Introduction

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Human life is oscillating constantly across a spectrum of degrees of health and disease. The genetical heritage and life circumstances make someone to live relatively healthy life free from major disease, while others experience various degrees of disease or injury. There is a close relationship of stress to the risk and the incidence of disease [*Selye 1970*]; stress being "the rate of wear and tear in the human machinery". This physiological stress either, normal or abnormal is met with a number of automatic physiologic responses to maintain the body in a 'state of dynamic equilibrium' or 'homeostasis'. Any illness or injury which actually impairs this homeostasis involving one or more vital organ systems in such a way that the patients' survival is jeopardised and under this condition, the patient is said to be *critically ill* [*Anon 2000*]. Care of such patients involves decision making of high complexity to assess, manipulate and support organ systems so as to prevent further deterioration. The body requires a constant supply of energy to maintain homeostasis. This energy supply is accomplished by constantly converting of complex forms of energy substrate such as carbohydrate, protein and fat into adenosine tri-phosphate (ATP) depending on the needs [*Bursztein et. al., 1989*]. It has been observed that the survival or magnitude of recovery processes is greatly depended on the state of immunostatus, which apart from genetical factor, is remarkably designed by the nutritional status of the body.

The incidence of hospital malnutrition is a common problem with 40% of the surgical and medical patients reported to be malnourished on admission. The majority of patients experienced nutritional depletion during the course of their hospital admission, which was more severe in those patients who were already depleted at the time of their admission [*McWhirter and Pennington 1994*]. These patients are routinely exposed to the factors that cause metabolic stress, which include semi starvation, infection, trauma, and surgery and tissue ischemia. As nutrition and intestinal function are intimately interrelated, infections can be more serious in the presence of malnutrition, and many infections precipitate malnutrition. Malnutrition and nutrient deficiencies in the feeds can alter the ability of immune cells to recognize foreign stimuli, alter the proliferation response of the various cells, impair antigen presentation, reduce phagocytic and cytolytic capacity, change membranes or enzymes or purturb the cooperative interaction between the various types of immune system [*Beisel 1982* ; *Santos and Facao 1990*]. Thus, nutritional depletion is directly associated with changes in body composition, tissue wasting, impaired organ function leading to impaired immune and muscle function. Under these circumstances, he starts to burn his lean body mass and losses the ability to burn fat stores, thus predisposing to irreversible malnourished condition after which the survival is unlikely. A properly fed subject with balanced nutrition is definitely expected to withstand these turmoils better than malnourished subjects.

The gastrointestinal tract is a sensitive mirror of the individual human condition as the food, the body receives is digested and absorbed here through a series of intimately related secretory and neuromuscular mechanism in order to maintain life. It is also a central organ of aminoacid metabolism [*Souba et.al., 1985 ; Souba et. al., 1990*] as well as acts as a mechanical barrier so important in immune function [*Langekamp et. al., 1992*]. Thus, chronic gastrointestinal (GI) diseases will lead to chronic malnutrition and will surely impair digestive and absorptive function resulting in malnutrition and increased morbidity and mortality because food and nutrients are not only the major trophic factors to the gut but also provides the building blocks for the digestive enzymes and absorptive cells For example, recent studies have shown that weight loss of greater than 30% accompanying a variety of diseases was associated with reduction in pancreatic enzyme secretion of over 80% villus atrophy and impaired carbohydrate and fat absorption [*O'Keefe 1996*]. It is in general, not because of diagnostic and therapeutic measures in most of the cases, but develops when metabolic requirements exceed intake, and can develop due to reduced nutritional intake, increased nutrient requirement, or altered ability to utilise or absorb nutrients [*Mc Whriter and Pennington 1994*]. Hence gastrointestinal diseases dismantle the normal operation of this network and even during catabolic states like major surgery or inflammation, gut barrier could be altered.

Most patients admitted to a surgical ward are not malnourished. However, patients who have undergone a prolonged pre-admission illness are likely to have some element of malnutrition. Ideally, patients are evaluated for historic unintentional weight loss during the preoperative assessment. Unnoticed, malnutrition may impede healing and lengthen or preclude postoperative recovery [*The Veterans Affairs Total Parenteral Nutrition Cooperative Study Group 1991*]. Nutritional needs occasionally are neglected until they are profound. This is compounded by surgical procedures (and subsequent fasting) after admission. These patients can go into severe malnutrition quickly, often before the treating team realises it.

Disease process itself in every case places these patients at risk for malnutrition with subsequent post-operative complications [Harry *2005*]. It is generally observed in hospitalised situations that patients with or without complications such as sepsis rarely take calorie from the food tray. Others often initially have some degree of gastrointestinal ileus and hence cannot or should not eat. Even following the minor surgery, the calorie requirement in healthy active adults is increased to 50 – 60 % because of metabolic stress and negative nitrogen balance. The physiological stress of surgical trauma causes a surge of sympathetic activity and an associated rise in the catecholamine secretion. A more prolonged hyper metabolic state associated with pronounced negative nitrogen balance then follows. A patient's metabolic need increases when nutrition is electively withheld. An estimated 10% of the lean muscle mass can be lost before wound healing and immunity are compromised [*Karla,2000*].

