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HEPATIC STEATOSIS IN SEVERE ACUTE MALNUTRITION AND ITS CORRELATION WITH LIPID PROFILE

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ABSTRACT **BACKGROUND-** Fatty liver is a common feature of children with protein-energy malnutrition . Hepatic steatosis is usually held to be a clinical feature only of oedematous malnutrition and fatty liver does not occur in marasmus.The present study was undertaken to estimate lipid profile and its correlation with hepatic steatosis in SAM.

METHODS: : This descriptive cross-sectional study was carried out over 100 children of SAM & 50 Non SAM healthy children aged 6-59 months, over a period of 1 year duration at Bal chikitsalaya Udaipur, Rajasthan, India.A written informed consent was taken from parents of all children who fulfilled the inclusion criteria. Questionnaire, General examination, Anthropometric data (Weight, Length and Mid Upper Arm Circumference) were taken. Blood samples were taken to measure plasma levels of lipid profile (Total cholesterol, triglyceride, HDL-c, LDL-c and VLDL) .Ultrasonography abdomen was done to assess the hepatic steatosis and other fatty liver changes in all study children.

RESULTS-Out of total 150 cases, 100 were SAM and 50 were Non SAM. Of which 54 were males and 46 were females in SAM. Mean age of SAM children was 12.93±5.33 months, mean weight was 5.612±0.82 Kg, mean MUAC was 10.99±0.82cm,Length was 69.62±8.17 cm and BMI(kg/m2) was 11.14±1.65.The plasma levels of lipid profile (Total cholesterol, triglyceride, HDL-c , LDL-c and VLDL) were significantly decreased in malnourished children as compared with control group. For Total cholesterol (mean ± SD: 102.06 ±29.68 versus 146.33 ±26.94 mg/dl, Triglyceride (79.71± 37.17 versus 107.32±42.07 mg/dl), HDL-c (38.02±13.82 versus 55.12±9.62 mg/dl), LDL-c (54.18±21.50 versus 80.85±19.75 mg/dl), and VLDL (21.42±8.25 versus 23.18±4.98mg/dl)in all SAM versus non SAM. All fraction of lipid were low as compared to control which was significant p=0.001.Both oedematous and non-oedematous malnourished children had significantly more hepatic steatosis than the control group at admission .All SAM children show hepatic steatosis with different fractions of lipid but more severe grade had show with lows cholesterol and VLDL.

CONCLUSION-Plasma levels of cholesterol ,triglyceride,HDL-c and LDL-c were significantly decreased in malnourished children.Hepatic steatosis confined to all SAM edematous and non edematous.

KEYWORDS : Hepatic steatosis, serum lipid, severe acute malnutrion ,USG

INTRODUCTION

Fatty liver is a common feature of children with protein-energy malnutrition (PEM), and a hepatic lipid content >40% of liver weight is associated with a very poor prognosis[1,2]. The precise pathogenesis of fatty liver is unknown. Several theories to explain its occurrence in kwashiorkor have been proposed: endocrine abnormalities,[3]

increased fat synthesis,[4] redistribution from adipose tissue,[5] reduced lipoprotein synthesis,[6,7] abnormalities of lipoprotein lipase,[8] and peroxisomal dysfunction,[9] have each been put forward as playing a part. If the child recovers the fat disappears apparently without any long term sequelae[10].

Dyslipidemia is frequently associated with obesity,[11] recent studies have found that intrauterine and/or early life malnutrition may predispose the fetus to metabolic disorders, also leading to changes in the lipid profile in childhood[12,13].

Hepatic steatosis is usually held to be a clinical feature only of oedematous malnutrition[14] and 'fatty liver does not occur in marasmus'[15].

The present study was undertaken to estimate lipid profile and its correlation with hepatic steatosis in Severe acute malnutrition (SAM) children.

