Total parenteral Nutrition

Essay

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بسم الله الرحمن الرحيم

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Introduction

In Patients with a non functioning Gastrointestioal tract (G.I.T.) ., Total parenteral nutrition can provide all the daily requirement for protein, calories , fluid , Electrolytes , trace elements and vitamins . The decision to begin total parenteral nutrition (T. P. N.) is based on the clinical setting and the presence or absence of malnutrition *(ASPEN, 1986)* . Malnutrition is common among surgical hospitalized patients. A relationship between the nutritional status of the patients undergoing surgical procedures and the risk of perioperative mortality and morbidity is well established ***(Edmund etal.,1960)*** .

During the early 1940' s much work was done in a number of surgical clinics to improve the nutrition of surgical patients by I.V. route. By maintaining or reestablishing optimal nutritional status, one can help to ensure an optimal response to appropriate medical or surgical management of the primary process *(Robin and Greig, 1986)* .

Total parenteral nutrition (T.P.N.) may be delivered through either a peripheral or a central vein. peripheral TPN may be considered for patients with good peripheral veins who require T.P.N for short period of time usually 7 to 10 days . The phlebitis associated with the hypertonic solutions usually limits the use of any peripheral vein for more than 4 hours ***(Faubion etal., 1986)*** .

Enteric fistulae represent the classical Indication for T.P.N. short bowel syndrome, inflammatory bowel diseases , cancer , liver and renal failure are main indications for T.P.N. . TPN. can also be employed in pre and post operative periods. meticulous daily attension to a variety of parameters will ensure optimal results. A standard monitoring protocol includes serum electrolytes , urine and bloodsugar, blood urea and creatinine , blood picture and liver function tests. Complications of TPN can be classified into complications related to central venous catheter which may be either septic or technincal and metabolic complications associated with the use of dextrose, protein , fat , vitamins, electrolytes and trace elements. Surveillance during TPN is important for prevention or early detection of complications *(Jeejeebhoy, 1988).*

*Physiological aspect
*Nutritional assessment

Physiological background

** body composition : (Hill , 1988)*

The body mass may be thought of as being composed of two broad subdivisions, body fat and fat free body mass.

A) Body fat : -

This is largely neutral storage fat, and therefore doesn't contain water. It is the major energy store of the body

B) Fat free body mass: -

Composed of water, protein, minerals and glycogen . In healthy subjects 72% of the fat free body mass is H_20 (This may increase to over 80% in very ill surgical patients) and this is subdivided into intracellular and extracellular water . About 55% of the protein in the body is enclosed inside cells , the remainder being solute protein (mainly plasma protein) and extracellular connective tissue (C.T.) protein and skeletal protein . By weight most of the minerals in the body are in the skeleton although the rest of the minerals in the body weight less than half a kilogram , they are of crucial importance in determining water distribution .

** Water and electrolytes*

In average young adult male, 18% of body weight(wt.) is protein , 15 % is fat and 7% is minerals . The remaining is water,which constitutes about 60% of the normal body weight . The body water is distributed between two compartements, the intracellular and extracellular compartements. The intracellular water forms 40% of body wt. , while the extracellular water forms 20% of body wt . The intracellular water is separated from extracelluar water by cell membrane. Extracellular water

(ECW) is divided into extravascular or interstitial water which baths the cells and forms about 15% of body wt. and intravascular or blood plasma which forms 5% body wt. The interstitial fluid is separated from plasma by capillary walls (*Ganong, 1989*) .

Chemical composition of extra and intracellular fluids : -

a) Extracellular fluid : -

The main cation is sodium with little potassium, Ca^{++} , magnisium . The main anion is chloride with little bicarbonate, phosphate and protein. non electrolytes include glucose , lactic acid . , and fat (cholesterol and phospholipids) ,waste products include urea , uric acid , creatinine and bile pigments. its osmotic pressure is similar to plasma = 0.9 % NaCl solution

b) Intracellular fluid : -

The main cation is potassium with little sodium , magnesium and Ca^{++} . The main anion is protein and phosphate with little bicarbonate , chloride, and sulphur . Its osmotic pressure is similar to plasma = 0.9 % NaCl solution

Electrolyte balance : -

1 - sodium (Na^{+}) : -

Total amount of Na^{+} in adult body is about 105 gm., about one third in bone. Basic need of the body is 1 - 2 gm / day . Normal serum levels are 132 - 142 m mol ./L.

Functions of sodium are :

a) Sodium iones essential for initiation of heart beats , normal function of cells and starting depolarization of nerves and muscles

b) Sodium compounds Maintain blood pH and control urine pH

NaCl(Sodium Chloride) regulates osmotic pressure in extracellular fluid and has a role in gastric HCL formation . Sodium bicarbonate cause alkalinity of both bile and pancreatic juice -

2 - Potassium : -(K^+)

Most of the body potassium is found in the cells and only about 20% is in the extracellular compartement. normal serum levels are 3.5 - 5 m mol / L . Potassium maintains the intracellular osmotic pressure, forms important buffer system inside the cells e.g Potassium bicarbonate($KHCO_3$) ,potassium phosphate , and potassium hemoglobinate which is important for buffering and carriage of CO_2 , increases the contraction of smooth muscle. and increase ciliary movements, important for excitability and synaptic transmission

3 - Calcium : -(Ca^{++})

Normal values are 2.1 - 2.6 m mol . \ L . Blood levels of Ca^{++} are 9 - 11 mg% (all are present in plasma) .45 % is non diffusable (Carried on plasma albumen) . 55% is diffusable (Ionized Ca^{++} and non ionized in the form of citrate salt). The daily requirement is 0.8 for normal adults and 1.2 gram for pregnant and lactating females . Ca^{++} is important in the transmission of nerve impulses and normal contractility as will as it decreases the neuromuscular irritability, so its deficiency, leads to tetany. Ca^{++} also plays a role in regulation of capillary permeability and blood coagulation also, it enters in the formation of bone and teeth , Ca^{++} activates lipase dehydrogenase enzyme which converts neutral fat into glycerol and free fatty acids and also activates succinic dehydrogenase which dehydrgenates succinate into fumerate in citric acid cycle.

