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# Effect of Expressed Breast Milk versus Leg Massage on Preterm Neonates' Pain during Heel Lance

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***Abstract:*** *Nowadays, pain management is particularly essential for preterm neonates who are not able to verbally express their pain. So, non pharmacological interventions play crucial role in treating procedural pain among those neonates.* ***Objective:*** *This study aimed to determine the effect of expressed breast milk versus leg massage on preterm neonates' pain during heel lance.* ***Setting****: This study was carried out at Neonatal Intensive Care Unit at El-Shatby Maternity University Hospital in Alexandria.* ***Subjects****: The study subjects comprised of 75 preterm neonates.* ***Tools****: Two tools were used to collect necessary data namely; characteristics of the preterm neonates and Premature Infant Pain Profile Scale (PIPP).* ***Results****: The main result showed that, none neonate of expressed breast milk group and only 4% of neonates of leg massage group had severe pain score during heel lance compared to 48% of neonates of control group. Statistical significant difference was observed between three groups during heel lance, where* $^{MC}P<0.0001$*. Furthermore, it was found that all neonates (100%) of expressed milk group and 88% of neonates of leg massage groups had mild pain score after heel lance compared to only 12% of neonates of control group. On the other hand, approximately, one third (32% ) of neonates of control group had severe pain after heel lance compared to only 4% of neonates of leg massage and none neonate of expressed breast milk group. Statistical significant difference was found between three groups after heel lance, where* $^{MC}P<0.0001$*.* ***Conclusion****: It can be concluded that expressed breast milk and leg massage are effective in reducing pain responses in neonates during heel lance. Moreover, the neonates of expressed breast milk group experienced less pain score than those of the leg massage and control groups.* ***Recommendation:*** *Single or combined EBM and leg massage should be provided during heel lance of preterm neonates.*

***Keywords:*** *Expressed Breast Milk Leg Massage Preterm Neonates' Pain Heel lance*

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## I. Introduction

Pain management is very important for preterm neonates because they are not able to verbally express their feeling of pain. The traditional view that neonates are not capable of perceiving pain has been refuted and there is now no doubt that those neonates perceive pain. Evidences show that preterm neonates have increased sensitivity to pain and its long term effects compared with full terms one. Although neonates do not verbalize, they reveal their vulnerability to pain through specific pain behaviors and physiologic changes. Painful stimuli in neonates may have physiologic consequences such as increase intracranial pressure, increase heart rate or decrease oxygen saturation and behavioral consequences as cry and eye squeeze . Preterm neonates routinely undergo painful invasive procedures, even after uncomplicated birth. The most common painful procedures are heel lance and vein puncture [(1-3)].

Treating procedural pain has become a crucial part of neonatal care. There are two models for pain management; medical and non-pharmacologic models. The former model adopts pharmacologic methods of pain relief, such as topical local anaesthetic or paracetamol for heel pricks. Pharmacologic approaches are invasive, and have the potential to cause side effects such as neonatal debilitation of the central nervous system. So, they are rarely used to reduce neonates' pain during heal lance procedure [(4,5)].

The later model utilizes the non-pharmacologic measures of pain relief which include sweet oral solutions (sucrose or glucose), non--nutritive sucking, multisensory stimulation, swaddling positioning, holding and rocking and skin to skin contact. The effectiveness of several forms of non pharmacologic interventions to treat procedural pain in neonates has been proven with a high level of evidence. Recent studies have reported that pain can be reduced with such simple and benign interventions [(4,6,7)]. **Shah et.al** (2009 )[(8)] reported that, breast milk during a painful procedure is a non invasive, safe and natural method for pain relief in late preterm neonates. As early as, **Malngiang et.a**l (2016 ) [(9)] reported that, expressed breast milk **(**EBM) is easily available and useful for alleviating pain response and further studies should evaluate its effect for pain reduction. In addition, massage therapy is most commonly used with pain responses. Gentle massage may

inhibit the transmission of pain along the ascending fibers through closing the gate or by activating the descending endogenous opioid and non-opioid pathways to decrease pain [2,10].

Neonatal pain assessment can be complex and challenging, but is vital to ensure appropriate pain management. In fact, some health care facilities now identify pain assessment as the 5th vital sign [11-13] . A variety of valid and reliable pain assessment tools have been developed over the past decades. Until now, behavioral pain assessment remains challenging and controversial due to the lack of a gold standard for neonatal pain expression. Premature Infant Pain Profile (PIPP) was selected by an international consensus neonatal pain group for acute procedural pain in neonates. It is a pain assessment tool used commonly for assessment of pain in preterm neonates and is considered a reliable and valid instrument. It consists of gestational age, heart rate, oxygen saturation, behavioral state and three facial actions (brow bulge, eye squeeze, nasolabial furrow). In addition, it accommodates the recognition that neonates may not be able to mount or sustain a response to pain in the same fashion as an older one. Therefore, these neonates are given points toward their overall profile based on their gestational age in PIPP [11,14] .

