THE EVALUATION OF THREE NASOGASTRIC TUBE FEEDINGS FOR BURNED CHILDREN

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THE EVALUATION OF THREE NASOGASTRIC TUBE

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CHAPTER I

INTRODUCTION

Malnutrition in patients with severe burns occurs frequently and its prevention and management are serious problems (13). The metabolic stress of a burn injury may involve anything from simple mechanisms of wound healing to the body's all out effort to overcome profound shock, extensive loss of tissue integrity, and persistent bacterial invasion. Nutritional support, therefore, is a crucial factor in the care of the burn patient (16). Schenk and Moylan (47, p. 42) report: "The combination of increased evaporative losses, greater radiative heat loss, and increased metabolic rate makes daily dietary caloric requirements frequently three to five times greater than the normal need." To off-set the hypermetabolism and hypercatabolism, which characterize the response to thermal injury, an increased intake of nutrients is required (33). The nutritional requirements depend not only on the extent and condition of the burn, but also on the patient's age, sex, prior nutritional state, and other pre-existing nutritional deficits which impede the body's efforts to heal damaged tissue and resist bacterial invasion.

Pennisi (40) reports the three methods of achieving adequate nutritional support for burn patients include: the hospital diet with supplemental feedings, parenteral nutrition, and nasogastric tube feedings. Individual requirements will vary and in some cases all the various methods of feeding are needed to ensure adequate intake (16).

Every effort should be made to provide a necessary oral intake; however, excessively burned patients are frequently anorexic or incapable of consuming the volume of food required to achieve their elevated nutritional requirement (3). In these cases tube feedings become necessary and can be life saving. If the patient loses 15 percent of his or her preburn weight and fails to maintain an acceptable oral intake, a tube feeding should be initiated (3). A tube feeding is a method of providing necessary amounts of all nutrients in a form easily digested and absorbed. Tube feedings may vary from a homogenized mixture of the food served in a regular diet to food combinations planned to meet specific therapeutic needs (29).

The staff at Children's Memorial Hospital Burn Unit was concerned about the poor acceptance of nasogastric tube feedings among the burned children. Previous research shows the most common error in using tube feedings is to begin with excessive volume and excessive concentration of the tube feeding (16) (30). A highly concentrated tube feeding given to patients without allowing time for the body to adapt, can result in a pulling of fluids into the intestine causing diarrhea, vomiting, cramps, distention, or nausea. These symptoms were prominent among the children in the burn unit on tube feedings. When diarrhea or other side effects occur within a few hours of the first feeding it seems to cast suspicion on the tube feeding as the cause (48). Therefore, general guidelines for tube feeding of burn patients need to be developed as a means of off-setting the hazards of improper tube feeding for patients.

Purpose Statement and Objectives

The purpose in conducting the research was to evaluate the effectiveness of three common tube feedings: Ensure, Vivonex, and a pureed tube feeding on patient's tolerance and their success in meeting the nutritional requirements for the burned child. The objectives of the study follow:

1. To determine the incidence of symptoms of intolerance for each tube feeding among the burned children through the collection of data from the medical records.
2. To evaluate the effectiveness of three common tube feedings in relation to the patients' tolerance through the number of symptoms of intolerance for the burned patients.
3. To evaluate the effectiveness of Ensure, Vivonex, and the pureed tube feeding on their success in meeting the nutritional requirements of the burned children through a comparison of their nutritional composition and the patient's ability to maintain weight.
4. To determine the effect of different volumes per hour and concentrations used to begin tube feeding on the patient's ability to retain the feeding and maintain weight.
5. To make recommendations to the burn unit staff of the effectiveness of these three nasogastric tube feedings in relation to patients' tolerance and nutritional adequacy and to recommend the volume per hour and concentration in beginning tube feedings for different ages of children.

Hypotheses

The hypotheses for the study are:

H_1: There will be no difference in the incidence of symptoms of intolerance for the tube feedings when the feedings are begun at a volume per hour and concentration that allows the body to adapt to the feeding.

H_2: There will be no difference in the ability of the three tube feedings to meet the nutritional needs of the burned child.

H_3: There will be no difference in weight stabilization or weight gains for patients fed the three tube feedings.

Assumptions

The following assumptions were used in planning the research study:

1. The patient's chart records were correct and accurate.
2. The caloric intake calculations were an approximation due to the range in nutrient content of foods and the estimation of food intakes.
3. There may be other causes for the symptoms of diarrhea, cramps, vomiting, nausea, and distention, but these affected patients in each group and should not bias the study.

Limitations

The study was limited to burned patients at Children's Memorial Hospital in Oklahoma City, Oklahoma. The study includes children through 21 years of age who received Ensure, Vivonex, or a hospital number one pureed tube feeding in 1976, 1977, and 1978. The daily nutritional food intake records were limited to the last eight months of 1977 and the first month of 1978. Approximate daily calorie counts were limited to the opening of the burn unit, February 2, 1977. The

1976 nutritional records include approximate calorie counts only at the physician's request.

Definition of Terms

The following terminology is defined as used throughout the study:

1. A severe burn was defined as above 40 percent total body surface area burned, where death almost always occurs (27).
2. Tolerance was defined for the study when the patient consumes the tube feedings without symptoms of nausea, cramps, vomiting, diarrhea, or distention.
3. A tube feeding is a method of providing necessary amounts of all nutrients in a form easily digested and absorbed. The feedings may vary from a homogenized mixture of the food served in a regular diet to food combinations planned to meet specific therapeutic needs (29).
4. An elemental diet consists of L-amino acids, simple sugars, electrolytes, trace mineral elements, and a very low fat content. This permits rapid absorption with minimal digestion (34). This type of diet is also called a chemically defined diet.
5. Parenteral hyperalimentation provides the total caloric needs by intravenous route for a patient who is unable to take food orally. Although this is extremely difficult, patients have been maintained in a healthy state for prolonged periods by placing a catheter through the subclavian vein in the superior vena cava (55).

6. Ensure is a canned lactose-free liquid tube feeding low in residue. Caloric distribution is 54.4 percent carbohydrate, 31.5 percent fat, and 14.0 percent protein (20).
7. Vivonex is an elemental tube feeding composed entirely of chemical ingredients, amino acids, pure vitamins and minerals, simple carbohydrates, and an essential fat. Vivonex is a low residue food which contains no indigestible or bulk materials to pass through to the lower bowel. Caloric distributions are 90.8 percent carbohydrate, 0.7 percent fat, and 8.5 percent amino acids (57).
8. A hospital pureed tube feeding is a milk based tube feeding containing blended foods. This tube feeding is not suitable for the drip feeding. The pureed tube feeding does not meet the daily dietary allowances recommended by the National Research Council in protein and niacin for individuals over six years of age and is low in vitamin D for all ages if only 1000 millimeters are administered to the patient. Caloric distributions are 39.0 percent carbohydrate, 42.0 percent fat, and 19.0 percent protein (54).

A comparison of the composition of Ensure, Vivonex, and the hospital number one pureed tube feeding is found in Appendix A.

CHAPTER II

REVIEW OF LITERATURE

Introduction

This chapter gives background material helpful in understanding the research study. The review of literature is divided into four sections: the burn wound, patient burn care, nutritional problems for burn patients, and the nutritional management of burn patients.

The Burn Wound

Burns in children are tragic events resulting not only in injury or death of the victim but also in disruption of family life and frequently permanent changes in future plans. One million children are burned each year, and 100,000 children are hospitalized per year for burns (35). Jacoby (28, p. 94) reports, "Burn injuries rank as the third largest cause of accidental childhood deaths in the United States." Most of these accidents could have been avoided. Children receive burns mainly through adult carelessness or childhood curiosity.

Patterns of Children's Burn Injuries

Burn injuries of children fall into an age pattern. Below the age of three, immersion scalds, such as from bath water, are common. Spill scalds occur most frequently among toddlers who pull coffee or cooking pots over on themselves. Immersion scalds and spill scalds account for 15 percent of the burn injuries of all children. Flame burns are common in older children and involve 56 percent of all burn injuries for children. Boys tend to become burned playing with matches, gasoline, and bonfires (28).

Causes of Burns

Burn wounds result from many causes. Flame, steam, hot objects, or hot liquids can cause thermal injury. Electricity, acids, alkalis, and other chemicals, poison gases, x-ray or atomic radiation, and ultraviolet light can cause changes in tissue similar to those seen in thermal burns (28). Flame burns from ignited clothing most often result in a burn from mid-thigh up, with deep burns on the anterior neck and lower face and the front trunk (3). Most scald burns involve part of the face, neck, and one side of the arm and trunk. Contact burns are well localized to the point of contact. Chemical burns, even after thorough cleansing of the wound, can progress to full thickness skin loss with destruction to underlying tissue and bone. Electrical burns can be deceiving, the external wounds may appear relatively small, but damage to underlying tissues and blood vessels can be extensive (28).

Anatomy and Functions of the Skin

The skin is the primary organ damaged or destroyed from the burn injury. The skin, the largest organ of the body, covers almost two square yards in the adult male, and serves as a tough pliable surface covering. The skin's two major layers are the epidermis and the dermis. The epidermis is the thin, outer, nonvascular layer consisting of epithetial cells which serve as a physical barrier against the environment. The thicker dermis is fiberous connective tissue containing blood vessels, hair follicles, nerve endings, sweat glands, sebaceous glands, and capillary beds (5).

The skin has many functions. Protection against infection is the most important. Everyone has bacteria residing on their skin, and in the upper respiratory and gastrointestinal tract, and if these bacteria are kept in balance, there will be no infection. In a burn injury, the skin covering is damaged and infection can occur rapidly.

Body temperature is controlled to some extent by increasing and decreasing evaporation of water from sweat glands. Insensible fluid loss is 30 to 50 milliliters per hour in a normal healthy adult. In the burned patient this may increase to as much as 300 milliliters per hour due to skin loss (4). The water vapor barrier of the body is located in the epidermis; therefore, either partial or full-thickness burns will destroy this function.