A number of nutritional problems may develop following gastric surgery depending on the type of surgical procedures and the patient's response After gastric surgery especially with total gastrectomy, about 50 % of the patients fail to regain weight to optimum level [*Williams and Anderson 1996*]. Using the energy the body diverts from the liver, muscle and fat has subtle but profound effects on body homeostasis and influences healing and recovery time. Therefore, nutrition support immediately after injury is essential as it may improve wound healing, [*Schroder et. al., 1991*] limit the degree of hyper metabolism and infection complication [*Moore and Jones 1986; Moore 1989*]. Ignoring or neglecting nutritional management and patients ongoing evaluation predisposes the bowel atrophy and malfunction, including the translocation of bowel bacteria that might exponentially increase the rate of post-operative complications. Thus time is critical if form and function is to be preserved. Improving the nutritional status of a malnourished patient always improves the overall prognosis.

It is important to remember that it is easy to prevent a patient from slipping into the category of severe malnutrition but very difficult to bring him out of it again. Nutritional support leads to improved nutritional status and clinical outcome in severely depleted patients [*Bier et. al., 1996*]. Thus, nutrition must be stressed during the preoperative evaluation itself. Ignoring or neglecting nutritional management and the patient's ongoing evaluation predisposes the bowel to atrophy and malfunction, including the translocation of bowel bacteria that might exponentially increase the rate of postoperative complications [*Karla 2000*]. There are several trials that suggest pre-operative malnutrition supplementation improves outcomes and is cost effective by reducing complications [*Harry 2005*]. It has been reported that preoperative nutritional support may have beneficial effects on clinical outcome in patients with surgery on gastrointestinal tract [*Clinical trials.gov 2005*].

Earlier delivery of dextrose containing intravenous fluid or waiting until a patient was able to take an oral diet was considered adequate in years past whereas early aggressive nutritional support within 12 - 24 hours post-injury is now recognized as being essential to improving patient outcome. Parenteral nutrition was also previously recognized as "one of the greatest medical advanced of the 20th century", is now identified as being associated with significantly increased cost and increased patient morbidity and mortality when used indiscrimately.

Post-operative enteral feeding has been shown to be both effective, well tolerated and is also associated with specific benefits such as reduced incidence of post-operative infectious complications and improved wound healing response. A prospective randomised study reported that early enteral nutrition is also reported to be safe and is associated with beneficial effects such as weight loss, early achievement of positive nitrogen balance as compared to the conventional regimen of feeding in operated cases of gut perforation [*Malhotra et. al., 2004*]. Development of sophisticated enteral delivery access such as endoscopic, fluoroscopic and laparoscopic placements of feeding tubes are making the feeding of patients enteraly more feasible for those whose gut function is partial [*Trujillo 1998*]. There are numerous enteral formulas available in the market of other countries as well as a good number in India. However, the commercially available enteral formulas have not gained popularity due to many factors of which cost of the product is a major one. This calls for formulation of low-cost kitchen based enteral feeds meeting up the needs of the critically ill patients as well as easy to prepare in the hospital itself. Any success in this direction will have a great impact in the Indian scenario.

Since, there is marked alteration in protein catabolism in ill patients, which may lead to impair host defense hindering optimal response to medical and surgical therapy hence, development of amino-acid preparation close to amino-acid composition of a protein with high biological value has been in progress even though traditional diets protect against diseases. The content and type of protein used plus the concentration of individual aminoacid in the diet have been shown to affect the immune response [*Alverdy 1990*]. There are even special cases where enhances immunonutrition is certainly required – anyone who is critically ill, including postoperative and chemo patients; as well as HIV patients-a deficiency of zinc and selenium is associated with increased mortality; and athletes- supplementation is important as exercise depletes nutrients and triggers a depressed immune system. Current research considers individual *substrates* (e.g. specific aminoacid, fatty acids, micronutrient, growth factors) such as tissue or organ specific single nutrients to be an alternative and better approach. *Specific nutrients* can induce disease for example gluten-sensitive enteropathy, whilst dietary factors such as fibre, resistant starch, short-chain fatty acids, glutamine and fish-oils may prevent gastrointestinal diseases such as diverticulitis, diversion colitis, ulcerative colitis, colonic adenomatosis and colonic carcinoma. The role of dietary antigens in the etiology of Crohn's disease is controversial, but controlled studies have suggested that elemental diets may be as effective as corticosteroids in inducing a remission in patients with acute Crohn's disease [*O'Keefe 1996*]. Thus, delivery of balanced diet including an adequate amount of protein or suitable aminoacid preparation with *required substrates* might greatly facilitate an anabolic response to life threatening diseases including minor/minor surgical procedures.

