

## Case Study

# Effects of different parenteral nutrition infusions in a patient with short bowel syndrome

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In this case study, we demonstrate the effects of different lipid emulsions on liver function in a 52-year-old woman with short bowel syndrome who was totally dependent on parenteral nutrition. Over a 13-month period after small bowel resection and jejunostomy, we followed the patient's plasma triglycerides and liver enzyme levels as well as body weight and discomfort levels. During the first 3 months when parenteral nutrition including a lipid emulsion containing 50% soybean oil/50% medium-chain triglycerides was administered daily, the patient reported feeling unwell (experiencing dizziness and palpitations) and her triglycerides and liver enzyme levels rose to 366 mg/dL and 145 U/L (alanine aminotransferase [ALT]), respectively; these levels recovered when this emulsion was discontinued. For the following 9 months, an emulsion containing 80% olive oil and 20% soybean oil was administered, and the patient's triglycerides (182 mg/dL) did not increase to abnormal levels and liver enzyme levels were only mildly elevated (109 U/L). The patient felt well and her body weight increased from 51 kg to 55 kg during this period. These results suggest that parenteral nutrition with a reduced soybean oil content may better preserve liver function in patients with short bowel syndrome.

**Key Words:** lipid emulsion, parenteral nutrition, short bowel syndrome, abnormal liver function, hypertriglyceridemia

## INTRODUCTION

Short bowel syndrome (SBS) is characterized by a compromised bowel absorptive capacity that is associated with a severely reduced mucosal surface area. SBS often follows extensive surgical resection when the residual bowel function is not sufficient for adequate nutritional supply.<sup>1,2</sup> Although most nutrients are absorbed within the proximal 100-150 cm of jejunum, intestinal transit time is very rapid so there is limited nutrient-epithelial contact time.<sup>3</sup> As a result, patients experience diarrhea, fluid and electrolyte imbalance, and malnutrition,<sup>4,5</sup> and are dependent on parenteral nutrition (PN) and/or intravenous fluids (IV).<sup>6</sup>

Management of such cases is complex and challenging, in particular for those with a proximal jejunostomy as they may actually secrete more fluid than they ingest.<sup>7</sup> Most adults with SBS have <200 cm of residual small bowel, with or without the colon, but absorption is dependent upon the overall surface area and function as well as length of the intestine.<sup>3</sup> Moreover, different sections of the intestine are responsible for the distinct absorption of macronutrients, micronutrients (vitamins and minerals), and fluids.<sup>8</sup> Hence, the degree of malabsorption is also dependent on the location of the resection and the degree of postsurgical intestinal adaptation.<sup>9,10</sup> For example, absorption of vitamin B<sub>12</sub> and bile cannot occur if the ileum is resected regardless of adaptation of the residual bowel.<sup>2</sup> The patients at greatest risk for dehydration and malnutrition are those with an end-jejunostomy and <115 cm, jejunocolostomy and <60 cm (absent ileocecal valve), or jejunoleal anastomosis and <35 cm of residual small in-

testine (presence of ileocecal valve and colon).<sup>11</sup> Patients with colon in continuity have enhanced energy and fluid absorption and can therefore tolerate greater loss of small intestine.<sup>12</sup> The overall treatment goal is intestinal rehabilitation, a process in which the digestive and absorptive capacity of the remnant gastrointestinal (GI) tract is maximized so that the uptake of fluid, electrolytes, and nutrients is enhanced.<sup>2</sup> When successful, the patient will receive adequate nutrition during the period of intestinal adaptation after resection, and this may result in a reduced need for PN/IV therapy.

We describe here a case in which a patient with SBS experienced elevated plasma triglycerides and liver enzyme levels and significant general discomfort including dizziness and palpitations while being administered a standardized dextrose/amino acids PN formula plus an emulsion containing soybean oil (50%) and medium/long-chain triglycerides (50%). Liver function and other symptoms improved upon cessation of the lipid emulsion and replacement with a different emulsion containing olive oil (80%) and soybean oil (20%).

## CASE REPORT

A 52-year-old female patient presented with SBS with

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total PN (TPN) dependence. She had a past medical history of colon cancer stage 2 status post right hemicolectomy 9 years previously. Frequent ileus was noted thereafter, for which she underwent a near total small bowel resection from the jejunum (50 cm from the Treitz ligament) to the ileum (including the terminal ileum) and a jejunostomy, which were performed at another hospital 1 year earlier. She visited our clinic in February 2013 and was admitted to our hospital for assessment for small bowel transplantation. Her residual small bowel length was about 50 cm with no ileocecal valve and she was placed on the waiting list for small bowel transplantation. The patient experienced one episode of catheter-related infection and port-A removal and replacement by a Hickman's catheter at our hospital.

Initially, she was given a standardized PN formula (15.3% dextrose and 0.5% amino acids) at a rate of 100 mL/hour for 12 hours, and daily also received 250 mL of Lipofundin® MCT/LCT (20%) emulsion, which contains 25 g soybean oil and 25 g medium-chain triglycerides. Plasma triglycerides and liver enzyme levels were elevated to 366 mg/dL and 145 U/L (ALT), respectively. We decreased the infusion frequency of Lipofundin® MCT/LCT from daily to weekly after 1 week but the plasma triglycerides remained elevated, and she complained of persistent palpitations and dizziness. Therefore, Lipofundin® MCT/LCT was discontinued and her plasma triglycerides level gradually decreased. Subsequently, Oliclinomel N7-1000E®, containing a lipid emulsion (20%) composed of refined olive oil (80%) and soybean oil (20%), was commenced at a rate of 120 mL/hour for 12 hours as the nutrient was available at our hospital. Under this regimen, the patient's plasma triglycerides did not increase to abnormal levels and liver enzymes were only mildly elevated. Moreover, she did not complain of any discomfort such as dizziness or palpitations after infusion.

