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Assessment of growth pattern of newborn administered with medium chain triglyceride and coconut oil

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Abstract
The ability of very low birth weight infants to absorb fat is poor due to immaturity of liver and decreased bile salt synthesis. Medium chain triglycerides passively diffuse from the gastrointestinal tract to the portal system without requirement for modification like long chain fatty acids. Medium chain triglycerides can thus improve fat absorption in very low birth weight infant. Medium chain triglycerides have also shown to increase weight gain and to enhance calcium absorption and nitrogen retention but limited studies are available to prove it. As coconut oil is rich in medium chain triglycerides, it can serve as a good substitute for MCT in a resource limited developing country like India. So far, very few studies have been done to find out the efficacy of medium chain triglycerides and coconut oil. Hence the present study was planned for assessment of Growth Pattern of Newborn Administered with Medium Chain Triglyceride and Coconut Oil.
The present study was planned in Department of Paediatrics, Government Medical College, Bettiah, West Champaran, Bihar. Total 60 cases of the neonates were enrolled in the present study. These were divided in three study groups. The Group I consist of 20 cases administered with the daily massage of Coconut oil. The Group II consist of 20 cases of the neonates administered with the message with the MCT oil. The Group II neonates were givenMCT oil Massage with Oral intake. Massage therapy consists of tactileand kinesthetic stimulation given by mothers who weretrained for standardized steps of massage that was given for15 minutes two times a day in the NICU and similarlymother was explained quantity and duration of feeds givento the baby and also trained for making the feeds by theexpert nurses. In case of MCT oil oral intake it was mixed infeeds of the neonates.
The data generated from the present study concludes that MCT oil massage therapy with MCT oil intake is significantly better than Only MCT oil massage in terms of weight gain. With only MCT oil massage having significant advantage over coconut oil. So MCT oil therapy can be a cost-effective method for gaining weight in low birth weight babies low income countries.

Keywords: medium chain triglyceride, coconut oil, neonates, growth, length, etc

Introduction
Every year around 21 million low birth weight babies are born. They represent 16 percent of all newborns, but large regional variations exist. The percentage of babies born with LBW is 28 percent in South Asia, 14–15 percent in sub-Saharan Africa and North Africa/the Middle East, and 7–9 percent in Latin America and the Caribbean, East Asia, and industrialized countries in which India constitute about 60%-70% of intrauterine growth retardation and remaining 30%-40% preterm infants born before 37 weeks of gestation. As it is generally recognized that shorter the gestational age, smaller the body, higher is the risk of death, morbidity, poor sucking, loss of weight, respiratory distress, hypothermia and disability which have shown that the mortality rate vary 100 folds across the spectrum [1].
Most preterm LBW babies and some term LBW babies require special care and attention to feeding. This Facts for Feeding focuses on LBW babies who are medically stable but needextra care to ensure successful feeding. The exact definition of 'medically stable' will vary from program to program. At minimum, the baby is able to breathe without assistance. LBW refers to babies who have a birth weight less than 2500 grams or are born preterm. The same approaches can be used for preterm babies who are not LBW and for term babies, whether they are LBW or not, who have feeding difficulties [2].
Touch is a primary form of human communication and stimulation programs of various kinds influence long term developmental outcome of premature babies through improved neurophysiologic maturation and growth (Liaw, 2000; Lindrea & Stanton, 2000). Although the underlying mechanisms of massage therapy effects on growth and development are yet unknown, several possibilities have been proposed (Field, 2002). One possibility is that massage therapy increases vagal activity, which in turn releases food absorption hormones such as gastric and insulin, thus explaining the weight gain in premature infants (Field, 2002) [2].
Massage of newborns can be done by using a lubricant to reduce the friction between the surfaces.21 In order to choose an appropriate lubricant, availability, cost, and safety need to be considered. Among all lubricants, coconut oil and sunflower oil have been most commonly mentioned in literature about infant massage therapy. Massage is thus an intervention that may be useful in premature infants and newborns with low birth weight. Performing massage therapy for infants in NICU is a kind of alternative treatment that has been the subject of long debates. Studies have also indicated that infants who receive massage are usually better adapted to environmental stressors and suffer less negative effects [3].

