

# **Is there a good case for inclusion of fish oil in parenteral nutrition?**

**Philip C. Calder**  
**Professor of Nutritional Immunology**  
**University of Southampton**

# What should lipids used in parenteral nutrition provide?

- **Energy**
- **Building blocks**
- **Essential fatty acids**

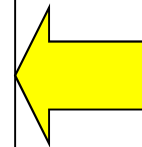
**Soybean oil was the lipid traditionally used in PN (from early 1960s) – so-called MCTs introduced later (mid-1980s)**

**Soybean oil and soybean oil/MCT (50:50) are the most widely used lipids in PN**



# What should lipids used in parenteral nutrition provide?

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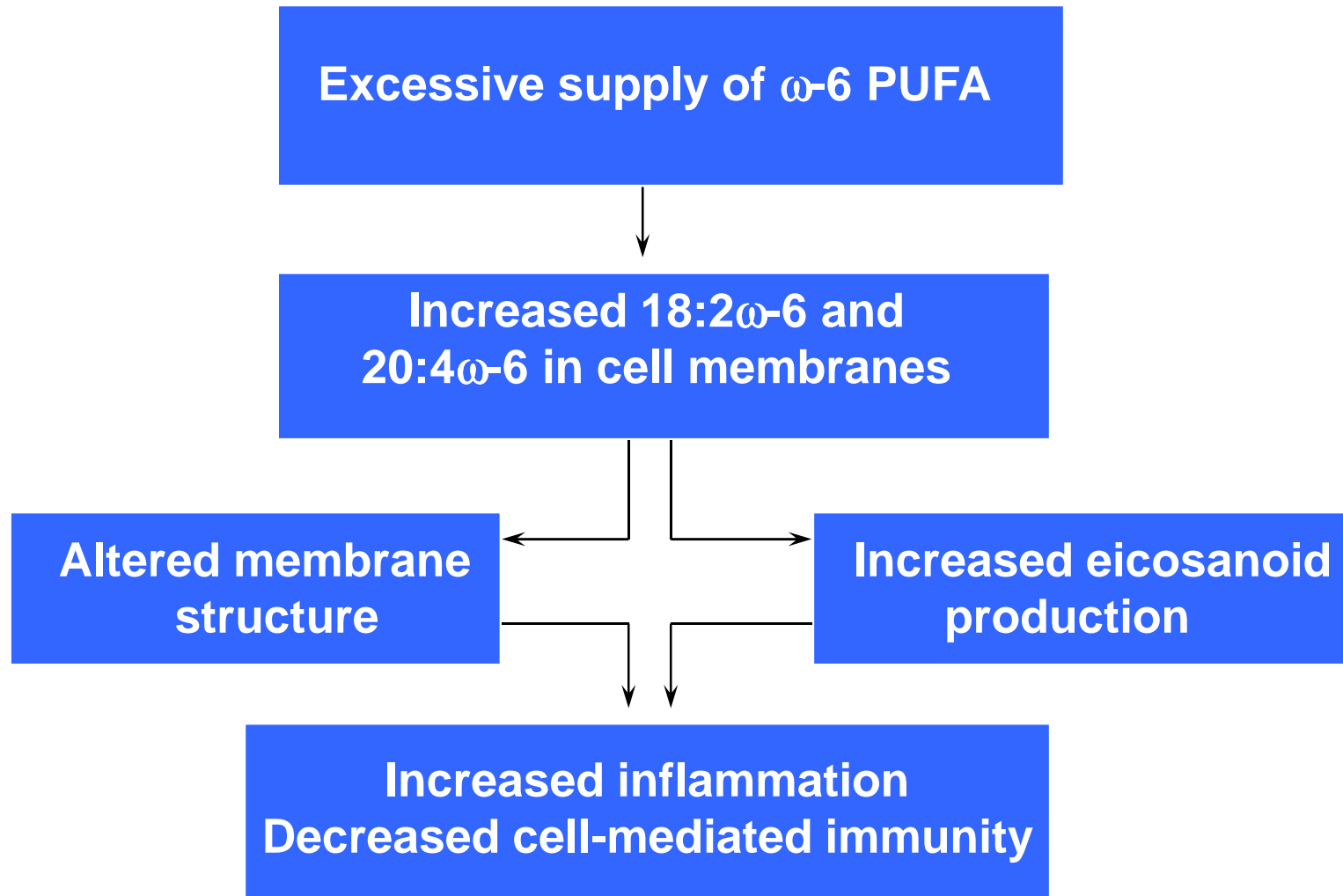


**Soybean oil does  
all these things**

# **What should lipids used in parenteral nutrition provide?**

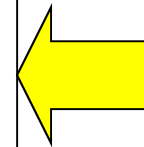
- **Energy**
- **Building blocks**
- **Essential fatty acids**
  
- **A “good” fatty acid balance**
- **Fatty acids with desirable biological activities**

**Soybean oil provides energy, essential fatty acids,  
and fatty acids for building blocks, but .....**



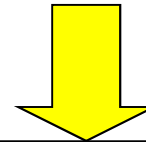
# What should lipids used in parenteral nutrition provide?

