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The effect of back massage using Frangipani aromatherapy on interleukin-6 (IL-6) levels and pain labor intensity

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Abstract--Childbirth is one of the female reproductive cycles. Spontaneous labor is characterized by uterine contractions which are manifested by complaints of pain. Labor pain in response to an inflammatory reaction due to strain in the lower uterine segment. The purpose of this study was to prove the effect of back massage using Frangipani aromatherapy oil on IL-6 levels and pain labor intensity. Methods: True Experiment (Randomized Clinical Trial / RCT) with a pretest posttest control group design. The research was conducted in inpatient community Health centers Badung Regency and Denpasar City. Research subjects were nulliparous, cervical opening of 6-8 cm. The sample size is 90 people, the number of samples is 3, namely the control group (C) there is no treatment, the positive control (CP) gets a back massage using original VCO oil; The intervention group (I) received a back massage using Frangipani aromatherapy oil. Simple random sampling was the sampling technic. Data analysis used computer. Results: mean pain intensity and IL-6 levels before treatment in the three groups obtained $p > 0.05$. After being given the intervention, the mean difference between the three groups was $p < 0.05$. R^2 intervention for pain labor intensity was 19.7% and IL-6 level was 20.4%. Conclusion: There is an effect of back massage using Frangipani aromatherapy oil to reduce labor pain intensity and IL6 levels.

Keywords--back massage, Frangipani aroma therapy, IL-6, labor pain.

Introduction

Childbirth is a continuation process experienced by women after their pregnancy ends. Spontaneous labor is a natural event characterized by simultaneous uterine contractions, causing labor pain. Labor pain consists of two patterns, namely visceral and somatic pain. Visceral pain occurs in the first stage which has a characteristic, dull pain and is difficult to localize. This pain is caused by the cervix stretching and opening. This triggers the activity of nociceptive afferents that innervate the endocervix and lower segment from Thoracic 10 to lumbar I. Somatic pain occurs at the end of stage I to stage II, which is characterized by sharp pain and is easily localized. The more frequent uterine contractions occur, the lower the fetus falls, causing stretching and distension of the pelvic floor, vagina, and perineum. Somatic pain is triggered by nerve fibers in the sacral 2 to sacral 4 (S2-S4). This event causes ischemia and tissue injury, which triggers the inflammatory process ⁽¹⁾⁽²⁾

Sriasih, et al (2019) found that out of 70 first birth mothers (nulliparous), only 4.28% experienced moderate pain (score 4-6). The rest (95.72%) experienced severe pain (score 7-9) (3). (3). The mean pain intensity in the active phase (cervical dilation 5-7 cm) was 8.43 ± 1.17 , while in the transitional phase (cervical opening 8-10 cm) was 9.7 ± 0.53 ⁽⁴⁾ Pain that is felt by the mother in labor, especially nulliparous can trigger stress. The acute stress experienced affects the hypothalamus-pituitary-adrenal (HPA) axis. Cortisol secretion leads to increased gluconeogenesis and decreased immunity ⁽⁵⁾. Decreased immunity causes the release of more cortisol and triggers cytokine activity. Under normal conditions, cytokines are barely produced. The lower the body's immunity, the more IL6 and TNF α are expressed ⁽⁶⁾. TNF- α can increase the sensitivity of sensory neurons to the excitation produced by capsaicin and this increase is likely mediated by the production of prostaglandin neurons ⁽⁷⁾⁽⁸⁾. The sensitivity of nociceptors is increased due to the presence of prostaglandins, which can reduce the threshold of receptor activation so that the pain sensation is felt by the mother in labor ⁽⁹⁾.

Sri Rejeki (2014) found that the average level of IL-6 in stage I labor mothers in the active phase was $214.469 \mu\text{g} / \text{mL}$ ⁽¹⁰⁾. Jeremy, dkk (2015) Jeremy, et al (2015) found that the greater the cervical opening, the higher the IL 6 levels⁽⁸⁾. TNF α in the preactive phase shows the higher its level is near the end of the preactive phase, while in the active phase it is the opposite. TNF α levels get lower as the end of the active phase approaches ⁽¹⁰⁾. Pain stimulation causes afferent pain fibers to secrete substance P which activates the ascending pathway that transmits nociceptive signals to the thalamus and reticular formation. The interconnection of the two organs leads to the hypothalamus and limbic system which elicits behavioral and emotional responses to pain. Maternity responds to pain by crying and screaming ⁽⁹⁾. This response causes fatigue and triggers vasoconstriction of blood vessels, which can interfere with uterine contractions and reduce oxygen supply to the fetus. This condition can be life threatening to both the mother and the fetus, so it requires immediate treatment and often ends in cesarean section.

