Transcutaneous Absorption of Oil in Preterm Babies - A Pilot Study

A.R. Fernandez, Geetha K.,* N. Patil,* J.A. Mondkar and B.D. Swar*

*From the Departments of Neonatology and *Biochemistry, L.T.M.G. Hospital and L.T.M.M. College, Sion, Mumbai, India.*

Correspondence to: Prof. Armida R. Fernandez, 53, Sea Springs, B.J. Road, Bandra, Mumbai 400 050. E-mail: rfern1@bom2vsnl.net.in

Manuscript received: April 29, 2003, Initial review completed: July 8, 2003; Revision accepted: September 8, 2004.

This study was conducted to determine transcutaneous absorption of oil in preterm neonates. A mixture of coconut oil and Meadowfoam oil which contains unique fatty acids, which acted as marker fatty acids was applied to the skin of babies. One ml blood was collected before and one-hour after post oil application. Both pre and post oil application serum samples were hydrolysed and derivatised with 2-phenyl hydrazine hydrochloride in order to detect fatty acids by HPLC analysis on C-8 column. None of the pre oil application serum sample showed the presence of the marker fatty acids. The post oil application serum sample of all the 12 babies showed the presence of marker fatty acids of Meadowfoam oil which indicates transcutaneous absorption of oil in preterm babies.

Key words: *Meadowfoam oil, Preterms, Transcutaneous absorption.*

PREMATURITY compounded by low birth weight is one of the major causes of neonatal mortality in India and other developing countries(1). Our previous study on oil application in preterm babies has shown a significant increase in serum triglycerides and cholesterol level and a significant increase in weight(2). Transcutaneous absorption of the oil applied to the skin is yet to be demonstrated although a large number of chemicals and drugs are thought to be absorbed through the skin(3). The present study was therefore undertaken to demonstrate transcutaneous absorption of oil through the skin of the preterm. This necessitated use of an oil having fatty acids, which are normally, not found in the human blood and hence serve as a marker. Meadowfoam oil extracted from meadowfoam seeds is safe and commercially used in baby skin products(4). The fatty acids present in the triacylglycerol of meadowfoam oil are unsaturated long chain fatty acids (C_{20} and C_{22}).

Subjects and Methods

Well preterm babies in the gestational age group of 32-36 weeks, born in the hospital and admitted in the premature baby care unit formed the study subjects. The written consent of each baby's mother was taken prior to the study. Sick preterm babies and those on medication were excluded from the study. Surface area was calculated using the formula, Surface area = (0.05) * wt + 0.05(5). One mL of blood was collected in the morning, which served as pre oil application sample. Meadowfoam oil was mixed with an equal volume of coconut oil in a clean steel container. The purpose of adding equal volume of coconut oil was to enable the entire body to be applied with oil as well as to dilute the amount of meadowfoam oil. This oil mixture was applied one hour after feeds by gentle and uniform strokes on the infant from head to foot with a cotton plug. Care was taken to prevent pressure during application. The

TABLE I–*Fatty Acid Composition of Triglycerides from Meadowfoam Oil.*

Number of carbon atoms	Double bonds	Percentage of marker fatty acid
C_{20}	Δ^5	62.5%
C_{22}	$\Delta^{5,13}$	18.0%
C_{22}	Δ^{13}	12.0%
C_{22}	Δ^5	2.5%

TABLE III– *Range and Mean of the Marker Fatty Acids Absorbed by Babies.*

Marker fatty acid in Meadowfoam oil	Range (%)	Mean (%)
$C_{20}\ \Delta^5$ (62.5%)	69.19 – 10.8	43.90
$C_{20}\ \Delta^5$,13 (18%)	82.75 – 0.85	78.21
$C_{22}\ \Delta^5$ (12%)	12.3 – 1.35	7.97
$C_{22}\ \Delta^{13}$ (2.5%)	33.3 – 9.2	19.15

process of oil application continued for 5-6 minutes. Post oil application blood sample was collected after one hour. As per the study protocol the glove area of right hand and wrist was excluded from oil application to prevent external contamination of the blood sample with oil during blood collection from this site.

The pre and post oil application serum sample of each baby were subjected to alkali hydrolysis(6). The fatty acids released were conjugated with 2-nitrophenyl hydrazine hydrochloride by the method of Hirosh and Miva(7). The derivatised fatty acids in the in the sample were analyzed by HPLC. Known laboratory standard fatty acids like capric acid, palmitic acid, oleic acid, linoleic acid were conjugated and analyzed under similar conditions to validate the method.

Results

The marker fatty acids of meadowfoam oil and that of the mixture of coconut oil and meadowfoam oil were identified by their retention time *i.e.*, the time taken by the fatty acid to exit the column. (*Table I & II*).

The pre oil serum samples from all the babies did not show the presence of the marker fatty acids.

The post oil serum samples of 4 out of the 12 babies showed the presence of all the four marker fatty acids of meadowfoam oil. Another four babies showed presence of only the predominant marker fatty acids *i.e.* present in higher concentrations. While of the remaining four, three babies showed absorption of only two of the marker fatty acids, which were not the predominant ones, the last of the baby showed only one peak of the marker fatty acids.

Table III shows the range and mean of each of the marker fatty acids absorbed in

TABLE II–*HPLC analysis of Meadowfoam Oil and Mixture of Meadowfoam and Coconut Oil (Derivatised Fatty acid fractions).*

Meadowfoam oil		Mixture of meadowfoam and coconut oil	
Retention time (minutes)	Area under curve	Retention time (minutes)	Area under curve
10.27	42618	10.68	6205
11.00	9055	12.07	3167
13.57	6233	13.23	2384
14.82	2104	14.45	888

Key Message

- Transdermal absorption of oil could be a method of nutrition supplementation in a preterm baby.

terms of percentage. The fatty acids with two double bonds (C_{20} $\Delta^{5,13}$) appears to be better absorbed as compared to fatty acid with single double bond.