- Energy
- Building blocks
- Essential fatty acids



**Soybean oil does all these things**

**?But not these**



- A “good” fatty acid balance
- Fatty acids with desirable biological activities

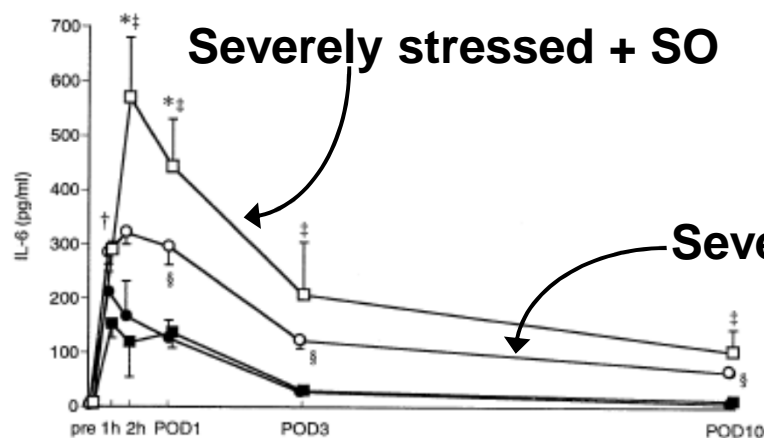
# Influences of Soybean Oil Emulsion on Stress Response and Cell-Mediated Immune Function in Moderately or Severely Stressed Patients

Katsunori Furukawa, MD, Hideo Yamamori, MD, Kazuya Takagi, MD, Naganori Hayashi, MD, Ryoji Suzuki, MD, Nobuyuki Nakajima, MD, and Tsuguhiko Tashiro, MD

*Nutrition* 2002;18:235-240

Post-GI surgery patients

Standard glucose containing PN with no lipid vs. Soybean oil (-7 to +14 d)  
Some “moderately stressed” and some “severely stressed”



=> Worse inflammation with SO

Also reported impaired T cell function with SO

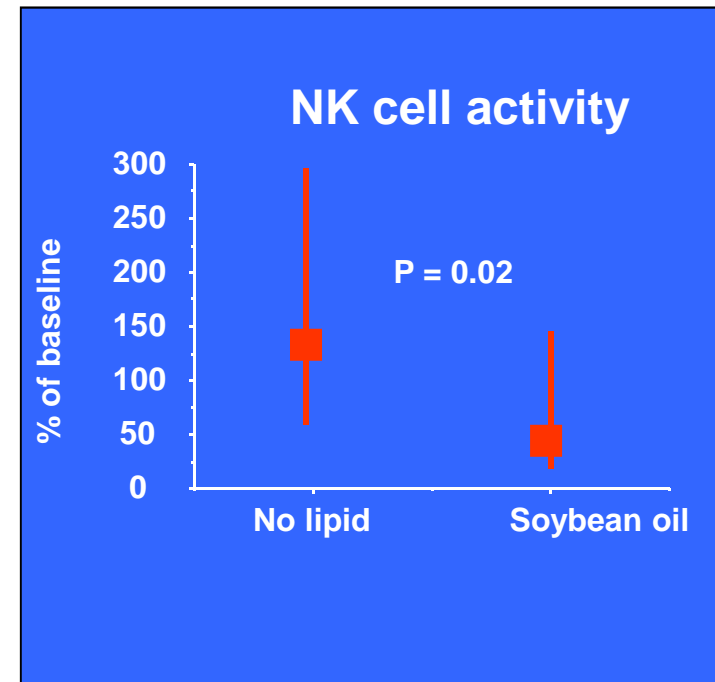


**Battistella et al. (1997) J. Trauma 43, 52-60**

**Polytrauma patients (APACHE II av. 22)**

**Standard glucose containing PN with no lipid vs.  
Soybean oil (10 days)**

	No lipid	Soybean oil
Length of stay (d)	27	39*
ICU stay (d)	18	29*
Days on ventilator	15	27*
Pneumonia (#)	13	22*
Total infectious complications	39	72



