

Laboratory Monitoring of Adult Hospital Patients Receiving Parenteral Nutrition

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The following guideline is for use by medical staff caring for the patient and members of the Nutrition Support Team. It applies to adult hospital based patients receiving parenteral nutrition (TPN). A separate guideline is available for the laboratory monitoring of patients receiving parenteral nutrition at home.

Laboratory monitoring

The following should be checked at least twice per week on TPN and prior to commencing TPN –

UE, glucose, LFT, calcium, magnesium, phosphate

Every 2 weeks trace element status should be checked -
Copper, zinc, selenium, CRP together with FBC, triglyceride

Other investigations are carried out according to the clinical scenario.

The above laboratory investigations represent those required to monitor the administration of TPN only. It is the responsibility of the medical team looking after the patient to carry out other investigations required for other aspects of the patient's care.

Blood samples should be taken according to hospital protocol. If sampling from a central line then particular care must be exercised to ensure that blood sample is NOT contaminated and that proper aseptic technique is used when handling line.

Blood samples should be taken into the appropriate tubes for analysis.

Brown top tube (serum)

UE, glucose, LFT, calcium, magnesium, phosphate
CRP, Triglyceride
Copper, zinc, selenium
IGF-1

Red top tube (EDTA)

FBC

Vitamins (to lab asap)

If other analyses are required then the Nutrition Support Team should be contacted prior to blood sampling to discuss.

Potential metabolic problems & prevention

Hyperglycaemia

An elevated glucose will result in glycosuria (usually when the serum glucose > 11 mmol/L) and an osmotic diuresis. If this continues then hyperosmolar non ketotic coma may ensue. In addition the metabolism of glucose results in the production of carbon dioxide, increasing respiratory work, which may result in difficulty in patients with chest disease and in weaning ITU patients from a ventilator.

Acute illness resulting in relative glucose intolerance, steroids, and diabetes increase the risk of hyperglycaemia when infusing TPN.

To reduce the risk of hyperglycaemia the calories infused are kept below calculated requirements (NB 1.1 kcal/ml from lipid in propofol) and only increased if the patient tolerates the calories infused.

If hyperglycaemia (a serum glucose > 11 mmol/L) does occur then the glucose measurement should be repeated to ensure the high result was not due to a contaminated sample (a BM will help to confirm). If the result is still high then reduce the calories in TPN and start insulin (best administered by iv sliding scale).

Hypoglycaemia

This may occur with the sudden slowing of a glucose infusion following high infusion rates. A BM should be carried out in patients displaying symptoms of hypoglycaemia following stopping TPN.

Increasing LFT

A cholestatic picture may occur on longer term TPN and can progress to severe liver disease if not managed. There are many causes of deranged LFTs besides TPN so a check also needs to be made on the clinical condition and drugs.

Further investigations include -

Hepatitis serology
Autoimmune screen
Immunoglobulins
Serum iron, TIBC, ferritin, copper, ceruloplasmin, CRP
Liver ultrasound

The pathogenesis of TPN-associated cholestasis is multifactorial and not completely understood. Management includes –

Change lipid source to Structolipid
Reducing or stopping the lipid in TPN - but taking care not to overload with glucose.
Reducing or stopping TPN, with oral feeding if possible.
Use cyclical TPN.
Medication eg metronidazole iv 500mg bd, ursodeoxycholic acid.

Consider checking manganese level (contact Nutrition Support Team first to discuss) if TPN continued in the presence of cholestasis (95% of manganese is excreted in bile). Manganese toxicity occurs due to deposition in the basal ganglia giving rise to movement disorders.

Low Phosphate

See 'Refeeding Syndrome' guideline.

Selenium deficiency

Selenium is an essential trace element which forms part of glutathione peroxidase - involved in reducing free radicals. It is present in additrac added to TPN (0.4 umol). Patients on longer term TPN may become selenium deficient. This can result in –

Cardiomyopathy
Muscle pain, tenderness and weakness
Nail and hair changes

Treatment is with extra selenium added to the TPN (up to a total of 1.2 umol) and/or oral selenium (up to 1000ug/day; high doses can result in toxicity).

Zinc deficiency

Zinc is an essential trace element involved in many enzymes eg alkaline phosphatase. It is present in additance added to TPN (100 umol). Zinc deficiency may occur through lack of intake. This can result in –

Skin changes - reduced healing, pustular dermatitis
Reduced immune response - infection
Hypogonadism

Treatment is with extra zinc added to the TPN (2ml zinc sulphate provides 100 umol of zinc).

Copper deficiency

Copper is an essential trace element involved in many enzymes. It is present in additance added to TPN (20 umol). Clinically apparent copper deficiency is rare and may occur with longer term TPN (>6 months). This can result in –

Anaemia
Neutropenia
Osteoporosis, subperiosteal haematomas

Thiamine deficiency

Glucose utilisation is thiamine (Vitamin B1) dependent. Thiamine is present in solivito added to TPN (3mg). Deficiency can result in –

High output cardiac failure
Oedema
Neuropathy
Wernicke-Korsakoff syndrome

There is no clinical trial data regarding when to give thiamine and how much to give. For patients who are most likely to be thiamine deficient (very poor oral intake for >2/52, alcoholics) then thiamine should be given as a one off dose prior to the first bag of TPN. Administer as Pabrinex 1+2 in 100ml normal saline iv over 30 mins prior to TPN.

Triglyceride

Measurement may rarely be required in order to assess lipid clearance. Reduced lipid clearance may occur in critically ill patients. Accumulation of lipid may result in liver dysfunction, bilirubin displacement from albumin (a more common problem in neonates), immune system impairment, pulmonary and cardiac dysfunction and the fat overload syndrome (fever, haemolytic anaemia, thrombocytopenia, deranged coagulation and multi-organ failure). The triglyceride concentration should be kept below 5 mmol/L if possible – NB blood sample must not be contaminated with TPN.