

Comparison of soybean oil-based versus olive oil-based lipid emulsions in patients requiring parenteral nutrition

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SUMMARY

Purpose: Malnutrition has a great importance and frequently encountered in hospitalized patients. Herein, the effects of olive oil-based and soybean oil-based fat emulsions on improvement of malnutrition status were compared together with evaluation of biochemical parameters and hospital stay and mortality in hospitalized patients receiving parenteral nutrition (PN).

Material and Methods: This retrospective study enrolled adult patients who were hospitalized longer than 24 hours, and considered as malnourished and supplied with parenteral nutrition were included in the study. Nutritional supplementation was applied by his/her clinician and they were followed up by hospital nutrition team without interfering the nutrition supplementation.

Results: A total of 605 patients received soybean oil-based (n=408) and olive oil-based (n=197) lipid emulsions. The length of hospital stay was significantly longer in the soybean based oil-PN group than that of olive oil-based PN group (14.2±10.7 and 11.5±8.2 days, respectively; p<0.01). The mortality rates for soybean based oil-PN and olive oil-based PN group were 21.8 % and 22.8 %, respectively. The percent change in NRS-2002 score and body mass index were not different significantly. The percent change in albumin level was 7.0 % and 6.7 %, respectively without significant difference between groups. The percent change in prealbumin level in the soybean oil PN group were 3.4 % and was 15.2 % in olive oil PN group without significant difference.

Conclusion: We found similar results between two groups in terms of serum albumin and prealbumin levels and mortality rates. Olive oil-based PN was associated with shorter duration of hospital stay than soybean oil-based PN.

Key words: Malnutrition, prealbumin, albumin, olive oil-based fat emulsion, soybean oil-based fat emulsion

ÖZET

Parenteral nütrisyona gerektiği hastalarda soya yağı bazlı ile zeytinyağı bazlı lipid emülsiyonları karşılaştırılması

Amaç: Malnütrisyona hastanede yatmakta olan hastalarda önemli olup, sıklıkla karşılaşılmaktadır. Parenteral nütrisyona (PN) almakta olan hastanede yatan hastalarda biyokimyasal parametreler, hastanede kalış süresi ve mortalite değerlendirilerek malnütrisyona düzeltilmesinde zeytinyağı bazlı ve soya yağı bazlı yağ emülsiyonlarının etkileri karşılaştırıldı.

Gereç ve Yöntem: Retrospektif olan bu çalışmada 24 saatten fazla yatışı olan ve malnütrisyona olduğu belirlenen, parenteral nütrisyona alan erişkin hastalar çalışmaya dâhil edildi. Nütrisyona desteği hastanın hekimi tarafından uygulanmış olup, nütrisyona takibi nütrisyona desteğine müdahale etmeden hastane beslenme ekibi tarafından yapıldı.

Bulgular: Toplam 605 hastaya soya yağı bazlı (n=408) ve zeytinyağı bazlı (n=197) lipid emülsiyonu uygulandı. Hastanede kalış süresi zeytinyağı bazlı PN grubuna göre soya bazlı yağlı PN grubunda anlamlı olarak daha uzundu (sırasıyla 14.2±10.7 ve 11.5±8.2 gün, p<0.01). Mortalite oranları soya yağı bazlı PN ve zeytinyağı bazlı PN grubunda sırasıyla % 21.8 ve % 22.8 idi. NRS-2002 skoru ve vücut kitle indeksi yüzde değişimi anlamlı olarak farklı değildi. Albümin düzeyi yüzde değişiminde gruplar arasında anlamlı bir fark olmamakla birlikte, sırasıyla % 7.0 ve % 6.7 idi. Prealbumin düzeyindeki yüzde değişim anlamlı fark olmaksızın soya yağı bazlı PN grubunda % 3.4 ve zeytinyağı bazlı PN grubunda % 15.2 idi.

Sonuç: İki grup arasında serum albümin ve prealbumin düzeyleri ve mortalite açısından benzer sonuçlar bulundu. Hastanede kalış süresi zeytinyağı bazlı PN grubunda soya yağı bazlı PN'dekinden daha kısa idi.

