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Short Communication

Hepatic Failure: Role for biochemists and nutrition experts

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The liver is the largest gland of the human body. Sometimes referred to as the "great chemical factory" of the body, the liver creates, regulates, and stores a variety of substances used by the gastrointestinal system and it serves a number of important digestive functions. The liver also plays a major role in the regulation of blood sugar. The liver synthesizes, dissolves, and stores amino acids, protein, and fat. It stores several important vitamins like B-12 and Vitamin A. The liver also disposes of cellular waste and breaks down harmful substances like alcohol, disposing them into the bile.

Acute injury to the liver due to causes such as hepatitis, toxins, encephalopathy and chronic liver failure are well-documented causes of a very nearly fatal manifestation termed "Hepatic Failure" (HF). Owing to the multitude of functions that the organ performs, the management and treatment of HF poses a true challenge to a clinician and a biochemist / nutrition expert put together. Pinning down the underlying cause with a battery of tests and investigations assists the clinician for diagnosis and mostly the prognosis of the condition, since mortality rate is very high in HF.

Simultaneously, a biochemist / nutrition expert needs to think on the lines of Supportive Nutritional Therapy. Since the liver eventually metabolizes all nutrients administered either parenterally or enterally, HF poses a formidable challenge. It is basic to review briefly the metabolic derangements in HF before considering Nutritional Support. Most of such changes are mediated by cytokines whose roles have yet to be clearly defined.

1. Hyperinsulinemia, a consequence of decreased hepatic clearance results in hyperglycemia and peripheral insulin resistance.

2. Decreased synthesis of IGF 1 causes excessive protein catabolism and a reduced glycogenesis.
3. A low insulin:glucagon ratio changes the normal "milieu interior" of the cells.
4. Lipid metabolism represents an accelerated state of starvation and leads to depletion of fat stores and essential fatty acid deficiency.(1)
5. Decreased activity of hepatic lipoprotein lipase and mild hypertriglyceridemia ensue.
6. Protein synthesis is decreased as is true with every hepatocellular disorder. An increase in ammonia production due to glutamine oxidation (2) may aggravate encephalopathy, bacteria contributing to very insignificant amounts of ammonia.

HF has a well-defined relation with ammonia levels and neurotransmitters. (3) Ammonia metabolism primarily occurs in the hepatic tissue and secondarily in the muscle tissue. Due to muscle wasting in HF, ammonia metabolism in the muscle is diminished and excess ammonia crosses the blood-brain barrier. The ammonia thus having entered the cranial space combines with glutamic acid resulting in the formation of Glutamine, a reaction catalysed by the enzyme Glutamine synthetase. Glutamine then acts as a predisposing factor to the cerebral edema that follows. (4)

The biological amines produced as a result of decarboxylation of selected amino acids such as tyrosine, tryptophan are the physiologically significant neurotransmitters. However, amines such as phenylethylamine, tryptamine which are not the "true" neurotransmitters also result from the process and are normally cleared by the liver. In HF, these "false" neurotransmitters are not cleared by the liver and get access to the brain.

Thus, bearing all these metabolic derangements in mind, a biochemist must institute a Nutritional Support to suit the delicate system. Protein energy malnutrition is common in HF (5) and more so with a history of alcoholism. In all such cases, appropriate nutritional intervention and support should be instituted as early as possible. Corrections for hemodynamic parameters and electrolytes need to be paid equal attention too.

Route of administration should not pose a problem if the physiology of the gut is normal. However, a combination of routes such as enteral, oral and parenteral may be used.

Guidelines for Nutritional Support in HF are defined by the European Society for Parenteral and Enteral Nutrition (ESPEN). (6) Protein requirements are increased in HF (7) and must be instituted as a part of the Nutritional Support along with neomycin which helps to lower the ammonia burden by reducing the activity of the synthetase. (8) Branched chain amino acids must be provided as a part of the supplementation and the protein feed could range from 0.6 g / kg body weight upto 1.5 / kg body weight depending on the grade of HF. Deficiencies of both water and fat-soluble vitamins are known. Though commercial vitamin supplements may provide support, adequacy may still be questionable. Thiamin and Vitamin K deficiency are well documented. Thiamin deficiency leads to lactic acidosis and may manifest as congestive heart failure.(9) A dose of up to 50 mg per day has been recommended.

HF has been associated with Zinc deficiency.(10) Parenteral supplementation up to 600 mg of sulfate salt /day has been found to be appropriate. Other trace elements that need to be supplemented are Selenium, Copper and Manganese.

With reference to electrolytes, mild sodium restriction has been recommended. Adequate Potassium, Magnesium and Phosphates have to be provided.

Calorie requirements have been estimated at 25-30 non-protein Kcal/kg/day. Only carbohydrate sources must be used for parenteral nutrition. Administration of intravenous fats have also been attempted.(11) Enteral route for fats is not recommended since malabsorption is common in HF.

A careful follow-up for such cases is absolutely essential. Serum triglyceride estimations need to be performed regularly alongside periodic determinations of glucose, Prothrombin time, electrolytes and trace elements.

CONCLUSION

In conclusion, nutritional support to HF patients is challenging and requires experience, skill, careful planning and meticulous follow-up. It is indeed an attempt to replenish the lost power of one of the most vital organs we possess.

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