

Parenteral Fish Oil-Based Lipid Emulsion Improved Lipid and Fatty Acid Profiles in Parenteral Nutrition-Dependent Patients

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Background: Parenteral nutrition (PN) with soybean oil-based lipid emulsion (SOLE) is a life-saving therapy but may be complicated by PN-cholestasis and dyslipidemia. We have previously demonstrated that a fish oil-based intravenous lipid emulsion (FOLE) can reverse PN-cholestasis. Fish oil supplementation has also been shown improve lipid profiles. The objective of this study was to describe the changes in fatty acid and lipid profiles of patients with PN-cholestasis who were treated with a FOLE (Omegaven[®]).

Methods: Lipid and fatty acid profiles of 79 pediatric patients who developed PN-cholestasis while on standard SOLE were examined before and after switching to FOLE. All patients

received PN with the FOLE at 1 g/kg/day for at least one month. The FOLE was used under a compassionate use protocol.

Results: Median age at the start of FOLE treatment was 12.6 weeks (IQR 14.7-41.6 weeks). After a median time of 18.1 weeks (IQR 14.7-41.6 weeks) on FOLE, median total and direct bilirubin improved from 7.9 mg/dL and 5.4 mg/dL to 0.5 mg/dL and 0.2 mg/dL, respectively ($p < 0.0001$). Serum triglyceride, total cholesterol, LDL and VLDL levels were decreased by 51.7%, 17.4%, 23.7% and 47.9%, respectively. Analysis of fatty acid profiles showed a 12 and 4.4 fold increase in serum eicosapentaenoic and docosahexaenoic acid, respectively, while serum arachidonic acid decreased by 46.3% ($p < 0.0001$), without the development of essential fatty acid deficiency in any patient. Improvement of PN-cholestasis, LDL, VLDL, total cholesterol, and triglyceride occurred gradually over the course of the treatment while changes in fatty acid profiles happened early and remained stable over time.

Conclusion: Switching from SOLE to FOLE in PN-dependent children was associated with significant improvement in PN-cholestasis and lipid profiles. The improvement of PN-cholestasis and lipid profiles may be resulted from the increase in serum omega-3 fatty acids such as eicosapentaenoic and docosahexaenoic acid, and the decrease in serum omega-6 fatty acids such as arachidonic acid. Fish oil-based lipid emulsion may be the preferred lipid emulsion in patients with PN-cholestasis or dyslipidemia.

Table 1. Summary of the Effects of Omegaven on Sterols for Cohort (N = 79 Patients)*

Variable, mg/dL	Baseline Value	Censoring Value	P value
TB	7.9 (5.0 – 13.0)	0.5 (0.3 – 1.3)	<0.0001
DB	5.4 (3.5 – 8.5)	0.2 (0.1 – 0.6)	<0.0001
TGL	147 (100 – 223)	71 (50 – 108)	<0.0001
CRP	1.3 (0.6 – 2.8)	0.2 (0.1 – 0.5)	<0.0001
Cholesterol	138.7 ± 56.1	114.2 ± 33.8	<0.001
HDL	28.0 ± 17.8	32.5 ± 15.3	0.087
LDL	83.4 ± 44.6	63.6 ± 32.7	<0.001
VLDL	31.7 ± 16.1	16.5 ± 9.7	<0.001
Eicosapentaenoic	53 (35 – 74)	644 (294 – 1046)	<0.0001
Docosahexaenoic	170 (114 – 280)	750 (504 – 986)	<0.0001
Arachidonic	749.3 ± 370.0	401.8 ± 149.7	<0.0001

* Data for normally distributed variables are mean ± SD and compared by paired *t*-tests. Other variables are given as median (IQR) and compared by Wilcoxon signed-ranks test.

TB, total bilirubin; DB, direct bilirubin; HDL, high density lipoprotein cholesterol; LDL, low density lipoprotein cholesterol; VLDL, very low density lipoprotein cholesterol; CHOL, total cholesterol; TGL, total triglycerides; EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid; AA, arachidonic acid.