K. J. Lee: Essential Otolaryngology and Head and Neck Surgery (IIIrd Ed)

Chapter 38: Nutritional Assessment and Support

History

The nutritional support of patients who have been stressed by disease has been the topic of research for years. Dudrick in 1968 showed that animals could be nutritionally supported by venous access for long periods and maintain a positive growth curve. The method was then applied to patients who had lost gastrointestinal functions with similar positive nutritional responses. This led to evidence which showed that surgical mortality was linked to malnutrition which was measured by body weight loss and protein depletion. The thrust of nutritional science in the past 10 years has been to develop a method and understanding that will reverse the malnourished state or prevent its occurrence.

Nutritional Assessment

Although the physical examination and history are the hallmarks of any clinical evaluation, they can be misleading regarding the true nutritional status of a given patient. To pinpoint the nutritional problems more accurately, Blackburn developed a nutritional profile to measure fat stores or somatic and visceral protein. Different parameters can be measured to quantify the deficits of the malnourished patient.

Anthropometric Measurements

1. Height and weight are the most simple and fundamental measurements. The current height and weight are compared to established norms. If the weight loss has been greater than 10% in the past 6 months the change is considered severe.

2. The body fat compartment is assessed by measurement of the triceps skin fold.

3. The midarm circumference measures both fat and somatic protein. The lean body mass or somatic protein can be estimated by using the triceps skin fold and midarm circumference data.

Laboratory Measurements

1. The creatinine: Height index was developed by Bristrian. As a sensitive measure of somatic protein, creatinine, broken down from muscle, is excreted in the urine. Reduced creatinine excretion is indicative of muscle loss and protein malnutrition. The expected creatinine excretion is dependent on the height of the patient.

2. Visceral proteins are measured in the form of serum albumin and transferrin. Transferrin is an acute phase protein and reflects early changes in protein nutrition. Its measurement is used to reflect early evidence of protein malnutrition as well as the earliest evidence of its reversal.

3. The immune response, the hallmark of the body's means to repond to invading substances, is measured by the lymphocyte count and the reaction to intradermal challenge antigens, i.e. mumps, candida, and purified protein derivative.

Energy Requirements for Adequate Nutrition

The basal energy requirements for in-hospital patients are similar to the requirements in those persons without medical needs. That is, the total energy needs are determined by the normal basal energy expenditure in addition to the energy needs related to the underlying injury or disease.

In the basal state, energy is required for the synthesis of structure, the mechanical work of the vital organs, and the chemical work of cells. The amount of physiologic activity is the determining factor in calculating the energy needs of a particular hospitalized patient. The basal metabolic rate is presumed to be constant for persons of the same age, sex, and shape. Various types of stress - fever, peritonitis, and burn shock - demand varying levels of energy expenditure above the basal requirements.

In the preoperative or preinjury state, the caloric requirement is determined by the basal metabolic rate plus the energy needed in such activities as walking, running, and working. Postoperative and postinjury patients need the same number of calories for basal metabolism in addition to calories to supply the needed energy for healing, sepsir, or fever. The ratio of carbohydrate, protein, and fat to supply the caloric requirements, as calculated, vary somewhat depending on the patient's baseline biochemical functions and nutritional state.

Data are lacking to determine the exact number of calories supplied intravenously to attain positive nitrogen balance. Thus Kinney suggests that the intravenous caloric need should be 50% above the calculated clinical needs. The ratio of nitrogen (derived from protein) to total calories determines the adequate utilization of the ingested protein. The ratio of 120-180 cal/g of nitrogen is used when calculating carbohydrate and protein needs for parenteral nutrition.

Parenteral Nutrition

Indications

The three main indications for parenteral nutrition are:

1. Severe protein malnutrition with loss of adequate gastrointestinal mucosal function, thus reducing digestive and absorption function of the gastrointestinal tract.

2. Primary disease of the gastrointestinal tract obviating its use either because of lack of access or need for bowel rest.

3. Altered mental state with inability to swallow or loss of gag reflex and the possibility of aspiration.

Route

The route of parenteral nutritional support may be peripheral or central.

Peripheral Parenteral Nutrition

This is indicated for the patient who may require long-term parenteral support, but this decision is pending further clarification of the clinical situation. While the decision as to ability or inability to utilize the enteral route is pending, and to prevent further nutritional deficits, peripheral nutritional support can be instituted. The preferred method to accomplish the task of reducing the catabolic state is to give 5-10% dextrose and 3.5% amino acids for a total of approximately 2000 mL/day with 500 mL or more of intralipid to adjust to the total caloric need.

The protein-sparing method, using the peripheral route with amino acids only, can be considered. Protein sparing implies the peripheral intravenous administration of amino acid fluid. Previous use of 5% dextrose provides an inadequate number of calories to block protein catabolism for caloric needs. In addition, use of dextrose leads to an increase release of insulin with its antilipolytic effect. This antilipolytic effect inhibits stored body fat breakdown for calories and therefore more protein is catabolized for the needed calories.

Amino acid solutions without glucose in a catabolic patient can reduce the negative nitrogen balance. The use of branch-chain amino acids may inhibit the flux of amino acids from muscle and thus effectively reduce muscle protein breakdown. However, it must be noted that others have shown that glucose does not impair nitrogen sparing because hyperinsulinemia, which occurs following the use of glucose with an amino acid mixture, is associated with a fall in the amino acid blood pool, and stimulates muscle uptake of branch-chain amino acids for protein synthesis.

Central Parenteral Nutrition

The central parenteral route is indicated when the enteral route is unavailable, the proposed support is greater than 7-10 days, and large caloric requirements are needed to reverse the catabolic state.

