The Role of L-Carnitine In Anemic and Hypoglycemic Neonates

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Abstract:

This study was designed to determine the effect of L-carnitine on anemic and hypoglycemic neonates. A total number of 70 neonates were divided into 2 groups: hypoglycemic group [n=40 (20 supplemented with L-carnitine and 20 not supplemented)], and anemic group [n=30 (15 supplemented with L-carnitine and 15 not supplemented)]. The effect of L-carnitine was compared on both groups. We found that there was a significant improvement of hypoglycemia and anemia after L-carnitine supplementation, this improvement significantly correlated with the duration of the treatment.

Introduction:

L-carnitine is a key molecule in energy production from various substrates.[1] It is needed to release energy from fat. It transports fatty acids into mitochondria the power houses of cells.[2]

L-carnitine is synthetized in the body from the amino acids lysine and methionine. However, in infancy and in situations of high energy needs, such as pregnancy and breast feeding, the need for L-carnitine can exceed production by the body, therefore L-carnitine is considered a conditionally essential nutrient.[2]

Carnitine availability is one of the factors that determine the rate of B-oxidation and ketogenesis.[3] L-carnitine is essential for the efflux of the products of peroxisomal lipid oxidation from the organelles, a process mediated through specific carnitine acyltransferases.[4]

The aim of this study was to determine whether L-carnitine supplementation to neonates would improve neonatal anemia and hypoglycemia or not.

Subjects and Methods:

A total number of 70 neonates were included and divided into 2 groups as follows:

Group 1: Hypoglycemic group, it included 40 neonates, 20 of them received L-carnitine (group A), and 20 neonates who did not receive L-carnitine (group B).

Group 2: Anemic group, it included 30 neonates, 15 of them received L- carnitine (group C), and 15 neonates did not receive L- carnitine (group D). The clinical characteristics of studied neonates are shown in table I .

All neonates were subjected to a thorough history taking, full clinical examination and laboratory evaluation [complete blood picture (CBC), and random blood sugar (RBS)].

The newborn groups who received L-carnitine were matching with those who did not receive it as regards gestational age, birth weight, and maternal obstetric characteristics

Table I: Clinical characteristics

Groups	Number	Gestational age In week (Mean±SD)	Birth weight in grams (Mean ±SD)
Group A	20	37.60 ±0.9	2.200±240
Group B	20	38.20 ±0.5	2.350 ±190
Group C	15	36.22±0.6	1.850±150
Group D	15	36.55 ±0.5	1.900±100

These laboratory evaluations were done on the 1st day of life, 1st week, 2nd week, and 2nd month of age for each group with or without L- carnitine supplementation.

L-carnitine was administrated on the 2nd day of life for group A and C in a dose of 100 mg/kg /day in three divided doses for 2 months. It was prepared in a sterile solution, which was added to the milk.

All of these groups were feed on breast-feeding and intravenous fluids.

Results and Discussion:

The results are illustrated in tables II-IV.

L-carnitine has been proposed as a treatment for a variety of metabolic abnormalities including hypoglycemia, anemia, hypercholesterolemia, hypertriglyceridemia, AIDS, neonates who receive TPN, cystic fibrosis, chronic fatigue syndrome, anorexia, hyperthyroidism, and male infertility.[5,6]

The digestion of L-carnitine poses no problem. In fact, the oral administration of L-carnitine has been used for years in the clinical treatment of human

Table II. Comparison between the laboratory data of the neonates with L-carnitine supplementation (A, C) and without L-carnitine supplementation (B, D) by paired sample t test.

Age	Random Blood sugar (mg/dl)		P-value	Hb level (gm/dl)		P-value
	Group A (n=20)	Group B (n=20)		Group C (n=15)	Group D (n=15)	
1st day of life	34.3±5.8	36.9±1.8	.000*	8.9±1.1	8.6±1.3	.412
1st week of life	83.3±7.9	60.2±7.3	.000*	8.6±1.3	9.1±1.0	.321
2nd week of life	89.0±9.3	67.9±8.6	.000*	12.5±1.1	9.6±1.1	.000*
2nd month of life	103.9±7.5	81.5±11.9	.000*	13.4±1.4	10.7± .9	.000*

**Significant*

Table III. Correlation between random blood sugar level and duration of treatment with L-carnitine.