METHODS

This descriptive cross-sectional study was conducted over 1 year duration at Bal chikitsalaya, Udaipur, Rajasthan India. Total 150 children were enrolled in study.Out of which 100 were of severe acute malnutrition (SAM) and 50 were well nourished. Proper ethical clearance was taken from Institutional ethical committee.A structured questionnaire was administered to the caregivers of each patient. Information obtained included socio-demographic characteristics such as age, gender, parent's educational status and occupation. Complete anthropometric assessment was done and categorized as SAM and Non SAM child. SAM was labeled in a child who fulfill WHO criteria of SAM [16], in children of age 6 months to 5 years as

1. Weight for height/length < - 3SD and/or
2. Mid upper arm circumference (MUAC) <11.5 cm and/or
3. Bipedal nutritional edema

Following recruitment, Sample for lipid profile was taken in plain vial and send to our central laboratory for analysing. The lipid estimation tests were done with the method of colorimetry[17,18,19] and Reports were collected within 24 hrs. Ultrasonography abdomen was done preferably within 48 hrs of admission to assess the hepatic steatosis and other fatty liver changes in children with severe acute Malnutrition. Ultrasound grading of severity of hepatic steatosis was based on previously published criteria[20,21] as follows:

Grade 0: No increase in liver echogenecity and no echodiscrepancy between liver and kidney.

Grade 1: Minimal increase in liver echogenecity and minimal exaggeration of the echodiscrepancy between liver and kidney.

Grade 3: Loss of echoes from the walls of some of the portal vein, resulting in a featureless appearance with a degree of posterior beam attenuation and a greater discrepancy between the liver and kidney echo pattern.

Grade 5: Greater degree of posterior beam attenuation, loss of echoes from most of the portal vein and marked, discrepancy between liver and kidney.

Grades 2 between (1-3) and 4 between (3-5) intermediate appearance.

Data Management and Statistical Analysis –

All the collected data was managed and analyzed with standard software of Biostatics (SPSS Version 20). Statistical analysis of data

was done with Chi-square ^{2} analysis (for quantitative analysis), Student t-test with assistance of qualified statistician. The analysis of the data was made on the basis of important statistical parameters like the mean, standard deviation, standard error, t-test and proportion test where applicable. All the values were compared at 5% or 0.05 and 1% or 0.01 levels of significance for the corresponding degrees of freedom to arrive at the conclusion regarding the objectives of the study.

RESULTS

Out of 150 cases, 100 were SAM while 50 were non SAM. In SAM children 54(54%) were males and rest were females.. In children with SAM 95 (95%) had weight for length/ height <-3SD, 62 (62%) MUAC <11.5cm and 23(23%) children had bipedal edema..

The plasma levels of lipid profile (Total cholesterol, triglyceride, HDL-c , LDL-c and VLDL) were significantly decreased in malnourished children as compared to control group. For Total cholesterol (mean ± SD: 102.06 ±29.68 versus 146.82 ±26.94 mg/dl, Triglyceride (79.72± 37.17 versus 107.68±42.07 mg/dl), HDL-c (38.78±13.82 versus 55.52±9.62 mg/dl), LDL-c (54.63±21.50 versus 80.50±19.75 mg/dl), and VLDL (21.42±8.25 versus 23.34± 4.98mg/dl) in SAM versus control. All fractions of lipid were low as compared to control which was significant p=0.001.

Both oedematous and non-oedematous malnourished children had significantly more hepatic steatosis than the control group at admission. Children with oedematous malnutrition had significantly greater steatosis than nonoedematous children at admission.

In this study hepatic steatosis was assessed with comparing different lipid profile fraction. We observed the Cholesterol and VLDL was in decreasing order when hepatic steatosis grading was deteriorating and other lipid profile (TG, HDL and LDL) they were not significantly associated with different grade of hepatic steatosis.None of the non SAM was having hepatic steatosis.

DISCUSSION-

PEM results from prolonged dietetic deprivation of proteins and calories. Due to protein deficiency, there is lack of release of lipids from liver as lipoproteins and hence these get accumulated in liver leading to hepatic steatosis[22]. Earlier, fatty infiltration of liver was regarded as a characteristic feature of only edematous PEM[23].

