

The Effect of Massage with Medium-Chain Triglyceride Oil on Weight Gain in Premature Neonates

Reza Saeidi¹, Zahra Ghorbani², and Abbas Shapouri Moghadam³

¹ Department of Neonatology, Neonatal Research Center, Imam Reza Hospital, Mashhad University of Medical Sciences, Mashhad, Iran

² Department of Pediatrics, Mashhad University of Medical Sciences, Mashhad, Iran

³ Department of Immunology, Avicenna Research Institute, Mashhad University of Medical Sciences, Mashhad, Iran

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Abstract- Prematurity and poor weight gaining are important causes for neonatal hospitalization. The present study aimed to investigate the role of medium-chain triglyceride (MCT) oil via massage therapy as a supplementary nutritional method on the weight gain of Neonatal Intensive Care Units (NICU)-hospitalized neonates. This randomized clinical trial performed among 121 stable premature neonates hospitalized in the NICU of Qaem Educational Hospital, Mashhad, Iran. They were randomly divided into three groups: oil-massage, massage alone and control groups. These groups were compared on the basis of weight gain during a one-week interval. The three groups were matched for sex, mean gestational age, birth weight, head circumference, delivery, and feeding type ($P>0.05$). The mean weight gain on the 7th day in the oil massage group was 105 ± 1.3 gr and 52 ± 0.1 gr in the massage group; whereas 54 ± 1.3 gr weight loss was observed in the control group. Significant differences were observed between the oil-massage group and the other two groups, respectively ($P=0.002$ and $P=0.000$). The findings of this study suggest that transcutaneous feeding with MCT oil massage therapy in premature neonates can result in accelerated weight gain in this age group with no risk of NEC.

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Introduction

Around 98% of infant mortality cases, occur in developing countries (1,2). Infant mortality rates (IMR) and neonatal mortality rates (NMR) in these countries have not decreased recently (3). In the recent years, various studies have reported that the most common causes for developmental delay and neonatal death are prematurity and low birth weight (VLBW) (4-6). Also, low birth weight and low weight gain is a common cause for their hospitalization in NICU. Unfortunately, these infants have feeding intolerance and should be fed very slowly (7).

Cluster trials of participatory learning through women's groups have shown large reductions in both maternal and neonatal mortality, with increased hand washing by birth attendants and increased use of clean delivery kits (8).

Topical application of emollient ointment such as

sunflower oil or Aquaphor™ reduces water loss, dermatitis, and risk of sepsis (9) and has been shown to reduce mortality for preterm babies in hospital-based trials in Egypt and Bangladesh (10,11). The skin of premature babies is more vulnerable and is not protected by vernix like a term baby's (12).

Some evidence also suggests that MT may promote weight gain in premature infants (13-15) though more evidence is needed to establish cost-effectiveness (16,17).

Solanki *et al.*, have shown that one of the main factors in premature neonatal weight gain is massage therapy with or without the application of oil. However, the available data on the transdermal absorption of topical oil, the role of the newborn's gestational age and the type of the applied oil on the level of absorption is rare (18). Sankaranarayana *et al.*, showed that the topical application of oil results in the better function of the dermal barrier, regulation of skin temperature and a

Corresponding Author: A. Shapouri Moghadam

Department of Immunology, Immunology Research Center, Mashhad University of Medical Sciences, Mashhad, Iran
Tel: +98 915 3152927, Fax: +98 511 8413006, E-mail address: shapourima@mums.ac.ir

positive effect on its growth. In addition, the effect of oil absorption from the premature neonate's delicate skin has been proven. Many studies have also approved a better growth and development in premature neonates receiving the tactile stimulation (19).

Damstadt study reported that massage with mustard, olive, and soya oil causes a significant delay in the skin barrier function in premature neonates (20). Oils consisting of medium chain triglycerides (MCT with 8-12 carbons) are useful in the supplementary feeding of premature neonates, having higher absorption and providing better calorie, but their consumption is accompanied by vomiting and food intolerance. The oil absorption through the skin of premature neonates has been confirmed (18,19) and the role of massage in the growth and development of newborns has been proved in many studies (15,18,19,21). Furthermore, many tactile stimulation studies have been conducted with preterm infants, only those that involved moderate pressure massage resulted in greater weight gain (15,22,23), suggesting that it is the stimulation of pressure receptors that mediates the effects of massage therapy on enhanced vagal activity, gastric motility, and weight gain.

Therefore, the aim of the present study was to investigate the effect of massage with MCT oil on weight gain of newborns hospitalized in the NICU of Qaem Hospital, Mashhad, Iran.

