NIPS score was significantly lower in the lavender group. Based on the repeated measures analysis, the NIPS score changed over time totally. However, the two groups were significantly different in relation to the NIPS score over time. The duration of crying was 75.47 (60.675) second in the lavender group and 105.22 (75.739) s in the control group. The statistical test showed a significant difference between the two groups.

Conclusion: A low concentration of the lavender oil inhalation can reduce the pain and improve soothing in the infants with the pentavalent vaccine injection.

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Introduction

Infections are the most common sources of diseases in humans. Today, vaccines are the most helpful means we employ to stop infectious diseases, even though vaccination is an invasive procedure that involves infants worldwide.¹ Myelination of nerve fibers develops in second and third trimesters of gestation and infants obtain the anatomical and functional capacity to respond to painful stimuli before birth.^{2,3} Therefore, exposure to noxious stimuli can cause infants to feel pain. The short-term consequences of painful procedures are behavioral, physiological and hormonal responses. On the other hand, repeated painful procedures supply hypersensitivity to painful stimuli, reduced pain threshold and increased behavioral reactions.^{4,6} These phenomena can be a basis leading individuals to avoid medical procedures in childhood or adulthood.⁷

Furthermore, parents anticipate that the caregivers utilize some methods to relieve their infant pain during medical procedures. However, the caregivers have a main responsibility for pain relief during medical procedures as a human right.^{8,9}

In recent years, numerous studies have assessed the utility of odors as calming strategies in neonates. Maternal odors such as milk, body and amniotic fluid odors could help to shorten the crying period and a more rapid return to a state of calm when offered during a heel

stick procedure.¹⁰ The unfamiliar odors such as vanilla and lavender have also been studied as analgesic and calming agents.^{11,12} Lavender oil is a well-known aromatic essence with mood-enhancing and sedative properties.¹³ Studies on non-human samples reported that the inhalation of essential oils could enter the bloodstream and induce pharmacologic effects through stimulating the production of endorphins and norepinephrine.^{14,15} Also, it has been speculated that the chemical components in essential oils can bind to the receptors of the olfactory bulb, impact the limbic system as the brain's emotional center and ultimately influence the pain sensation.^{16,17}

A pentavalent vaccine is a pooled vaccine with five entity vaccines shared into one. This vaccine can prevent someone from five serious diseases: diphtheria, tetanus, pertussis, hepatitis B, haemophilus influenza type B.¹⁸ In numerous studies on adults, the effect of lavender oil aromatherapy for pain relief has been studied with different results.¹⁹⁻²¹ However, there are a limited number of studies engaging aromatherapy on pain in infants as a non-pharmacological and noninvasive method that can be easily utilized. Moreover, there is no study conducted on the effects of lavender oil on the pentavalent vaccination pain. Therefore, this research was performed to examine the effects of inhalation aromatherapy of lavender oil on the pain resulting from the pentavalent vaccination.

Materials and methods

This clinical trial was performed on 97 infants attending Saadi health center affiliated to Shiraz University of Medical Sciences, Shiraz, Iran. This study included 43 subjects in the lavender oil group and 54 subjects in the control group and was in progress from late May to early August 2016. Our study was reviewed by the ethics committee of Shiraz University of Medical Sciences and its code is IR.SUMS.REC.1394.204. Moreover, this study was registered in the Iranian Registry of Clinical Trial under Cod No. IRCT2016 072310327N14.

The following inclusion criteria were used: infants with a gestational age of 37-42 weeks, healthy, without abnormalities, in need of pentavalent vaccination, and at two months of age. If the infants were agitated before vaccination or developed an allergic reaction such as skin rash, to the study substances, they would be excluded from the study. The participants were selected based on the inclusion criteria through an interview with the parents and the informed consent form was signed by those parents who willingly agreed to take part in this study. The lavender oil was obtained from the Baridge-essence pharmaceutical company, Kashan, Iran. A technician in the traditional medicine pharmacy reduced the concentration based on the sweet almond oil to 0.5%.

In previous western studies, different concentrations of lavender oil, up to 10%, had been used in the infancy period^{22,23} with no serious side effects reported. In Iran, Razaghi et al., used ten drops of 0.5% lavender essential oil to deal with blood sampling pain in the newborns.²⁴ We made use of five drops of 0.5% concentration approximating to the above mentioned study. In this study, the sweet almond oil was used as placebo and provided by the Baridge-essence pharmaceutical company, Kashan, Iran. Both the placebo and lavender oil were prepared in the same containers. Pain in the infants was evaluated via the Neonatal Infant pain scale (NIPS). It comprised six components; facial expressions, crying, breathing patterns, arms, legs, and state of arousal. Each component is scored with 0 or 1 except "crying", which has three possible scores, 0, 1 or 2. Overall pain scores range between 0-7.⁸ The validity and reliability of NIPS have been studied in Iranian infants.²⁵

A research assistant was trained to execute the study protocol. She was not notified about the materials of the containers. In the lavender group, the infants were placed on the vaccination bed, one minute before intervention and the baseline pain intensity was determined and then inhalation of the lavender oil was started. Five drops of the lavender essential oil were spilled on a cotton ball tissue and fixed to the upper part of infant clothe at least for one minute, subsequently the vaccine was injected

One skilled vaccinator injected all pentavalent vaccines during our study. The aromatherapy was ongoing during vaccination. The pain was evaluated 15 seconds and 5 min after injection. A video recording of the procedure was performed for all infants and was reviewed at the right time. The sweet almond oil aromatherapy was used by the same protocol in the control group.