Random Blood Sugar (RBS)	Number	Correlation	Significance
Random blood sugar (RBS) in the 1st day of life Vs RBS in the 1st week of life	20	.935	.000*
Random blood sugar (RBS) in the 1st day of life Vs RBS in the 2nd week of life	20	.978	.000*
Random blood sugar (RBS) in the 1st day of life Vs RBS in the 2nd month of life	20	.950	.000*
Random blood sugar (RBS) in the 1st week of life Vs RBS in the 2nd week of life	20	.935	.000*
Random blood sugar (RBS) in the 1st week of life Vs RBS in the 2nd month of life	20	.947	.000*
Random blood sugar (RBS) in the 2nd week of life Vs RBS in the 2nd month of life	20	.965	.000*

** Significant*

Table IV. Correlation between hemoglobin level and duration of treatment with L- carnitine.

Hemoglobin (hb) level	Number	Correlation	Significance
Hemoglobin level (hb) in 1st day of life Vs hb in 1st week of life	15	.995	.000*
Hemoglobin level (hb) in 1st day of life Vs hb in 2nd week of life	15	.975	.000*
Hemoglobin level (hb) in 1st day of life Vs hb in 2nd month of life	15	.835	.000*
Hemoglobin level (hb) in 1st week of life Vs hb in 2nd week of life	15	.977	.000*
Hemoglobin level (hb) in 1st week of life Vs hb in 2nd month of life	15	.814	.000*
Hemoglobin level (hb) in 2nd week of life Vs hb in 2nd month of life	15	.889	.000*

**Significant* *N.B: Correlation was done by Pearson's correlation.*

carnitine deficiency.[7] This is also true for the numerous studies done on infants, more specifically pre-term neonates in which evidence is beginning to mount towards it actually being an essentially nutrient.[7]

Carnitine may however be considered conditionally essential when there is inadequate metabolism, absorption, or synthesis. Such conditions may be inborn as in genetic disorders, or acquired through hemodialysis, chronic renal failure, infancy, or intake of carnitine depleting drugs.[4]

As L-carnitine is an essentially co-factor in fatty acid and energy metabolism, it is possible that abnormal carnitine metabolism in hypoglycemic and anemic neonates may be associated with clinical problems; so we evaluated the outcome of the neonates who were treated with L-carnitine.

In this study, the results of the hypoglycemic group showed that there was a significant increase in the serum level of glucose after L-carnitine supplementation ($p< 0.000$), and there was a significant correlation between its use and the duration of treatment ($p< 0.000$).

This is in agreement with Boehm et al,[5] in 1993, Costa et al,[6] in 1996 and Krabbe,[7] in 1996, who stated that the use of L-carnitine during hypoglycemia and physiological states such as fasting and extreme metabolic stress, helps to detoxify much of the excess acetyl Co-A produced in this states but its exact role in ketosis is not yet completely clear.

Broderick et al,[8] in 1995, pointed out that carnitine has an important role in the regulation of glucose oxidation. It improves the coupling between glycolysis and glucose oxidation, links between glucose and fatty acid oxidation, and plays a major role in myocardial metabolism. This may explain some of the beneficial effect associated with L-carnitine treatment in various pathological conditions.

Girard et al,[9-11] in 1974, 1976 and 1983, documented the insensitivity of the α-cells of the neonatal pancreas to acute changes in plasma glucose concentration. Alternatively, it has been suggested that the neonatal increase in plasma glucagon and the fall in plasma insulin could be related to the stress of birth through an activation of the sympathetic nervous system.[12-14] Their concentration are increased several folds in newborns in response to transient hypoxia, cold exposure, or cord cutting.[15-17]

On the other hand, Labadaridis et al,[1] in 2000, found that there was no statistically significant difference in the blood glucose levels, and that

these levels were within the normal range in all neonates at all time points studied.

The effect of L-carnitine on the Hb level before and after L-carnitine administration, in this study, were not affected in the 1st week of life ($p<0.321$). In the 2nd week and 2nd month, however, there was a significant increase in the Hb level ($p< 0.000$), There was also a significant correlation between Hb level and duration of treatment ($p< 0.000$).

Similar results were observed by Abertazzi et al,[18] in 1982, Laboniow et al,[19] in 1987, Arduin et al,[20] in 1994 and Fritz et al,[21] in 1995. This could be explained by the effect of L-carnitine on erythrocyte. L-carnitine is thought to repair the oxidatively damaged membrane.[20] Another explanation is that L-carnitine stabilizes the red blood cell membrane by improving the uptake of lipids forming the structure of the membrane.[21]

Profound changes in serum and tissue levels of iron, trace elements and antioxidant vitamins occur and remain depressed for up to 1 week during sepsis and injury.[22,23] This observation could explain why serum level of Hb remains low in the 1st week of life after labor, and a gradual increase occurs after L-carnitine supplementation.

Conclusion:

L-carnitine supplementation to neonates improves neonatal anemia and hypoglycemia, and a significant improvement occurs when the duration of treatment is prolonged for more than one month.

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