Weight gain is the most consistent parameter associated with massage therapy in neonates. In a study by Scafidi, *et al*., forty preterm infants (mean gestational age 30 weeks; mean birth weight 1.17 kg) were subjected to tactile/ kinaesthetic stimulation of 45 minutes per day (three sessions of 15 minutes each) for 10 days. It was observed that infants who received massage had 21% greater weight gain (34 vs 28 g). The weight gain was observed to be 47% greater in another study on preterm infants (mean gestational age 31 weeks; mean birth weight 1280 g) who received similar session of massage therapy with weight gain of 21.9%; 4.24g/day. Most of the studies have enrolled medically stable infants>30 weeks of gestation. The effect of massage therapy in infants <30 weeks is not known. Infants who receive massage therapy appear more alert and spend less time in sleep [4]

In a study by Kelmanson, *et al*., infants less than 36 weeks of gestation (birth weight <2.5 kg) subjected to massage till 8 months of age, had improved quality of sleep with less awakening during sleep. These infants were more active during the day. It also hastened the onset of sleep. Preterm infants receiving massage therapy scored better on the Brazelton behaviour assessment scale in terms of 'orientation', 'range of state' 'regulation of state' and 'autonomic stability'. Improved scores on mature habituation, orientation, motor, and range of state behaviour were observed in another study. Preterm infants (mean gestational age 30 weeks) who received moderate pressure therapy (5 days) were less fussy, cried less and showed less stress behaviour. Infants who received oil massage were seen to show fewer stress behaviour in the form of grimacing and clenched fist. Massage treatment improves the mother infant interaction and thus enhances their bonding [5].

Various mechanisms are postulated for the weight gain shown by the infants who receive massage therapy. It was initially thought that weight gain from massage therapy was secondary to increase in caloric consumption resulting from altered sleep-wake pattern. However, in a study by Dieter, *et al*. it was observed that although infants who received massage therapy for 5 days spent less time sleeping, the caloric consumption was same and did not contribute to the observed weight gain. In a study conducted by Diego, *et al*, a significant increase in vagal activity was noticed during the period of 15 minute massage therapy. The vagal activity was interpreted from ECG as a measure of heart rate variability. It was also seen that there was a significant increase in gastric motility in post massage period. It was postulated that massage causes increase in vagal activity, hence improved gastric motility; this leads to better absorption of nutrients resulting in better weight gain [3].

About 1.2 million neonates die annually in India alone, amounting to almost one-fourth of all global newborn deaths. Two-third of infant deaths in India occurring the first month of life, and three-fourth of newborn deaths occur in first week and 90 percent of all neonatal deaths occur by the fifteenth day of life. Most (70%) of newborn in India die due to low birth weight, infections and complications of pregnancy [6].

Quick weight gain is a critical component of any pre-term infant's development. Smaller body mass in combination with early exposure to the out of womb environment is one of the main contributing factors to weaker body defense as well as delays in the emotional and mental development. There is a correlation between the rise in ADD and autism among children associated with an increased number of premature deliveries. Thus, quick weight gain becomes a great priority [7].

Preterm delivery (<37 weeks of gestation) complicates almost 10% of births but contributes disproportionately to at least two-thirds of the infant deaths and to a significant amount of neonatal and long-term morbidity. Growth status and velocity are important markers of the health and wellbeing of the preterm newborns. It is recommended that composition of weight gain in the preterm infant approximates that of the fetus at the same postconceptional age. Perinatal hypoxia and poor sucking ability places the preterm infant at risk for malnutrition and weight loss. Topical oil application is suggested to have a positive effect on growth. Massage with oil enhances the positive effects of massage on newborns. The practice of oil massage has gained favour in neonatal intensive care units in the developed countries as well. Coconut oil is composed entirely of medium chain acids (MCFAs) which provides a source of highly efficient cellular food. When it is applied topically, the cells absorb the MCFAs and convert them into energy. Because MCFAs are used to produce energy rather than packed away into fat cells, coconut oil can be in weight gain. Topically applied coconut oil can be absorbed in neonates and is probably available for nutritional purposes and enhanced weight gain velocity in the preterm babies. Topical oil massage is traditionally practiced in many countries [8].