# A role for fish oil?

**Contains very long chain  $\omega$ -3 fatty acids (EPA and DHA)**

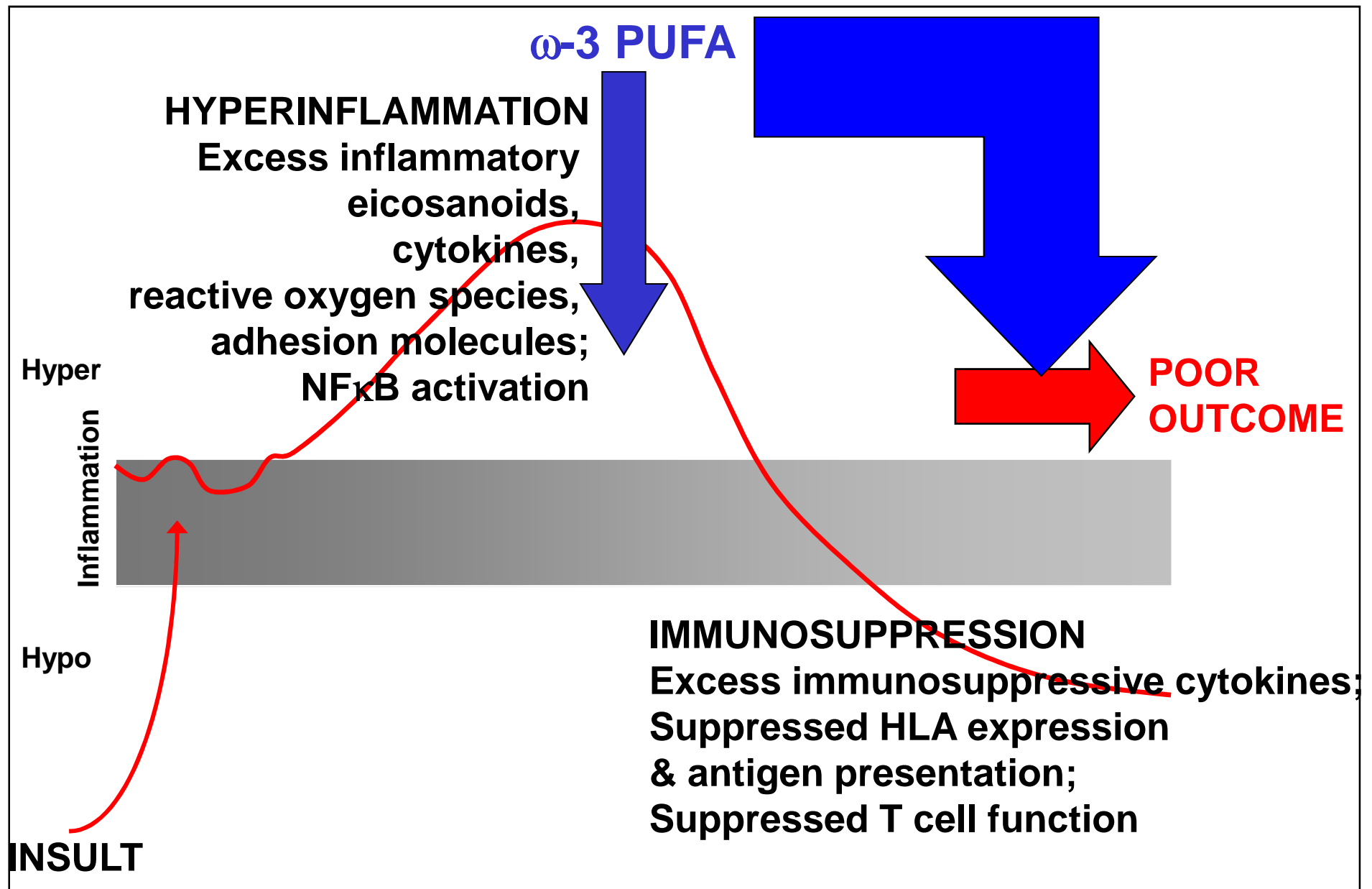
**Strong evidence of human health effects:**

- blood lipids**
- blood coagulation**
- inflammation**
- endothelial function**
- cardiovascular disease**

**Antagonise  $\omega$ -6 fatty acids**



# Hypothetical timecourse of response to insult



## **Three lipid emulsions containing fish oil are currently available**

- **Lipoplus (aka Lipidem): 50:40:10 mixture of coconut, soybean and fish oils**
- **SMOFLipid: 30:30:25:15 mixture of coconut, soybean, olive and fish oils**
- **Omegaven: 100% fish oil – should be diluted at point of use with another lipid emulsion**

# **There are a number of trials of intravenous fish oil in post-surgical patients**

**Findings are generally consistent and show**

- **Decreased inflammation**
- **Decreased length of ICU stay**
- **Decreased length of hospital stay**
- **Perioperative may be superior to post-operative**

Original Communication

# Safety and Efficacy of Fish Oil– Enriched Parenteral Nutrition Regimen on Postoperative Patients Undergoing Major Abdominal Surgery: A Meta-Analysis of Randomized Controlled Trials

Bo Chen, MM; Yong Zhou, MD; Ping Yang, MM;  
Hong-wei Wan, MM; and Xiao-ting Wu, MD