Discussion

Transcutaneous absorption of a mixture of coconut oil and meadowfoam oil in preterm babies has been successfully demonstrated for the first time. The variations observed in the amount and the number of marker fatty acids is probably due to the dynamic state of triglycerides which are continuously metabolized. Coconut oil has predominantly short chain and saturated fatty acids. These are normally present in the serum of an individual, diet being one of the important sources.

The level of short chain fatty acids in the post oil sample was observed to be higher than that of pre oil serum sample. However, since it is not possible to differentiate whether it was from the mother's breast milk or the oil applied to the baby, we chose to observe only the presence of the marker fatty acids of meadowfoam oil. Long chain fatty acids with more than one double bond appear to be better absorbed than fatty acids with single bond. The skin of the preterm neonate has increased permeability as compared to full term babies. This is because the skin stratum corneum in neonates is yet to develop fully. Therefore, permeability through skin is more and lipids could be absorbed through the skin by dermal vessels(8). This is a pilot study carried out with 12 preterm babies. Further studies need to be carried out to determine the effectiveness of this alternative route of nutrition.

Acknowledgement

The authors are indebted to Dr. Alain Khaiat, for identifying meadowfoam oil as a marker Dr. Ajit Manke, Dr. Vijay Bambulkar, Dr. J.S. Vidwans, for the financial as well as constructive suggestions and help provided by them throughout the study. We thank Dr. Sandeep Kadam from NICU for the help extended in the collection of blood samples. Ms. V. Sarwade for application of oil to study subjects and We thank Dr. Mamta Shetty for her constructive suggestions in preparing the manuscript.

Contributors: ARF conceptualized the project, JAM identified the study subjects and collected samples; GK,NP and BDS did the biochemical analysis of pre and post serum samples.

Funding: Meadowfoam oil from Johnson & Johnson Limited, Mulund, Mumbai.

Competing interests: None stated.

REFERENCES

1. Newborn Health, Key to Child Survival. Present Scenario, Current Strategies, Future Directions for Newborn Health in India. Child health division, Department of family Welfare, Ministry of Health and family Welfare, 2001. pp. l-21.
2. Fernandez A, Patkar S, Chawla C., Taskar T, Prabhu S. Oil application in preterm babies- A source of warmth and nutrition. Indian Pediatr. 1987; 24: 1111-1116.
3. Siegfried EC. Neonatal Skin Care and Toxicology. i Eichenfield LF, Frieden U, Esterly NB, editors. Textbook of Neonatal Dermatology, 1st ed. Philadelphia: WB Saunders . 2001, pp. 62-72.
4. Worak JD. Meadowfoam Triglyceride. A

unique extract for functionally enhanced personal care products (skin and hair). Agro Food Industry Tech 1994; July/August; pp. 19-21.

5. Needlman RD. Assessment of growth and development, *In:* Nelson WE, Vaughan VC III, Behrman RE, Kliegman RM, editors. Nelson Textbook of Pediatrics. 14th ed. Philadelphia: WB Saunders Co. 1992. pp. 40-43.

6. Plummer DT. In: An Introduction to Practical Biochemistry, 2nd edition. New Delhi: Tata McGraw Hill Publication. 1978. p 207-209.

7. Miwa H, Yamamoto M, Nishida T, Nunoi K, Kikuchi M. High-performance liquid chromatographic analysis of serum long chain fatty acid by direct derivatisation method. J Chromatogr 1987; 416: 237-245.

8. Rutter N. Hull D. Reduction of skin water loss in the newborn. Effect of applying topical agents. Arch Dis Child 1981; 56: 669-672.

Computerized Tomography Detects Pulmonary Lesions in Children with Normal Radiographs Diagnosed to have Tuberculosis

Soumya Swaminathan, Aarti Raghavan, Manjula Datta*, C.N. Paramasivan and K.C. Saravanan†

*From the Tuberculosis Research Center (Indian Council of Medical Research), Chennai, *The Tamil Nadu Dr. M.G.R. Medical University, Chennai and †Government Stanley Medical College and Hospital, Department of Radiology, Chennai, India.*

Correspondence to: Dr. Soumya Swaminathan, Division of HIV/AIDS, Tuberculosis Research Center, Mayor V. R. Ramanathan Road, Chetpet, Chennai 600 031, India. E-mail: doctorsoumya@yahoo.com

Manuscript received: May 11, 2004, Initial review completed: August 4, 2004; Revision accepted: September 21, 2004.

This report is based on observations during the conduct of a larger study to develop diagnostic criteria for childhood tuberculosis (TB). Of 20l children confirmed to have pulmonary or lymph node TB, 84 had normal chest radiographs. Computerized tomography (CT) of the chest was performed in nine of them, seven of whom had normal chest radiographs while two had visible calcification. Eight of the nine children had definitive lesions detected by computerized tomography of the chest. While five children had primarily hilar lymph node enlargement, three had pulmonary parenchymal lesions. The use of more sensitive diagnostic tests like computed tomography helps to detect tuberculosis lesions not otherwise visualized on chest radiographs. This report highlights the difficulty in excluding active tuberculosis in children. More studies are required on the role of CT scans in the diagnosis of tuberculosis in children.

Key words: *Computerized tomography, Tuberculosis.*

TUBERCULOSIS (TB) in the pediatric population produces short-term morbi-dity and mortality and also serves as a reservoir for adult forms of the disease. The natural history of tuberculosis in any age group comprises of exposure, infection and disease. In children, the differentiation between infection and disease is not as clear-cut as in adults. The situation is compounded by the absence of signs and symptoms as well as the lack of specific