Nerve endings within the dermis of the skin send impulses from stimulus such as pressure, hot and cold, touch, and pain. In a full-thickness burn, where the skin is competely destroyed, there will be no pain to the burn patient because all nerve endings have been destroyed (5). Sensory functions return to the skin about two months after grafting, but the nerve regeneration process may continue for many years (28). The sebaceous glands in the skin secrete oil which softens and lubricates the skin. Vitamin D is produced when sunlight reacts with cholesterol compounds. Also the cosmetic effect of beautiful skin cannot be forgotten.

Burn Wound Classification

Various forms of classification are used to describe the severity of the burn injury. The classification of first, second, and third degree burns is commonly used and based on the surface appearance of the burn wound; therefore, they are not really descriptive terms (28). Full-thickness and partial-thickness are descriptive of the depth of burn. Partial-thickness burns are further divided into first degree, partial-thickness burns which involve the epidermis. The areas affected appear red or pink. Pain and slight edema are present, but both subside rather quickly. Sunburn and hot water scalds produce this type of injury. Complete healing occurs in five to ten days.

Superficial, partial-thickness burns involve the epidermis and the dermis. The burn wound appears mottled pink or red. This type of wound can heal in 10 to 14 days with no scarring, if it does not become infected. In the deep dermal partial-thickness burn wound much of the dermis and possibly the subcutaneous fat tissue are involved. This type burn can be mottled, with white areas predominating over red, or they can be dull white, tan, or cherry red in color.

Third degree, full-thickness burns have no remaining viable epithelial cells. The injury extends through and destroys all the dermal layer of the skin. These wounds can be white, tan, brown, black, or deep cherry red in color. This type of wound needs to be grafted in order to heal properly. Fourth degree, full-thickness burn injuries may involve the subcutaneous fat, fascia, muscle, and bone (28).

Degree of Burn Injury

The degree of burn injury is determined by the temperature of the heat source and the length of exposure to it. The severity of the injury depends on the extent (size) of the burned area, the depth and location of the burn, the age of the victim, and the presence of other injuries and illnesses. It is also important to know the circumstances in which the burn injury occurs. Burns occurring in enclosed areas can cause severe respiratory damage. Prolonged contact with objects of relatively low temperature can cause more damage than flash or brief scald wounds.

The extent of burn is expressed as a percentage of total body surface area burned. Survival is directly related to the extent (size) of the wound (21). Burns may be classified as: (a) under 15 to 20 percent total body surface area burns, where most patients are expected to survive, (b) 20 to 40 percent total body surface area burns, patients usually survive but some fatalities are seen which most often depends on the patient's age, and (c) above 40 percent total body surface area burns, where mortality in patients almost always occurs (27).

The depth of burn refers to partial- or full-thickness burn classification. The deeper the burn the more serious the problem. Survival is directly related to full-thickness burn injury, the greater percentage of full-thickness burn area the higher the mortality rate (4).

The age of the patient is an important factor in determining severity. Research shows patients less than two years old and over 60 years of age have a higher mortality than other age groups for a similar size injury. The older patient most likely has latent degenerative processes which may prove to be fatal. For example, a patient with arteriosclerosis may suffer a coronary thrombosis or a stroke precipitated by the stress resulting from the burn (5). The child below the age of two has a 20 percent higher mortality rate in burns because of physiologic deficiencies which include the ability to regulate temperature, thinner skin, and under developed renal and cardiovascular system (35).

Past medical history must also be taken into consideration when judging the severity of the burn. The stress caused by a severe burn may activate a latent disease process or worsen an active process. Examples are diabetes and rheumatic heart disease.

The part of the body injured influences the severity of the injury. Burns of the hands, neck, and chest may lead to an increased incidence of pulmonary problems, and burns of the perineum are prone to early infection. Burns of the hands, while covering only a small body area, usually necessitate special exercising and splints to prevent lost range of motion. Burns to the face, neck, and chest area can cause problems in the patient's ability to chew foods and swallow liquids.

Patient Burn Care

When the patient is admitted to the hospital, the respiratory needs are immediately checked for adequate airways. Respiratory complications resulting from the burn accident are either upper airway obstruction or primary pulmonary damage. In the early post-burn period, patients with burns exceeding 30 percent total body surface area experience a profound change in circulating blood volume as capillary permeability increases. Fluid containing electrolytes and plasma proteins leaks into interstital spaces, as well as from exposed capillaries at the burn site. The greatest decline in plasma volume occurs during the first 2 to 18 hours after injury. During this time a reduction in cardic output compounded by a reduced circulatory volume, can lead to severe shock, frequently with a fatal outcome.

Fluid resuscitation begins for most patients with more than 20 percent total body surface area burns (9). Electrolytes and fluid balance are maintained by the intraveneous route. Intravenous solutions of physiologic saline and other electrolytes with five percent glucose are administered to the patient. One-half the amount of fluids is administered in the first four hours and the other one-half is administered over the next 20 hours. In children, with their relatively large surface area, the insensible water loss is of critical magnitude (28).

Next, pain medication is given intravenously and the wound is cleansed. The components of wound care for all burn injuries are surgical cleansing and appropriate local treatment. Regardless of the site or depth of the sound, removal of all loose skin and the stripping of dead epidermis are imperative for wound healing. Prophylactic administration of penicillin or other penicillin type antibiotics are started on the day of injury to help prevent early infection. Blood, urine, and blood gas laboratory tests are obtained to monitor the patient's progress.

The second phase of burn care is referred to as the management phase and can last for only a few weeks or for several months. The treatment during this period includes wound cleansing, preparation for grafting, prevention and minimizing of infection, closure of burn wounds, and meeting the nutritional and psychological needs of the patient.

The burn accident itself is very upsetting. Jacoby (28) states:

> A severely burned child needs to be observed constantly for changes in mental status as well as physical status. Physiologic factors (dehydration, overhydration, electrolyte imbalance, sepsis) may modify the child's mental status (p. 97).

Nightmares, unfamiliar people and surroundings, painful treatment, and anxious relatives also upset the burned child.

Medical Treatments

The following material is the researcher's summary of medical treatments for burn patients:

1. The dietitian monitors calorie and protein intake to check on the nutritional status of the patient. Daily planned menus are needed to take into consideration the patient's food preferences.
2. Controlled environmental temperature and humidity are used at hospitals to make the patient more comfortable and decrease the rate of water loss by evaporation from the patient.
3. Dressings are used to assist in further wound debridement, protection from bacteria, stimulate granulation tissue, provide coverage of open wounds, and provide continuous temporary wound coverage after autografting.
4. Hydrotherapy is tubbing the patient in a tank to clean the burn wound and exercise the patient. Tubbing facilitates the loosening of slough, eschar, exudate, topical medications, and dressings.
5. Debridement is the removal of non-viable tissue (eschar) from the wound, which is essential to wound healing.

6. Physical therapy, occupational therapy, and recreational therapy helps maintain joint mobility and free range of motion.
7. Splints are used to prevent flexion contracture of joints and maintain full range of motion.
8. Jobst anti-scar stocking is an elastic garment to provide continuous, even pressure to the healed burn area. The jobst garment aids in the prevention of contractions, which are shortening of joint spaces that result in decreased mobility of the joints. The garment also helps soften healing skin. Some patients are prone to keloid or hypertropic scar formation and the pressure stockings are the best prevention method.
9. Medications such as pain relieving drugs and tranquilizers are used to control pain. Topical antimicrobials are used to control the number of bacteria.
10. Surgery consists of split-thickness skin grafts, autografts, or homografts, which are obtained by cutting a split-thickness or partial-thickness of the skin. The graft is taken in a long narrow sheet, usually about two to three inches wide. An autograft is the taking of a piece of tissue from one part of a subject and inserting it in another part. Homograft is tissue taken from another individual of the same species. Heterograft is replacement of lost parts or tissue by materials derived from an individual of a different species, or by synthetic or nonorganic matrials. Homografts and heterografts are only temporary wound coverage (28).

Complications for Burn Patients

The conditions of acute stress caused by a severe burn can lead to many complications; therefore, only a few of the major problems will be discussed. Constant efforts are needed to heal the wound, manage the pathological changes in organ systems, maintain optimum nutrition, and balance the need for rest with exercise. The complications leading to early mortality in thermal burns include: respiratory distress, inadequate fluid resuscitation, cardiovascular and hemotologic complications, hypermetabolism and infection.

Prevention of infection is the primary objective of almost all burn care. The burn wound can never be sterile or free from organisms, and some degree of infection is expected. The wound provides the medium necessary for bacterial growth, warmth through the body heat, moisture through body fluids, and food through dead tissue or eschar. Dressing changes, cleansing through hydrotherapy, and debridement are treatments designed to help control wound infection (5). The patient is placed on sterile sheets while personnel and visitors wear masks, gloves, and gowns.

Control of bacteria by systomic antibiotics is ineffective, except for penicillin type drugs, because the drugs cannot reach the burn wound. Topical therapy is used to prevent or suppress bacterial, viral, or fungal growth. The choice of antimicrobial agent and the form or manner in which it is used is dependent on the characteristics of the burn wound and the stage of care. The wound is monitored by frequent biopsies, and the topical agents are changed according to the flora of the wound. If the bacteria is not controlled, partial-thickness burns can convert to full-thickness burns by the septic destruction of viable epithelial cells. Gram-negative organisms (Klebsialla, Serratia, Pseudomonas, Escherichia coli, and Protius) are the hardest to control. Jacoby (28, p. 83) describes invasive burn wound sepsis as ". . . 100,000 [10^5] organisms in each gram of tissue involved on wound biopsies."

Cardiovascular, pulmonary, renal, gastrointestinal, and endocrine systems failure occurs often with severe burn injury. Failure of the cardiovascular system is the most frequent organ system complication. Any type cardiovascular complication may occur in the severely burned patient because the cardiovascular system assumes the major burden of response to stress following a severe burn. Heart failure is the third most common cause of death in burn patients (5). Careful monitoring of vital signs, laboratory results, and physical changes make it possible to detect complication early and hopefully prevent irreversible conditions.