Pain management during labor aims to maintain the balance of parturient body functions. The goal of pain management is to reduce or eliminate maternal pain

and discomfort with the minimum possible side effects. Several alternatives that can be selected to treat labor pain, such as hypnobirthing, acupuncture, water birth, massage, and transcutaneous electrical nerves stimulation (TENs) ⁽¹¹⁾ Massage is a touch that provides light pressure using the hands, fingertips, with the aim of relieving pain and facilitating relaxation ⁽¹²⁾. Massage is useful for reducing labor pain ⁽¹³⁻²⁹⁾, as well as reducing anxiety ^(4,30,31). The use of aromatherapy as an essential oil, absorbed through breathing can reduce cortisol secretion or increase serotonin. During skin absorption massage, it can help reduce parturient anxiety ⁽³⁰⁻³⁶⁾. Frangipani essential oil contains Linalool which can inhibit the release of acetylcholine and change the function of ion channels at the neuromuscular junction. Linalool also functions as a sedative ⁽³⁷⁻³⁹⁾. Although it has been proven to be useful, however, there is no standard for the duration of the intervention. The duration of the intervention varied between 15-60 minutes. Thus further research still needs to be done to determine the efficacy of back massage using essential oils from plants. This study aims to determine the effect of back massage using frangipani aromatherapy oil on pain intensity and IL6 levels in the first stage of labor.

Method

The research design was True Experiment (Randomized Clinical Trial / RCT) with a pretest posttest control group design. The independent variable in this study was the provision of back massage using frangipani aromatherapy oil, while the dependent variable was IL-6 levels and pain labor intensity in the active phase. This study aims to prove the effect of the independent variable on the dependent variable. The research was conducted in inpatient Puskesmas Denpasar City consisting of Puskesmas I Denpasar Timur, Puskesmas II Denpasar Barat (Puskesmas Pembantu Dauh Puri), and Puskesmas IV Denpasar Selatan. Inpatient Puskesmas in Badung Regency consists of Puskesmas Abiansemal I, Puskesmas Mengwi I, and Puskesmas Kuta I. The research was conducted for 8 months.

Sample and sampling

The target population of this study were all women with normal delivery. The affordable population in this study were all normal delivery mothers who were served in inpatient Puskesmas Denpasar City and Badung Regency. The inclusion criteria of this study were nulliparous, cervical opening of 6-8 cm, cooperative and willing to participate. The exclusion criteria were having suffered from allergies. The drop out criterion is that the mother is not willing to continue with the treatment given, complications occur. This study consisted of 3 groups, namely the control group (C), the positive control group (CP) and the intervention group (I). The sample size for each group was 30 people. so that the overall sample size is 90. The sampling technique is simple random sampling, which is to provide equal opportunities for every member in the population to become the research sample. Determination of the sample in this study by lottery, both mothers who were served in the Puskesmas inpatient Denpasar City and in Badung Regency. Thus in each place, there is a sample of members of the treatment and control groups.

Measurement instrument

The measurement of pain intensity used a numeric rating scale (NRS). The pain measurement scale uses a ruler with a series of numbers 0 to 10. The number 0 indicates no pain; number 10 indicates severe pain (very severe). The NRS instrument has a validity value of $r = 0.941$ and a reliability of 0.95⁽⁴⁰⁾. The measurement results are recorded on the observation sheet. The observation sheet consists of data, namely respondent initials, respondent characteristics data, pain labor intensity ang IL-6 before and after treatment.

Material

The research materials consisted of virgin coconut oil (VCO) original (non-fragrant) and VCO with 10% Frangipani (*Plumeria*) aroma. Original VCO and VCO with frangipani aromatherapy produced by Bali Usada. Frangipani contains 3.86% tannins; Total phenol 18.94 mg GAE / g; vitamin C 2.28 mg / 100 g⁽⁴¹⁾. Frangipani among them contains Linalool 8% (India) and 20.7% (China)⁽³⁷⁾ IL6 examination uses materials, such as a disposable 3 mL syringe, alcohol swab tissue, blood collection tube, gloves, and masks. IL6 examination using Human IL-6 (Interleukin 6) ELISA Kit Catalog number: cat.E00090Hu, BT-Lab.

Ethical considerations

Data collection was carried out after obtaining ethical approval from the Ethic Commission of the Sanglah Central General Hospital and obtaining research permits from Dinas Perijinan dan Penanaman Modal satu Pintu Provinsi Bali, Dinas Kesehatan Kota Denpasar dan Dinas Kesehatan Kabupaten Badung. Prospective respondents were given an explanation of the objectives and benefits of the study, the treatment given, and the examinations carried out. Prospective respondents who are willing, are given an agreement to become a respondent (approval after explanation) to be signed. Because the respondent is a vulnerable group, also gave consentinform the witness (husband or family).