The fatty liver characteristic of kwashiorkor is perhaps due to increased fat transport from the adipose tissues to liver[24] decreased beta lipoproteins synthesis[25] and possibly due to Increased liver lipogenesis. Various studies suggested that the low levels of total lipids are due to reduced levels of triglycerides, cholesterol, phospolipid and lipoprotein during the active stage of disease in kwashiorkor group.[26,27,28]

Our study showed presence of hepatic steatosis in 92% of non-edematous cases on admission. Out of which 23%, 18%, 22% and 29% were in grade-1-4 respectively. All the 23 cases of edematous SAM had shown hepatic steatosis. Out of 23 cases, 13.1% and 82.6% children had shown grade 3-4 hepatic steatosis. Both oedematous and non-oedematous malnourished children had significantly more steatosis than the control group at admission. Children with oedematous malnutrition had significantly greater steatosis than non oedematous children at admission.

Similar study was conduct by Doherty, et al[20] on hepatic steatosis by USG. His study had included 55 cases, of which 24 were non-edematous PEM. Of these non-edematous cases, 12 (50%) had shown hepatic steatosis on admission. Follow up USG after adequate weight gain had shown improvement in 75% cases.

This is similar to study by Lalwani, et al[29] that study showed presence of hepatic steatosis in 91% of non-edematous cases on admission. There were only 3 cases of edematous PEM and all the 3 had shown hepatic steatosis. There was no correlation between the severity or type of PEM and USG grade of hepatic steatosis. In fact, one of the marasmic children had grade V hepatic steatosis.

In this study hepatic steatosis was assessed with comparing different lipid profile. We observed the Cholesterol and VLDL were in decreasing order when hepatic steatosis grading was deteriorating and other lipid profile (TG, HDL and LDL) they were not significantly associated with different grade of hepatic steatosis.

Fatty liver emerged as an additional and independent factor.Type 2 diabetes and cardiovascular disease represent a serious threat to the health of the population worldwide. Although overall adiposity and particularly visceral adiposity are established risk factors for these diseases. Furthermore, the effects of fatty liver on glucose and lipid metabolism,specifically via induction of subclinical inflammation and secretion of humoral factors, are highlighted.. Novel findings from the research in this field may help to implement intervention strategies aimed at preventing and reversing fat accumulation in the liver, as well as its metabolic complications like dyslipidemia, Inflamation, insulin resistance and dissociation of fatty liver and insulin resistance.(30)

CONCLUSION-

All edematous SAM and 91 % non edematous children having hepatic steatosis at admission.

Recommendation-

There is need of doing USG to assess hepatic steatosis in children with SAM and it should be correlated with lipid profile.

Limitation-

Study curops only at admission ,no follow up was done.

RESULTS

Table 1: Age and Sex wise Distribution of Study Population

Age (months)	Case (SAM)					Control				
	Male		Female		Total	Male		Female		Total
	No.	%	No.	%	No.	No.	%	No.	%	No.
6-<12	31	70.45%	13	29.55%	44	13	50%	13	50%	26
12-<24	23	42.59%	31	57.41%	54	12	63.16%	7	36.84%	19
24-<60	0	0.00%	2	100.0%	2	2	40%	3	60%	5
Total	**54**	54%	46	46%	100	27	54%	23	46%	**50**
Mean± SD	12.04±4.11		13.98±6.36		12.93 ±5.33	13.33±5.55		13.42± 4.82		13.38 ±5.13

Table 2: Distribution of study population on basis of SAM criteria

Age (month)	WFH/L <-3SD	MUAC <11.5		Edema		
			1+	2+	3+	TOTAL
6-<12	43	28	2	3	1	6
12-<24	50	32	8	8	0	16
24-<60	2	2	0	1	0	1
Total	**95 (95%)**	**62 (62%)**	**10(10%)**	**12(12%)**	**1(1%)**	**23(23%)**

Table 3: Basic Anthropometric Variables in SAM Patients

Values	SAM (100)		Control (50)	
	Mean	SD	Mean	SD
Weight (kg)	5.512	0.82	8.68	1.03
Height (cm)	70.26	8.17	73.96	15.26
MUAC (cm)	10.99	1.18	12.3	0.44
BMI (kg/m^2)	11.02	1.65	15.77	0.86