The primary complication of the gastrointestinal tract is Curling's ulcer, a stress peptic ulcer, secondary to the burn injury. Decreased absorption of nutrients is a common complication of the gastrointestinal tract. Paralytic ileus may occur immediately following the burn injury. Paralytic ileus is the paralysis of the intestinal wall with distention and symptoms of acute obstruction. Once bowel sounds return, the patient is put on a progressive diet.

A patient with a severe burn may experience many metabolic problems. Debilitation of the patient is best prevented by careful monitoring of the patient's nutritional intake to make sure the patient is receiving adequate calories, carbohydrates, fats, proteins, as well as vitamins, minerals, salts, and water. Metabolic acid-base disturbances, such as metabolic acidosis and metabolic alkalosis may also be seen. Hypernatremia, the increase in blood sodium, can occur in the burned patient.

The Rehabilitative Phase

The rehabilitative phase takes many years for a severely burned person. In many instances, discoloration and rough appearances will fade and smooth out in time, especially with the use of jobst garments. Hypertrophic scars and contractures need to be exercised and regrafted. Unless function is markedly impaired, surgery for burned children is delayed until tissue maturation occurs. There is no easy path for aiding the severely disfigured or functionally impaired burn patient, but with proper support, he or she can be helped to realize maximum capacity to lead as normal a life as possible.

Nutritional Problems of Burned Patients

Metabolic Response to Thermal Injury

Before any form of nutritional management can be attempted, it is necessary to first assess the seriousness, or degree of the burn injury (2). In general, the metabolic response to injury for patients with burns may be altered by: (1) age and stage of development, (2) sex, (3) the extent and depth of the burn injury, (4) preburn nutritional status, (5) physical condition, or (6) pre-existing disease. Blackburn and Flat (12) list other major variables to be considered in the formation of a nutritional support plan as the body surface area, whether a child or an adult, degree of hypermetabolism, presence of secondary organ failure, and/or sepsis.

An increase in metabolic rate and tissue wasting characterizes the response to burn injury (44). The body metabolism is thought to be speeded up by the response of the adrenal glands to the shock of the burn injury, the so called alarm reaction (46). Wilmore (60, p. 1005) reports, "A major burn is distinguished by increased adrenergic activity, a shift of body substrate from storage to utilization and an increase in energy requirements." The resulting increase in metabolic rate is accomplished by diminished energy storage and increased energy utilization directed toward maintenance of body function and preservation of the vital organs.

A major burn elicits a maximal or near maximal response to stress. Pruitt (44) states:

> The relationship of metabolic rate to increasing burn size has been found to be a curvilinear function with increased metabolic rate in patients with burns of more than 40 percent of the body surface approaching two to two and one-half times normal (p. 398).

Patients with burns less than 40 percent total body surface area burned probably will not have fully tapped their physiologic reserve, and injuries or disease states other than the burn wound can modify the metabolic response to injury by imposing additive stress. Davies and Liljedahl (17, p. 160) report, "When the burned area exceeds one tenth of the body surface the environmental temperature significantly affects the basal metabolic rate." Davies and Liljedahl (17) further state:

> In a warm environment, patients with burns covering 20% to 30% of the body surface have basal metabolic rates that are approximately 25% above the expected normal value. When the burned area covers about half of the body surface, the basal metabolic rate will vary between 30% and 50% above normal (p. 161).

When the burned area is over 60 to 85 percent of the body surface area, the basal metabolic rate will reach twice the normal value and may be greater than 75 percent above normal for the first three weeks postburn. The hypermetabolism found in burn patients extends from the third post-burn day until the burn either heals or is grafted, and is associated with hyperdynamic circulation, elevated skin temperature, hyperventilation, and markedly increased evaporative water loss (44).

Increased water loss from the burn wound results in surface cooling and may stimulate metabolic heat production to maintain body temperature (61). For every liter of water evaporation from the surface of the body there is a loss of 580 kalcalories. Since evaporation losses in major burns are usually between two and one-half and four liters daily, 1440 to 2300 kalcalories are needed to prevent a fall in body temperature (25).

Since increased oxygen consumption and insensible water loss are both correlated with burn size, it has been thought that increased evaporative water loss is the principal reason for hypermetabolism in the burn patient (6). Studies by Zawacki et al. (63) suggest that the raised metabolic rate observed in burned patients is not the direct result of the evaporative water loss, since prevention of this evaporative loss by covering the burned area with an impermeable plastic film for periods of 12 hours does not significantly reduce the elevated metabolic rate. Camp and Kinney (25) and Davies and Liljedahl (17) believe these conclusions may not be contradictory if the period of 12 hours is insufficient to cause a dramatic change in heat production.

Wilmore's (61) study shows burn patients remain hypermetabolic in a warm environment and in general, when exposed to a cooler environment, maintained or even slightly increased their already elevated metabolic rate, while their body temperatures remain higher than those of normal controls subjected to the same ambient temperature. These findings indicate that between temperatures of 25° C and 33° C, the burn patient is internally warm, not externally cold, and that this hypermetabolism is related to a change in metabolic activity and not to increased evaporative water loss and surface cooling. The decreased metabolic rate due to temperature has lead most burn units to use controlled environmental temperatures to promote patient comfort and lower caloric demands.

The sequence of metabolic events occurring after thermal injury is related to hormonal control. Following burn shock, the sympathetic nervous system may change temperature regulation while stimulating an increased production of catecholamines. The increased catecholamine production augmented by the action of glucagon and gluconeogenesis, regulates substrate mobilization and stimulates calorigenesis. Evidence of this activity is the elevation of fasting blood glucose concentration above normal, a rise in insulin production and the increased excretion of catecholamines. Glucose flow parallels oxygen consumption, is elevated during periods of negative nitrogen balance and returns to normal levels when weight stabilization and nitrogen equalization are achieved in patients (61).

Many healthy, well nourished patients before the acute burn trauma deplete their fat and protein stores within two to four weeks because of major catabolic responses to the trauma. Death can occur from muscle weakness, respiratory failure, and sepsis (46). Vaporizational heat loss and increased adrenergic activities are considered the primary reason for the increased metabolic rate for the burn patient. Metabolic demands also increase markedly with pain, fear, anxiety, fever, shivering, inflammation, and infection. Early wound closure helps return the patient to metabolic equilibrium.

Weight Loss

The intake in the early days after the burn injury is low, while at the same time this is the period of the most severe catabolic response. Thus, with the low nitrogen intake and the high nitrogen output, a deficiency is rapidly built up. The body will attempt to reduce this deficit by drawing on its own stores of protein and fat, and it is this stage in which the most rapid and severe weight loss occurs (52).

Extensive weight loss commonly occurs in burn patients. It is estimated that patients with large burns lose between one-fourth to one-third of their preburn weight during recovery from the injury. A greater weight loss is associated with a greater extent and depth of burn; therefore, calorie supplementation is of critical importance since severe and rapid weight loss can cause death for the patient (27). Wilmore (61) reports:

> Patients with injuries greater than 40 percent total body surface burned predictably lose more than 20 percent of the initial body weight if vigorous nutritional support is not instituted. Weight loss over approximately 40 percent of pre-injury weight is fatal (p. 609).

Wilmore (61, p. 609) states, "weight loss over 10 percent of normal body mass is usually detrimental." Controlling the rate of weight loss and establishing a loss of 10 percent body weight as a limit are important guidelines for the nutritional care of individuals with small thermal injuries; however, this limit may be impossible to maintain in patients with burns greater than 40 percent of the total body surface.

Whatever the extent of burn, body weight is an excellent indicator of the effectiveness of the nutritional therapy for the patient (27) (47). Maintaining the patient's weight allows for better acceptance of skin grafts, epithetial growth, and a reduced need for blood transfusions. Schenk and Moylan (47, p. 42) state, "The initial increase in body weight, a consequence of fluid resuscitation, is followed by a period of sustained weight loss, which may at times exceed one percent of preburn weight per day." Weight loss can continue indefinitely and may in itself be lethal depending to some extent on the patient's preburn state of nutrition.

Protein

The most significant nutritional problem in burn care is the loss of protein nitrogen associated with the burn injury. Crenshaw (16, p. 5) states, "In the healthy adult, the synthesis and breakdown of protein are in equilibrium at a daily protein intake of .5 to 1.0 grams per kilogram body weight." Artz (1, p. 224) states, "A severely burned adult needs about 3 grams of protein per kilogram of body weight and about 30 calories for each gram of protein." Soroff, Pearson and Artz (49) estimate that the daily protein needs of burned patients should be two to four times the 0.8 grams per kilogram of body weight required by normal man.

After the onset of disease or a burn injury, the breakdown of protein speeds up, and the appearance of nitrogen and potassium in the urine indicates that tissues are breaking down faster than the body can restore them. Nitrogen excretion provides a reliable estimate of the actual protein losses; one gram of urinary nitrogen reflects the loss of 30 grams of lean body tissue, which is equivalent to 6.25 grams of protein.

Post-injury catabolism accounts for the increased nitrogen loss by mobilizing amino acids from body protein stores within the liver, converting their carbon fragment to glucose and their nitrogen residual to urea (17). The period of increased catabolism lasts for varying periods of time depending on the severity of the injury, the rate of wound healing, and the nitrogen and caloric intake.

Protein metabolism is speeded up in response to the initial stress of the burn injury. Protein anabolism may be inefficient because of important hepatic and pancreatic function and hormonal disturbances (47). The demands of the body for protein are increased by the process of repair and healing. Hypermetabolism and healing are the primary causes of increased protein needs. Pruitt (44) states:

> The postburn negative nitrogen balance will be further increased by additional stress, such as anesthesia or a septic complication, bedrest, muscle inactivity, ambient temperature below 25°C., and an inadequate nutritional intake (p. 401).

While catabolism is the main cause of the depletion of body protein, exudate also contributes significantly to the depletion of plasma proteins (18). Jacoby (22, p. 76) states, "It has been determined that two to three grams of protein can be lost each day from each percentage of body surface wound draining exudate." Protein loss from the burn wound contributes approximately 20 to 25 percent of the total nitrogen lost from the body in the early postburn period (36) (53). Protein losses decrease in time and return to normal with wound closure (44) (61).