Procedure

This study involved 24 midwives (4 people in each research location) as field researchers and enumerators. All field researchers were given training on back massage techniques, guided by standard operational procedures (SOPs) and shared perceptions about how to collect data. The pretest data collection included assessment of pain intensity and IL-6. Assessment of pain perception by asking the respondent to point to one of the numbers on the 0-10 numerical pain scale, then recorded on the observation sheet. The enumerator took 2 cc of venous blood from the median cubital vein using a disposable syringe, then the blood was put into a tube containing a cloth activator (tube with a red cap). The blood is picked up by researchers to be delivered to the laboratory.

The treatment was given to the positive control (PC) and intervention (I) groups. The control group (C) there is no treatment, the positive control (PC) gets a back massage using original virgin coconut oil (VCO); The intervention group (I) received a back massage using Frangipani aromatherapy oil. Back massage is a

gentle rubbing and pressing on the back in the thoracic X area to the sacrum for six cycles of uterine contraction in both groups. The massage technique is in accordance with standard operating procedures which have been tested for validity r 0.99, reliability 0.83. Posttest data is obtained after the respondent is given treatment. The type and method of data collection were the same as the pretest data (measurement of pain intensity, venous blood collection for IL6 examination). Observation results were recorded on the observation sheet.

Laboratory examination

Blood that has been put into the red cap tube, centrifuged at 3,000 rpm for 15 minutes, the serum is put into 2 sample cups, then stored in the freezer at -20°C . After the number of samples is met, an IL6 examination is carried out according to the inspection procedure from the factory. The examination was carried out at the Clinical Pathology Laboratory of Sanglah Sanglah Central General Hospital Denpasar

Data analysis

Data analysis includes descriptive analysis, data normality test, homogeneity test of variance, paired t test, one way Anova, and Manova. Data analysis using the SPSS program.

Result

Subject Characteristics

Table 1
Subject Characteristics

Characteristics	Groups						<i>p</i>
	Control (C)		Positive Control (PC)		Intervention		
	f	%	f	%	f	%	
Age							
20 – 25 years	25	83,33	25	83,33	27	90	0,993
26 – 30 years	5	16,67	5	16,67	3	10	
Total	30	100	30	100	30	100	
Education							
Elementary	2	6,67	2	6,67	2	6,67	0,639
Intermediate	18	60,00	20	66,67	19	66,33	
higher education	10	33,33	8	26,66	9	30,00	
Total	30	100	30	100	30	100	
Childbirth companion							
Husband	29	96,67	28	93,33	28	93,33	0,858
Parent	1	3,33	2	6,67	2	6,67	
Total	30	100	30	100	30	100	

Note: Control (C) = no treatment; Positive Control (PC) = back massage using original VCO; Intervention (I) = back massage using VCO with Frangipani aromatherapy

Data on age, education level, and birth attendant for the three groups in table 1 shows no difference ($p > 0.05$). This confirms that the characteristics of the research subjects of the three groups are equivalent. The effect of the intervention on the dependent variable was tested by using the Paired T test, One Way Anova test, Post Hoc, and Manova tests. The prerequisite analysis conducted for the analysis of data normality and homogeneity of variance. Data on pain intensity and interleukin 6 (IL-6) levels pretest and posttest in the three groups, all of them were normally distributed ($p > 0.05$) and all variance was homogeneous ($p > 0.05$).

Pain Labor Intensity and Interleukin 6 (IL-6) levels

Table 2
Differences of Pain Labor Intensity Pretest and Posttest

Groups	Pain Labor Intensity		<i>p</i>
	Mean ± SD Pretest	Mean ± SD Posttest	
Control (C)	6,57 ± 1,43	7,17 ± 1,36	0,007
Positive Control (PC)	6,73 ± 1,41	6,43 ± 1,38	0,286
Intervention (I)	6,40 ± 1,49	5,57 ± 1,27	0,034
<i>p</i>	0,673	0,000	

Note: Control (C) = no treatment; Positive Control (PC) = back massage treatment using original VCO; Intervention (I) = back massage treatment using VCO with Frangipani aromatherapy

Table 2 illustrates that the pain labor intensity before treatment (pretest) was not different in the three groups ($P > 0.05$). After being given the intervention (posttest), the pain intensity in the three groups was significantly different ($p < 0.01$). The average pain intensity before and after being given treatment, it appears that in the control (C) group there was a significant increase in pain intensity ($p < 0.01$). In the positive control (PC) group there was a decrease in pain intensity (6.73 vs 6.43), but it was not significantly different ($p > 0.05$). In the intervention (I) group, it appears that there is a significant decrease in pain intensity ($p < 0.05$). This shows that back massage with Frangipani aromatherapy can reduce the intensity of pain in parturient during the active phase of labor.

