Learning from errors

Essential fatty acid deficiency while a patient receiving fat regimen total parenteral nutrition

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A 32-year-old man was diagnosed with lymphoma and underwent Billroth's II operation because of upper gastrointestinal haemorrhage. Although the patient received fat regimen total parenteral nutrition (TPN), the patient developed typical skin rash of essential fatty acid deficiency after 2 weeks of starting TPN. The diagnosis was confirmed by biochemical and histological analyses. After increasing the lipid infusion, the rash was gradually improved with complete resolution after 19 days.

BACKGROUND

The two essential fatty acids required for human health are linolenic acid (C18:3W3) and linoleic acid (C18:2W6).¹ Clinical manifestation of essential fatty acid deficiency (EFAD) has been frequently described due to deficiency of linoleic acid. Clinical signs of EFAD were found to appear in a few weeks and characterised by xerosis, scaly, diffuse erythema, intertriginous erosions, capillary fragility, brittle nails, alopecia, abnormal pigmentation and poor wound healing. Previous reports of EFAD revealed that patients had scaly dermatitis over anterolateral thighs, posterolateral upper arms, shoulders, abdomen, back, buttocks, face and posterior aspect of neck.²

In this report, we describe a patient who had biochemical and histological evidence of EFAD and developed skin rashes consistent with EFAD 2 weeks after initiating total parenteral nutrition (TPN).

CASE PRESENTATION

A 32-year-old man presented with history of anorexia, weight loss of 30 kg. in 3 months, from 104 to 74 kg., multiple subcutaneous nodules with ulceration on both legs along with persistent fever for 1 month. He was diagnosed as having subcutaneous T-cell lymphoma with cytophagocytic panniculitis from skin biopsy. After received chemotherapy (CHOP regimen; cyclophosphamide, vincristine, doxorubicin and prednisolone) for 4 days, the patient developed upper gastrointestinal haemorrhage and underwent Billroth's II operation (distal gastrectomy), truncal vagotomy, wedge hepatectomy and splenectomy, which the histopathology results revealed as atypical cells. After surgery, the patient received TPN regimen consisted of: 340 g carbohydrate, 80 g protein and 50 g fat (20% structolipid 250 ml) per day, everyday. In addition, the patient received vitamin and trace element supplementation. The patient did not develop major electrolyte abnormalities or biochemical evidence of refeeding syndrome. On the third day after starting TPN, the patient's blood chemistry showed hypertriglyceridemia. Fat regimen was changed to 50 g of 20% structolipid three times (750 ml)

per week. After 2 weeks of TPN, the patient developed generalised xerosis, multiple well-defined dark brownish plate-like patches with dilated follicular opening and keratotic plug and multiple hypopigmented patches at both skins (figure 1).

INVESTIGATIONS

The skin biopsy showed multiple hyperkeratotic plugs in epidermal layers compatible with EFAD (figure 2).

Figure 1 Before adequate essential fatty acid therapy.

Figure 2 The skin biopsy revealed multiple hyperkeratotic plugs in epidermal layers.

Table 1 The recommendation of adequate linoleic acid in form of lipid emulsions for prevent essential fatty acid deficiency (EFAD) in critically ill patient and the amount of linoleic acid in lipid emulsions.

Lipid emulsion	Linoleic acid (% weight)	Linoleic acid (g per unit per day)	Recommendation (unit per week)
Liposyn (safflower oil)	77	38.5	1.63–2.18
Intralipid (soybean oil)	52	26	2.42–3.23
Structolipid (soya/coconut/palm kernel oil)	33	16.5	3.81–5.09
SMOF lipid (Soybean/MCT/olive/fish oil)	18.7	9.35	6.73–8.98
Clinoleic acid (olive/soybean oil)	18	9	7.00–9.30

MCT, medium-chain triglycerides.

The plasma analysis revealed low linoleic acid level (C18:2W6) 19.78% (normal 26–37%), oleic acid (C18:1W9) 24.85% (normal 14–23%) and triene/tetraene ratio (C20:3W9/C20:4W6) 0.29. The red blood cell fatty acid showed triene/tetraene ratio 0.13. The typical appearance of cutaneous manifestation, histological and biochemical profiles were compatible with EFAD.