Neonatal intensive care nurses have crucial role in pain assessment and management. To effectively assess pain, nurses must have the critical thinking skills necessary to differentiate pain behaviors from other behaviors that occur apart from painful situations. They should use pain assessment tools that are multidimensional, reliable and valid, as well as clinically useful and appropriate for gestational age. They should also use non-pharmacologic strategies that are effective and safest method to relieve neonatal pain [12,13]. Thus, the present study aimed to determine the effect of expressed breast milk versus leg massage on preterm neonates' pain during heel lance.

**Aim of the Study**

This study aimed to determine the effect of expressed breast milk versus leg massage on preterm neonates' pain during heel lance.

**Research Hypothesis**

- Preterm neonates who receive leg massage exhibit less pain intensity than those who do not.
- Preterm neonates who receive expressed breast milk exhibit less pain intensity than those who do not.

## II. Materials and Method

**Materials**

**Research Design:**

A quasi experimental design was used to accomplish this study.

**Setting:**

The study was conducted at the Neonatal Intensive Care Unit (NICU) at El-Shatby Maternity University Hospital in Alexandria .

**Subjects**

Epi Info program was used to estimate the sample size using the following parameters

- Population size = 150 preterm neonates.
- Expected frequency = 50%.
- Acceptable error = 10%.
- Confidence coefficient = 95%.
- Minimum sample size =59 preterm neonates.

A convenient sample of 75 preterm neonates were recruited in the study. The study subjects were selected through a non-probability sampling technique.

**Inclusion criteria**

Preterm neonates who have homodynamic and physiological stability; free from congenital anomalies and did not receive any sedative agents due to any possible difference in their behavioral or pain response to the procedural stimulation were included in the study. The preterm neonates were equally randomly assigned into three groups. Preterm neonates of each group were chosen alternatively.

Group 1: **expressed breast milk group (**EBM) which consisted of 25 preterm neonates were received expressed breast milk.

Group 2: **leg massage group**, which comprised of 25 preterm neonates were received leg massage.

Group 3: **control group which** included the remaining 25 preterm neonates were received routine NICU care.

**Tools**

**Two tools were used to collect the needed data.**

The tools for data collection were developed by the researcher after thorough review of related literature. They comprised the following:

**Tool I: Characteristics of the Preterm Neonates:**

This tool was developed by the researcher. It entailed preterm neonates' characteristics such as sex, birth weight, type of delivery and diagnosis on admission.

**Tool II: Premature Infant Pain Profile Scale (PIPP):**

This tool was originally developed by Stevens et.al (1996)[(15)] to assess a behavioral response of pain of pain for preterm neonates.It consists of 7 indicators behavioral observation scale; gestational age, behavioral state, heart rate, oxygen saturation and 3 facial actions (brow bulge, eye squeeze, and nasolabial furrow). Each indicator has four likert scales: 0,1,2,3. The total score ranged from 0 to 21 as follows:

- 0= no pain
- 1-7=mild pain
- 8-14= moderate pain
- 15-21 = severe pain

**Method**

- An official approval for conducting the study was obtained from the responsible administrative personnel after explaining the aim of the study.
- Tools of the study were developed after thorough review of the related literature.
- Content validity of the tools was done by five experts in the pediatric nursing field and recommended changes were done.
- A pilot study was carried out on 7 neonates to test the feasibility and applicability of the tools. Those neonates were excluded from the study.
- Subjects were assigned into three groups. Group (1) was received EBM, group (2) was received leg massage and group (3) was received routine NICU care. Preterm neonates of each group were chosen alternatively.
- Initially, data concerning characteristics of each preterm neonate among three groups were assessed using tool I.
- Gestational age was assessed before examining the preterm neonates.
- Neonates' physiological responses were assessed before, during and after the heel lance using tool II for the three groups.
- Behavioral state of the preterm neonates was observed within a period of 15 seconds before, during and immediately following the heel lance using PIPP score.

- **Heel lance considerations were performed for three groups as follows:**
- The nurse performed the heel stick using a lancet.
- Swabbing the heel with a small gauze pad and disinfectant.
- Lancing the heel and then gently squeezing the heel intermittently to collect the required amount of blood.

- **Expressed Breast Milk Group:**
- Five milliliters of mothers' expressed breast milk were prepared in disposable syringe.
- Expressed breast milk was orally administered to preterm neonates for 2 minutes prior to heel lance.

- **Leg Massage Group:**
- Leg massage of preterm neonates was provided for 2 minutes before starting the heel lance procedure.
- The chosen leg for heel lance was massaged from toes to mid thigh by using a firm but gentle pressure by fingers and thumbs in circular motion.
- The massage pressure was adjusted to keep the preterm neonates comfortable [(15)].
- The control group was received routine care of the NICU as no intervention was used during heel lance.
- Comparison between three groups was done to evaluate the effect of EBM versus leg massage on pain of preterm neonates during heel lance.
- Data were collected three days per week over a period of four months, started from the beginning of June till the end of September 2015.

