A 57 year old, female patient with weight 50 kg, height 152 cm, sustains severe injuries in a road traffic accident and is brought in emergency department of a hospital in an unconscious state. She suffers from multiple rib fractures with fracture right femur and fracture pelvis. CT scan of head revealed cerebral contusions involving frontal and parietal lobe. Patient is immediately shifted to ICU, intubated, kept on ventilatory support and central venous catheter is inserted. She is sedated with a continuous infusion of propofol @ 5 ml/hr and her current hemodynamic status is satisfactory. (Please select one best option)

Q 1. What would be her daily nutritional requirements considering her a case of moderate stress (stress factor 40%):
   a) 1500 kcal/day + 132 kcal/day
   b) 1750 kcal/day - 132 kcal/day
   c) 2000 kcal/day - 132 kcal/day
   d) 2500 kcal/day - 132 kcal/day

Q 2. What would be the most appropriate time for starting the nutritional supplementation and of which type?
   a) Starting enteral nutrition from next day of admission
   b) Starting parenteral nutrition from next day of admission
   c) Starting parenteral nutrition after 72 hours of admission
   d) Starting enteral nutrition after 72 hours of admission

Q 3. Enteral feeding can be given in all of the following conditions except:
   a) Gastric atony
   b) Absence of bowel sounds
   c) Abdominal distension
   d) Colonic ileus

Q 4. Following enteral nutrition, the risk for aspiration can be reduced by all of the following except:
   a) Intermittent bolus feeding
   b) Positioning the head of the bed and the patient upright at 30° – 45°
   c) Use post-pyloric feeding route
   d) Administration of pro-kinetic drugs (metoclopramide and/or erythromycin)

Q 5. Lipid rich nutritional supplements are preferable in which of the following disorder?
   a) Cardiac failure
   b) Hepatic failure
   c) Respiratory failure
   d) Renal failure

Q 6. Intravenous lipid emulsions are available in 10% and 20% strengths in 100-500 ml volumes. The percentage here refers to grams of which lipid per 100 ml of an emulsion?
   a) Phospholipids
   b) Cholesterol
   c) Triglycerides
   d) All of the above

Q 7. Which of the following statements regarding linoleic acid is incorrect?
   a) It is a long chain, polyunsaturated fatty acid derived from safflower oil
   b) Linoleic and linolenic acid are the two essential fatty acids that needs supplementation from feeding formulas
   c) It is supplemented as 0.5% conc. of the dietary fatty acids in nutritional formulas
   d) Its deficiency causes scaly dermopathy and cardiac dysfunction.

Q 8. Which of the following statement is incorrect?
   a) Glutamine is the principle fuel for intestinal mucosa cells
   b) Branched chains amino acids prevent
breakdown of the aromatic amino acids and prevent formation of false neurotransmitters in hepatic encephalopathy

c) Pectins and gums metabolize to fatty acids which are used as an energy substrate by the large bowel mucosa

d) Glucose concentration above 100 mg/dl in tracheal aspirates, is an evidence of silent aspiration

Q 9. A 40 year old male patient, chronic smoker, suffering from comorbidities of type 1 diabetes and congestive heart failure was operated for peptic perforation with jejunostomy tube in situ. Patient is on ventilatory support in assist control mode with following ventilatory parameters; TV: 8 ml/kg RR: 12 breaths/minute, FiO₂: 50%, PEEP: 5 cmH₂O. Patient is on antibiotics, dobutamine infusion and loop diuretics. For glycemic management, dextrose 5% (piggybacked with insulin) was infused at 100 ml/hr to keep target range of random blood sugar between 100-140 mg/dl. Maintenance fluid was titrated to a CVP of 8-10 cm H₂O. On the third day jejunostomy feeding was to be initiated. The patient developed tachycardia (heart rate 180/min) and hypotension (BP 80/50 mmHg) with the ECG as shown in Fig b. A review into previous ECG shows the trace in Fig a.

The most likely cause for this unforeseen complication is:

a) Hypocalcemia
b) Hypoglycemia
c) Hypokalemia
d) Metabolic Acidosis

Q 10. Which of the following statement regarding parenteral nutrition is incorrect?

a) A respiratory quotient (R/Q) greater than 1 generally indicates overfeeding
b) Monitoring of pre-albumin can be used to assess response to feeding in the ICU setting
c) The target plasma glucose levels during nutritional supplementation should be between 70-100 mg/dl.
d) Parenteral or enteral nutrition can lead to refeeding syndrome.