A study was conducted to assess the effects of moderate and light pressure massage on the growth and development of young infants. A recent study showed that persons who were given moderate pressure massage when compared with infants who received light massage or vibratory stimulation decrease in heart rate, EEG changes associated with a relaxation response and decrease in stress. Mothers were instructed to massage their newborn infants once per day using either light or moderate pressure .The infants' growth (i.e., weight, length, and head circumference), sleep behavior and performance on the Braselton scale were assessed soon after birth and at one month of age. As compared to infants who received a light pressure massage, infants in the moderate pressure group gained more weight, were of greater length, performed better on the orientation scale of the Braselton and exhibited less agitated behavior during sleep [9]. From above it is observed that oil massage therapy, promotes the weight gain, increases appetite, improve in sucking behavior, thermoregulation, positive effects on neurobehavioral pattern, enhance mother to child bonding and induce sleep to the infants, which helps the preterm infants and low birth weight babies to improve health status as like term infants and decreases the mortality, morbidity rate. There are studies proved that the stay hospital significantly reduced by massage therapy. Even though oil massage is traditionally practiced in India. It is not routinely practiced in the hospital setting, if practiced in hospital setting it will play an important role in reduce the infant morbidity and mortality rate and helps to maintain the normal growth pattern .Thus the investigator has taken an effort to promote the weight gain of preterm infants by oil massage in the clinical setting [10].

The ability of very low birth weight infants to absorb fat is poor due to immaturity of liver and decreased bile salt synthesis. [8] Medium chain triglycerides passively diffuse

from the gastrointestinal tract to the portal system without requirement for modification like long chain fatty acids. Medium chain triglycerides can thus improve fat absorption in very low birth weight infant [9, 11-12]. Medium chain triglycerides have also shown to increase weight gain and to enhance calcium absorption and nitrogen retention but limited studies are available to prove it. As coconut oil is rich in medium chain triglycerides, it can serve as a good substitute for MCT in a resource limited developing country like India. So far, very few studies have been done to find out the efficacy of medium chain triglycerides and coconut oil. Hence the present study was planned for assessment of Growth Pattern of Newborn Administered with Medium Chain Triglyceride and Coconut Oil.

Methodology

The present study was planned in Department of Paediatrics, Government Medical College, Bettiah, West Champaran, Bihar. Total 60 cases of the neonates were enrolled in the present study. These were divided in three study groups. The Group I consist of 20 cases administered with the daily massage of Coconut oil. The Group II consist of 20 cases of the neonates administered with the message with the MCT oil. The Group II neonates were givenMCT oil Massage with Oral intake. Massage therapy consists of tactileand kinesthetic stimulation given by mothers who weretrained for standardized steps of massage that was given for15 minutes two times a day in the NICU and similarlymother was explained quantity and duration of feeds give into the baby and also trained for making the feeds by the expert nurses. In case of MCT oil oral intake it was mixed infeeds of the neonates.

Weight, length and head circumference were recorded at the beginning of intervention. Weight was taken on digital electronic scale after removing clothes and diaper. The weighing scale was corrected for zero error before measurement. Serial measurement of weight was done on the same weighing scale. Length was taken on an infantometer. The neonate was placed supine with head held firmly in position and keeping legs straight with toes pointing upward. Head circumference was measured by an inch tape. The maximum circumference of the head from the occipital protuberance to the supraorbital ridges on the forehead was recorded.

All the patients were informed consents. The aim and the objective of the present study were conveyed to them. Approval of the institutional ethical committee was taken prior to conduct of this study.

Following was the inclusion and exclusion criteria for the present study.

Inclusion Criteria: Neonates with gestation age of more than 30 weeks.

Exclusion Criteria: neonates with major congenital anomalies at birth, skindisease, neonates requiring mechanical ventilation orreceiving supplementary oxygen therapy and having anyneurological manifestations.

Results & Discussion

Fat provides the major source of energy for the growing premature infants. Fat is a major determinant of growth, visual and neural development and long term health [13-15]. Medium chain triglycerides are absorbed faster and more completely by pancreatic lipase than Long chain triglycerides. Medium chain triglycerides are prepared by the hydrolysis and fractionation of coconut oil. Coconut oil can serve as a good substitute for medium chain triglycerides in a resource limited developing country like India.

Massaging neonates and infants has been an important component of infant rearing in many traditions, especially in India. However, while the practice has been in place for decades, its scientific basis remains uncertain. There is also a lack of uniformity on the type of oil used for infant massage which appears to be region specific. Information on intact absorption of topically applied oil through skin and influence of neonate's gestation and type of oil used on absorption are either scanty or non-available.

Body oils can be classified as essential fatty acid rich (e.g., Safflower oil) and saturated fatty acid rich oil (e.g., coconut oil). Coconut oil is especially rich in medium chain triglycerides (MCT), which are known to have different absorptive mechanisms from the gut and are said to be easily metabolised in the body.