Journal of Parenteral and  
Enteral Nutrition

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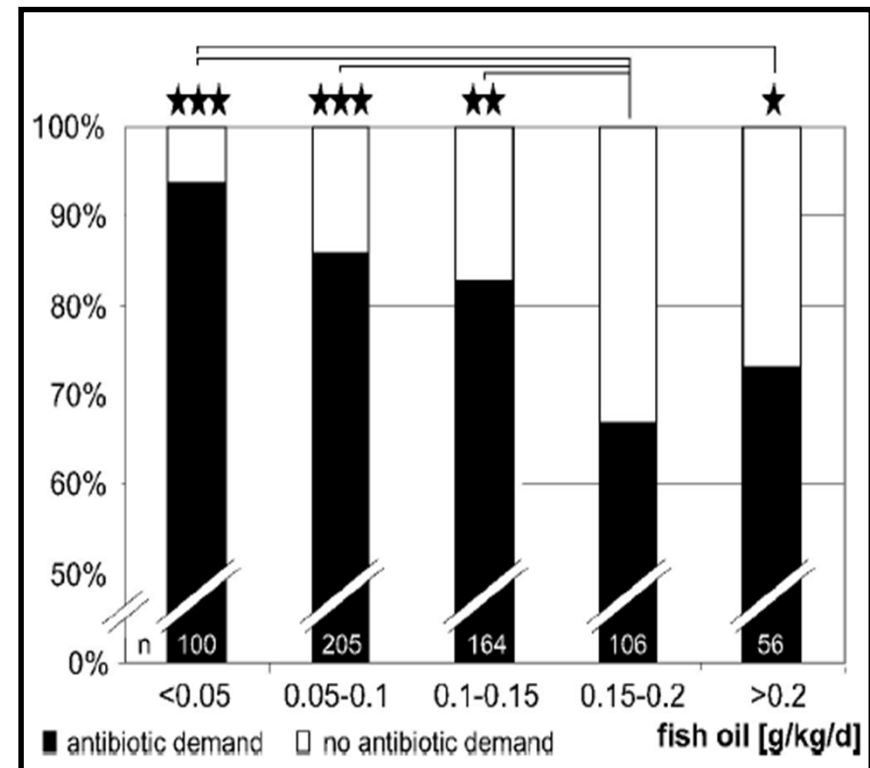
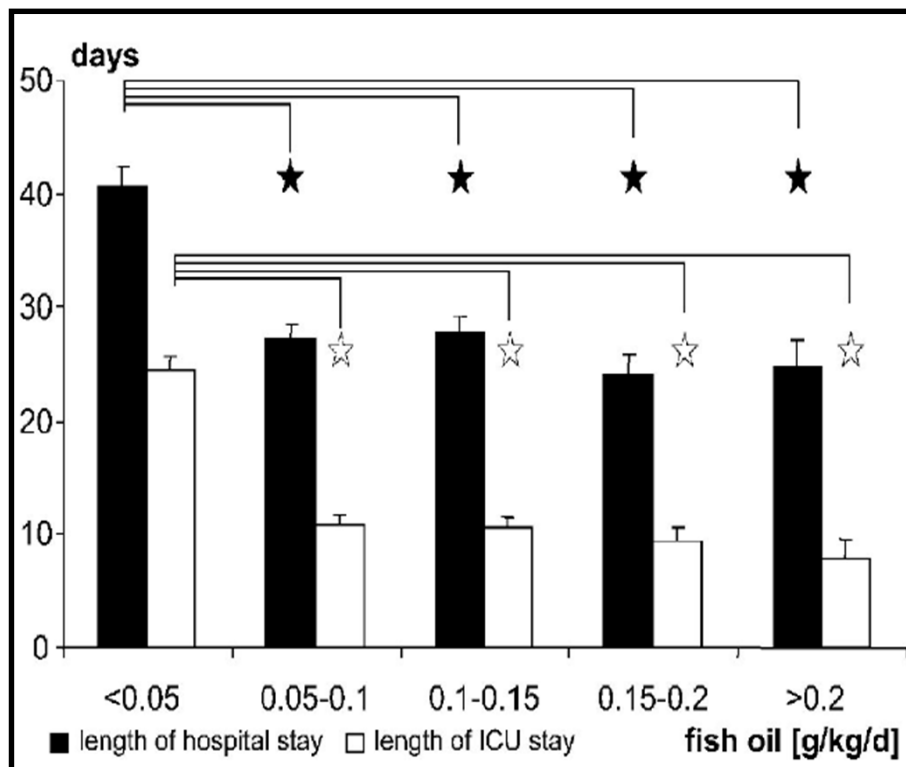
