List of Abbreviations

Abb.	Full term
AC	*Arm Circumference*
ALB	*Albumin*
ASPEN	*American Society for Parenteral and Enteral Nutrition*
BCP	*Bromcresol Purple*
BEE	*Basal Energy Expenditure*
BMI	*Body Mass Index*
CRBIs	*Catheter Related Blood Stream Infection*
CRI	*Catheter Related Infection*
EEN	*Early Enteral Nutrition*
ELISA	*Enzyme Linked Immunosorbent Assay*
EN	*Enteral Nutrition*
IC	*Indirect Calorimetry*
LCT	*Long Chain Triglcerides*
MAMC	*MID Arm Muscle Circumference*
MCT	*Medium Chain Triglcerides*
MUAC	*Mid Upper Arm Circumference*
MV	*Mechanical Ventilation*
NB	*Nitrogn Balance*
PEM	*Protein Energy Malnutrition*
PICU	*Pediatric Intensive Care Unit*
PIM2 Score	*Pediatric index Of Mortality*
PN	*Parenteral nutrition*
Pre Alb	*Prealbumin*
PRISM Score	*Pediatric Rism Of Mortality*
REE	*Resting Energy Expenditure*
RQ	*Respiratory Quotient*
SAM	*Severe Acute Malnutrition*

SCCM..................Society of Critical Care Nutrition

List of Abbreviations (Cont…)

Abb.	Full term
SCFA	*Short Chain Fatty Acids*
TPN	*Total Parenteral Nutrition*
TST	*Triceps Skin Fold Thickness*
UN	*Urinary Nitrogen*
UUN	*Urinary Urea Nitrogen*
WHZ	*Weight for Height Z Score*

ABSTRACT

Background: Nutrition deficiency is common among hospitalized children. Although nutrition support in the form of enteral or parenteral nutrition may improve malnutrition in this population, the benefits of each form and the difference between forms of nutrition associated with their use have not yet been fully explored. **The objective of this study** was to study the effect of enteral and parenteral nutrition among patient's outcome in pediatric intensive care unit (PICU) and analysis of nutritional practice in PICU. **Materials and Methods:** Prospective cohort study done on 50 patients PICU of Ain Shams University during period of six months, all patients aged from 30 days till 18 years old admitted during this period were included in this study. Anthropometric measures of all patients measured at time of admission and repeated when patients reached 50% of their normal calculated requirements of calories and proteins. **Results:** EN was prescribed in eighteen patients (36%). Patients received EN had shorter LOS (days) (7 vs 9 days in PN; 12days in mixed feeding .Patients received had lower mortality rate 11.1% compared with patients received PN 61.1% and patients received mixed feeding 36.7%). **Conclusions:** Nutrition support improve catabolic state of patients by decreasing urinary urea nitrogen (UUN), improve nitrogen balance by being positive instead of negative. EN was associated with lower sepsis, lower LOS, lower mortality compared with other forms of nutrition.

Introduction

Optimal nutrition therapy is a vital component of pediatric critical care. Malnutrition remains prevalent among children admitted to the pediatric intensive care unit (PICU) ***(Joosten et al., 2004)***.

The origin of malnutrition in critically ill children is multifactorial, and dependent on prescription and delivery of feeding ***(Van Der, 2006).***

Failure to provide adequate nutrient delivery during a prolonged course of critical illness may be associated with further nutritional deterioration ***(Hulst et al., 2004).***

The goals of nutrition therapy in the critically ill child include accurate assessment of nutrient requirements, prevention of both underfeeding and overfeeding, initiation of early nutrition support through enteral or parenteral nutrition ***(Skillman, 2011).***

Currently, the indication for pediatric parenteral nutrition (PN) is limited to those children whose gastrointestinal tract is inadequate to support normal growth and development, intensive care low birth weight infant, severe malnutrition. Clinical conditions such as intractable vomitting or diarrhea, hypercatabolic ICU patients and patients with short bowel syndrome that cannot meet their needs enterally. parenteral

Nutrition access be through central or peripheral line ***(Shulman and Phillips, 2003).***

Enteral nutrition should be used instead of or in addition to PN whenever possible. PN should be used only when it is not possible to meet nutritional requirements via the gastrointestinal tract or when there is bowel dysfunction resulting in inability to tolerate enteral nutrition for a prolonged time: 1 to 3 days in infants, 4 to 5 days for children ***(Mehta, 2009).***

Enteral nutrition has several physiological advantages as compared with PN and generally has fewer complications. So In critically ill children, EN is generally recommended, but there are no recommendations on when it should be started ***(Mehta, 2009).***

Early EN (EEN), defined as EN that is begun within 48 hours of admission to the PICU. EN is more physiological, favoring the maintenance of an adequate intestinal trophism, stimulating the immune system, and reducing bacterial translocation and, secondarily, the incidence of sepsis and multisystem failure ***(McClave et al., 2009).***

The early initiation of enteral feeding reduces the incidence of septic complications and improves the prognosis ***(Galbán et al., 2000).***

Studies in children have demonstrated that the early initiation of EN improves the nutritional indices and reduces complications such as changes in the healing processes, deterioration in immune system activity, and muscle fatigue ***(Suri, 2002).***

So, enteral nutrition (EN) is considered to be the best form of nutritional support in the critically ill patient ***(Lefor, 2002).*** Enteral nutrition (EN) via a nasogastric tube is the preferred method for immediate feeding of multiply injured patients, because it is easy and therefore not time consuming to institute ***(Adam, 1997).***

AIM OF THE WORK

- Analysis of nutritional practice in pediatric intensive care unit (PICU).
- Studying the effect of enteral and parenteral nutrition among patient's outcome in PICU.