**Ethical considerations** were considered all over the study phases as the following:

- Written informed consent of preterm neonates' parents was obtained after explaining the aim of the study.
- Parents were ascertained about confidentiality of their preterm neonates' data.
- The researcher received training course of massage technique before staring the study.

**Statistical Analysis**

The raw data were coded and entered into Statistical Package for Social Science (version 18). Analysis and interpretation of data were conducted.

The following statistical measures were used:-

- Descriptive statistics including frequency and distribution were used to describe different characteristics.
- Univariate analyses including Chi-Square test and Friedman test were used to test the significance of results of qualitative variables.
- The significance of the results was at the 5% level of significance.

## III. Results

Table (1) illustrates characteristics of preterm neonates among EBM, leg massage and control groups. It was clear from the table that, male neonates constituted 68% among EBM, control groups and 60% of those neonates of leg massage group. Concerning the birth weight, it was observed that, 48% of neonates among EBM and leg massage groups were low birth weight compared to 56% of those among control group. Slightly more than two thirds of neonates (64%) among EBM group and (68%) of neonates among control group were delivered by cesarean section compared to 72% of those among leg massage group

**Table (1):** Characteristics of preterm Neonates among Expressed Breast Milk, Leg Massage and Control Groups

| Preterm neonates' characteristics | EBM (n=25) | | Leg massage (n=25) | | Control (n=25) | | Significance |
|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | |
| Sex | | | | | | | |
| • Male | 17 | 68.0 | 15 | 60.0 | 17 | 68.0 | $X^2$=0.471 |
| • Female | 8 | 32.0 | 10 | 40.0 | 8 | 32.0 | P=0.79 |
| Birth weight | | | | | | | |
| • Very very low | 0 | 0.0 | 0 | 0.0 | 2 | 8.0 | $X^2$=19.14 |
| • Very low | 3 | 12.0 | 6 | 24.0 | 9 | 36.0 | $^{MC}$P=0.002 |
| • Low | 12 | 48.0 | 12 | 48.0 | 14 | 56.0 | * |
| • Normal | 10 | 40.0 | 7 | 28.0 | 0 | 0.0 | |
| Type of delivery | | | | | | | |
| • Normal | 9 | 36.0 | 7 | 28.0 | 8 | 32.0 | $X^2$=0.368 |
| • Cesarean section | 16 | 64.0 | 18 | 72.0 | 17 | 68.0 | P=0.853 |

**$X^2$: Chi-Square test $^{MC}$P: Monte Carlo corrected P-value *significant at P≤0.05**

Table (2) portrays distribution of preterm neonates among EBM, leg massage and control groups according to their diagnosis. It was observed that, 48% of neonates among EBM and leg massage groups had hyperbilirubinmia compared to 32% among those neonates of control group. Moreover, 48% of neonates in EBM, control groups and 28% of neonates in leg massage group had congenital pneumonia.

**Table (2):** Distribution of Neonates among Expressed Breast Milk, Leg Massage and Control Groups according to their Diagnosis

| Diagnosis on admission | EBM (n=25) | | Leg massage (n=25) | | Control (n=25) | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| RDS | 1 | 4.0 | 6 | 24.0 | 5 | 20.0 |
| Congenital pneumonia | 12 | 48.0 | 7 | 28.0 | 12 | 48.0 |
| Hyperbilirubinemia | 12 | 48.0 | 12 | 48.0 | 8 | 32.0 |

Table (3) illustrates premature infant pain profile among neonates of EBM group. It was clear from the table that approximately three quarters of neonates (72%) were from 32 to35 weeks of gestation. Concerning behavioral state, none of neonates was quite/ sleep eye closed with no facial movements before heel lance (score 3). This percent increased to only 12% during heel lance. While, after heel lance none of those neonates was quite/ eyes closed with no facial movement .There was statistical significant difference before, during and after heel lance where $^{Fr}$P<0.0001.

Concerning the heart rate, it was observed that 84% of neonates of EBM group exhibited minimum heart rate increase from 0-4 b/m before heel lance (score 0). This percent declined to 28% during heel lance, while it increased to 40% after heel lance. The difference was statistically significant between before, during and after heel lance where $^{Fr}P<0.0001$.

It was apparent that all neonates (100%) of EBM group exhibited no de saturation (oxygen saturation decrease from( 0-4.2%) before and after heel lance. This percent slightly decreased to 92% during heel lance. Concerning, facial actions of neonates of EBM, it was observed that only one neonate exhibited maximum eye squeeze, maximum brow blug and maximum nasolabial furrow during heel lance and statistical significant differences were observed before ,during and after heel lance regarding eye movement ( $^{Fr}P<0.0001$) , brow blug ( $^{Fr}P=0.0001$) as well as nasolabial furrow ( $^{Fr}P<0.0001$).