4 - Chloride : - (Cl^-)

Normal levels in serum are 98 - 106 m mol.\ L

It is important for the activity of amylase enzyme as well as for formation of gastric HCL.

5 - magnesium :-

It is important in the various enzyme systems in cellular metabolism . normal values 1.5 - 2.5 m mol./ L .

The daily requirements is 0.3 gm / day for normal adults.

6 - Phosphate : -

The daily requirements is 0.8 - 1 gram for normal adult and 1.2 gm for pregnant and lactating females. Phosphate, enters in the formation of bone, teeth , phospholipid , buffers, nucleic acids ., neocleotides (ATP, ADP and AMP) and high energy bonds e.g. creatine phosphate. also it enters in the formation of many Co enzymes *(Ganong, 1989)*

* (Nutritional assessment)

Malnutrition has long been recognized as a potential source of increased morbidity and mortality in surgical patients . The reported incidence of malnutition has ranged from 10% to 50 % in different series of hospitalized patients , this variability is attributable in part to difficulty in defining and assessing the malnourished state and in part to the different patient population studied .

Malnutrition can be defined as nutritional deficit associated with an increased risk of adverse clinical events such as morbidity or death and with a decreased risk of such events when corrected.

The goal of nutritional assessment is to identify those patients who are at increased risk so that they can receive appropriate nutritional therapy . Since the development of T.P.N. in 1968 , the number of available assessment measures has been continually increasing. If a large number of tests are used, almost all patients manifests some abnormlities *(Mullen etal,1979)*.

The difficulty is in deciding which subset of patients will benefit significantly from nutritional support and which will not .

The ideal test would therefore identify prospectively all those patients who have a nutrition related complications and wouldn't falsely identifiy as at risk any one who would have no such adverse event. In clinical practice no such perfect test exists. The best tests have cut off values designed to have a high sensitivity to avoid missing any malnourished patients.

To identify all malnourished patients , it is better to sacrifice some spesificity and thus to overtreat few patients rather than to miss a malnourished patient who would benefit from nutritional intervention .The complications related to overtreating are minimal and easily corrected *(Lloyd etal.,1991)* . This article reviews the available methods of assessment of nutritional status .

(Clinical assessment of nutritional status)

** Body size and composition : -*

Weight loss is probably the most common variable considered in nutritional assessment and there is a definite correlation between significant weight loss and morbidity . as far back as 1936, Studley reported a mortality of 33% in patients undergoing gastrectomy for peptic ulcer disease and having 20 % weight loss *(Studley, 1936)* .

The mortalitly in patient with less than a 20% weight loss was 5% . Most studies suggest that a weight loss of 10% is associated with increased morbidity . It is important to note that chronic weight loss is much better tolerated by the surgical patients than acute weight loss. In assessing the importance of weight loss, current body weight is compared with the usual and ideal body weights. Usual weight is the patient's recollected weight when he or she was last well . such figures usually are quite reliable.

The ideal body weight is obtained from standard reference tables of age, height and sex, such as Metropolitan life Insurance tables (***Metropolitan , 1983***) .

The limitation of over all weight loss as a nutritional assessment index is that the spesific compartements of the body contributing to the lost mass are not identified . For example, in unstressed starvation , significant depletion of fat stores occurs with relative preservation of lean body mass .

In trauma patients, however, the weight lost may represent primarily loss of lean body mass. Acute weight loss often reflects only changes in fluid balance. Weight loss measurements alone are not sufficiently discriminating to be reliable for nutritional assessment. One also, needs to consider the composition , the rate, and the cause of the weight loss. Therefore weight loss is usually combined with other measures of nutritional assessment to interprete its significance.

* *Anthropometry: -*

Anthropometric data are used in two ways in nutritional assessment. The first is to compare the measured values with standardized controls, the second is to compare serial measurements over time in the same patient . The problem with the first method is that its interpretation is dependent on the normal range. Thus an inherent error occurs when the patient started out well above the normal range but at the time of measurement is within this range . The patient therefore may have been in a negative nutritional state for sometime but at the time of assessment is mistakenly classified as normal . The pitfall with comparing serial data is the variance of individual measurements . The validity of anthropometry is greatly enhanced when the measurements are obtained by skilled, conscientious personnel of time (>1 month) have the most value. Anthropometric measurements are used to estimate subcutaneous fat and skeletal muscle Stores in somewhat objective manner overall, their usefullness is little better than the clinical judgment of an experienced surgeon .

1) Total body fat : -

Subcutaneons fat constitutes approximately 50% of body fat stores and can accurately reflect the total body fat content. The use of calipers to assess skin fold thickness as a measure of subcutaneous fat is an easy and inexpensive test . The most common measurement is the triceps skin fold thickness , which is compared with percentile standards or serial measurements its actual value as a part of nutritional assessment is questionable. In some studies , depletion of fat stores , as detected by triceps skin fold thickness , correlates with poor outcome *(Jeejeebhoy., 1986).*

However this is not a constant finding ,Baker and colleagues found clinical judjment to be a better predictor of outcome *(Baker etal ., 1982)*

2) Skeletal muscle Stores : -

Skeletal muscle represents 60% of the total body protein pool and is the major source of aminoacids during time of stress and starvation .