We have regularly monitored the patient's general condition, plasma triglycerides and liver enzyme levels (AST and ALT), and body weight (BW) (see Table 1). The patient has continued on Oliclinomel N7-1000E which, at the time of this case report, has been given for 9 months. Her body weight has increased from 50 kg to 55 kg since she has been followed at our hospital. Upon initiation of Oliclinomel, her liver enzyme levels did not abruptly increase and her plasma triglycerides have since remained within normal limits. No dizziness or palpitations have been reported.

## DISCUSSION

Long-term PN is often associated with complications, and

liver disease is widely recognized as the most serious of these. Newborn infants with SBS are particularly susceptible to developing intestinal failure-associated liver disease, ranging from cholestasis steatosis, cirrhosis, and end-stage liver failure,<sup>13</sup> with a prevalence rate of 85% after receiving PN for more than 100 days.<sup>14</sup> The case fatality rate of 40%-50% seen in such patients is caused mainly by liver failure or sepsis.<sup>15,16</sup> In another report, 57% of children who had received TPN for longer than 2 years had biochemical liver abnormalities, with risk factors of younger age at TPN commencement, longer duration of TPN, higher rate of catheter-related infections, and higher volume and energy content of TPN.<sup>17</sup> Furthermore, 94% of patients in this population had liver fibrosis on liver biopsies, and the fibrosis was associated with a shorter length of bowel and a longer duration of TPN. In a recent case study of an adult patient with high output enterocutaneous fistulae, PN was the major source of nutrition support with a total of 229 days of PN during the hospital stay.<sup>18</sup> The patient suffered cholestasis and steatosis 3 months after PN was initiated. Her liver function tests (LFT) and gamma-glutamyltransferase (GGT) and triglyceride (TG) levels remained high while the patient was on PN but the LFT and GGT levels returned to normal when PN was stopped due to line sepsis, and LFT, GGT, TG and total bilirubin levels became elevated again when PN was restarted.

It has been suggested that a major contributing factor towards liver complications in patients with SBS may be the soybean oil-based lipid emulsions historically used in PN, which contain predominantly long-chain triglycerides. A recent review has summarized the evidence for the link between liver disease associated with intestinal failure and factors such as the duration and lipid content (long-chain  $\omega$ -6 >1 g/kg·day) of PN.<sup>4</sup> Improvements in cholestasis have been associated with a reduction or discontinuation of soybean oil-based lipid emulsion and the use of medium-chain triglycerides and  $\alpha$ -tocopherol. Combinations of oils may provide optimal nutrition while minimizing hepatic toxicity. Indeed, newer lipid preparations containing  $\omega$ -3 and  $\omega$ -6/9 lipids have shown promise as a means of decreasing the incidence of liver complications.<sup>13,19</sup>

Our case report describes an adult patient who was totally dependent on PN after undergoing a near total small bowel resection (residual length ~50 cm with no ileocecal valve) followed by a jejunostomy. When a lipid emulsion containing 50% soybean oil and 50% medium-chain triglycerides was commenced, the rise in LFTs and triglyceride levels we observed is consistent with results

**Table 1.** Clinical parameters during different PN regimens

Clinical parameter	Parenteral nutrition regimens		
	15.3% dextrose + 0.5% amino acids + Lipofundin® MCT/LCT (20%) (administered from Feb 2013 for 3 months)	15.3% dextrose + 0.5% amino acids, (administered from May 2013 for 1 month)	Oliclinomel N7-1000E®, (administered from June 2013 for 9 months)
AST (U/L)	149	81	81
ALT (U/L)	145	125	109
Triglycerides (mg/dL)	366	218	182
BW (kg)	50	51	55
Discomfort	Dizzy, palpitations	A little unwell	None

observed by others in terms of the deleterious effects on the liver produced in SBS patients by PN based on emulsions of soybean oil. Recovery of these levels upon cessation of soybean oil emulsion has also been observed by others and seems to indicate the patient's malabsorption-associated liver disease is reversible initially. Since the 80% olive oil/20% soybean oil emulsion was introduced 9 months ago, our patient's LFTs/triglycerides have not risen to abnormal levels, and she has experienced no discomfort, so it might be that PN with reduced soybean oil content is better in SBS patients.

#### AUTHOR DISCLOSURES

The authors declare no financial or commercial conflict of interest.

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## 不同肠外营养输液对一位短肠综合症病患的影响

本篇报告一位 52 岁因罹患短肠综合症需完全依赖静脉营养治疗的女性，因接受不同成分比例的脂肪制剂导致肝功能不同的变化。在小肠切除与空肠造口后十三个月期间，我们追踪病患的血中甘油三酯、肝脏酶水平、体重与临床症状。患者于小肠切除后前三个月初期使用的全静脉脂肪乳剂成分比例为 50% 大豆油及 50% 中链脂肪酸，病人表示有心悸及头晕的感觉，病人有肝功能异常及高甘油三酯血症，血清升至 336 mg/dL，谷丙氨酸转氨酶(GPT)为 145 U/L。在中止脂肪乳剂后，这些参数均得到改善。尔后九个月，我们将全静脉营养脂肪乳剂比例改为 20% 大豆油及 80% 橄榄油，病人表示无心悸及头晕的感觉，血清甘油三酯降为 182 mg/dL，谷丙转氨酶 (GPT) 为 109 U/L，体重由 51 公斤增至 55 公斤。本研究结果表明降低全静脉营养中脂肪乳剂里大豆油的比例，对病人的肝功能有好的影响。

**关键词：**脂肪乳剂、静脉营养、短肠症、肝功能异常、高三酸甘油血症