**Table (3):** Premature Infant Pain Profile among Neonates of Expressed Breast Milk Group

| Premature Infant Pain Profile Scale (PIPP) | Expressed Breast Milk group | | | | | | Significance |
|---|---|---|---|---|---|---|---|
| | Before | | During | | After | | |
| | No. | % | No. | % | No | % | |
| Gestational age | | | | | | | |
| > = 36 weeks. (0) | 7 | 28.0 | 7 | 28.0 | 7 | 28.0 | P=1.0 |
| 32 to 35 weeks. (1) | 18 | 72.0 | 18 | 72.0 | 18 | 72.0 | |
| Behavioral state | | | | | | | |
| Active / awake eyes open facial movements. (0) | 20 | 80.0 | 19 | 76.0 | 16 | 64.0 | $^{Fr}X^2=35.826$ P<0.0001* |
| Quiet/awake eyes open no facial movements. (1) | 5 | 20.0 | 3 | 12.0 | 7 | 28.0 | |
| Active /sleep eyes closed facial movements. (2) | 0 | 0.0 | 0 | 0.0 | 2 | 8.0 | |
| Quite /sleep eyes closed no facial movements. (3) | 0 | 0.0 | 3 | 12.0 | 0 | 0.0 | |
| Heart rate | | | | | | | |
| Heart rate increase from 0-4 B/M (0) | 21 | 84.0 | 7 | 28.0 | 10 | 40.0 | $^{Fr}X^2=24.111$ P<0.0001* |
| Heart rate increase from 5-14 B/M (1) | 4 | 16.0 | 2 | 8.0 | 0 | 0.0 | |
| Heart rate increase from 15-24 B/M (2) | 0 | 0.0 | 13 | 52.0 | 12 | 48.0 | |
| Heart rate increase > 25 B/M (3) | 0 | 0.0 | 3 | 12.0 | 3 | 12.0 | |
| Oxygen saturation | | | | | | | |
| No desaturation "from 0 to 2.4% decrease" (0) | 25 | 100.0 | 23 | 92.0 | 25 | 100 | $^{Fr}X^2=4.0$ P=0.135 |
| Slight desaturation "from 2.5 to 4.9% decrease" (1) | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | |
| Moderate desaturation "5 -7.4% decrease" (2) | 0 | 0.0 | 2 | 8.0 | 0 | 0.0 | |
| Severe desaturation "7.5% decrease or more" (3) | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | |
| Eye movement | | | | | | | |
| No eye squeeze (0) | 25 | 100.0 | 13 | 52.0 | 16 | 64.0 | $^{Fr}X^2=19.5$ P<0.0001* |
| Slight eye squeeze (1) | 0 | 0.0 | 11 | 44.0 | 9 | 36.0 | |
| Moderate eye squeeze (2) | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 | |
| Maximum eye squeeze (3) | 0 | 0.0 | 1 | 4.0 | 0 | 0.0 | |
| Brow blug | | | | | | | |
| No brow blug (0) | 12 | 48.0 | 3 | 12.0 | 16 | 64.0 | $^{Fr}X^2=14.812$ P=0.001* |
| Minimum brow blug (1) | 12 | 48.0 | 19 | 76.0 | 9 | 36.0 | |
| Moderate brow blug (2) | 1 | 4.0 | 2 | 8.0 | 0 | 0.0 | |
| Maximum brow blug (3) | 0 | 0.0 | 1 | 4.0 | 0 | 0.0 | |
| Nasolabial furrow | | | | | | | |
| No nasolabial furrow (0) | 24 | 96.0 | 13 | 52.0 | 16 | 64.0 | $^{Fr}X^2=17.568$ P<0.0001* |
| Minimum nasolabial furrow (1) | 0 | 0.0 | 9 | 36.0 | 7 | 28.0 | |
| Moderate nasolabial furrow (2) | 1 | 4.0 | 2 | 8.0 | 2 | 8.0 | |
| Maximum nasolabial furrow (3) | 0 | 0.0 | 1 | 4.0 | 0 | 0.0 | |

**$^{Fr}X^2$: Friedman test *significant at P≤0.05**

Table (4) delineates the premature infant pain profile among neonates of leg massage. As regards gestational age, it was observed that slightly more than three quarters (76%) of neonates among leg massage group were from 32 to 35 weeks of gestation.

Concerning behavioral state, it was clear that only one neonate of leg massage group was quite / sleep eye closed with no facial movements before heel lance (score 3). During heel lance, the percent increased to only 3%. Meanwhile, after heel lance, none of those neonates were quite / sleep eyes closed with no facial movements. There was statistical significant difference between before, during and after heel lance $^{Fr}P<0.0001$.

It was observed that, 92% of neonates of leg massage exhibited heart rate increase from 0-4 b/m before heel lance. This percent dropped to approximately one third (32%) while, it increased to 44% after heel lance. There was statistical significant difference between before, during and after heel lance $^{Fr}P<0.0001$.