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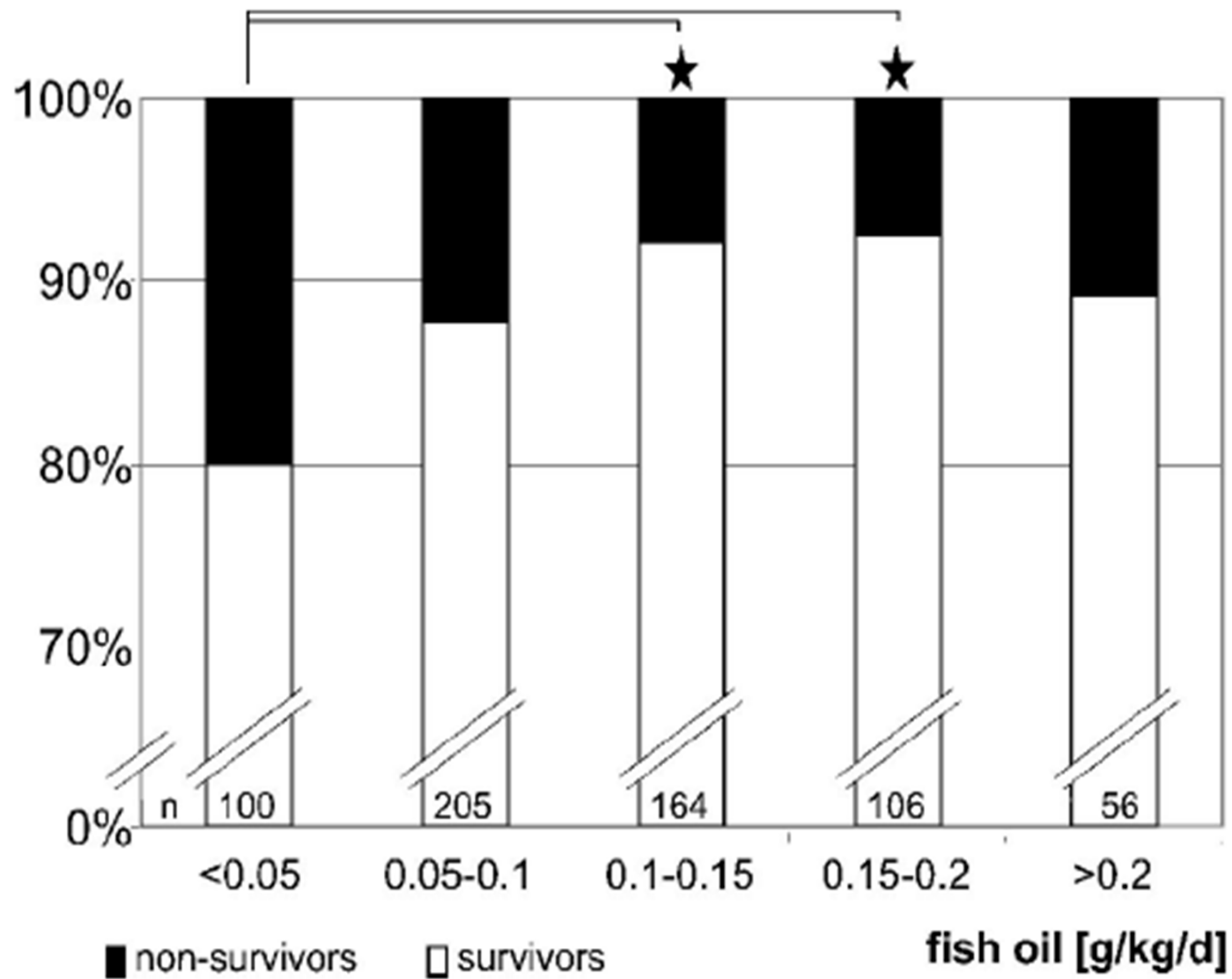
# Omega-3 fatty acids improve the diagnosis-related clinical outcome\*