Table 3
Differences of Interleukin 6 (IL-6) levels Pretest and Posttest

Groups	Interleukin 6 (IL-6) Levels (ng/L)		<i>p</i>
	Mean ± SD Pretest	Mean ± SD Posttest	
Control (C)	26,33 ± 3,43	28,75 ± 4,36	0,002

Positive Control (PC)	25,64 ± 3,94	26,58 ± 3,44	0,217
Intervention (I)	26,74 ± 3,87	24,33 ± 2,91	0,011
<i>p</i>	0,521	0,000	

Note: Control (C) = no treatment; Positive Control (PC) = back massage using original VCO; Intervention (I) = back massage using VCO with Frangipani aromatherapy

Table 3 shows that IL-6 levels pretest were not different in the three groups ($P > 0.05$). After being given the intervention (posttest), IL-6 levels in the three groups were significantly different ($p < 0.01$). There was a significant increase in IL-6 levels posttest ($p < 0.01$). In the positive control group there was an increase in IL-6 levels, but it was not significantly different ($p > 0.05$). That means, IL-6 levels are stable with back massage using the original VCO. In the intervention group, it appears that there is a significant decrease in pain intensity ($p < 0.05$). This means that back massage with Frangipani aromatherapy, can reduce IL-6 levels of parturient during the active phase of labor. To prove the differences between groups, a Post Hoc test was performed.

Table 4
Differences in Pain Labor Intensity and Levels of Interleukin 6 (IL-6) Between Groups

Groups		Pain Labor Intensity		IL-6 Level	
		Mean difference	<i>p</i>	Mean difference	<i>p</i>
Pretest	C - PC	-0,167	0,657	0,688	0,480
	PC - I	0,333	0,375	-1,100	0,260
	I - C	-0,167	0,657	0,411	0,672
Posttest	C - PC	0,733	0,037	2,167	0,023
	C - I	1,600	0,000	4,418	0,000
	PC - I	0,867	0,014	2,250	0,018

Note: Control (C) = no treatment; Positive Control (PC) = back massage using original VCO; Intervention (I) = back massage using VCO with Frangipani aromatherapy

Table 4 shows the mean pain labor intensity and IL-6 levels between the C-PC group; PC-I; I-C before intervention (pretest) was not different ($p > 0.05$). After the intervention, the mean pain intensity and IL-6 levels between groups, namely control (C) with positive control were significantly different ($p < 0.05$); control with different interventions ($p < 0.01$); and positive control with significantly different interventions ($p < 0.05$). To prove the effect of the intervention on pain intensity and IL-6 levels, the Manova test was performed

Table 5
Results of Analysis of the Effect of Back Massage with Frangipani Aromatherapy
on Pain Labor Intensity and Levels of Interleukin 6 (IL-6)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Noncent. Parameter	Observed Power ^c
Corrected Model	Pain labor intensity posttest	38.489 ^a	2	19.244	10.671	.000	21.342	.988
	IL-6 levels posttest	292.816 ^b	2	146.408	11.143	.000	22.287	.990
Intercept	Pain labor intensity posttest	3673.611	1	3673.611	2036.993	.000	2036.993	1.000
	IL-6 levels posttest	63456.625	1	63456.625	4829.833	.000	4829.833	1.000
ID	Pain labor intensity posttest	38.489	2	19.244	10.671	.000	21.342	.988
	IL-6 levels posttest	292.816	2	146.408	11.143	.000	22.287	.990
Error	Pain labor intensity posttest	156.900	87	1.803				
	IL-6 levels posttest	1143.047	87	13.138				
Total	Pain labor intensity posttest	3869.000	90					
	IL-6 levels posttest	64892.487	90					
Corrected Total	Pain labor intensity posttest	195.389	89					
	IL-6 levels posttest	1435.863	89					

a. R Squared = .197 (Adjusted R Squared = .179)

b. R Squared = .204 (Adjusted R Squared = .186)

c. Computed using alpha = .05

Table 5 illustrates that the back massage intervention using frangipani aromatherapy oil has an effect on the reduction of labor pain intensity ($p < 0.01$) and IL-6 levels ($p < 0.01$). The contribution of back massage using Frangipani aromatherapy to the reduction of labor pain intensity by 19.7%; while the levels of IL-6 were 20.4%. This means, there are still other factors that influence the reduction of labor pain intensity and IL-6 levels, which require further research.