Concerning oxygen saturation, all neonates (100%) of leg massage group exhibited increase of oxygen saturation from 0 to 2.4% ( no desaturation) before heel lance. This percent decreased to 80% during heel lance. The percent slightly increased to 84% after heel lance. Statistical significant difference was observed between before, during and after heel lance $^{Fr}P<0.04$.

As regards facial actions, it was clear that, none of the neonate exhibited maximum eye squeeze, maximum brow blug and maximum nasolabial furrow before heel lance while, only 20% of those neonates exhibit maximum eye squeeze, maximum brow blug. A statistical significant difference was observed between before, during and after heel lance $^{Fr}P<0.0001$.

**Table (4):** Premature Infant Pain Profile among Neonates of Leg Massage Group**.**

| Premature Infant Pain Profile Scale (PIPP) | Leg massage group | | | | | | Significance |
|---|---|---|---|---|---|---|---|
| | Before | | During | | After | | |
| | No. | % | No. | % | No. | % | |
| **Gestational age** | | | | | | | |
| **> = 36 weeks. (0)** | 6 | 24.0 | 6 | 24.0 | 6 | 24.0 | P=1.0 |
| **32 to 35 weeks 6 days. (1)** | 19 | 76.0 | 19 | 76.0 | 19 | 76.0 | |
| **Behavioral state** | | | | | | | |
| **Active / awake eyes open facial movements. (0)** | 19 | 76.0 | 13 | 52.0 | 16 | 64.0 | $^{Fr}X^2$=25.182 P<0.0001* |
| **Quiet/awake eyes open no facial movements. (1)** | 5 | 20.0 | 6 | 24.0 | 8 | 32.0 | |
| **Active /sleep eyes closed facial movements. (2)** | 0 | 0.0 | 3 | 12.0 | 1 | 4.0 | |
| **Quite /sleep eyes closed no facial movements. (3)** | 1 | 4.0 | 3 | 12.0 | 0 | 0.0 | |
| **Heart rate** | | | | | | | |
| **Heart rate increase from 0-4 B/M (0)** | 23 | 92.0 | 8 | 32.0 | 11 | 44.0 | $^{Fr}X^2$=21.0 P<0.0001* |
| **Heart rate increase from 5-14 B/M (1)** | 2 | 8.0 | 5 | 20.0 | 3 | 12.0 | |
| **Heart rate increase from 15-24 B/M (2)** | 0 | 0.0 | 9 | 36.0 | 8 | 32.0 | |
| **Heart rate increase > 25 B/M (3)** | 0 | 0.0 | 3 | 12.0 | 3 | 12.0 | |
| **Oxygen saturation** | | | | | | | |
| **No desaturation "from 0 to 2.4% decrease" (0)** | 25 | 100.0 | 20 | 80.0 | 21 | 84.0 | $^{Fr}X^2$=6.421 P=0.04* |
| **Slight desaturation "from 2.5 to 4.9% decrease" (1)** | 0 | 0.0 | 1 | 4.0 | 2 | 8.0 | |
| **Moderate desaturation "5 -7.4% decrease" (2)** | 0 | 0.0 | 3 | 12.0 | 0 | 0.0 | |
| **Severe desaturation "7.5% decrease or more" (3)** | 0 | 0.0 | 1 | 4.0 | 2 | 8.0 | |
| **Eye movement** | | | | | | | |
| **No eye squeeze (0)** | 25 | 100.0 | 9 | 36.0 | 16 | 64.0 | $^{Fr}X^2$=24.531 P<0.0001* |
| **Slight eye squeeze (1)** | 0 | 0.0 | 8 | 32.0 | 6 | 24.0 | |
| **Moderate eye squeeze (2)** | 0 | 0.0 | 3 | 12.0 | 2 | 8.0 | |
| **Maximum eye squeeze (3)** | 0 | 0.0 | 5 | 20.0 | 1 | 4.0 | |
| **Brow blug** | | | | | | | |
| **No brow blug (0)** | 14 | 56.0 | 2 | 8.0 | 11 | 44.0 | $^{Fr}X^2$=17.014 P<0.0001* |
| **Minimum brow blug (1)** | 7 | 28.0 | 13 | 52.0 | 8 | 32.0 | |
| **Moderate brow blug (2)** | 4 | 16.0 | 5 | 20.0 | 5 | 20.0 | |
| **Maximum brow blug (3)** | 0 | 0.0 | 5 | 20.0 | 1 | 4.0 | |
| **Nasolabial furrow** | | | | | | | |
| **No nasolabial furrow (0)** | 21 | 84.0 | 9 | 36.0 | 15 | 60.0 | $^{Fr}X^2$=17.077 P<0.0001* |
| **Minimum nasolabial furrow (1)** | 0 | 0.0 | 8 | 32.0 | 7 | 28.0 | |
| **Moderate nasolabial furrow (2)** | 4 | 16.0 | 3 | 12.0 | 2 | 8.0 | |
| **Maximum nasolabial furrow (3)** | 0 | 0.0 | 5 | 20.0 | 1 | 4.0 | |

**$^{Fr}X^2$: Friedman test *significant at P≤0.05**

Table (5) explicates premature infant pain profile among neonates of control group. It was found that, 76% of neonates of control group were from 32 to35 weeks of gestation. It also observed that, 8% of neonates of control group were quite/ sleep, eyes closed with no facial movement before heel lance (score 3). This percent increased to 40% during heel lance. Meanwhile, after heel lance the percentage of those neonates was declined to 36% with statistical significant difference between before, during and after heel lance $^{Fr}P= 0.0001$.