Axel R. Heller, MD, PhD, DEAA; Susann Rössler, Cand Med; Rainer J. Litz, MD; Sebastian N. Stehr, MD; Susanne C. Heller, MD; Rainer Koch, PhD; Thea Koch, MD, PhD **Crit. Care Med (2006) 34, 972-979**

**661 patients receiving TPN for  $\geq 3$  d:  
ICU and hospital LOS; antibiotic demand vs. fish oil dose**

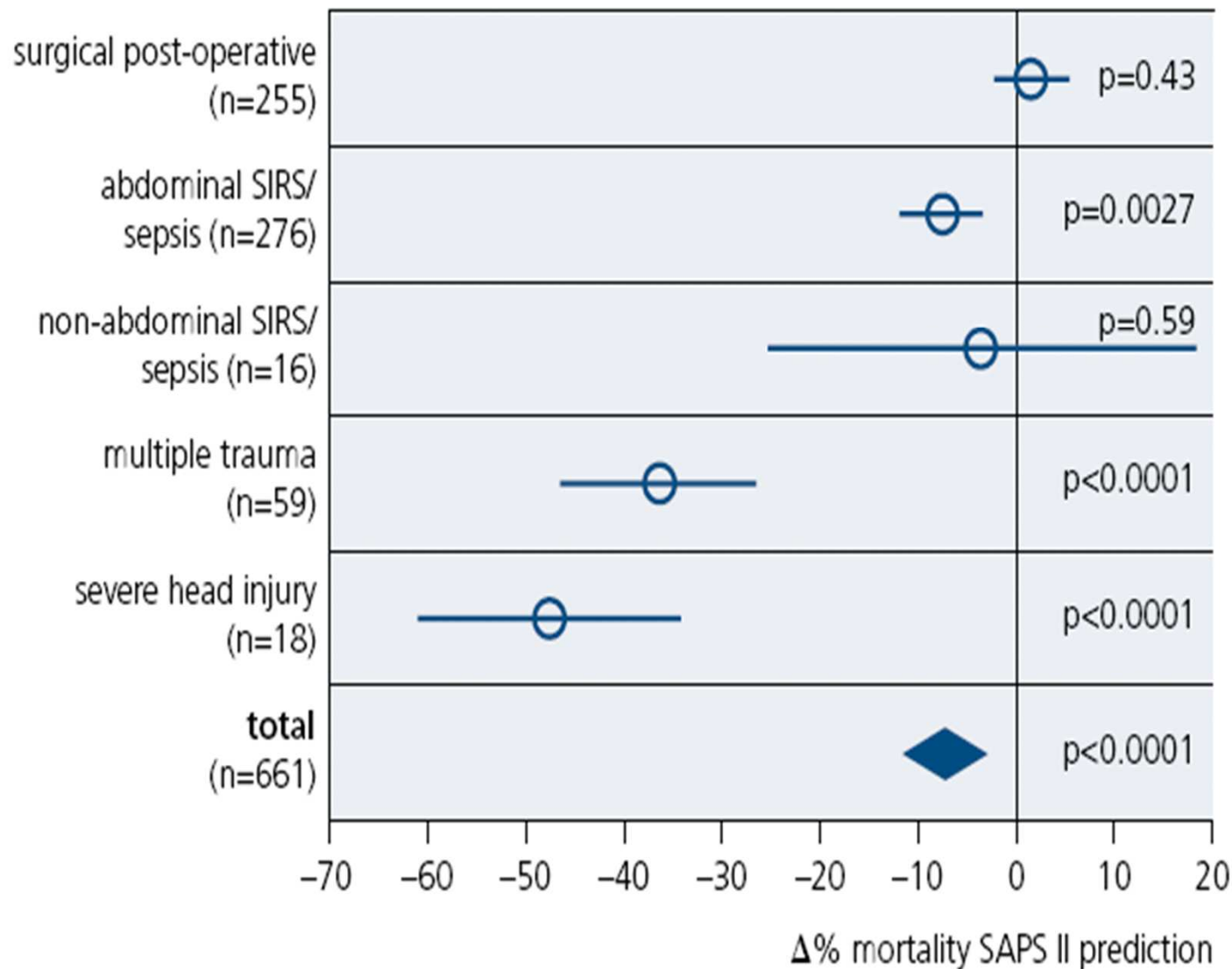


## Survival according to fish oil dose





# Survival vs. Predicted survival



**FAVOURS FISH OIL**

# **$\omega$ -3 Fatty Acids–Supplemented Parenteral Nutrition Decreases Hyperinflammatory Response and Attenuates Systemic Disease Sequelae in Severe Acute Pancreatitis: A Randomized and Controlled Study**

Xinying Wang, MD; Weiqin Li, MD; Ning Li, MD; and Jieshou Li, MD

Journal of Parenteral and

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- **Severe acute pancreatitis**
- **Soybean oil vs. Soybean oil/fish oil**
- **5 days**
- **Better gas exchange and less requirement for continuous renal replacement therapy**

Table 4. Effects of Treatment on Primary Outcome<sup>a</sup>

	Control Group	$\omega$ -3 Fatty Acids Group
SIRS ratio	9/20	4/20
ARDS ratio	5/20	4/20
Infectious complication, n	5/20	3/20
Renal dysfunction, n	2/20	1/20
CRRT days	26 $\pm$ 3.4	18 $\pm$ 2.3 <sup>b</sup>
ICU days	27.5 $\pm$ 5.6	21.4 $\pm$ 4.2
Length of hospital stay, d	70.5 $\pm$ 9.1	65.2 $\pm$ 7.3