The increased protein requirement is greatest during the first four weeks, then decreases slowly. Davies and Liljedahl (17, p. 166) report, "During the first week after burning there is an increased rate of breakdown of protein that may provide up to one-third of the extra calorie requirements." All body protein is consumed at some cost, since all is functional in some way.

Since energy, as well as amino acids, is necessary for positive nitrogen balance, the proper ratio between dietary protein and non-protein calories is necessary for optimum use of protein. Protein ingested in excess will be used as an energy source rather than for protein synthesis during the first week of the burn injury. It is necessary to provide additional calories to spare, as far as possible, the breakdown of body proteins and to furnish energy needed in connection with the utilization of administered protein for tissue repair (26). Positive nitrogen balance was most likely to be achieved when both nitrogen and caloric intake were high (56).

It is well known that healing does occur in the presence of negative nitrogen balance although it is felt to be somewhat delayed. It is also true that persistent negative nitrogen balance results in serious debilitation, decreased muscle mass and tone, poor appetite, increased susceptibility to infection, poor granulation tissue, poor acceptance of skin grafts, and delayed healing of donor sites. These complications are often responsible for the death of the poorly treated patient (3). With resting starvation, man could survive two months without nutrition. However, in the burn patient losing 30 grams of nitrogen and up to one kilogram of body mass per day, fatal starvation may occur in three to four weeks (61).

Carbohydrate

The body normally uses carbohydrate as its direct fuel. Crenshaw (16, p. 6) reports, "It is used so readily that it comprises less than one percent of our body stores of calorigenic substances." The body stores of carbohydrate, mainly glycogen (about 200 grams), are rapidly catabolized following a burn injury (17). The limitations of glycogen stores for conversion to glucose necessitate that amino acids be mobilized primarily from muscle protein to provide glucose for the increased energy needs of the burn patient (17).

Carbohydrate metabolism may be deranged following a severe burn, and hyperglycemia and glycosuria may be present (52). A high calorie, high carbohydrate diet can cause pseudodiabetes. This condition is manifest by high urine output and high urine specific gravity (28).

Fat

Extraordinarily large fat losses may occur during the burn patient's recovery. In severely burned patients the rate of catabolism of fat may increase until as much as 600 grams are mobilized and catabolized per day, thereby liberating more than 5000 kalcalories of energy (28). Carbohydrate is required if ketosis is to be prevented. Kenney (31) noted that the ratio of fuel burned in stress patients was remarkably constant, with 80 to 85 percent of the calories from fat and the remaining energy coming from the body protein stores. The fat loss may continue at a slower rate even in the presence of a positive nitrogen balance.

Vitamins and Minerals

Vitamin requirements of the sick and injured are not well established but it seems desirable to increase the intake above the recommended level for healthy individuals. Disease may indirectly upset the mechanisms controlling the metabolism of essential nutrients, thereby altering dietary requirements. The requirement of ascorbic acid for the burn patient is certainly raised and it is reasonable to assume that at this time of intense tissue activity, other vitamins are required in greater amounts, so an ample supply should be provided (52).

Zintel (64) reports:

> . . . when a serious illness or severe trauma or burn exists the requirement for the first few days is five to ten times the recommended daily requirement. Thereafter, the patient should receive two to three times the minimum daily requirement until recovery is complete (p. 1053).

Schenk and Moylan (47, p. 43) suggest, "Usual supplements recommended include ascorbic acid (2 gm), riboflavin (50 mg), thiamine (50 mg), nicotinamide (500 mg), folic acid (1.5 mg), and vitamin B_{12} (4 µg)." Zintel (64) also suggests particular attention be given to the burn patient's intake of ascorbic acid, vitamin K and B_{12}. Administration of supplemental potassium (80 to 250 mEq/day) may be required. Preparations of calcium, zinc, magnesium, and phosphorus are not routinely necessary, but deficiency states can develop in burn patients.

Factors Hindering Adequate Nutritional Intake

Many factors can hinder the nutritional intake for the burn patient. Most patients may not eat for periods of a few days to weeks if complications occur (46). Because of intense early catabolism, mobilization of edema fluid, and frequent paralytic ileus, it is rare to achieve weight gains in the initial weeks post-burn (47). Facial burns, oropharyngeal thush, obtundation, and the ileus that commonly accompanies sepsis may prevent oral intake. Vomiting which occurs often during the burn patient's recovery can be caused by gastric dilalation, from swallowings, or it may indicate Curling's ulcer, sepsis, or superior mesenteric artery compression of the duodeum.

The loss of appetite may result from emotional reaction, pain, fatigue, unfamiliar surroundings, or unfamiliar foods. Patients receiving parenteral hyperalimentation frequently have no appetite for oral feedings. One of the greatest deterrents to adequate nutritional intake is the use of narcotics since many of these agents cause anorexia, nausea, and constipation. Trips to surgery, dressing and tubbing procedures can cause the patient to miss meals which interfers with proper nutrition. It is helpful if painful procedures are not scheduled immediately before mealtime.

Nutritional Management of Burn Patients

Adequate nutritional support may make the difference between survival and death in a patient having a severe burn (3). The patient with an extensive burn has a markedly increased caloric need which frequently exceeds that of patients with any other disorder (26) (46). Studies by Blocker et al. (13) indicated higher levels of both protein and caloric levels were needed by the burned child and Becker and Artz (10) proposed a 50 to 100 percent increase over the National Research

Council's Recommended Daily Allowance for the same child in health, depending on the extent of the injury.

An unsatisfied caloric demand leads to weight loss proportional to the extent of the burn, unhealthy granulation tissue, poor acceptance of skin grafts, delayed epithelialization of partial-thickness burns, and derangement of cellular metabolism (47). Cope et al. (15) report that following extensive thermal injury the caloric requirements are increased for as long as two months after the accident. The presence of certain conditions such as sepsis, operative trauma, and emotional stress increase caloric requirements (47). Undernutrition has also been associated with increased operative morbidity, and increased incidence of complications during convalescence resulting in prolonged hospitalization, and a delay in return to a useful life (51). In spite of the most appetizing meals, patients rarely receive the necessary calories, because of the quantity of nutrients required and the neurohormonal changes caused by the injury. To correct nutritional deficiencies the burn patient should be given a high calorie, high protein diet, with supplemental high protein snacks (42). A diet of a seriously burned patient must obviously contain a balanced mixture of protein, fat, carbohydrate, vitamins, minerals, as well as an adequate total of calories and water.

In minor burns, oral feedings are usually well tolerated after the initial shock of the injury wears off (28). Most physicians withhold oral fluids from patients with moderate or major burns for 24 hours or longer. These patients are often nauseated and have a tendency to vomit. In a patient without complications, a good intake should be attainable within 7 to 10 days (3). After bowel sounds are heard the patient is put on a progressive diet. At first the patient cannot tolerate large quantities of food or fluids; therefore, small quantities at frequent intervals are given to the patient.

Maintaining the patient's weight and meeting the calculated nutritional requirements are the two main dietary goals. Weight loss is the most consistently reliable indicator of long term caloric balance. Schenk and Moylan (47, p. 44) report, "If necessary, a ten percent weight loss can be tolerated, but a 15 percent loss should be viewed as cause for concern since this level is associated with increased morbidity and mortality."

Obviously, some variable in caloric requirements will be encountered from patient to patient, but the following formula sets a daily dietary program that should minimize weight loss and complications of severe post-burn malnutrition. Pennisi (40) and Batchelor and Sutherland (8) recommend the following basic formulas to calculate the patient's protein and caloric requirements:

Energy requirement: Adult--20 Kcals. x Kg. body weight + 70 Kcals. x percent burn

Child--60 Kcals. x Kg. body weight + 35 Kcals. x percent burn

Protein requirement: Adult--1 gm. x Kg. body weight + 3 gm. x percent burn

Child--3 gm. x Kg. body weight + 1 gm. x percent burn.

Davies and Liljedahl (17, p. 16) suggest, "Patients with very extensive burns (over 50% of the body surface) should receive a protein and calorie intake appropriate for a burned area of only 50% of the body surface." These formulas are based on body size and magnitude of injury which allows for rapid and reliable estimates of calories and protein requirements. By using these formulas appropriate early dietary supplementation can be started for the patient.

The dietitian must be in close contact with the patient in order to determine whether appropriate caloric intake is maintained. Food and fluid intake records for each patient are helpful in ascertaining the patient's intake. The daily totals should be checked and supplemental foods added if necessary (28).

The patient should be treated as an individual by the use of individualized menu selection or individualized diets. A diet history including food preferences and eating patterns must be used in planning the patient's nutritional program. The patient should be encouraged to eat as soon as possible. Great ingenuity is necessary to find acceptable foods for anorectic children. In some cases, it is not unusual to have food become a convenient scapegoat under which the patient may vent his hostilities, since eating provides one of the few areas in which the patient can resist or express anger.

Burned children need supervision, help, company, encouragement, and patience during mealtime. Long handled eating utensils which allow patients with bulky dressings on their hands and arms to feed themselves give the patient a sense of accomplishment and may encourage the patient to eat (35).

The most appropriate method for achieving adequate nutritional support for the individual patient should be planned for the patient. Pennisi (40) reports three methods for achieving adequate nutritional support for the burn patient: the hospital diet with supplemental feedings, parenteral nutrition, and nasogastric tube feedings. The patient with a small burn can usually receive adequate intakes on the hospital diet with high protein supplements.

Sutherland and Batchelor (52) describe a nutritional management plan for the burn patient combining tube feeding with a free diet. The advantage of this combination of tube feeding and free diet makes it much easier to ensure that the necessary intake is reached and the patient is not harassed by constant attempts to eat what he is given and he can select what he wants to eat. The meals must be planned so as not to overload the patient's alimentary tract.

Tube Feeding

The importance of nasogastric feeding in serious illness was first appreciated by John Hunter in 1776, and in 1790 he achieved complete nasogastric alimentation for 18 days in a man with paralytic dysphagia (39). Tube feeding by indwelling nasogastric tube becomes necessary for those with more severe injury and for those who, for varying reasons, may refuse to take an adequate intake orally. Harper (26) reports that during the convalescent period of severe burn patients, it is almost inevitable to resort to some type of tube feeding to maintain the patient's weight. Sutherland (52, p. 71) states, ". . . the dividing line has been found to be around a 35 percent burn, patients below receive oral supplement, those above being tube fed."