Materials and Methods

This clinical trial study was conducted (in the NICU ward of Qaem Educational Hospital, Mashhad, Iran. Participants of this study were all the neonates under 28 days with a gestational age less than 37 weeks hospitalized in the stable condition at NICU. Neonates with a skin disease, major congenital anomaly, and total parental nutrition requiring mechanical ventilation or receiving supplementary O₂ therapy were excluded from the study. All the newborns, that entered the study, received an equal or over 120cc per day feeding regimen. The sample size was calculated with a 95% confidence interval and a power of 80% as 40 for the two study groups and 41 for the control group; in total 121 participants. The study protocol was fully explained to the parents, and an informed consent was obtained from the parents.

The sampling method was simple and non-probability type. All the neonates hospitalized in the NICU having the inclusion criteria were randomly divided into three groups: 1) MCT oil massage group, 2)

massage group and 3) control group. Control group newborns consisted of no oil or massage administration. In the self-designed questionnaire, personal data and growth factors such as weight, height, head circumference before study entrance and daily weight gain after study entrance for seven consecutive days were recorded.

In the first group (MCT oil massage group), the neonates received massage therapy by an expert nurse for four times a day (each time five minutes) during one week. The massage was performed on the whole body (below the neck) with 10cc/kg/d of MCT oil. In case of oral feeding, each turn of massage was performed one-hour post-feeding. During massage, the neonates were placed completely naked on a plastic cover under the warmer. The neonates' weight was measured naked with a digital scale with ± 5 gr accuracy at 8 o'clock every morning, by a single observer. The reliability of the scale was previously confirmed by standard weights.

In the massage group, the neonates received whole body massage therapy four times daily, five minutes each and for a period of one week without using oil (with the same massage technique as the first group and by the same massager).

Probable confounding factors including an underlying disease, medications and phototherapy were recorded in the questionnaire and controlled in the final data analyzes. The data were analyzed by the one-way variance analysis technique. The Chi-square test was applied to determine the qualitative data and the value of $P < 0.05$ was considered statistically significant.

Results

In this clinical trial 121 neonates were allocated into three groups; the MCT oil massage, the massage and the control groups in which 23 (57.5%), 24 (60%) and 24 (57.5%) were male in the three abovementioned groups, respectively.

In the MCT oil massage group, the mean gestational age was 30.8 ± 2.4 yrs. In the massage and the control groups, the mean age was 31.6 ± 2.7 , respectively. No, statistically meaningful difference was observed between the three groups regarding age ($P=0.08$).

The mean neonatal weight in the first, second and third group was 1484 ± 378 gr, 1589 ± 589 gr, and 1559 ± 425 gr, respectively; again without any significant difference ($P=0.4$).

The mean head circumference at birth in the abovementioned groups was 29 ± 1.9 cm, 30.4 ± 2.7 cm, and 30.0 ± 2.5 cm, respectively. No statistically significant

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difference was observed between the three groups ($P=0.2$).

Mean neonatal height at birth in the same groups was 39.5 ± 4.1 cm, 40.8 ± 4.7 cm, and 40.8 ± 3.8 cm; demonstrating no remarkable difference ($P=0.1$).

Breastfed infants were 36 (90%) in the MCT oil massage, 37 (92.5%) in the massage group and 37 (90.24%) in the control group, showing no significant difference ($P=0.05$). Also, no significant difference was observed ($P=0.09$) in the above groups. Subsequently 28 (70%), 28 (70%) and 30 (73.17%) were formula-fed, respectively;

Mean neonatal weight from at 1 to 7day for the three

studied groups is shown in table 1.

The mean weight gain in the MCT oil massage group on the 7th day was 105 ± 1.3 and in the massage group was 52 ± 0.1 gr whereas in the control group 54 ± 1.3 gr weight losses was observed at the same time.

Weight gain was significantly more in the MCT massage group and the sole massage group ($P=0.002$). Also, the difference in mean weight gain between the MCT oil massage and the control group was significant ($P=0.000$).

Using the one-way variance analysis test showed that the mean weight difference between the three mentioned groups from the 3th day to 7th day was significant.

Table 1. Comparing the mean neonatal weight (gr) in three groups

Group	Day 1		Day 2		Day 3		Day 4		Day 5		Day 6		Day 7	
	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
MCT	1434	3.5	1444	3.4	1472	3.4	1493	3.4	144	2.9	1505	2.8	1539	2.8
Massage	1763	5.9	1756	5.8	1755	5.8	1772	5.9	1767	5.8	1778	5.8	1815	5.8
Control	1564	3.9	1977	2.7	1556	3.4	1528	4.2	1576	3.4	1533	2.8	1510	2.6
P-value	0.975		0.937		0.011		0.010		0.0010		0.000		0.000	
F	1		2		2		2		2		2		2	
df	0.01		0.9		4.6		4.7		10.2		15.1		9.7	

M: mean, SD: standard deviation

Discussion

The results of this study showed that massage with MCT oil causes significant better weight gain in comparison with the control group.