It was clear that none of the neonates of control group exhibited increase in heart rate more than 25b/m (score 3). Meanwhile, this percent was raised to 44% during heel lance. Further increase was observed among slightly more than half of neonates (52%) after heel lance. Statistical significant difference was observed between before, during and after heel lance $^{Fr}P<0.0001$.

The table also showed that, none of neonates had severe de saturation before heel lance. On the other hand, the percent of those neonates increased to 40% during heel lance and jumped to 64% after heel lance. Statistical significant difference was found between before, during and after heel lance $^{Fr}P<0.0001$.

Regarding eye movement and brow blug, it was observed that more than three fifth (64%) of neonates had maximum eye squize and maximum brow blug during heel lance. This percent was raised to more than half (56%) of neonates after heel lance. Statistical significant difference was observed between before, during and after heel lance $^{Fr}P<0.0001$.

Before heel lance, none of neonate of control group had nasolabial furrow. Meanwhile, the percent jumped to 68% during heel lance then declined to 40% after heel lance. Statistical significant difference was observed between before, during and after heel lance $^{Fr}P<0.0001$.

**Table (5): Premature Infant Pain Profile among Neonates of Control Group**

| Premature Infant Pain Profile Scale (PIPP) | Control group | | | | | | Significance |
|---|---|---|---|---|---|---|---|
| | Before | | During | | After | | |
| | No. | % | No. | % | No. | % | |
| **Gestational age** | | | | | | | |
| 32 to 35 weeks 6 days. (0) | 19 | 76.0 | 19 | 76.0 | 19 | 76.0 | P=1.0 |
| 28 to 31 weeks 6 days. (1) | 6 | 24.0 | 6 | 24.0 | 6 | 24.0 | |
| **Behavioral state** | | | | | | | |
| Active / awake eyes open facial movements. (0) | 11 | 44.0 | 4 | 16.0 | 2 | 8.0 | $^{Fr}X^2$=13.351 P=0.001* |
| Quiet/awake eyes open no facial movements. (1) | 6 | 24.0 | 1 | 4.0 | 2 | 8.0 | |
| Active /sleep eyes closed facial movements. (2) | 6 | 24.0 | 10 | 40.0 | 12 | 48.0 | |
| Quite /sleep eyes closed no facial movements. (3) | 12 | 8.0 | 10 | 40.0 | 9 | 36.0 | |
| **Heart rate** | | | | | | | |
| Heart rate increase from 0-4 B/M (0) | 22 | 88.0 | 4 | 16.0 | 7 | 28.0 | $^{Fr}X^2$=28.455 P<0.0001* |
| Heart rate increase from 5-14 B/M (1) | 3 | 12.0 | 6 | 24.0 | 5 | 20.0 | |
| Heart rate increase from 15-24 B/M (2) | 0 | 0.0 | 4 | 16.0 | 0 | 0.0 | |
| Heart rate increase > 25 B/M (3) | 0 | 0.0 | 11 | 44.0 | 13 | 52.0 | |
| **Oxygen saturation** | | | | | | | |
| No desaturation "from 0 to 2.4% decrease" (0) | 23 | 92.0 | 7 | 28.0 | 4 | 16.0 | $^{Fr}X^2$=26.385 P<0.0001* |
| Slight desaturation "from 2.5 to 4.9% decrease"(1) | 2 | 8.0 | 5 | 20.0 | 1 | 4.0 | |
| Moderate desaturation "5 -7.4% decrease" (2) | 0 | 0.0 | 3 | 12.0 | 4 | 16.0 | |
| Severe desaturation "7.5% decrease or more" (3) | 0 | 0.0 | 10 | 40.0 | 16 | 64.0 | |
| **Eye movement** | | | | | | | |
| No eye squeeze (0) | 19 | 76.0 | 2 | 8.0 | 1 | 4.0 | $^{Fr}X^2$=38.164 P<0.0001* |
| Slight eye squeeze (1) | 4 | 16.0 | 3 | 12.0 | 4 | 16.0 | |
| Moderate eye squeeze (2) | 2 | 8.0 | 4 | 16.0 | 6 | 24.0 | |
| Maximum eye squeeze (3) | 0 | 0.0 | 16 | 64.0 | 14 | 56.0 | |
| **Brow blug** | | | | | | | |
| No brow blug (0) | 19 | 76.0 | 3 | 12.0 | 1 | 4.0 | $^{Fr}X^2$=41.325 P<0.0001* |
| Minimum brow blug (1) | 6 | 24.0 | 1 | 4.0 | 4 | 16.0 | |
| Moderate brow blug (2) | 0 | 0.0 | 5 | 20.0 | 6 | 24.0 | |
| Maximum brow blug (0) | 0 | 0.0 | 16 | 64.0 | 14 | 56.0 | |
| **Nasolabial furrow** | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No nasolabial furrow (0) | 21 | 84.0 | 2 | 8.0 | 1 | 4.0 | $^{Fr}X^2$=40.786 P<0.0001* |
| Minimum nasolabial furrow (1) | 4 | 16.0 | 1 | 4.0 | 3 | 12.0 | |
| Moderate nasolabial furrow (2) | 0 | 0.0 | 5 | 20.0 | 11 | 44.0 | |
| Maximum nasolabial furrow (3) | 0 | 0.0 | 17 | 68.0 | 10 | 40.0 | |