Table 4 – Lipid Profile In SAM And Control

Parameters	SAM		CONTROL		P value
	Mean	SD	Mean	SD	
Cholesterol	102.06	29.68	146.82	26.94	<0.001
Triglyceride	79.72	37.17	107.68	42.07	<0.001
HDL	38.78	13.82	55.52	9.62	<0.001
LDL	54.63	21.50	80.50	19.75	<0.001
VLDL	21.42	8.25	24.34	4.98	<0.01

Table 5 –Hepatic Steatosis In Non Edematous SAM And Edematous SAM

	GRADE 0		GRADE –I		GRADE -II		GRADE -III		GRADE-IV		GRADE V		TOTAL
	N	%	N	%	N	%	N	%	N	%	N	%	
Non Edematous SAM	6	8%	18	23%	14	18%	17	22%	22	29%			77
Edematous SAM	0						3	13.1%	19	82.6%	1	4%	23
Total	7		17		14		21		40		1		100

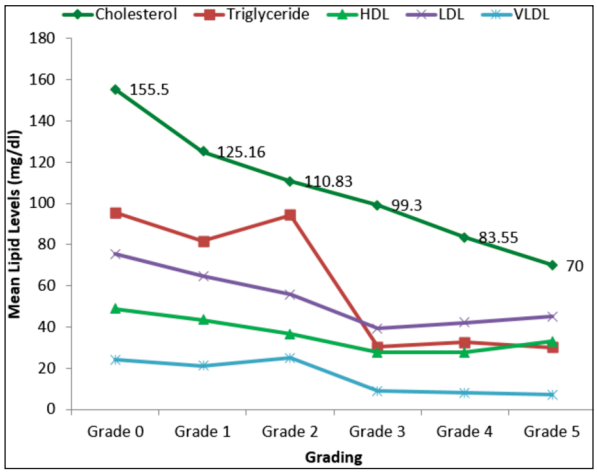

Table 6- Lipid Profile And Hepatic Steatosis Grading

REFERENCES.