**RESEARCH**

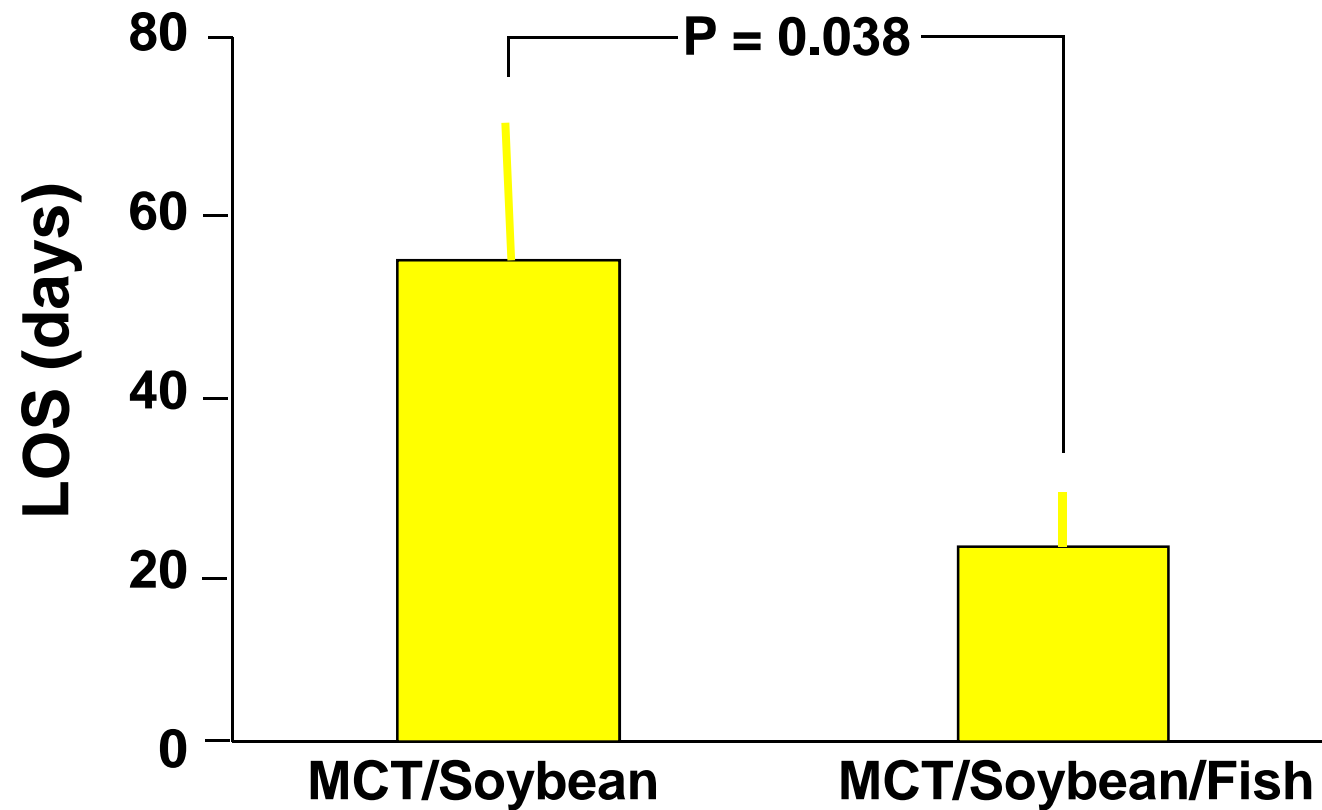
**Open Access**

# Effects of a fish oil containing lipid emulsion on plasma phospholipid fatty acids, inflammatory markers, and clinical outcomes in septic patients: a randomized, controlled clinical trial

Vera M Barbosa<sup>1,2</sup>, Elizabeth A Miles<sup>1</sup>, Conceição Calhau<sup>3</sup>, Estevão Lafuente<sup>2</sup> and Philip C Calder<sup>\*1</sup>

- **Septic ICU patients**
- **Continuous TPN**
- **Soybean oil/MCT (50:50) vs. Soybean oil/MCT/fish oil (50:40:10)**
- **5 days (Within 24 h of admission to ICU until day 6)**
- **Better gas exchange at d6 in patients receiving fish oil**
- **Less inflammation at d6 in patients receiving fish oil**

## Length of hospital stay shorter in patients receiving fish oil



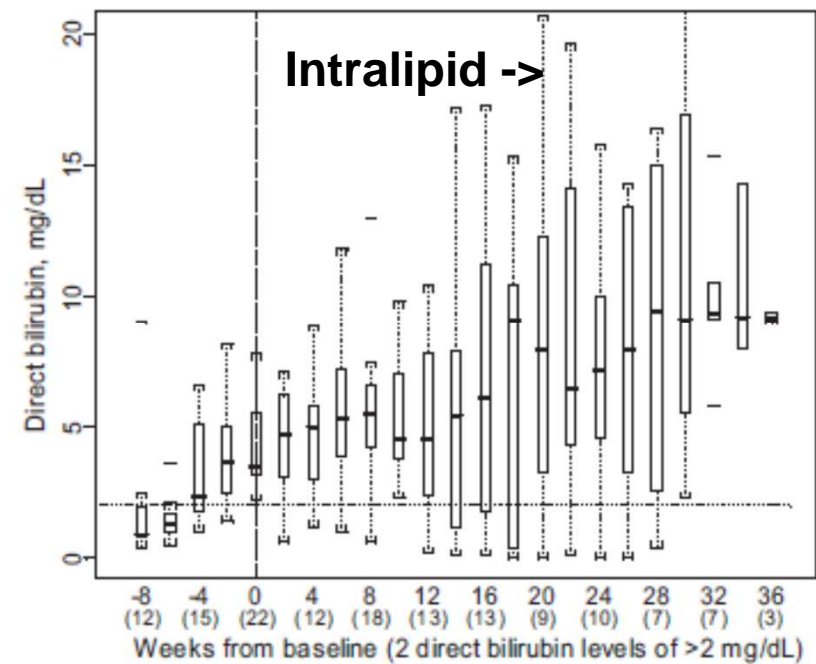
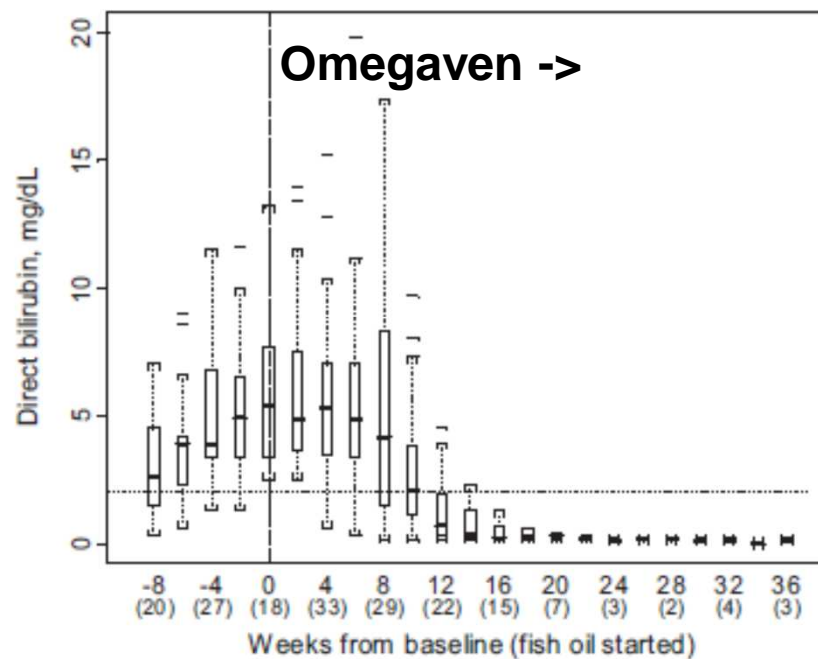
# **Liver failure**