Chapter 1
EFFECTS OF CRITICAL ILLNESS ON CHO, PROTEIN AND FAT METABOLISM

Critically ill patients are characterized by a number of alterations in carbohydrate, lipid, amino acid, protein and electrolytes metabolism. These changes (proportional to the severity of illness) lead to increased energy requirement and protein catabolism and contribute to alterations of the immune system, the body composition and the muscle and gastrointestinal tract functions.

A- Carbohydrate Metabolism:

1) Surgical and accidental injury increase secretion of the counter regulatory hormones insulin, cortisol, catecholamines, and glucagon, resulting in elevated endogenous glucose production secondary to accelerated hepatic gluconeogenesis ***(Buunen et al., 2004).***

This increase glucose production coupled with peripheral tissue resistance to insulin results in reduced glucose utilization and lead to hyperglycemia ***(Buunen et al., 2004)***.

This insulin resistance occurs likely due to a post receptor defect that hinders cellular glucose uptake ***(Zauner et al., 2007).***

2) Carbohydrate is the main nutrient that fuels exercise of a moderate to high intensity, while fat can fuel low intensity, Exercise for long periods of time ***(Ronald et al., 2009).***

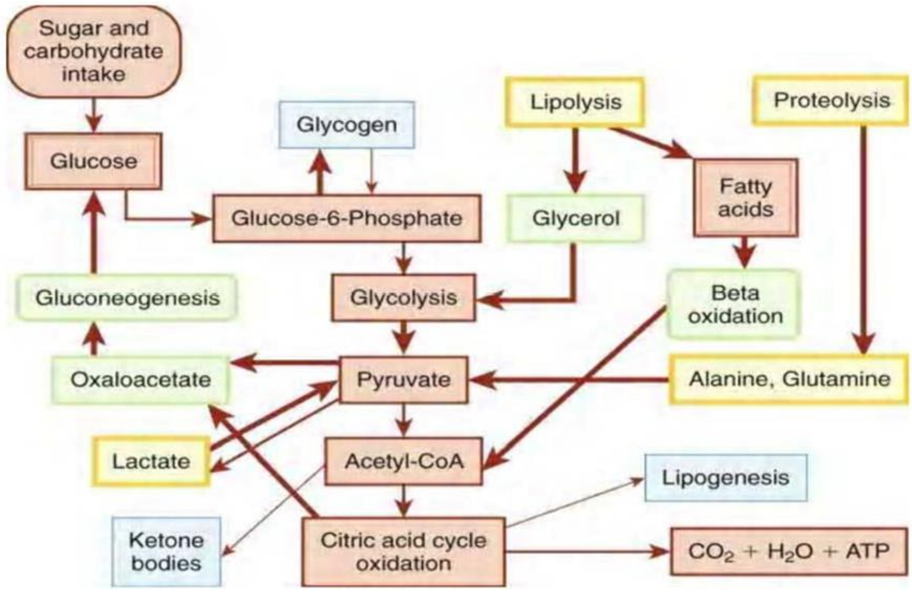

Figure (1): Carbohydrate metabolism during injury ***(Ronald et al., 2009).***

B- Lipid Metabolism:

Stressful situations (e.g., injury, sepsis, and congestive heart failure) alter lipid metabolism. The major change is accelerated lipolysis due to increased β2-adrenergic stimulation ***(van Hall et al., 2003).***

C- Protein Metabolism:

One of the hallmarks of the metabolic response to injury and sepsis is catabolism (negative nitrogen balance ***(Buunen et al., 2004).*** So, during stress there is increased hepatic synthesis of the acute-phase proteins such as fibrinogen, complement, immunoglobulin, and CRP ***(Bjornson et al., 2007).***

The metabolic response to injury and sepsis increase synthesis of acute phase proteins and reduce synthesis of binding proteins, such as albumin, transthyretin (prealbumin), retinol binding protein, and transferrin ***(Koretz, 2007).***

Chapter 2

MALNUTRITION IN CRITICALLY ILL CHILD

Malnutrition is usually of multifactorial origin. It is associated with an altered metabolism of certain substrates, increased or decreased metabolism and catabolism depending on severity, kind of lesion and reduced nutrient delivery ***(Briassoulis et al., 2010).***

The presence of malnutrition prior to admission worsens the prognosis in the critically ill child, furthermore severe illness has marked effect on the nutritional status of these patients ***(Briassoulis et al., 2010).***