To date, about half of trials have shown significant neonatal mortality effect especially for premature babies and particularly with early application, which may be challenging for home births (24,25). Uvans *et al.*, by using the animal models observed that tactile motivation increases the vagus nerve activity consequently simulates the release of hormones affected in enhanced food absorption and leads to improved weight gain (21). Field in 1990 investigated this model in premature neonates and found that massage therapy also increased vagus nerve activity, and this increased the release of effective insulin up to 62% (15). Field and Schanberg (1995) evaluated this model in human preterm neonates and found that massage therapy increased the vagal tone and was associated with a 62% rise in insulin release. Furthermore, they examined the effects of preterm infant massage therapy on insulin-like growth factor I and oxytocin, two peptide hormones that play a role in weight gain and may be stimulated through heightened vagal activity (26). Recent cluster-randomised trials have shown some benefit from chlorhexidine topical application to the baby's cord and no identified adverse effects (27).

Diego *et al.*, evaluated the first study to examine gastric motility in response to massage therapy in neonates. They reported that the change in vagal activity elicited by massage therapy was significantly related to improved weight gain after five-day treatment period. In the other hand, it is suggested that the neonates, who show increased vagal activity during massage, seems more likely to benefit from massage therapy (22).

Consistent with current study, Fernandez *et al.*, showed that serum triglyceride levels are significantly higher in premature neonates with 1500-2250gr weight after the administration of corn oil every four hours for three days, showing the probable fatty acid absorption through the neonatal skin (28). In a study by Soriano *et al.*, there was a significant increase in height; triceps skin fold thickness and arm circumference that was seen after 30 days of oil-massage therapy in premature neonates (29). Mathai *et al.*, showed better neuro-behavioral results after kinetic tactile stimulation with the application of oil or powder in comparison to controls receiving no stimulation (30). Moreover, their findings were most probably related to the kinetic tactile stimulus rather than the applied oil (30).

Dieter *et al.*, evaluated the effect of five-day massage therapy on weight gain and the sleep-wake behavior of stable hospitalized premature neonates. It showed that low risk healthy premature neonates have a greater weight gain with only five days of massage therapy (4).

Sankaranarayanan *et al.*, investigated the effect of coconut oil massage in comparison with mineral oil and placebo powder massage on the growth rate and the nervous behavior of premature and term neonates. They concluded that coconut oil massage therapy increased weight gaining in comparison to mineral oil and control groups. In addition, the premature neonates receiving coconut oil massage therapy showed a higher increment in height compared to the control group. However, no significant difference in neurobehavioral was observed between the three groups (19).

In another study by Solaniki *et al.*, the topical absorption of the massaged oil in neonates, especially essential fatty acid rich oils and saturated fats rich oils, on the fatty acid profile of the massaged neonates were studied. It was observed that serum triglycerides significantly increase in both groups receiving oil and controls groups (18). Mendes showed that massage therapy by the mother in neonates and infants with very low birth weight reduces hospitalization period and the incidence of delayed sepsis (31). Agarwal *et al.*, studied the effect of massage therapy and oil on the weight, blood circulation and the sleep pattern of healthy term infants. The findings of their study pointed out that massage in infants improved growth indices (weight, height, and arm and calf circumference) and also the neonates' sleep pattern. Also, among the different types of applied oil in this study (herbal oil, sesame oil, mustard oil and mineral oil), only sesame oil showed a significant improvement (32). Arora *et al.*, investigated the effect of massage therapy on sunflower oil on the growth and neuro behavior of premature neonates with very low birth weight. Weight gain in the oil-massage group was higher than the massage group alone and the control group. In the mentioned study the main increase happened in height, head circumference, skin fold thickness and behavioral score during 28 study days, in the oil-massage group when compared with the other two groups, but not statistically meaningful (33). The impact of topical oil (mustard, olive, and soya) administration on the skin barrier was evaluated by Damstadt *et al.*, This oil delayed improvement in the skin barrier function in comparison to the control group and only the application of sunflower seed oil significantly increased the skin barrier recovery (20).

The results of previous studies and this study indicate that topical oil administration in neonates especially premature neonates (because of increased vascularity and high skin permeability), might be useful in temperature regulation and prevention of hypothermia in newborns (34). In addition, its fatty acid components

can alter the lipid profile of the newborn's body in terms of both quality and quantity in which is also dependent on the type of the applied topical oil.

Also, dermal administration of oil can compensate the deficiency of essential fatty acids in neonates. It can also improve the general growth in stored fat cells as a source of energy and accelerate weight gain without significantly affecting the body's lipid metabolism. Oil massage therapy can be used as a beneficial feeding method in premature neonates considering problems such as feeding intolerance, inability to breast fed, lack of coordination in sucking, swallowing and respiration reflexes in premature neonates and also restriction of oral intake, and the possibility of complications including necrotizing enterocolitis and subsequently inadequate weight gain and long term hospitalization in NICU.

The results of the present study showed that the daily massage with MCT oil in premature neonates is effective for weight gain without causing any complications.

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