# Safety and Efficacy of a Fish-Oil-Based Fat Emulsion in the Treatment of Parenteral Nutrition–Associated Liver Disease

Kathleen M. Gura, PharmD<sup>a,b</sup>, Sang Lee, MD<sup>c</sup>, Clarissa Valim, MD, ScD<sup>b,c,d</sup>, Jing Zhou, MS<sup>d</sup>, Sendia Kim, MD<sup>c</sup>, Biren P. Modi, MD<sup>c</sup>, Danielle A. Arsenault, BS<sup>c</sup>, Robbert A. M. Strijbosch, BS<sup>c</sup>, Suzanne Lopes, RN<sup>e</sup>, Christopher Duggan, MD, MPH<sup>b</sup>, Mark Puder, MD, PhD<sup>c</sup>

*Pediatrics* 2008;121:e678-e686

Infants with short bowel receiving PN

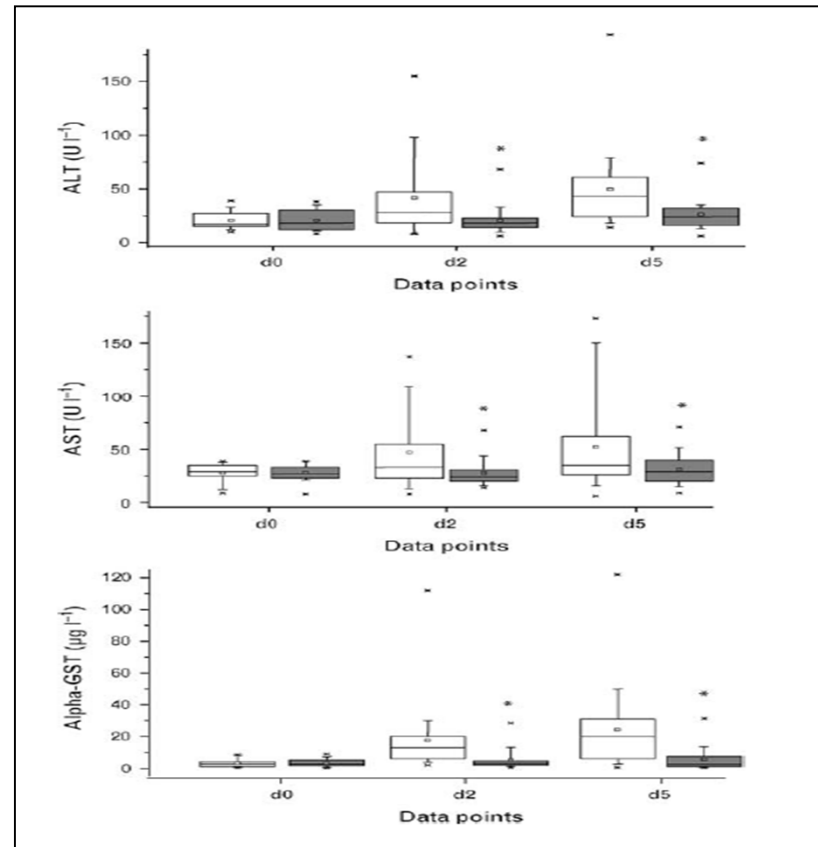


# Hepatocellular integrity after parenteral nutrition: comparison of a fish-oil-containing lipid emulsion with an olive-soybean oil-based lipid emulsion

Swen N. Piper<sup>a</sup>, Ingo Schade<sup>b</sup>, Ralf B. Beschmann<sup>a</sup>, Wolfgang H. Maleck<sup>c</sup>, Joachim Boldt<sup>b</sup> and Kerstin D. Röhm<sup>b</sup>

European Journal of Anaesthesiology 2009, 26:1076–1082

- Post-operative patients in ICU
- Soybean/olive oil vs. soybean/MCT/olive/fish oil
- 5 days
- Open boxes: Soybean/olive
- Grey boxes: Fish oil
- Liver function better preserved in the group receiving fish oil



# ESPEN PN Guidelines 2009

**Surgery:** At present there is some evidence that inclusion of  $\omega$ -3 fatty acids in PN may benefit organ function and reduce length of stay in patients undergoing major surgery or admitted to the surgical ICU.

The optimal PN regimen for critically ill surgical patients should probably include supplemental  $\omega$ -3 fatty acids (Grade C).

**Braga et al. (2009) Clin. Nutr. 28, 378-386**

**Intensive care:** Addition of EPA and DHA to lipid emulsions has demonstrable effects on cell membranes and inflammatory processes (Grade B). Fish-oil enriched lipid emulsions probably decrease length of stay in critically ill patients (Grade B).

**Singer et al. (2009) Clin. Nutr. 28, 387-400**