Indications for the Use of Tube Feedings. Psychological problems, such as anorexia, food prejudices, and depression, can cause resistance to ingesting food by mouth. For the burn patient, nutritional needs may be increased beyond what can reasonably be obtained from the hospital diet. Although oral feeding is preferable, tube feeding may be essential in patients who have mechanical difficulties in chewing and swallowing.

Protein Sources Used in Tube Feedings. These include purified beef, casein salts, egg albumin, skim milk powder, hydrolyzed casein, or individual amino acids. Excessive protein can cause water to be drawn from the body resulting in dehydration unless sufficient extra fluids are provided. Protein not needed by the body has to be excreted as urea through the kidney and an excessive amount of urea may result in azotemia (19).

Fat Sources Used in Tube Feedings. Fat contributes to a higher caloric ratio without increasing the osmolality and often gives a formula greater palatability. The amount of fat added to any specific formula is based on the patient's caloric requirement, his requirement for essential fatty acids, and his ability to absorb fat without significant increases in diarrhea or steatorrhea and loss of minerals and electrolytes in the stools. A high level of fat tends to remain in the stomach too long and can cause regurgitation and possibly aspiration. Too little fat can cause gastric contents to empty from the stomach more rapidly (29).

Carbohydrate Sources Used in Tube Feedings. These include fruits, cereals, vegetables, corn syrup solids, glucose, sucrose, lactose, glucose oligosaccharides, dextrins, inverted sugar, and starches in any combination. The percent of calories from carbohydrate range from 40 to 90 percent, depending on the formula. The type of carbohydrate is a factor in influencing the osmolality of a formula. The osmolality of blood is about 300 mOsm per kilogram solvent (water). Therefore, an ideal tube feeding product should have a similar osmolality. A fluid of this osmolality would be termed as essentially isotonic and would not tend to draw water into the intestine.

The more hypertonic a formula is, the more carefully administered it must be to avoid problems of diarrhea or "dumping syndrome". Cornstarch, maltodextrin, and oligosaccharides give additional carbohydrate calories, while minimizing the osmolality and the sweetness of the formula. For some patients, the level of electrolytes is very important to compensate for inadequate absorption or losses due to diarrhea or vomiting.

The Initial Feeding and Progression of Tube Fed Patients. The recommended technique for using the tube feeding is to aspirate the stomach immediately prior to giving the next feeding. It is not unusual to find 200 or 300 milliliters of fluid remaining in the stomach at this time. This is composed of the previous tube feeding plus the normal gastric secretions, and the volume aspirated frequently exceeds the amount given during the preceeding feeding. If one were to add an additional 100 to 150 milliliters of tube feeding on top of this, the problem is compounded and the risk of regurgitation and aspiration greatly increases (52). The adequacy of gastric emptying of the infused volume must be ascertained by aspiration of residual intragastric content prior to each tube feeding to adjust the infused volume or omit a scheduled feeding if necessary. Kaiser (29) suggests if more than 50 milliliters remain in the stomach, the feeding should be held and the physician notified.

Enteral feeding should be started cautiously and increased progressively as tolerated, with care being taken to avoid gastric over loading and its associated risk of emesis and aspiration. Tube feedings should be started slowly, at rates of not more than 40 to 50 milliliters per hour for adults. Harper (26) recommends a gradual increase over a period of a week to 10 days to a maximum of 100 to 200 milliliters every two hours. Kaiser (29, p. 30) states maximum levels in concentration and volumes are individual for patients but ". . . a realistic maximum would seem to be no greater than 360 milliliters given every three to four hours, which also includes additional water."

Administration of most formulas are best tolerated in small doses, one-half strength the first day, progressed to full strength as tolerated by the patient (14) (45). Begin by increasing only the concentration but not the volume each day. Once the concentration is reached the volume can be increased as tolerated.

The Problems Related to Receiving Tube Feedings. When tube feeding comprises a major part of the daily diet, dehydration can become a problem if sufficient fluids are not provided to permit the excretion of an adequate urine volume. Unless a patient is carefully observed, tube feedings may cause gastric dilatation, regurgitation of food and aspiration especially in children and seriously ill patients. These symptoms are related to too large a volume of formula or too concentrated a mixture as well as a lack of sufficient feeding rest periods during the day. Nasogastric tubes left in place for prolonged periods irritate the nasal mucosa and increase the incidence of infections in the pulmonary tract.

Constipation can be a problem in tube fed patients. If constipation occurs there may be some value in increasing vegetables and fruits in the feedings. Milk and milk products can be constipating for some people so a reduction of these products may be helpful in the pureed tube feedings. Diarrhea caused by lactose intolerance is sometimes seen in patients on milk based formulas. Bloating and gas can accompany diarrhea which may be due to too frequent and too large a volume of tube feeding. Despite the risk, tube feedings are extremely valuable when sufficient protein and calories cannot be taken by any other method.

The Choice of Tube Feeding. No single tube feeding can fulfill the nutritional requirements for all patients; therefore, a choice of the most appropriate tube feeding for each individual patient is the best practice. The commercial formulas range from blenderized natural foods to highly purified defined formula diets. Most commercial formulas meet or exceed the recommended dietary allowances for individuals in vitamins and minerals. Ready to use liquids can be stored at room temperature, opened and used immediately. When deciding on a tube feeding the price of the product should be considered. When hospital labor costs are added to the homemade formulas the cost balances out with the commercial formulas (14).

Pureed tube feedings can be made of natural foods which provide excellent sources of protein, fat, carbohydrate, vitamins, minerals, plus all other discovered and yet to be discovered essential nutrients (7). The contents of the feeding must be of a consistency to pass through the feeding tube without clogging the nasogastric tube. Care must be taken in sanitary preparation of the tube feeding using sterilized utensils. Only a 24-hour supply of the tube feeding should be made at one time for the patient.

The term elemental diet has been applied to diets which provide for the nutritional management of patients requiring nutrients in an easily digestible and absorbable form (37). Various formulations of complete and partial elemental diets for oral nutrition have been used since 1930. In contrast to standard liquid diets of tube feedings, the elemental diet derives approximately 80 percent of its calories from carbohydrate and only 0.4 percent from fat. The obvious advantage over intravenous hyperalimentation is that it does not require an indwelling intravenous catheter and the risk of septicemia is eliminated. The elemental tube feeding allows for a smaller, more comfortable tube because there are no problems with clogging the tube. The gastrointestinal tract must be functioning, or at least partially so before beginning oral alimentation. The nutrients are rapidly absorbed in the upper gastrointestinal tract with minimal necessity for digestion.

A patient who is on an elemental diet exclusively will pass only one small stool every three to nine days, the average being about seven days. Since the stool is one major source of infection in the burn injury, reducing the stool bulk will also reduce the source of infection. The low fat content of the elemental diet does not delay gastric emptying, and the feeding will pass into the small intestine without difficulty, thus regurgitation and aspiration are avoided.

<u>Parenteral Hyperalimentation</u>

Parenteral nutrition is life saving for the burn patient who is too physically depleted to get proper nutrition orally. Many burn patients do not tolerate tube feedings so parenteral hyperalimentation becomes necessary. Since the pioneering work by Dudrick, intravenous hyperalimentation has come to be used with increasing frequency.

The basic component of parenteral hyperalimentation solutions is carbohydrate, usually in the form of glucose. This feeding may be a solution of 20 percent glucose and 3.5 percent protein as amino acids, providing approximately 0.94 kalcalories per milliliter. The rate of infusion is one of the factors which affects utilization of intravenous administration of nutrients and the incidence of adverse reactions. Too fast a rate produces marked diuetic effects, and increased urinary loss. Strate (50) reports:

> Better utilization is obtained if the infusion is given at a steady rate over a 24 hour period. The rate of infusion must begin slowly at 1,000 to 1,500 cc per hour then gradually increased up to 3,000 to 4,000 cc per hour over the next few days (p. 2).

Most commonly a catheter is threaded through the subclavian or jugular vein into the superior vena cava where blood flow is rapid and the infused solution is quickly diluted with blood. It is important to keep the insertion site of the catheter surgically clean to prevent the spread of bacteria along the catheter's tract. Septicemia and phlebitis are two of the major drawbacks of this technique of nutrition. The danger of catheter related sepsis is considerable in the burn patient because of the large number of surface bacteria colonizing the burn wound (62). The mortality from septic complications in burn patients is 30 to 50 percent and when the subclavian catheter must be inserted through burn eschar, this figure approaches 75 percent (43).

The demonstration that up to 5,000 kalcalories per day could be provided exclusively by vein with resultant weight gain, positive nitrogen balance, wound healing and in the treatment of pediatric patients, normal growth and development prompted utilization of this feeding technique in thermally injured patients (62).

CHAPTER III

RESEARCH PROCEDURES

This chapter includes the methods and procedures employed in implementing the research study. The type of research, sample plan, instrumentation for collecting the data, and the analysis of data are discussed in detail.

Type of Research

The descriptive research design will be used in collecting the data. Best (11) defines descriptive research as:

> The description, recording, analysis, and interpretation of conditions that now exist. It involves some type of comparison or contrast and may attempt to discover relationships that exist between existing nonmanipulated variables (p. 15).

The study will analyze medical records to evaluate three common tube feedings. The medical record, a primary source of information, is accepted as valid and a proper basis for interpreting the hypotheses. The weakness of the research design will be the lack of control over the recording of the data in the patients' medical charts.

The independent variables include: Ensure, Vivonex, and the hospital pureed tube feeding. The dependent variables are the incidence of intolerance, the difference in the success of each tube feeding in meeting the nutritional requirements for burned children, and the amount of tube feeding received by the patient.

Sample Plan

The total population of burned patients having received tube feedings in Oklahoma was not available to the researcher; therefore, the largest population of hospitalized burned children in the State was at the location for the study. The deliberate selection of the only children's burn unit in Oklahoma was designated for the study.