Method of Central Parenteral Nutrition

Catheter Placement. Hypertonic solutions require a central high-flow vein for infusion. Superior vena cava infusion via the subclavian vein is the preferred route. The catheter is placed in the subclavian vein after a sterile surgical preparation of the skin of the neck, supraclavicular region, and anterior chest wall. The skin and periosteum overlying the clavicle are infiltrated with local anesthesia. The patient is placed in a Trendelenburg's position and a needle is placed into the subclavian vein which allows for placement of the catheter into the vena cava.

Preparation and Composition of Central Parenteral Solutions. A laminar blood flow hood in the pharmacy is used for preparation of the hypertonic glucose and amino acids solution. The composition of this hypertonic fluid (1800-2400 mOsm) is glucose and protein, as amino acids. Fats are given in tandem as a 10 or 20% fatty acid solution. The glucose is given as 20 or 25% solution which produces 800-1000 cal/L. The infusion of glucose causes a rise in blood sugar and stimulates insulin release. This provides an immediate energy source and in high concentrations provides the calories for total energy needs allowing concomitant amino acid infusion to be used for protein synthesis and efforts to obtain an anabolic state. The amino acids, either centrally or peripherally, are needed to obtain this anabolic state for protein build-up.

Fat metabolism is influenced by the insulin release. The glucose is broken down into carbon fragments which are used for the synthesis of fatty acids. Glycerophosphate, produced from the glucose, binds with fatty acids for the production of triglycerides. The type of intravenous alimentation appropriate for the individual patient depends on the underlying problem, the nutritional state at the time of evaluation, and the length of time needed for intravenous nutritional support. The catabolic patient requires 100-150 cal/g of nitrogen for tissue synthesis. Hypertonic glucose with the addition of 3.5% amino acids provides the necessary calories as well as the nitrogen required for reversal of this catabolic state.

The hyperalimentation mixture also contains multiple electrolytes and minerals. Sodium, chloride, and potassium are essential. Potassium is needed in large quantities because of the protein synthesis. Calcium, phosphate, magnesium, and vitamin K are all needed on a daily basis to maintain adequate cellular function. Trace elements are necessary in conditions where parenteral nutrition is maintained for long periods.

Monitoring Central Parenteral Infusions

Laboratory studies which include liver function tests, electrolytes, measurement of acute phase protein, CBC, prothrombin time, calcium, phosphorus, and magnesium are all necessary before the institution of central parenteral nutrition. This gives a baseline of the nutritional state; these levels also must be followed closely after the institution of therapy to maintain adequate homestasis.

Complications of Central Parenteral Nutrition

The catheter insertion may result in pneumothorax, hemothorax, or injury to the subclavian artery, vein, brachial plexus, phrenic nerve, thoracic duct, or vagus nerve. The catheter may cause sepsis, and this is the most frequent complication of the catheter placement. There are multiple metabolic complications which can occur. In particular, hypertonic glucose loading may produce hypoglycemic shock, and essential fatty acid deficiency can result if lipids are not administered. The imbalance of various mineral levels such as sodium, potassium, calcium, phosphorus, magnesium are common difficulties, and deficiencies of trace elements including zinc, copper, and chromium have been described. Careful metabolic monitoring as previously described is needed to prevent these complications.

Enteral Nutrition

The route of enteral nutrition support is via a nasogastric tube, tube gastrostomy, or tube enterostomy. The nasogastric tube is valuable for its ease of placement. It has many disadvantages, especially in patients with nasopharyngeal disease either in the pre- or postoperative state. The commonly used No. 16 French plastic or rubber tube causes significant reaction along the tissues in which it is in contact. The gastroesophageal junction becomes incompetent because of the tube traversing the gastroesophageal sphincter. This leads to esophageal reflux and esophagitis, but more importantly, reflux and possible aspiration. When the nasogastric route is chosen, and it is the preferred route under certain circumstances, a No. 8 French silastic catheter should be used. This reduces the tissue reaction, sphincter incompetence, and gastric irritation. The placement of a gastrostomy tube or tube jejunostomy is indicated for long-term enteral nutritional support in patients who cannot maintain adequate oral alimentation. The dietary liquid formulas for tube use are many. They vary in their physical and chemical characteristics.

The elemental diet is residue-free and contains protein in the amino acid or hydrolysate form. It is significantly fat free except for essential fatty acids and the carbohydrates are oligosacharides with or without dextrose of sucrose. Its indication for use is in a patient who cannot tolerate residue in the gastrointestinal tract, i.e. gastrointestinal fistulas, short bowel syndrome, or the markedly malnourished with impaired small-bowel mucosal function needed for digestion and absorption of more complex chemical nutritional substances.

The full-liquid commercial diets have varying features that make it possible to tailor them to each clinical situation and patient. These diets can be used orally in the preoperative patient for nutritional supplement or in the pre- or postoperative period when the patient cannot or will not chew or swallow solid foods. Full-liquid commercial diets have varying palatability, but some can easily be orally ingested. With a silastic No. 8 French nasogastric catheter, a gastrostomy, or jejunostomy tube, these commercial full-liquid diets are easily used to provide full or partial nutritional support. The gastrointestinal tract can be used in this fashion to eventually tolerate 2000-3000 mL/day providing 2000-3000 calories of balanced nutrients with daily allowances of vitamins and minerals.

Nutritional assessment and support are the hallmarks of reducing morbidity and mortality in the malnourished patient undergoing surgical treatment. The route of support is determined by the needs of the patient and routes available for delivery. The central parenteral route is available in lieu of the preferred, but at times, inaccessible enteral route.