Anahtar kelimeler: Malnütrisyona, prealbumin, albümin, zeytinyağı bazlı yağ emülsiyonu soya yağı bazlı yağ emülsiyonu

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Malnutrition is an important factor which impairs immune system, increases frequency of infections leading to increased hospital mortality and hospital stay with resultant high costs ^(1,2). In the management of malnutrition, parenteral nutrition (PN) is used in indicated cases, however use of inappropriate products and methods leads to hepatic steatosis, hyperglycemia and increase in the rate of infections ⁽³⁻⁶⁾ with resultant increases in mortality and morbidity rates. Soybean oil-based products are widely used by TPN route in patients with malnutrition and recently olive oil-based emulsions have been introduced. Investigations of these parenteral products continue intensively to decrease complications and increase the efficacy of PN.

Evaluation of studies comparing olive oil-based and soybean oil-based fat emulsions revealed that some studies reported differences while some have noted no difference between them.

Herein, we have compared the effects of olive oil-based and soybean oil-based fat emulsions on improvement of malnutrition status by evaluating the biochemical parameters and duration of hospital stay and mortality in hospitalized patients receiving parenteral nutrition.

MATERIALS and METHODS

This retrospective study enrolled adult patients who were hospitalized between April 2012-December 2012 (9 months, and considered as malnourished according to Nutritional Risk Screening-2002 (NRS-2002) scoring system. The study has been conducted in accordance with the Declaration of Helsinki and Good Clinical Practice Principles after approval of Institutional Ethics Committee.

Patients and Nutrition Assessment

All patients' nutritional status were evaluated and patients with NRS-2002 score ≥ 3 , and hospitalized longer than 24 hours and supplied with parenteral nutrition were included in the study. Nutritional

supplementation was applied in accordance with ESPEN (European Society for Parenteral and Enteral Nutrition) guidelines by the attending clinician of the patients, and the patients were followed up by hospital nutrition team without interfering the nutrition supplementation. Nutrition support team interfered if nutrition supplementation is insufficient or used inappropriately or if there is a request for consultation. Patients who did not receive nutrition supplementation according to guidelines were excluded.

Nutritional Support

According Nutritional Risk Screening (NRS-2002) scoring system, the nutritional care plan is indicated in following cases; patients who are severely undernourished (score=3), or severely ill (score=3) or moderately undernourished and mildly ill (score 2+1), or mildly undernourished + moderately ill (score 1+2).

Two commercial all-in-one parenteral nutrition admixtures were examined in the study: a soybean oil-based emulsion (Kabiven[®], Fresenius) and olive oil-based emulsion (OliClinomel[®], Baxter). The soybean oil-based product comprises 100 % soybean oil, glucose, phospholipids and amino acids. The olive-oil based product comprises 80 % olive oil and 20 % soybean oil and phospholipids.

We compared the biochemical and physiological parameters of patients receiving olive oil or soybean oil-based fat emulsions.

Biochemical Examination

Serum samples were analyzed for albumin and pre-albumin using an autoanalyzer (Aeroset, Abbott Architect, Germany) by immunoturbidimetric methods. Also body mass indices (BMI) of the patients were calculated at admission. Laboratory analytes and BMIs were measured at weekly intervals.

Table 1. Clinical characteristics of study patients treated with soybean oil- and olive oil-based parenteral nutrition infusion.

	All	Soybean Oil PN	Olive Oil PN	P value
No of patients	605	408	197	
Age, yrs	67.5±17.4	68.8±16.8	64.9±18.4	0.013*
Gender, male/female	309/296	213/195	96/101	0.42 ^a
Body mass index, kg/m ²		24.5±4.6	25.3±5.3	0.058
Weight, kg		66.3±14.9	68.4±16.6	0.12
Hospital length of stay, days	13.3±10.0	14.2±10.7 (median: 11.0)	11.5±8.2 (median: 9.0)	0.004**
Mortality	134 (22.1%)	89 (21.8%)	45 (22.8%)	0.77 ^a
Serum albumin on admission, g/dL		2.4±0.7	2.2±0.6	0.001**
Serum albumin after PN, g/dL		2.3±0.6	2.2±0.6	0.66
Serum prealbumin on admission, mg/dL		11.6±5.8 (median: 10.4)	11.4±6.7 (median: 9.5)	0.35
Serum albumin after PN, mg/dL		12.1±5.7 (median: 11.4)	11.8±6.4 (median: 9.5)	0.43

PN: parenteral nutrition; Values are mean ± SD.