All burn patients at Children's Memorial Hospital receiving Ensure, Vivonex, or a hospital number one pureed tube feeding during 1976, 1977, and 1978 were included in the study. Only three years were included in the study since the hospital pureed tube feedings were mainly used in the preceding years. All in-patient medical records were checked for the use of these tube feedings if the burn is over 10 percent of the total body surface of the patient or for patients with burns to the face and neck, since this includes the patients needing tube feedings. The hospital burn logs were used to locate burn patients meeting this criteria.

The Hospital Burn Unit

The burn unit is a 10 bed intensive care unit which also includes an in-service classroom, offices, out-patient treatment area, patient playroom, and the hydrotherapy room. The unit has a snack area which is stocked with supplemental foods for the children. These items include: weiners, bologna, cheese slices, bread slices, crackers, malts, cookies, ice cream, cokes, seven-up, fruit juice, fruit, whole milk, buttermilk, chocolate milk, gelatin, pudding, and sandwiches.

The dietitian visits each patient to discuss his or her food likes and dislikes. If the patient cannot discuss his or her food preferences, a family member is interviewed. Daily caloric intake records are kept to provide information on the patient's nutritional progress. If a patient is not eating well, the physician will prescribe a tube feeding. When the patient is discharged, the patient and mother are instructed on a dietary home care plan.

The burn unit utilizes the team approach in helping the patient. Burn unit rounds are held every Tuesday and Friday so the burn team consisting of a nurse, dietitian, therapists (occupational, physical, and recreational), social worker, and occasionally the chaplin can discuss problems. A burn conference is held once a month to discuss each patient's progress and provide feedback from each medical team member. An in-service class is held in the burn unit every week and all members of the unit team are urged to attend these classes.

Instrumentation

In order to measure the tolerance of the three tube feedings the incidence of nausea, vomiting, consistency and frequency of stools, and abdominal distention were recorded and analyzed. The tolerance parameters were collected from the nursing procedures, progress notes, and the Intensive Care Unit Day Sheet (ICUDS). The nutritional information was obtained from the caloric intake records in the progress notes and from the food intake records.

Plans were made to cross check the charted material from the medical records. Tube feeding fluid volumes were recalculated to check the dietitian's caloric intake record charted in the progress notes. The material recorded on the graphic sheet (fluid volumes, stools, and vomitus) was used to recheck the material charted on the Intensive Care Unit Day Sheet. The daily food intake was recalculated using the United States Department of Agriculture Handbook No. 8 as a cross check for the protein and caloric intake of the patient. Tolerance parameters were interpreted from the patient's chart and recorded as a direct quote so another dietitian could spot check the interpretation.

The information for the research study was gathered from the following records in the patient's chart:

1. Physician's Orders were used for obtaining the diet orders, type, concentration, volume per hour, and specific procedures in relation to the use of tube feedings, such as aspirating the stomach before beginning each feeding.
2. Progress Notes included records of the patient's acceptance of the tube feeding. Approximate daily caloric intake for each patient was found in the progress notes. The percentage of calories coming from the tube feeding was obtained from the caloric intake records.
3. The Intensive Care Unit Day Sheet gave information about the number and consistency of stools, fluid intake records, aspirations, and medications. The nursing procedure notes gave information on the patient's progress on the tube feeding and any symptoms of intolerance.
4. The Graphic Sheet listed the fluid volumes, number of stools, vomitus, weight, and diet.
5. The Burn Estimate and Diagram Sheet gave the percentage of total body surface area burned for each patient, age, sex, and pre-burn weight of the patient.

Samples of the medical records used in the research study are found in Appendix C.

The research data was collected on the record sheets found in Appendix D:

1. The daily Food Intake Records gave all the liquid and food consumed by the patient. These records were recalculated to determine the caloric and protein intake of the burned children.
2. The Pediatric Burn Patient Nutritional Records were used to record the nutritional information for each patient.
3. The Tolerance Parameter Record Sheet was used to record the number of incidences of intolerance for the patients on the three tube feedings. Intolerance for stools was recorded if there were three or more liquid or loose stools or five or more stools per day. If any incidence of nausea, emesis, abdominal distention, or abdominal pain occurred these were recorded on the Tolerance Parameter Record Sheet.
4. The Weight Record Sheet was used to record the patient's daily weight.
5. The Research Graphic Sheet was used to record material from the patient's medical record Graphic Sheet.
6. The Tolerance Quote Record was used to record the patient's tolerance to the tube feeding as a direct quote from the Progress Notes and the Intensive Care Unit Day Sheet.

Analysis of Data

The first objective in analyzing the data was to categorize the patients into one of the three groups of tube feedings. A chart was prepared showing each patient by number and the following information: age, sex, kilogram preburn weight, percent body surface area burned, days on the tube feeding, post-burn days studied, and the outcome.

The number of incidences of nausea, vomiting, consistency and frequency of stools, and abdominal distention were recorded and charted for patients with one or more symptoms of intolerance (Appendix E). These symptoms of intolerance were recorded and analyzed for the first two weeks or for the full length of tube feeding the patient. The percentage of patients with symptoms of intolerance to the tube feedings was charted and compared.

The patient's caloric and protein intake was calculated from the food intake records when these records were available for the study. The distribution of calories was recorded to arrive at the actual caloric intake (Appendix F). The actual caloric and protein intakes were compared with the caloric and protein requirements. The percentage of caloric and protein intakes were determined for the study.

The objective of analyzing the burned children's weights was determined by comparing the patients' weights on the day of discharge from the hospital and the patients' lowest weights. The means of the patients' weights in the three groups of patients on the tube feedings were compared to determine which group of patients gained the most weight.

The last objective of analyzing the administering of the tube feeding to the burned children was done by recording the number of patients meeting the recommended criteria for using a tube feeding. The percentage of patients meeting the recommended criteria for using the tube feeding was compared for the three groups of patients.

CHAPTER IV

RESULTS AND DISCUSSION

The findings of this study will be discussed in this chapter. The description of the sample, analysis of the number of incidences of intolerance, analysis of the nutritional composition of the tube feedings, 24-hour nutritional analysis, analysis of the burned children's weight changes, and the evaluation of the initial feeding and progression of the tube fed patients will be presented in detail.

Description of the Sample

Twenty-two patients were on one of the tube feedings for at least three days. Two patients were on two of the feedings in the study. Six patients were on Ensure; eight patients were on the hospital pureed tube feeding; and eight patients were on the Vivonex elemental diet. The children were between the ages of nine months and 19 years old and had burns covering between 8 and 70 percent of their bodies. Two patients died because of their burn injury. A summary of the burn children in the study is presented in Table I on the Case Material Record Sheet (CMRS).

Group I includes the patients on Ensure, Group II includes the patients on the hospital pureed tube feeding and Group III was the patients on Vivonex. The tube feedings were referred to as Group I, Group II and Group III throughout the study.

TABLE I

CASE MATERIAL RECORD SHEET

Group	Patient	Age	Sex	Kilogram Preburn Weight	Percent Burn	Days on Tube Feeding	Postburn Days Studied	Outcome
I. Ensure	004-98-55	4 1/2 Months	Male	17.45	28	15	9-24	Discharged
	004-45-77	8 Months	Female	7.80	23	10	17-27	Discharged
	004-89-79	2 Years	Male	10.20	37	16	10-26	Discharged
	004-33-67	18 Months	Female	12.00	50	4	49-53	Discharged
	005-47-52	9 Months	Male	9.20	40	3	11-14	Discharged
	003-23-12	20 Months	Female	10.46	15	11	2-23	Discharged
II. Pureed Tube Feeding	043-62-58	5 Years	Female	18.40	30	19	7-26	Discharged
	002-95-72	5 Years	Female	22.90	15	17	11-28	Discharged
	003-49-97	1 Year	Female	8.53	34	5	4-9	Discharged
	003-04-07	5 Years	Female	18.00	40	20	4-24	Discharged
	045-61-35	3 Years	Female	20.00	55	33	7-40	Discharged
	003-29-67	18 Months	Male	13.00	60	45	3-48	Discharged
	004-16-77	19 Years	Female	28.60	15	11	9-20	Discharged
	002-49-89	4 Years	Male	17.60	35	31	5-36	Discharged
III. Vivonex	004-56-07	2 Years	Male	12.30	8	7	11-18	Discharged
	004-69-93	10 Months	Male	8.50	70	6	9-15	Death
	002-56-14	16 Months	Male	9.60	25	5	10-15	Discharged
	004-55-77	6 Years	Male	22.50	23	13	19-32	Discharged
	004-16-77	19 Years	Female	28.60	15	8	1-8	Discharged
	004-33-67	18 Months	Female	12.00	50	26	22-48	Discharged
	003-05-57	20 Months	Male	12.80	20	9	59-68	Discharged
	033-36-08	13 Years	Female	100.00	60	6	7-13	Death

Analysis of the Number of Incidences of Intolerance

The number of symptoms of nausea, vomiting, abdominal distention, frequency and consistency of stools, were recorded and are summarized in Appendix E. The number of symptoms of intolerance to the tube feedings were analyzed from day 1 through day 14 that the patient was on the tube feeding. All three groups of patients had a high incidence of intolerance to the tube feedings. For all three groups of patients on tube feedings, there was a daily intolerance average (mean) of 48.4 percent. Group II had the lowest percentage (mean) of intolerance to the tube feeding and Group III had the highest percentage (mean) of intolerance to the tube feeding as shown in Table II. Because the tube feedings were not used as suggested by most authorities the results are not valid as to one tube feeding being better tolerated than another.

Analysis of the Nutritional Composition of the Three Tube Feedings

The composition of the three tube feedings will be found in Appendix A. Each tube feeding has some advantages and disadvantages; therefore, the tube feeding should be selected which is most appropriate for the patient. All three tube feedings will supply a normal individual a full day's nutritional intake if over 2000 milliliters are administered each day.