**$^{Fr}X^2$: Friedman test *significant at P≤0.05**

Table (6) illustrates total score of premature infant pain profile among EBM, leg massage and control groups. It was found that all neonates (100%) of the EBM, leg massage and control groups had mild pain before heel lance. While, 88% of neonates of EBM and 60% of neonates of leg massage had mild pain during heel lance compared to only 4% of neonates of control group. In addition, non of the neonates of EBM and only 4% of neonates of leg massage had severe pain during heel lance compared to 48% of neonates of control group. Statistical significant difference was observed between three groups during heel lance $^{MC}$P<0.0001.

It was clear that, all neonates (100%) of EBM and 88% of leg massage groups had mild pain score after heel lance compared to only 12% of neonates of control group. On the other hand, approximately , one third (32% ) of neonates of control group had severe pain after heel lance compared to only 4% of neonates of leg massage and none neonate of EBM group with statistical significant difference between three groups $^{MC}$P<0.0001.

**Table (6):** Total Score of Premature Infant Pain Profile among Expressed Breast Milk, Leg massage and Control Groups

| **Total pain score** | | **EBM (n=25)** | | **Leg Massage (n=25)** | | **Control (n=25)** | | **Significance** |
|---|---|---|---|---|---|---|---|---|
| | | **No.** | **%** | **No.** | **%** | **No.** | **%** | |
| Before | **Mild Pain (1-7)** | **25** | **100.0** | 25 | 100.0 | 25 | 100.0 | -- |
| During | **Mild Pain (1-7)** | **22** | **88.0** | 15 | 60.0 | 1 | 4.0 | $X^2$=43.764 $^{MC}$P<0.0001* |
| | **Moderate Pain (8-14)** | **3** | **12.0** | 9 | 36.0 | 12 | 48.0 | |
| | **Severe Pain (15-21)** | **0** | **0.0** | 1 | 4.0 | 12 | 48.0 | |
| After | **Mild Pain(1-7)** | **25** | **100.0** | 22 | 88.0 | 3 | 12.0 | $X^2$=51.247 $^{MC}$P<0.0001* |
| | **Moderate Pain (8-14)** | **0** | **0.0** | 2 | 8.0 | 14 | 56.0 | |
| | **Severe Pain (15-21)** | **0** | **0.0** | 1 | 4.0 | 8 | 32.0 | |
| Significance | | $^{Fr}X^2$=6.0 P=0.05* | | $^{Fr}X^2$=15.8 P<0.0001* | | $^{Fr}X^2$=43.053 P<0.0001* | | |

**$X^2$: Chi-Square test $^{MC}$P: Monte Carlo corrected P-value $^{Fr}X^2$: Friedman test *significant at P≤0.05**

## IV. Discussion

Till recently management of pain among the neonates was hampered by the lack of awareness among the healthcare professionals that the neonate is capable of perceiving pain [15]. The heel stick is the most common way of drawing blood from neonates. Although, the heel stick procedure is short in duration, it can affect behavioral and physiological responses such as facial expression, heart rate, respiratory rate, and oxygen saturation of the neonates. Untreated pain in neonates has adverse physiologic consequences including blood pressure and glucose alteration. The short-term effects may include feeding problems, parent-infant interaction dysfunction, and interruption of sleep wake cycles. Possible long-term effects of repeated heel sticks include impairments of neurodevelopment, learning, and memory. Currently no pain relieving measures are undertaken during heel lance in day-to-day practice [16].

Although there are studies on pharmacologic and non pharmacologic agents which may reduce neonatal pain, more researches are needed to find the most effective, least expensive methods for decreasing pain related heel lance in neonates. These pharmacologic (Sucrose) or non pharmacologic agents (pacifier) may interfere with correct breastfeeding. So, it may be interesting, especially in developing country; to use safest, less expensive and most available method such as breast milk and leg massage for analgesia. Unfortunately, there are no study compare between breast milk and leg massage among preterm neonates during heel lance [17]. Because neonates cannot verbalize their pain, they depend on other to recognize, assess and mange their pain. Therefore, heath care providers, especially pediatric nurses should assess neonatal pain through physiological and behavioral responses for providing better management.