^aPearson Chi-square Test

* $p < 0.05$

** $p < 0.01$

Table 2. Percent change in BMI, weight, NRS-2002 score, serum albumin and prealbumin levels in study groups.

	Soybean Oil PN	Olive Oil PN	P value
Body mass index	-7.85 / 13.52 (median: 0)	-22.84 / 39.34 (median: 0)	0.168
Weight	-8.33 / 13.51 (median: 0)	-6.00 / 64.00 (median: 0)	0.153
NRS-2002 score	-60.00 / 66.67 (median: -20.0)	-66.67 / 66.67 (median: -25.0)	0.084
Serum albumin	-84.62 / 140.00 (median: -7.0)	-55.88 / 121.43 (median: -6.7)	0.364
Serum prealbumin	-59.13 / 415.67 (median: 3.4)	-73.59 / 371.1 (median: 15.2)	0.211

Percent change values are minimum/maximum

Nutrition Support Unit

Nutrition Support Team is a multidisciplinary team in our hospital including 4 specialist physicians (anesthesiologist, general surgeon, internist, and pharmacologist), 1 pharmacist, 2 dietitians, and 2 nurses.

Statistical Analysis

Statistical analysis was performed using NCSS (Number Cruncher Statistical System) 2007 & PASS (Power Analysis and Sample Size) 2008 Statistical Software (Utah, USA). Results were considered statistically significant if p value was less than 0.05. Comparisons between two groups were assessed by means of Student t test for normally distributed variables and Mann-Whitney U test for non-normally distributed continuous variables.

We used Spearman's correlation analysis for non-parametric variables. Pearson chi-square Test was used to assess gender differences and comparative mortality rates among groups.

RESULTS

Total of 605 patients received soybean oil-based (n=408) and olive oil-based (n=197) lipid emulsions. The groups were well-matched for gender, body mass index, and body weight (Table 1). The majority of patients were male (51.1 %) and the mean age of entire population were 67.5±17.4 years (range:18-75).

The length of the hospital stay was significantly longer in soybean based oil-PN group than that of the olive oil-based PN group (14.2±10.7 and 11.5±8.2 days, respectively; $p < 0.01$). The mortality rates for soybean based oil-PN and olive oil-based PN groups were 21.8 % and 22.8 %, respectively, without any difference between treatment groups.

The percent change in NRS-2002 score was 20.0 % in soybean oil PN group and 25.0 % in olive oil PN group without statistically significant intergroup difference. In addition, there were no differences in percent change in body mass index and weight in either group (Table 2).

The mean albumin levels at admission were 2.4±0.7

g/dl in soybean oil PN group and 2.2 ± 0.6 g/dl in olive oil PN group, with a statistically significant difference between groups. However percent change in albumin level was 7.0 % and 6.7 %, respectively without any significant intergroup difference.

There was no difference between nutritional groups as for admission prealbumin levels. The percent change in prealbumin levels in the soybean oil, and olive oil PN groups were 3.4 % and 15.2 %, respectively without any statistically significant difference between groups.

DISCUSSION

In the treatment of malnutrition, enteral nutritional therapy is the first choice, however in cases where enteral nutrition is contraindicated or it is inadequate for patients' nutritional status, indications for parenteral nutrition occur ⁽⁷⁾.

Parenteral nutrition is required to provide metabolic support, and maintain nutritional status of patients. The olive oil-based and soybean oil-based fat emulsions are frequently used for essential fatty acid supply in patients with malnutrition. While these products were being used separately, in recent years they have begun to be used as mixed in specific proportions, however there is still debate about how the combination of the products should be ⁽⁸⁾.

In this study the results were similar except for length of hospital stay between two groups. We found that olive oil based emulsions had similar BMI, NRS-2002 score and biochemical results when compared with soybean oil-based emulsions and also mortality rates were not different.