Friend's (23) dietary study shows the actual distribution of calories in a typical United States diet to be 12 percent protein, 42 percent fat, and 46 percent carbohydrate. Ensure and the hospital

TABLE II

PERCENT OF PATIENTS BY DAY WITH SYMPTOMS OF INTOLERANCE

Day	Group I Ensure	Group II Pureed Tube Feeding	Group III Vivonex
1	66.7	12.5	50.0
2	100.0	37.5	62.5
3	50.0	12.5	75.0
4	60.0	37.5	12.5
5	100.0	37.5	62.5
6	100.0	57.1	100.0
7	75.0	14.3	60.0
8	--	14.3	100.0
9	25.0	28.6	33.3
10	25.0	42.9	100.0
11	66.7	14.3	100.0
12	50.0	16.7	50.0
13	--	33.3	50.0
14	50.0	--	50.0
Mean	54.9	25.6	64.7
Mean for Total Intolerance--48.4			

pureed tube feeding are both close to the distribution of protein, fat, and carbohydrate in the normal diet. Vivonex is a hypertonic formula; therefore, careful administering of the tube feeding is necessary to avoid problems with diarrhea or "dumping syndrome". Artz (1, p. 224) states, "A severely burned adult needs about 3 grams of protein per kilogram of body weight and about 30 calories for each gram of protein." Vivonex will not meet this recommended protein intake. The hospital pureed tube feeding is milk based which would cause problems for lactose intolerant patients.

Twenty-Four Hour Nutritional Analysis

A 24-hour nutritional analysis was done for the burned children on the third day of receiving the tube feeding except for two patients in Group III whose nutritional intake was analyzed on the second day of tube feeding the patient. The distribution of calories from the tube feeding, intravenous fluid, parenteral hyperalimentation, and food intake for all the patients in the study are shown in Appendix F.

The burned children's caloric and protein requirements and caloric and protein intake are shown in Table III. Because the food intake records were not available for all the patients in the study, the percent of the patient's caloric and protein intake was lower than the actual amounts consumed by the patient.

Table IV shows the number of patients meeting their caloric and protein requirements. Artz and Moncrief (3) state a patient without complications should be able to attain a good nutritional intake within a week to 10 days. All but two patients in the study were a week postburn, yet the nutritional intake for most patients was not adequate.

TABLE III

BURN CHILDREN'S CALORIE/PROTEIN REQUIREMENT AND CALORIE/PROTEIN INTAKE

Group	Patient Number	Age	Desired Calories	Actual Calories	Percent	Desired Protein	Actual Protein	Percent	Days Post-Burn
I. Ensure	004-98-55	4 1/2 Years	2027	2128	104.98	80	64.70	80.82	13
	004-45-77	8 Months	1273	1072	84.21	46	43.30+	94.13	21
	004-89-79	2 Years	1907	1278	67.02	48	44.80	65.88	12
	004-33-67	18 Months	2470	2417	97.85	80	57.10+	71.38	52
	005-47-52	9 Months	1952	537	27.51	68	2.00	2.94	13
	003-23-12	20 Months	1153	1199	103.99	46	42.30	91.96	7
II. Pureed Tube Feeding	043-62-58	5 Years	2154	1698	78.83	85	10.30+	12.12	10
	002-95-72	5 Years	1899	2361	124.33	84	58.60+	69.76	13
	003-49-97	14 Months	1702	1190	69.92	60	56.10	93.50	7
	003-04-07	5 Years	2480	2456+	99.03	94	122.40+	130.21	7
	045-61-35	3 Years	2950	1959	66.41	110	38.25+	34.77	9
	003-29-67	18 Months	2524	1670	66.16	89	83.13	93.13	6
	004-16-77	19 Years	2241	1223	54.57	101	6.21+	6.15	11
	002-49-89	4 Years	2281	1786+	78.30	88	82.00	93.18	8
III. Vivonex	004-56-07	2 Years	1018	2013	197.74	45	58.34	129.64	13
	004-69-93	10 Months	2260	328	14.51	76	2.47	3.27	12
	002-56-14	16 Months	1451	223+	15.37	54	2.06+	3.81	13
	004-55-77	6 Years	2155	1770	82.13	91	50.50	55.80	22
	004-16-77	19 Years	2241	1313	58.60	101	23.90	23.66	3
	004-33-67	18 Months	2470	2796	113.20	86	36.12+	42.00	25
	003-05-57	20 Months	1468	1833	124.86	58	45.24	78.00	66

Only six of the 22 patients had the desired caloric level and only two patients had the desired protein level. Earlier administering of a tube feeding may be helpful for the burned children who cannot or will not take the necessary oral intake. This research finding agrees with Artz's (1) conclusion that burn patients rarely receive the necessary calories because of the quantity of nutrients required by the patient.

TABLE IV

NUTRITIONAL ANALYSIS OF BURNED PATIENTS

		Percent of Desired Calories			Percent of Desired Protein		
Groups	Patients	100%	Above 75%	Below 75%	100%	Above 75%	Below 75%
I	6	2	2	2	0	0	6
II	8	1	3	4	1	3	4
III	8	3	1	4	1	1	6
Totals	22	6	6	10	2	4	16

Even though the protein intake records are incomplete, it is certain that more careful monitoring of the patient's protein intake would be helpful in the patient's recovery. In addition to the increased protein losses caused by the burn injury, the low protein intake contributes substantially to negative nitrogen balance (3). Persistent negative nitrogen balance results in serious debilitation, decreased muscle mass and tone, poor appetite, increased susceptibility to infection, poor granulation tissue, poor acceptance of skin grafts, and delayed healing of wounds.

Analysis of Burn Children's Weight Changes

There are many factors which influence the burn patient's weight, such as pre-nutritional status, percent of body surface area burned, food and fluid intake, degree of hypermetabolism and catabolism, fluid resuscitation and edema. In spite of these factors influencing body weight, Schenk and Moylan (47) and Pennisi (40) state that body weight is an excellent indicator of the effectiveness of nutritional therapy.

Table V shows the burned children's weight changes. One patient lost 23.13 of his preburn weight. Seven patients lost between 10 and 16 percent of their preburn weight. The greatest weight gain was 23.53 percent above the preburn weight.

The greatest weight lost on the day of discharge from the hospital occurred for patients in Group III, who lost an average of 4.2 percent of their preburn weight. Patients in Group I averaged the largest percent of weight gain, 6.8 percent. Group II patients also gained weight, .42 percent of their preburn weight. As expected, Group II, with the largest percentage of body surface burns, also had the longest hospitalization. Group III had the shortest stay but the largest decrease in body weight.

Although there are many factors which influence the burn patient's weight, the results suggest the children gained more weight in Group I. Some weight was also gained by patients in Group II. Patients actually lost weight in Group III.

TABLE V

BURNED CHILDREN'S WEIGHT CHANGES

Group	Patient Number	Percent Burn	Preburn Weight (kg)	Discharge Weight (kg)	Percent Weight Change	Discharge Day Postburn	Lowest Weight	Percent Weight Change	Days Postburn
I. Ensure	004-98-55	38	17.45	16.70	- 4.30	36	15.05	-13.75	5 & 9
	004-45-77	23	7.80	7.98	+ 2.30	26	6.75	-13.46	16
	004-89-79	37	10.20	12.60	+23.53	40	9.99	- 2.05	8
	004-33-67	50	12.00	13.20	+10.00	57	11.70	- 2.50	13
	005-47-52	40	9.18	9.80	+ 6.75	17	9.18	0.00	1
	003-23-12	15	10.46	10.70	+ 2.29	19	10.10	- 3.44	14 & 15
Mean		32.2			+ 6.80	32.5			
II. Pureed Tube Feeding	043-62-58	30	18.40	17.90	- 2.72	27	17.38	- 8.45	22
	002-95-72	15	22.90	21.80	- 4.80	27	21.10	- 7.86	10
	003-49-97	34	8.53	9.76	+14.42	9	8.53	0.00	1
	003-04-07	40	18.00	19.20	+ 6.66	25	16.00	-11.00	18
	045-61-35	55	20.00	19.70	- 1.50	89	19.40	- 3.00	1
	003-29-67	60	12.90	14.09	+ 9.22	52	11.81	- 8.45	22
	004-16-77	15	28.60	25.60	-10.49	18	25.00	-12.58	9
	002-49-89	35	17.60	16.30	- 7.39	44	16.30	- 7.39	13 & 42
Mean		35.5			+ 0.42	36.4			
III. Vivonex	004-56-07	8	12.30	12.20	- 0.81	16	11.78	- 4.23	11
	004-69-93	70	8.50	8.61	+ 1.29	15	8.08	- 4.94	8
	002-56-14	25	9.60	8.33	-13.23	23	7.38	-23.13	7
	004-55-77	23	22.50	21.40	- 4.89	38	19.00	-15.56	24
	004-16-77	15	28.60	25.60	-10.29	18	25.00	-12.58	9
	004-33-67	50	12.00	13.20	+10.00	57	11.70	- 2.50	13
	003-05-57	20	13.30	12.70	- 4.51	90	12.70	- 4.51	4 & 74
	033-36-08	60	10.00	89.00	-11.00	33	89.00	-11.00	
Mean		33.9			- 0.42	36.3			

The relationship of the greater percent weight loss to the greater percent of body surface area burned was not observed for the children. The best weight stabilization was found for the patients with burns over 40 percent of their body, which probably was the result of more immediate nutritional support. From this study, it is suggested that more attention also needs to be directed to the patients with burns over less than 40 percent of their bodies.

Evaluation of the Initial Feeding and Progression of the Tube Fed Patient

The following criteria has been recommended by various authorities for beginning patients on tube feedings. Most tube feedings are best tolerated at one-half strength the first day, then progress to full strength as tolerated by the patient. Begin the tube feeding by increasing only the concentration. Once the full concentration of the tube feeding is reached, the volume is increased as tolerated by the patient. The volume should begin at less than 40 milliliters per hour for children. Although maximum rates of administering the tube feeding will vary from patient to patient, 200 milliliters every two hours is the maximum rate recommended by Kaiser (29).