Table 1: Baseline characteristics

Groups	**Group I**	**Group II**	**Group III**
Administration of	**Coconut oil Massage**	**MCT oil Massage**	**MCT oil Massage with Oral intake (MCT oil)**
No. of Cases	20	20	20
Mean Gestation at birth (weeks)	31 - 35	31 – 34	31 - 35
Mean birth weight (kg)	2. 1 – 2.4	2.0 – 2. 3	2.1 – 2.5
Mean length at birth (c.m.)	42 – 46	43 – 46	42 – 45
Mean head circumference at birth(c.m.)	31 – 34	29 – 33	30 – 33
Mode of delivery			
Vaginal	11	15	17
LSCS-	9	5	3
Gender			
Male	12	10	11
Female-	8	10	9
Feeding			
Breastfeed	16	17	14
Mixed	3	2	4
Top feed-	1	1	2

Table 2: Comparison of Weight gain and Length

Groups	Group I	Group II	Group III
Administration of	**Coconut oil Massage**	**MCT oil Massage**	**MCT oil Massage with Oral intake (MCT oil)**
No. of Cases	20	20	20
Weight Gain in 1 month	0.25 – 0.39	0.27 – 0.40	0.28 – 0.42
Weight Gain in 3 month	1.23 – 1.69	1.49 – 1.96	1.65 – 2.24
Length Gain in 1 month	2.42 – 3.9	2.53 –3.51	2.51 –3.63
Length Gain in 3 month	6.2 – 9.5	7.05 – 10.3	7.2 – 11.6
Head Circumference	4.75 – 5.60	4.75 – 5.61	4.7 – 5.63

Table 3: Comparison of neurodevelopmental outcome

Groups	Group I	Group II	Group III
Administration of	**Coconut oil Massage**	**MCT oil Massage**	**MCT oil Massage with Oral intake (MCT oil)**
No. of Cases	20	20	20
head wobbling	2	2	1
neck holding in prone position	18	18	19
Alert to sound	19	20	20
social smile	18	19	10
Cooing	16	17	18
Recognizes mother	16	18	17

Vaidya *et al*. in 1992 in their study took 75 very low birth weight babies and divided them into 3 groups. In first group safflower oil and in second group coconut oil was used for fortification and third group consisted of controls with no fortification. The mean weight gain was highest and significantly higher than the controls in the coconut oil group [16] The weight gain was definitely superior in the coconut oil group as compared to the safflower oil group but in this study control group did not receive any fortification.

Cochrane neonatal reviews on 182 infants from eight randomized trials on high versus low medium chain triglyceride content of formula for promoting short term growth of preterm infants reported no difference in growth parameters when high or low MCT were used [17].

Yet neonates in our country especially the preterm and LBW babies would be benefited greatly by an additional source of calories and EFAs, especially if the 'source' is as easy and non invasive as an oil massage. Though breast feeding is more or less universal in our country, extra nutrients are often needed for the sick and small LBW babies because of limited capacity of the stomach and immaturity of fat metabolism. Though our studies could not ratify this finding, prematures are said to absorb oil better because of increased vascularity and permeability of their skin [18]. Our studies and others have shown that massaged oil can be absorbed to a significant degree in neonates [19]. Soriano, *et al*. have demonstrated a significant increase in somatic growth in preterms in four weeks of oil application [20]. However, no studies to date have been directed towards determining the exact proportion of oil absorption or towards its metabolic fate in the long range. Obviously, sophisticated studies such as radio-isotopic labeling or DEXA are required to further answer this question.

There are many other recorded advantages of oil massage in babies. Fernandez, *et al*. in an elegant study in Mumbai demonstrated the value of oil massage in thremoregulation of small preterm babies [21]. It was suggested that oil application conserves internal body heat probably by reducing insensible water losses thereby, proving useful in community management of low birth weight babies. Our study was conducted under controlled thermal conditions (servo-controlled) and hence we are not in a position to comment on this aspect. So also, the advantages of human bonding and environmental stimulation which would come automatically with massage are obvious but hard to measure [22].

Early nutrition in the infant plays an important role in the overall growth and development of the immune system, especially if it includes essential fatty acids. When a term or preterm infant is breast fed, she is provided with all the nutritional benefits as breast milk contains all the vital nutrients required for physical and mental development, and immunity of the child. All efforts, therefore, should be made to ensure breastfeeding in young infants, and mothers should be helped in the process by appropriate counseling.

Conclusion

The data generated from the present study concludes that MCT oil massage therapy with MCT oil intake is significantly better than Only MCT oil massage in terms of weight gain. With only MCT oil massage having significant advantage over coconut oil. So MCT oil therapy can be a cost-effective method for gaining weight in low birth weight babies low income countries.

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