TREATMENT

Fat regimen was re-changed to 50 g of 20% structolipid (250 ml) per day.

OUTCOME AND FOLLOW-UP

After increasing the lipid infusion, the rash was gradually improved with complete resolution after 19 days (figure 3).

DISCUSSION

Based on the typical skin rash, histological characteristic, abnormal fatty acid profile and resolution of clinical symptoms with increased lipid infusion, we believed that this patient had clinical picture of EFAD.

In 1971, Collins *et al.* reported a case with biochemical and clinical of EFAD in an adult patient maintained on fat-free TPN following extensive small bowel resections. After giving lipid infusion, dry scaly skin rash disappeared.³ The minimal requirement of linoleic acid in healthy adults is estimated to be 1–2 per cent of total calories.⁴ However, Jeejeebhoy *et al.* reported an adult patient who was unable to prevent development of EFAD with 50 g, and even 100 g of intralipid per week.⁵ Tanphaichitr *et al.* reported EFAD could occur in 1 week after fat-free TPN infusion, and intralipid (50 g fat) infusion three times per week can prevent EFAD.⁶ The patient developed EFAD in spite of structolipid infusion three times per week. Intralipid composes of linoleic acid, 52 per cent of total fatty acids, while structolipid has only 33 per cent. Clinical picture of EFAD has been most frequently described with a deficiency of linoleic acid. European Society for Clinical Nutrition and Metabolism guidelines recommended 9–12 g per day of daily linoleic acid requirement for critically ill patient.⁷ Therefore, 20% structolipid infusion 750 ml consisting of linoleic acid 49.5 g per week could not prevent EFAD. The recommendation of adequate linoleic acid in form of lipid emulsions to prevent EFAD in critically ill patient and the

Figure 3 After 19 days of adequate essential fatty acid therapy.

amount of linoleic acid in lipid emulsions are summarised in table 1.

Refeeding in chronically starvation state could have led to increased protein synthesis in the skin. Because of few adipose storage resulting from undernourished state, the skin manifestation of EFAD could develop. In addition, a constant infusion of glucose could result in increased insulin levels, which would prevent mobilisation of linoleic acid from the limited adipose storages that the patient in this report did possess.⁸

The plasma triene/tetraene ratio was 0.29 and red blood cell triene/tetraene ratio was 0.13 (normal level is below 0.2). The results confirmed the acute episode of EFAD in this patient. The patient's skin biopsy showed multiple hyperkeratotic plugs in epidermal layers. In animal model, cellular proliferation and differentiation of the epidermis are accelerated by EFAD. Histologically, the epidermis of patients with EFAD became noticeably thicker in as few as

10 days and reached a maximum thickness in all strata of the epidermis by 50 days.⁹

In conclusion, clinicians should be aware of EFAD even if we give fat regimen TPN in caring of severe malnourished patient or in patient with hypertriglyceridemia, it could be inadequate dose of linoleic acid and patients can develop clinical manifestation of EFAD. Supplementation of diet with linoleic acid is imperative. Based on this case, we recommend that severe malnourished patients should receive infusion of 20% structolipid of at least 1000–1500 ml consisting of linoleic acid 66–82.5 g per week.

Learning points

- ▶ Inadequate dose of linoleic acid could lead to EFAD even in severe malnourished patient patients who received fat regimen TPN or in patient with hypertriglyceridemia.
- ▶ Supplementation of diet with linoleic acid is imperative.
- ▶ Based on this case, severe malnourished patients should receive infusion of 20% structolipid of at least 1000–1500 ml consisting of linoleic acid 66–82.5 g per week.

Competing interests None.

Patient consent Obtained.

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Please cite this article as follows (you will need to access the article online to obtain the date of publication).

Roongpisuthipong W, Phanachet P, Roongpisuthipong C, Rajatanavin N. Essential fatty acid deficiency while a patient receiving fat regimen total parenteral nutrition. *BMJ Case Reports* 2012;10.1136/bcr.07.2011.4475, Published XXX

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