ANSWERS

Ans. 1 (b): Basal energy expenditure (BEE) can be calculated using Harris-Benedict equation or more conveniently by multiplying body weight (kg) x 25 kcal/kg (50 kg x25 kcal/kg =1250 kcal/day). Then total energy expenditure (TEE) is calculated by multiplying BEE x stress factor, i.e. for moderate stress: BEE x 1.4 (stress factor of 40%) TEE=1250 kcal/kg x1.4= 1750 kcal/kg. Then calculate additional energy provided by propofol (1%) which is 1.1 kcal /ml (5 ml/hr x 24 hr=120 ml x 1.1 kcal/ml = 132 kcal). So, the total calories amount to 1750 + 132 = 1882 kcal/day approximately.

Ans. 2 (a): Exhaustion of the body’s metabolic reserve occurs in most patients and under most clinical circumstances after 24–48 h of illness. In the sickest patients, early enteral feeding showed the most pronounced effect on reducing mortality, when feeding was initiated within 24–48 h of ICU admission. It is always preferable to start enteral feeding when compared to parenteral feeding due its protective effects on gut mucosal barrier and lesser incidence metabolic effects. In patients with long ICU stay (≥ 7–10 days), delay in starting nutrition causes negative protein balance leading to myopathy, delayed weaning from ventilator, with increased morbidity and mortality.

Ans. 3 (c): Initiation of enteral feeding does not require active bowel sounds or the passage of flatus or stool. Gastric atony and colonic ileus do not preclude enteral feeding but may require gastric decompression and small bowel feeding. Enteral nutrition is contraindicated in small bowel obstruction or ischaemia, high output enterocutaneous fistula (> 500 ml), diarrhoea, severe pancreatitis, hemodynamic instability or unconscious patient with unprotected airway.

Ans. 4 (a): Applying continuous instead of bolus feeding @ 30 ml/hr decreases the risk of aspiration compared to intermittent bolus feeding, and is a grade D recommendation by American Society of Parenteral Nutrition (ASPN). The rest options are grade C recommendations by ASPN.
**Ans. 5 (c):** Liquid feeding formula with a high fat content provides up to 55% of the total calorie intake. This formula is intended for patients with respiratory failure. When lipids replace carbohydrates as the principal nutrient substrate, metabolic CO2 production will decline and there will be less of a tendency for CO2 retention in patients with compromised lung function.

**Ans. 6 (c):** The percentage refers to concentration of triglyceride in an emulsion. 10% & 20% intralipid emulsions provide 1 kcal/ml and 2 kcal/ml respectively.

**Ans. 7 (b):** The only dietary fatty acid that is considered essential (i.e. must be provided in the diet) is linoleic acid.

**Ans. 8 (d):** Glucose concentrations in tracheal aspirates can be checked using glucose oxidase reagent strips. Values greater than 20 mg/dl are evidence of silent aspiration.

**Ans. 9 (c):** The clinical scenario here revolves around the hypokalemia induced by the peptic perforation that causes metabolic alkalosis due to loss of H+ ions and potassium in gastric secretions. Hypokalemia may get worsened by insulin, loop diuretics and dobutamine administration. Since patients with respiratory co-morbidities are likely to receive inhaled bronchodilators (β2 agonists) during their ICU stay and ventilator management, episodes of hypokalemia are likely to occur more frequently.

The first ECG shows ST segment depression, shallow ‘T’ wave and prominent ‘U’ waves which are a hallmark of hypokalemia. The second ECG shows deterioration into monomorphic ventricular tachycardia. Hypoglycemia also produces flattened T waves and u waves on ECG, prolonged QTc interval and ventricular tachycardia; however, is unlikely in this case because of intensive glucose monitoring. Hypocalcemia may also lead to dysrhythmias by prolongation of QTc interval however ‘T’ waves are typically unchanged. Metabolic acidosis, on the other hand, is associated with hyperkalemia which presents with tall ‘T’ waves.

**Ans. 10 (c):** R/Q is the quotient of ml CO2 produced per ml O2 consumed. Increased CO2 production will cause a rise in the R/Q from 0.80, a normal steady state. Pre-albumin has been used to assess response to feeding in ICU owing to its short half-life of 2 days. Evidence from NICE-SUGAR (normoglycemia in Intensive Care Evaluation-Survival using Glucose Algorithm Evaluation) and other systemic reviews indicates a range of 145-180 mg/dl for preventing mortality as well as hypoglycemic events seen more commonly with tight control. Hypophosphatemia occurring after initiation of nutritional feeds has been termed the refeeding syndrome. Following periods of starvation, caloric supplementation leads to regeneration of ATP which requires phosphate, resulting in its consumption and deficiency.

**REFERENCES**