Sample size and statistical analysis: based on the data obtained from a similar study²⁶ with $\alpha=0.05$, $\beta=0.2$ and power=80% the sample size was concluded 40 participants for each group, totaling 80 participants.

The data were analyzed via the SPSS software, ver. 13. (SPSS Inc., Chicago, IL) $P<0.05$ was considered statistically significant. The normal distribution of the data as determined, using Kolmogorov-Smirnov test.

After that, the independent t-test or the Mann-Whitney U-test was used as a nonparametric test for comparing the means between the groups. Moreover, the qualitative data were analyzed, using Chi-square test or Fisher's exact test. Also, the repeated measures test was used to assess the changes over time. In order to make an identical inhalation space, considering aromatic odor, the researcher randomized the days of sampling. Therefore, each day of sampling was specified to one of the study groups by randomly drawn pairs of cards. One card indicated the lavender group and another indicated the almond group. This study was double-blinded. The infants were obviously uninformed on the type of aromatherapy. Also, the research assistant who reviewed the videos and filled out the NIPS checklists was blind to group allocations.

Results

Totally, 97 infants participated in this study. All of them finished the study (Figure 1).

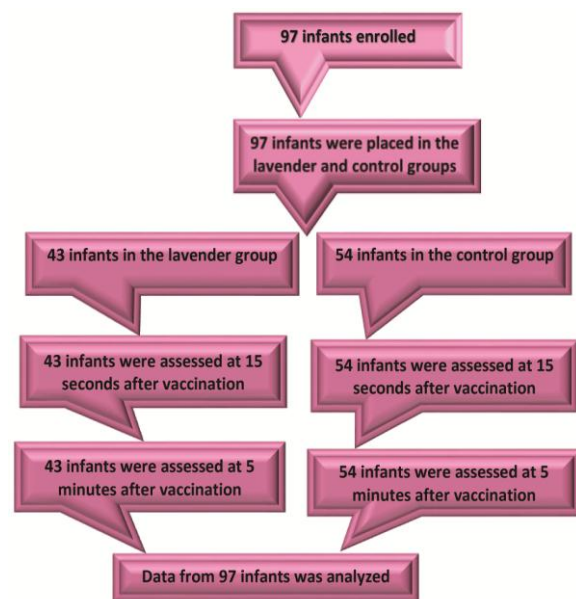


Figure 1. The flow chart of sampling

The mean of gestational age was 38.35 (1.86) weeks. Of all, 56 (57.7%) infants had undergone cesarean section and 41 (42.3%) infants had been delivered vaginally. The two groups were not different in relation to the gestational age ($P=0.24$) and birth methods ($P=0.27$). At baseline, the two groups were similar in relation to the NIPS scores. However, only after 5 minutes, the NIPS

score was significantly lower in the lavender group (P=0.02). Based on the repeated measures analysis, the NIPS scores changed over time absolutely (P<0.001).

Moreover, the two groups were significantly different in relation to the NIPS score over time (P=0.043) (Table 1). The statistical test showed a significant difference between the two groups in relation to the duration of crying (P=0.026) (Table 2). When NIPS components were analyzed separately, the following results were obtained: at baseline the six components: facial expression, crying, breathing patterns, arms, legs, and state of arousal, were

the same in both groups. At 15 seconds after vaccination, the only difference observed between the groups was in relation to the arms. The contraction in the arms was observed in 21 infants (48.8%) in the lavender group and in 39 infants (72.2%) in the control group. The statistical test showed a significant difference (P=0.018) (Table 2).

At five minutes after vaccination, six infants (14%) in the lavender group and 18 infants (33.3%) in the control group had grimace. The two groups were statistically different (P=0.028) (Table 3).

Table 1. Comparison of NIPS score at 15 seconds and 5 minutes and results of repeated measures test in the two study groups

Group	Baseline Mean (SD)	At 15 s post injection Mean (SD)	At 5 min post injection Mean (SD)	P time ^{ab}	P group ^c	P time*group ^{ad}
Lavender oil, n=43	0.41 (1.27)	4.41 (1.11)	0.39 (0.95)	<0.001	0.04	0.03
Control, n=54	0.27 (0.65)	4.85 (0.99)	1.03 (1.67)	<0.001 ^f	<0.001 ^g	0.001 ^h
P-value ^e	0.47	0.05	0.02			

^aRepeated measure test, ^bWithin subjects results, ^cBetween groups results, ^dInteraction Between groups and time, ^eStudent's t-test, paired sample t test for the control group, ^fbaseline and 15 s, ^g15 s and 5 min, ^hbaseline and 5 min

Table 2. Crying duration in the two groups

Group	Lavender Mean (SD)	Control Mean (SD)	P*
Crying duration (Second)	75.47 (60.67)	105.22 (75.73)	0.02