In our study, the difference between two groups regarding body weight and BMI were not statistically significant, which supports the results of Onar P et al. ⁽⁹⁾ and Beaufriere B ⁽¹⁰⁾, where the effects of olive oil and soy oil on weight loss were evaluated in hypercatabolic patients. Also in the study of Umpierrez GE et al. ⁽¹¹⁾, there was no significant

difference in BMI of patients of both groups in a randomized trial. BMIs of patients were 27 ± 6 kg/m² and 27 ± 8 kg/m² in patients receiving soybean oil-based parenteral nutrition, and olive oil-based lipid emulsion nutrition ⁽¹¹⁾.

Hypoalbuminemia is one of the markers of prolonged malnutrition ^(12,13). Thus albumin was found to be decreased in both groups in our study, being lower in the olive oil-based group. However hypoalbuminemia persisted in patients after supplementation with both emulsions. In the study of Onar P ⁽⁹⁾, in olive oil-based group, total protein and albumin levels were increased after treatment but in soybean oil-based group, they did not change. In another study where olive oil-based group and soybean oil-based group were compared in critically ill patients, patients were hypoalbuminemic after treatment without any difference between two groups ⁽¹⁴⁾.

Serum prealbumin level was considered to be cost-effective and objective benchmark for the assessment of disease severity in critically ill patients ^(15,16). Prealbumin was shown to be used for the assessment of protein calorie malnutrition in surgical patients together with transferrin, arm muscle circumference, percentage weight loss, and hemoglobin ⁽¹⁷⁾. Low prealbumin concentration was regarded as a signal identifying the patient who requires assessment and monitorization and nutritional support ⁽¹⁸⁾. In our recent study, we found that higher prealbumin levels were associated with less mortality risk ⁽¹⁹⁾.

In our study, change in prealbumin levels after treatment was not different between groups. However, in a study where the effects of soybean oil-versus olive oil-based lipid emulsions on hepatobiliary function were compared, weight gain as well as the increase in prealbumin levels after parenteral nutrition supplementation was found to be significantly higher in the olive oil group compared with the soybean oil group and the intergroup change for prealbumin was higher for the olive oil group ⁽²⁰⁾.

In addition, increase in prealbumin levels was not

evident within each group in our study. Also in the study of Lim SH et al ⁽²¹⁾, the authors demonstrated that serum prealbumin level did not respond sensitively to nutritional support in critically ill patients ⁽²¹⁾.

Malnutrition is common in critically ill patients and it is associated with increased complications, mortality, length of hospital stay, and costs ^(1,22,23). Although parenteral nutrition improves nutritional status, it has been shown to be associated with metabolic and infectious complications and also mortality in intensive care unit patients ^(5,6).

The inpatient mortality during parenteral nutrition was 22.1 %, without any difference between patients who received soybean oil-based (21.8 %) or olive oil-based PN (22.8 %). Similarly, in the study of Umpierrez GE et al ⁽¹¹⁾, intensive care unit patients treated with soybean oil-based or olive oil-based parenteral nutrition, had similar mortality rates (16.3 % and 9.8 %, respectively).

The length of hospital stay was 13.3±10.0 days in our study, and it was significantly longer with soybean oil-based PN group (14.2±10.7 days) than olive oil-based group (11.5±8.2 days). However, length of stay (47±47 days and 41±36 days, respectively) was not different between groups of soybean oil-based and olive oil-based parenteral nutrition groups in the study of Umpierrez GE et al. ⁽¹¹⁾. Also other studies have reported no differences with regard to mortality, complications and length of ICU, hospital stay between soybean oil-based vs. olive-oil based lipid emulsion in PN ⁽²⁴⁾.

Here, we evaluated the effects of soybean oil-based PN and olive oil-based PN on various parameters in patients with malnutrition and found similar results between two groups in terms of serum albumin and prealbumin levels and mortality rates. Olive oil-based PN was associated with shorter duration of hospital stay than soybean oil-based PN.

In conclusion, further studies including immunolo-

gic variables and biochemical parameters such as glycemic control, inflammatory and oxidative stress markers are needed to show potential advantages of different fat emulsions.

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