Discussion

Normal delivery is a process of spontaneous removal of the product of conception without requiring special action, without complications to the mother or baby. Intervention is needed when the well-being of the mother and / or fetus is threatened ⁽¹⁾. Labor is characterized by cervical opening, bloody shows, and uterine contractions ⁽¹⁵⁾. Uterine contractions are stimulated by the hormones prostaglandins and oxytocin, which cause an increase in intrauterine pressure. This condition triggers the activity of nociceptive afferents that innervate the endocervix and lower segments from Thoracic 10 to lumbar I (T10-L1). The more frequent uterine contractions occur, the lower part of the fetus decreases, causing stretching and distension of the pelvic floor, vagina and perineum, which can trigger nerve fiber activity in sacral 2 to sacral 4 (S2-S4). This event causes ischemia and tissue injury, which triggers the inflammatory process. As a result, the mother felt pain^{(1) (2)(42)}

Labor pain is an emotional experience. The pain perceived by the mother in labor (pain intensity) can be measured with a numeric rating scale (NRS) ⁽⁴⁰⁾ The average labor pain intensity in this study before the intervention was in the moderate degree range, Control group 6.57; Positive control group 6,73; and the intervention group 6.40. Similar results were found in several studies ⁽⁴³⁾⁽³⁾. Labor pain is unique and different from other pain. Pain intensity is influenced by several factors, including age, parity, education, family support ⁽⁴⁴⁾. In this study, all subjects were nulliparous, aged 20-30 years, most of the education was secondary level, all subjects were accompanied by their families, especially husbands. The results of different tests in the three groups showed that there was no difference between the three groups. Age, education, and delivery assistance were equivalent ($p > 0.05$) in the three groups, indicating that changes that occurred in one group were not fully influenced by the characteristics identified in this study.

Mean levels of IL-6 before intervention in the control group were 26.33 ng / L; positive control group 25.64 ng / L; and the intervention group 26.74 ng / L. There were no significant differences between the three groups. IL-6 is produced by endometrial stromal cells, decidual cells, and macrophages in response to inflammation, such as interleukin-1 and tumor necrosis factor. IL-6 stimulates the production of prostaglandins which triggers an increase in metalloproteases which in turn lead to cervical ripening and thinning. As you approach the end of the first stage, IL-6 levels increase to trigger the myometrium to contract. Increased levels of IL-6 are also influenced by stress, uteroplacental circulation disorders, infection, as a response^{(45,46,47)(48)}. In contrast to the results of the study by Omere, C., et.al (2020) which found that IL-6 was not proven to be a functional mediator of the labor induction pathway. Increased production of IL-6 by fetal membranes and other fetal tissues in response to infection is probably a nonspecific inherited response⁽⁴⁹⁾

The intensity of labor pain and IL-6 levels in this study was significantly different in the three groups after intervention. The average pain intensity in the control group increased significantly ($p < 0.01$), in the positive control group tended to decrease, but not significantly different ($p > 0.05$), and in the intervention group

decreased ($p < 0.05$). It was also found that back massage intervention with Frangipani aromatherapy oil contributed to a reduction in pain intensity and IL-6 levels. Massage causes relaxation of the body muscles, triggers the release of endorphins, which is useful for reducing pain during the birth process of the baby (13–29), and reducing anxiety (4,30–36). The use of aromatherapy as an essential oil, is absorbed through the smell and then passed on to the olfactory nerve. Delivery of the response carried out by the hypothalamus, can reduce cortisol secretion or increase serotonin.

Frangipani aromatherapy oil contains Linalool which can inhibit the release of acetylcholine and change the function of ion channels at the neuromuscular junction. Linalool also functions as a sedative (37–39). If the mother is calm, it can increase anti-inflammatory activity, so that IL-6 decreases, prostaglandins decrease and increases endorphin secretion so that labor pain decreases. This triggers the secretion of oxytocin (the love hormone) which can regulate the contraction and relaxation of the uterus in a rhythmic manner so as to facilitate the birth process. (48)(31,47)

Conclusions and Suggestions

Back massage using Frangipani aromatherapy oil has an effect on reducing labor pain intensity and reducing IL6 levels. The contribution of the intervention was 19.7% to decrease pain intensity and 20.4% to decrease IL6 levels. Therefore, the recommendation for future investigators is to find other factors that contribute to the reduction in pain intensity and IL-6

Conflict of interest

This study has no conflict of interest

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