*The results of the independent t-test

Table 3. The six components of NIPS at 15 seconds and 5 minutes post injection in the two groups

Variable	At 15s post injection		At 5 min post injection	
	Lavender N (%)	Control N (%)	Lavender N (%)	Control N (%)
Facial expression				
Relaxed	0 (0)	0 (0)	37 (86)	36 (66.7)
Grimace	43 (100)	54 (100)	6 (14)	18 (33.3)
P-value*	-		0.02	
Cry				
No cry	0 (0)	0 (0)	37 (86)	39 (72.2)
Moan	27 (62.8)	29 (53.7)	6 (14)	11 (20.4)
Vigorous	16 (37.2)	25 (46.3)	0 (0)	4 (7.4)
P-value*	0.36		0.11	
Breathing pattern				
Normal	43 (100)	54 (100)	43 (100)	53 (98.1)
Change in breathing	0 (0)	0 (0)	0 (0)	1 (1.9)
P-value*	-		0.55	
Arms				
Relaxed	22 (51.2)	21 (48.8)	43 (100)	51 (94.4)
Flexed /extended	15 (27.8)	39 (72/2)	0 (0)	3 (5.6)
P-value*	0.01		0.16	
Legs				
Relaxed	19 (44.2)	17 (31.5)	43 (100)	52 (96.3)
Flexed /extended	24 (55.8)	37 (68.5)	0 (0)	2 (3.7)
P-value*	0.19		0.30	
State of arousal				
Sleeping or awake	1 (2.3)	0 (0)	37 (86)	41 (75.9)
Fussy	42 (97.7)	54 (100)	6 (14)	13 (24.1)
P-value*	0.44		0.21	

*The results of the Chi-square -test

Discussion

In the present study, we examined the effectiveness of the lavender oil inhalation on the pain resulting from the injection of pentavalent vaccination. Upon injection, all infants in both groups developed grimace and cried, indicating that the injection of this vaccine is painful. Shortly after the injection (15 seconds later), the pain scores were no different between the lavender and placebo groups. However, after 5 min, the pain was relieved significantly in the lavender group compared to the placebo group. Other results such as the changes over time, shorter crying periods and fewer numbers of grimaces in the lavender group 5 min after vaccination showed that the lavender oil had outperformed the placebo. There are a few studies investigating the effects of the lavender oil on the pain in neonates and infants.

Kawakami et al., showed that the odor of the lavender had no effect on the crying duration during heel stick puncture though it caused the cortisol level to be reduced.¹² In the above mentioned study, they used 10% concentration of linalyl acetate as the lavender odor.

However, we used the whole lavender oil which consisted of other substances such as linalool, a possible explanation for conflicting observation between our results and those of Kawakami et al., Also, an animal study performed on the ape neonates was not in line with our study.²⁷ Razaghi et al., studied the effects of lavender oil aromatherapy during venepuncture of term neonates. In that study, the neonates had been introduced the odor of lavender the previous night. Ten drops of the lavender oil (0.5%) had relieved the pain significantly while the oil had no significant effect on the crying duration.²⁴ In contrast, the infants in our study had not previously been familiarized with the lavender odor. We can assume that an unfamiliar odor could be more effective than a familiar one. On the other hand, considering the difference in the behavioral reactions of the two groups in a long period (5 minutes after injection), it was recognized that lavender aromatherapy needs a significant time to induce sedative effects.

Some distraction techniques have been used to reduce pain and stress. The effects of odors as the distractors during painful procedures have been studied in infants. Badiie et al., assessed the effects of the odor of mother's milk versus the odor of formula on the pain resulting from the heel stick puncture in the preterm neonates.

The pain intensity was significantly lower in the mother milk group compared to the formula group.²⁸ Guobet et al., showed that the odor of vanilla can reduce the pain resulting from the heel stick puncture in the preterm neonates. This result was revealed only when the neonates had been introduced to the vanilla odor previously.¹⁰ Moreover, Guobet et al., and Sadathosseini et al., reported that the familiar vanilla odor relieves the pain of heel stick puncture in the term infants.^{29,30} Our study indicated that primary exposure to the lavender oil can improve the calming state of the infants during a painful procedure such as vaccine injection.

One of the strengths of the present study is its double-blind design, though it imposes certain limitations. We could not evaluate the cortisol level, oxygen saturation and heart rate changes in the infants. In our study, we did not observe any adverse effects in the infants. It is suggested that in the future works, researchers should examine the higher concentration of the lavender oil to achieve a more rapid pain reduction. Also, they should consider further evaluations, including the cortisol level, oxygen saturation and heart rate changes in the infants.

Conclusion

The results signify that a low concentration of the lavender oil inhalation can reduce the pain and improve soothing in the infants with the pentavalent vaccine injection. Further research studies should be conducted on the pain relief capacity of natural aromatic agents such as the lavender oil in infancy. It is hoped that the natural aromatic agents can be applied routinely for pain control in vaccination and other invasive procedures as non-pharmacological methods in infancy.

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Ethical issues

None to be declared.

Conflict of interest

The authors declare no conflict of interest in this study.

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