Glutamine is a nonessential (dispensable) amino acid, as it can be readily synthesised de novo in virtually all tissues in the body. Because the body has the capacity to synthesise considerable quantities of glutamine, it has been assumed that glutamine is not required in the diet. However, this amino acid becomes quite depleted during the course of a catabolic insult such as injury or infection, indicating that the ability of glutamine production to meet demands during a variety of surgical illnesses is impaired homeostasis [*Labow and Souba 2001*]. It is evidenced that hyper catabolic and hyper metabolic situations are accompanied by a strong deprivation of glutamine. A considerable decline in the concentration of glutamine has been observed after elective surgery, major injury [*Askanazi et. al., 1980*] infections and pancreatitis [*Roth et. al.,1985*] irrespective of nutritional effort.

In states of health, the assumption that glutamine is not required in the diet is probably valid, although it is difficult to test the hypothesis, as glutamine is present in virtually all dietary proteins. Most naturally occurring food proteins contain 4 % to 8 % of their amino acid residues as glutamine; therefore less than 10 g of dietary glutamine is likely to be consumed daily by the average person. In contrast to this usual dietary availability, studies in stressed patients indicate that considerably larger amounts of glutamine (20 - 40 $gday^{-1}$) may be necessary to maintain glutamine homeostasis

Although glutamine is absent from the conventional regimens aimed at nutritional support, glutamine deficiency can occur during periods of metabolic stress, thereby this aminoacid is reclassified as 'conditionally essential'. Glutamine can contribute to the production of other amino acids, glucose, nucleotides, protein and glutathione. Its acts not only as a precursor for protein synthesis, but is an important intermediate in large number of metabolic pathways. It acts as nitrogen transporter between various tissues, which is an important metabolic fuel for the cells of gastro intestinal tract [*Souba 1991*]. It also operates as a nitrogen shuttle, taking up excess ammonia and forming urea. It is primarily formed and stored in skeletal muscle and lungs and is principal metabolic fuel for small intestine enterocytes, lymphocytes, macrophages and fibroblasts. Maintenance of intracellular glutamine pool promotes concentration of muscle protein and hence indicates glutamine supplementation in the nutrition of patients in a large number of complications including gastro intestinal dysfunction even in catabolic patients. Supplemental use of glutamine either, in oral/enteral or parenteral form, has been reported to increase villus height and is associated with significant reduction in length of stay in surgical patients. Glutamine uptake takes place largely in the splanchnic area (gut, spleen and pancreas) by kidney and by the immune system. Its uptake in portal drained viscera, however, is an indicative of glutamine consumption by not only the small intestine, large intestine and stomach, but also the pancreas and spleen. Gut is indeed glutamine consumer. Studies also report a relation between glutamine uptake and arterial glutamine concentrations in vivo in humans. A decline in plasma glutamine may therefore, result in decreased uptake of glutamine by the gut.

As nutrition overall has both a supportive and therapeutic role in the management of chronic gastrointestinal diseases. With the judicious practice of modern techniques of nutritional support, the morbidity and mortality associated with chronic gastrointestinal disease can be reduced. Even, dietary manipulation may be used to treat to prevent specific gastrointestinal disorders hence, dietary manipulation through formulation of kitchen-made enteral feeding formula with *substrate* enriched with glutamine stands promise. It is expected that, such a venture will not only help use of this short chain peptide glutamine in a variety of clinical complications but at the same time will enhance the immunostatus of the critically ill / patients undergoing surgical procedures, which in turn is expected to help quick recovery and reduced hospital stay.

The preliminary pilot-study in the selected hospitals of Ahmedabad, Gujarat, revealed that gastrointestinal complications were most common amongst the patients next to cardiovascular diseases. With this background in mind, an investigation entitled **"Impact of substrate-enriched kitchen-based protein rich polymeric enteral diets with enteral glutamine on the surgical gastrointestinal patients"** was made in a number of hospitals of Ahmedabad during the year 2003 - 2006 with the following objectives:

1. To assess the existing pre- and post-operative nutritional status of critically ill gastrointestinal patients during hospitalisation.

2. To assess the therapeutic efficacy of two protein rich kitchen-based polymeric enteral formulas in improving overall nutritional status and decreasing length of stay.

3. To compare the therapeutic efficacy between two kitchen-based protein rich polymeric enteral diets and routine hospital enteral nutrition in surgical gastrointestinal patients in improving overall nutritional status and decreasing length of stay.

4. To assess the therapeutic efficacy of protein-rich two kitchen-based enteral formulas and subsequent substrate enrichment with glutamine on post-operative surgical gastrointestinal patients in improving overall nutritional status and decreasing length of stay.

5. To evaluate the cost effectiveness between protein enriched kitchen-made enteral diets and substrate-enriched glutamine enteral formulation with existing commercial formulations.