1. Waterlow JC. Amount and rate of disappearance of liver fat in malnourished infants in Jamaica. Am J Clin Nutr.1975; 28:1330–6.
2. McLean AEM. Hepatic failure in malnutrition. Lancet. 1962; 11: 1292–4.
3. Gillman J, Gilbert C. Fatty liver of endocrine origin with special reference to fatty liver of malnourished African infants. BMJ. 1958; i: 57-63.
4. Fletcher K. Observations on the origin of liver fat in infantile malnutrition. Am J Clin Nutr .6; 19(3): 170-4.
5. Lewis B, Hansen JD, Wittman W, Krut LH, Stewart F. Plasma Free Fatty Acids In Kwashiorkor And The Pathogenesis Of The Fatty Liver. Am J Clin Nutr. 1964 Sep;15:161–168.
6. Flores H, Seakins A, Brooke OG, Waterlow JC. Serum and liver triglycerides in malnourished Jamaican children with fatty liver. Am J Clin Nutr .1974; 27:610-4.
7. Dhansay MA, Spinnler Benade AJ, Donald PR. Plasma lecithin cholesterol acyl-transferase activity and plasma lipoprotein composition and concentrations in kwashiorkor. Am J Clint Nutr. 1991; 53:512-9.
8. Agbedana EO, Johnson AO, Taylor GO. Studies on hepatic and extrahepatic lipoprotein lipases in protein-calorie malnutrition. Am J Clin Nutr. 1979; 32:292-8.
9. Doherty JF, Golden MHN, Brooks SEH. Peroxisomes and the fatty liver of kwashiorkor-an hypothesis. Am J Clin Nutr. 1991; 54: 674-7.
10. Cook GC. The liver after kwashiorkor. BMJ. 1967; iii:454-7.
11. Ceres C. Romaldini, Hugo Issler, Ary L. Cardoso, Jayme Diament, Neusa Forti. Risk factors for atherosclerosis in children and adolescents with family history of premature coronary artery disease .J Pediatr . 2004;80(2):135-40.
12. Lussana F, Painter RC, Ocke MC, Buller HR, Bossuyt PM, Roseboom TJ. Prenatal exposure to the Dutch famine is associated with a preference for fatty foods and a more atherogenic lipid profile. Am J Clin Nutr. 2008;88:1648-52.
13. Lumey LH, Stein AD, Kahn HS, Romijn JA. Lipid profiles in middle-aged men and women after famine exposure during gestation: the Dutch Hunger Winter Families Study. Am J Clin Nutr.2009; 89: 1737-43.
14. Suskind D, Murthy KK, Suskind RM. The malnour- ished child: an overview. In: Suskind RM,Lewinter-. Suskind L, editors.The malnourished child. New. York, NY: Vevey/Raven Press, 1990:1 22.
15. Alpers DH, Isselbacker KJ. Fatty liver: biochemical and clinical aspects. In: Schiff L, ed. Diseases of the liver. Philadelphia: J B Lippincott. 1975:815-32.
16. *WHO* Child Growth Standards and the Identification of severe acute malnutrition in infants and children .A joint statement by WHO and UNICEF.2009.Accessed from *http//who.int/nutrition/publications/severe malnutrition/9789241598163-eng.pdf*
17. Allain, C.C., Poon, L.S., Chan, C.S.G., Richmond, W and FU PC. Enzymatic determination of total serum cholesterol. ClinChem.1974; 20:470-475
18. Fossati, P and Prenciple,L. Serum triglycerides determined colorimetrically with an enzyme that produces hydrogen peroxide. Clin Chem. 1982; 28(10): 2077-2080.
19. Burstein, M., Scholnick, H.R and Morfin, R.Rapid method for the isolation of lipoprptein from human serum by precipitation with polyanions. Scand J Clin Lab Invest .1980; 40: 583-564.
20. Doherty JF, Adam EJ, Griffin GE, Golden MHN. Ultrasonographic assessment of the extent of hepatic steatosis in severe malnutrition. Arch Dis Child .1992; 67: 1348-1352
21. Saverymuttu SH, Josheph AE, Maxwell JD. Ultrasound scanning in the detection of hepatic fibrosis and steatosis. Br Med J. 1986; 292: 13-17
22. Seakins A, Waterlow JC. The effect of a low protein diet on the incorporation of amino acids into rat serum lipoproteins. Biochem J .1972; 129:793-5.
23. Williams CD. Kwashiorkor: A nutritional disease of children associated with maize diet. Lancet .1935; 11: 1151-1152.
24. Lewis B, Hansen JD, Wittman W, Krut LH, Stewart F. Plasma Free Fatty Acids In Kwashiorkor And The Pathogenesis Of The Fatty Liver. Am J Clin Nutr. 1964 Sep;15:161–168
25. Flores H, Pak N Maccioni A,Monckberg F.Brt J Nutr. 1970;24,1055.
26. Schwarts R, Dean RFA. The serum lipids in kwashiorkor neutral fat, phospholipids and cholesterol. J Trop Ped. 1957; 3: 23-31.
27. Cravioto J, De La Pena, Burgos G. Fat metabolism in chronic severe malnutrition. Lipoprotein in children with kwasiorkor Metabolism. 1959; 8: 722-730.
28. Metcoff, J. : Cellular energy metabolism in protein-calorie malnutrition. In Olson, R.E. (ed.) : Protein-Calorie Malnutrition. New York: Academic Press, 1975;65
29. Lalwani, Shivkumar & Karande, Sunil & Khemani, R & K Jain, M. Ultrasonographic Evaluation of Hepatic Steatosis in Malnutrition. Indian Pediatr.1998; 35; 650-2.
30. Stefan N, Kantartzis K, Häring HU. Causes and metabolic consequences of Fatty liver. Endocr Rev. 2008 Dec;29(7):939-60. doi: 10.1210/er.2008-0009. Epub 2008 Aug 21. PMID: 18723451.