Critically ill children, particularly infants, are at risk of developing nutritional deficiencies due to high basal metabolic rates and limited energy reserves ***(Pawellek et al., 2008)***

A recent study by ***Hulst et al*** still found 24% of the children to be acutely or chronically malnourished on admission to the ICU despite improvements in intensive care technology, feeding possibilities and increased awareness of the significance of adequate nutritional support ***(Hulst et al., 2004).***

Malnutrition interferes with the appropriate response of the body to the disease and to the infection .critically ill patients with malnutrition on admission have high risk of morbidity and mortality ,prolonged hospital stay compared with other patients ***(Acosta and Valoración, 2008 and López-Herce, 2009).***

Monitoring of the nutritional status of the critically ill or chronically ill child, nutritional treatment of these patients reduce prevalence of malnutrition in paediatric intensive care units (PICU) to some extent ***(Zamberlan et al., 2011 and Hulst et al., 2004)***.

The possible explanations for adverse outcome in malnourished children including atrophy ,increased permeability of the intestinal epithelial barrier, which facilitates infection and bacterial translocation, higher incidence of pneumonia due to poor respiratory excursions and sepsis due to altered immune functions ***(Correia and Waitzberg, 2003)***.

During critical illness, adequate nutritional support with avoiding complications of under or overfeeding is an important aspect of the clinical management of the critically ill patients So we must identify children at risk of malnutrition as these children may benefit the most if we apply adequate substrate supply ***(Taylor et al., 2003).***

Risk factors of malnutrition in critical ill child:

There are numerous factors that contribute to the onset of malnutrition in children admitted to intensive care. The incidence of malnutrition is higher in children under two years of age, in those with prolonged hospital stay, patients who require mechanical ventilation. Children with congenital heart disease and extensive burn injuries are also at increased risk of malnutrition ***(Hendricks et al., 1995).***

An additional factor is that critically ill children frequently receive an insufficient calorie and protein delivery because enteral or parenteral nutrition cannot be initiated due to gastrointestinal intolerance or the need to restrict fluid intake, initiation of nutrition is delayed, or there are interruptions in nutrition in order to administer medication or to perform interventions requiring sedation ***(Mehta and Duggan, 2009).***

Screening tools to identify children at risk of malnutrition

Currently, there is no ideal method to identify children at risk of malnutrition during their hospital stay. There are four screening tools to determine children at risk ***(Secker and Jeejeebhoy, 2007).***

Sermet Gaudelus et al. and Secker and Jeejeebhoy developed the Pediatric Nutritional Risk Score and the Subjective Global Nutritional Assessment. These identify children at risk of malnutrition during hospitalization. However, the tools of ***Sermet Gaudelus et al.*** are considered too complicated and time consuming to use in daily clinical practice ***(Sermet Gaudelus et al., 2000, Secker and Jeejeebhoy, 2007).***

McCarthy et al. developed a simple tool (STAMP tool) which is a combination of weight and height measures, with two additional questions on disease risk and intake ***(McCarthy et al., 2008).***

Gerasimidis et al. developed the Paediatric Yorkhill Malnutrition Score, which is a four stage evaluation based on four questions considering the BMI value, recent weight loss, decreased intake in the previous week, and expected affected nutrition by the admission/condition for the next week ***(Gerasimidis et al., 2010).***

The validity of this tool was assessed by comparison with a full dietetic assessment as a golden standard for nutritional assessment (dietary history, anthropometric measurements, nutrition associated physical examination, ability to maintain age appropriate energy levels, and review of medical notes). Children were classified as having low, medium, or high malnutrition risk) ***(Gerasimidis et al., 2010).***

Hulst et al. developed a simple tool of assessing nutritional risk. This tool, STRONG kids, It consists of four key items, risk of disease, intake, weight loss, and Subjective Global Assessment ***(Hulst et al., 2010).***

The four questions in this tool can be completed just after admission and are not time consuming. With this tool, the risk can immediately be calculated. Using this tool, a significant relation was found between having a ‘‘high-risk’’ score, a negative SD score in weight for height, and a prolonged hospital stay ***(Hulst et al., 2010).***

It was concluded that use of the STRONG kids tool helps to raise the clinician’s awareness of the importance of nutritional status in children and enable the clinician to refer children at risk for early dietary intervention ***(Hulst et al., 2010).***

Diagnosis of malnutrition:

The diagnosis of malnutrition in the critically ill child must be based on an objective evaluation of the nutritional status; this includes an adequate history of recent food intake and weight loss, anthropometric measurements, analysis of biochemical parameters and cellular immunity, and calculation of the body composition ***(Delgado et al., 2008 and Mehta, 2009).***

An adequate nutritional evaluation is essential in order to institute early nutritional intervention ***(Delgado et al., 2008, Zamberlan et al., 2011, Sánchez et al., 2005, Mehta and Duggan, 2009).***

There is a clear correlation between parameters reflecting poor nutrition, such as prealbumin or body mass index and rate of in hospital complications, readmissions and mortality ***(Correia and Waitzberg, 2003).***