The result of the current study revealed that, the physiological responses of preterm neonates of control group were affected during and after heel lance such as increase in heart rate and decrease in oxygen saturation (score 3).These findings could be explained in the light of the fact that physiological responses to pain involving activation of sympathetic nervous system[18] .These are supported by **Rao et.al (2007)** who stated that acute pain is associated with increased heart rate, respiratory rate, elevated blood pressure, oxygen saturation, apnea and palmer sweating[19].

On the other hand, the neonates of EPM experienced less increase in heart rate during and after heel lance (No pain). Moreover, all neonates of EPM exhibited no de saturation before and after heel lance and the majority of them during heel lance. These results are in agreement with a systemic review which done by **Shah et.al (2007)** about breast milk for procedural pain in neonates. They reported that neonates in the breastfeeding group had statistically significantly less increase in heart rate, reduced duration of crying during procedural pain compared to swaddled group or pacifier group [20] .

In addition, the neonates of leg massage experienced less increase in heart rate during and after heel lance (No pain). Moreover, those neonates experienced minimal decrease in oxygen saturation during and after heel lance. These findings could be justified in the light of the fact that leg massage provides securing, calming and soothing effect of the neonates. Moreover, massage stimulates pressure receptors, which in turn stimulate the vagus nerve and increase vagal activity. This leads to slow heart rate and promote relaxation. This result is congruent with **Mirzarahimi et.al (2013)** who had studied the effect of non-nutritive sucking and leg massage on physiological and behavioral indicators of pain following heel blood sampling in term neonates [5] .

It is imperative to note that the behavioral components of studied neonates under the PIPP scale a graded from 0-3 points with active alert state scoring less on the pain scale (0 points) and sleepy state being given the highest points (3points) .Several studies demonstrated that irrespective of gestational age, facial expressions (brow bulge, eye squeeze and nasolobial furrow) are reliable indicators of pain[18] .The results of the current study revealed that the neonates of EBM and leg massage exhibited better behavioral responses than the neonates of control group. The findings of the current study are congruent with **kulkarni et.al (2010**) who did study about massage and touch therapy in neonates.They reported that massage enhanced sleep-wake pattern and neonate's state [21]**.** Furthermore, **Sabety et.al (2013**) reported that EBM is effective in reducing crying time and improve behavioral responses among neonates [22] **.**

The total pain scores of (PIPP) among the neonates of the three groups revealed significant difference between before, during and after heel lance within the same group. The findings also reflected significant difference between three groups, during and after heel lance. The change of PIPP scores in EBM and massage groups was lower than the control group. It reflects that interventions had positive effect on both studied groups.

The total PIPP scores among the neonates of EBM were lower than the neonates of control group. These findings could be justified by sweetness of breast milk and presence of lactose or other ingredients in the breast milk. This result is in agreement with Iranian study done by **Sapety et.al (2013)** who concluded that expressed breast milk is the safe and natural agent for reducing pain in neonate [22] .

On the other hand, the findings of the current study contradict with **Simonse et.al (2012**) who did study about analgesic effect of breast feeding versus sucrose for analgesia during heel lance in late preterm infants. They concluded that, there is no significant difference in analgesic effect between breast milk and oral sucrose. They also mentioned that breast milk is a safe and natural method for pain relief in late pre term infant [23] . Such discrepancy between this study and the current study could be justified by sweet taste of sucrose which promotes analgesia through activation of endogenous opioids and work on descending pain pathways.

In addition, the total scores of PIPP among the neonates of leg massage were lower than the control group. This may be due the fact that massage may activate the descending endogenous opioid and non-opioid pathways to decrease pain [24]. The findings of the present study is in harmony with **Mirzarahimi et.al (2013)** who reported that leg massage is effective in reducing pain in neonates undergoing heel stick. It may also contribute to a soothing environment [5].

The finding of the present study reflected the effectiveness of EBM more than leg massage in pain relief among the pre term neonates. These could be justified by breast milk contains agents that have analgesic properties or can be endogenously converted into analgesic substances and considered as a natural way to achieve analgesia. Mother's milk also contains carbohydrates and precursors of melatonin (B endorphins release stimulator) which can probably affect pain reduction [25].The findings of the current study are somewhat similar to a comparative study done by **Esfahani et.al (2013)**. They concluded that breast feeding during vaccination has more analgesic effect than massage therapy [26].

**Conclusion**

Based on the findings of the present study, it can be concluded that expressed breast milk and leg massage are effective in reducing pain responses in neonates during heel lance .Moreover, the neonates of expressed breast milk group experienced less pain score than those of the leg massage and control groups.

## Recommendation

Based on the previous findings, the following recommendations are suggested:

- Single or combined EBM or leg massage should be provided during heel lance of preterm neonates.
- Educational programs about non pharmacological management of neonatal pain during heel lance should be provided to health care professionals.

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