Only one patient in the 22 patients studied met all the above recommended criteria for using tube feedings. From this study, it is suggested that the high incidence of intolerance in all three groups of tube fed patients was caused from the most common error in using tube feedings--beginning with an excessive concentration and excessive volume of tube feeding (16) (30). The physician may be in such a hurry to reach the level of nutrient intake necessary for the patient, that time is not allowed for the patient to adapt to the tube feeding. With the symptoms of diarrhea and vomiting, the nutrients from the tube feeding are not completely utilized by the patient. Table VI shows the number of patients and the percent of patients in the three groups who met each criteria for starting the tube feeding.

TABLE VI

PERCENT OF PATIENTS CORRECTLY RECEIVING THE TUBE FEEDING

Tube Feeding	Group I		Group II		Group III		Total*
	Percent of Patients	No. of Patients	Percent of Patients	No. of Patients	Percent of Patients	No. of Patients	
Tube Feeding Started at One-Half Strength	33.3	2	62.5	5	12.5	1	8
Tube Feeding Concentration Increased First, then the Volume	16.7	1	25.0	2	0.0	0	3
Tube Feeding Began at Less than 40 ml/hr	66.7	4	50.0	4	50.0	4	12
Tube Feeding Maximum Volume Less than 200 ml/2 hrs	100.0	6	87.5	7	100.0	5	18

*Total patients from the three groups.

CHAPTER V

SUMMARY AND CONCLUSIONS

Twenty-two children's medical records were studied to evaluate the effectiveness of Ensure, Vivonex, and a hospital pureed tube feeding on the patients' tolerance and their success in meeting the nutritional requirements for the burned child. The children studied were between nine months and 19 years old and had burns covering between 8 and 70 percent of their bodies.

In order to measure the tolerance of the three tube feedings, the number of incidences of nausea, vomiting, consistency and frequency of stools, and abdominal distention were recorded and analyzed from the medical records. The nutritional compositions of Ensure, Vivonex, and the hospital pureed tube feeding were compared for the study. A 24-hour analysis of the protein and caloric intake was done on the third day the patient received the tube feeding, and all but two patients were a week postburn. The percent of weight changes were recorded and analyzed to see which group of patients gained, maintained, or lost weight during the treatment for the burn injury. The physician's orders were analyzed on the initial feeding and progression of the tube feeding procedures.

The 24-hour nutritional analysis of the 22 burned children, a week postburn, showed only 27 percent of the patients had the desired caloric intake and nine percent of the patients had the desired protein intake as recommended by Pennisi (40) and Batchelor and Sutherland (8). This research finding agrees with Artz's (1) conclusion that burn patients rarely receive the necessary calories because of the quantity of nutrients required by the patient. A comparision of the three tube feedings showed the hospital pureed tube feeding and Ensure to both be close to the normal distribution of carbohydrate, fat, and protein in the typical United States diet.

Seven patients lost between 10 and 16 percent of their preburn weight even after tube feeding. The best weight stabilization was for patients with over 40 percent surface area burned, which was probably a result of more immediate nutritional support for these patients. Although there are many factors which influence the burn patient's weight, the research study's findings suggest the children gained more weight on the Ensure tube feeding.

Only one patient out of the 22 patients studied met all the recommended criteria for using tube feedings. Due to the problems in adequately beginning and administering the tube feedings there could be no conclusion as to which tube feeding was best tolerated by the burn patients.

The researcher feels that one of the most important findings of the study was the need for better education of hospital staff on the use of tube feedings, especially in regard to initial feedings and progression on the tube feeding. There may be such a desire to give the needed nutritional support to the patient that time is not sufficiently allowed for the patient to adapt to the tube feeding. Therefore, the researcher would like to make the following recommendations:

1. Begin tube feeding concentrations for patients below two years of age at:

   1/4 strength--day one--if tolerance permits,

   1/2 strength--day two--increase as tolerated by patient,

   3/4 strength--day three, and

   full strength--day four.

2. Begin tube feeding concentrations for patients above two years of age at:

   1/2 strength--day one--if tolerance permits,

   3/4 strength--day two--increase as tolerated by patient,

   full strength--day three.

It may take 7 to 10 days to reach the desired volume and concentration of the tube feeding to meet the nutritional requirements for the burn patient. Increase concentration first, then volume. Begin feeding at 40 milliliters per hour or less for children and increase as tolerated by the child to not more than 200 milliliters per hour.

This study could be done again with more controls over the use of the tube feedings. It would also be valuable to know the patient's preburn nutritional status in analyzing the data for the study.

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APPENDIXES

APPENDIX A

NUTRITIONAL COMPOSITION FOR TUBE FEEDINGS

TABLE VII

COMPOSITION OF TUBE FEEDINGS

Components	Hospital Pureed Tube Feeding	Ensure	Vivonex
Cal./Ml.	1.06	1.06	1.0
mOsm/L.	--	460	610
% Calories--Protein	19	14	8.1
Protein/gms.	51	37	20.6
% Calories--Carbbohdrate	39	54.5	90.3
Carbohydrate/gms.	104	145	230
% Calories--Fat	42	31.5	1.3
Fat/gms.	49	37	1.45
N:Calories	1:123	1:155	1:286
Grams of Protein:Calories	1:19.6	1:27.0	1:48.5
Protein Source	Milk, Strained Pork, Strained Egg Yolk	Casein, Soy Protein Isolate	Crystalline Amino Acids
Carbohydrate Source	Rice Cereal, Lactose, Fruit	Sucrose, Corn Syrup Solids	Dextrins, Maltose
Fat Source	Cream, Strained Pork	Corn Oil	Safflower Oil
MEq. Na+/L.	54.0	32.0	37.3
Function	Tube Feeding	Elemental Tube Feeding Lactose-free	Lactose-free Tube Feeding

Sources: Ensure Liquid Nutrition (1976); Vivonex in Medicine and Surgery: New Dimensions in Nutritional Management (1973); The University of Oklahoma Medical Center Diet Manual (1967).

APPENDIX B

MEDICATIONS FOR BURN PATIENTS

MEDICATIONS*

1. Atropine Sulfate--(pain reliever) inhibition of smooth muscle and glands innervated by postganglionic cholinergic nerves. The drug depresses the central nervous system activity.

2. Garamycin--a wide spectrum antibiotic, provides highly effective topical treatment in primary and secondary bacterial infections of the skin.

3. Ancef--bactericide.

4. Bacitracin--an antibacterial substance produced by the growth of a gram-positive spore forming organism belonging to the Bacillus licheniformis group. Used to fight Staphylococci bacteria.

5. Mycostatin cream--an agent which inhibits the growth of fungi. The cream fights infections caused by Candida species.

6. Silver Nitrate--opthalmic solution and antiseptic.

7. Silvadene (Silver Sulfadiazine)--is a topical antimicrobial drug indicated as an adjunct for the treatment of wounds and the prevention of sepsis in patients with second and third degree burns. It is a bactericidal for many gram positive and negative bacteria as well as effective against yeast.

8. Sulfamylon (mafenide acetate cream)--topical antibacterial agent for adjunctive therapy in second and third degree burns. The substance is active in the presence of pus and serum, and the activity is not altered by changes in the acidity of the environment. The substance exerts bacteriostatic action against many gram positive and gram negative organisms including Pseudomonas Atruginosa and certain strains of anaerobes.

9. Halothane--is an inhalation anesthetic.

10. Betadine solution--antiseptic, germicide.

11. Tetanus toxiod--immunization against the specific toxin of a bacillus (Clostriduim tetani) which is usually introduced through a wound.

12. Nembutal Sodium--(Pentobarbiatal) a short acting barbital which depresses the central nervous system. The duration of the sedative is three to six hours. Side affects include nausea, vomiting, lethargy, and apnea.

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*Physician's Desk Reference (1976).

13. Poly Vi-sol--multivitamin supplement for children, chewable tablet.

14. Tylenol--antipyretic and analgesic for pediatric use which elevates the pain threshold.

15. Amphojel--symptomatic relief or hyperacidity which may cause constipation.

16. Morphine Sulfate--an analgesic and sedative.

17. Procaine Penicillin--an antibiotic used especially against cocci.

18. Ascorbic Acid--Vitamin C.

19. Ketamine--anesthetic.

20. Travase Ointment--selectively digests necrotic soft tissue by proterolytic action. It dissolves and facilitates the removal of necrotic tissues and purulent exudates that otherwise impair formation of granulation tissue and delay wound healing. The drug is indicated for wound debridement.

21. Keflex--is an oral antibiotic indicated for infections.

APPENDIX C

CHILDREN'S MEMORIAL HOSPITAL BURN UNIT

MEDICAL RECORDS

OKLAHOMA CHILDREN'S MEMORIAL HOSPITAL

PHYSICIAN'S ORDER

DATE	HOUR		ACTION

YOU ARE MAKING COPIES

USE BALL POINT PEN ONLY

PLEASE USE NEW ORDER FORM IF NO NUMBER REMAINS IN THE WINDOW AT THE RIGHT.

Okla. DISRS Revised 2-1-76

CMH-61

OKLAHOMA CHILDREN'S MEMORIAL HOSPITAL

PROGRESS SHEET

Recorders Sign and Date Every Entry

Okla. DISRS Revised 8-13-73 CMH-8

OKLAHOMA CHILDREN'S MEMORIAL HOSPITAL
INTENSIVE CARE UNIT DAY SHEET

VITAL SIGNS:								INTAKE:											OUTPUT:											MEDICATIONS:
								IV		IV		CVP				TF GAST PO														
TIME	TEMP.	PULSE	RESP.	B P	CVP	ART/P		VOL	INF	VOL	INF	VOL	INF	VOL	INF	OFF / TKN			URINE	SP GRAV	GOMCO	STOOL	CHEST							

Okla. DISRS Issued 3-76

CMH-263

TIME	PARENTS HERE	PARENTS CALLED	
			TODAY'S WEIGHT
			YESTERDAY'S WEIGHT

OKLAHOMA CHILDREN'S MEMORIAL HOSPITAL

GRAPHIC SHEET

Date																																												
Hospital Day																																												
Day PO or PP																																												
Pulse	Temp	3	7	11	15	19	23	3	7	11	15	19	23	3	7	11	15	19	23	3	7	11	15	19	23	3	7	11	15	19	23	3	7	11	15	19	23	3	7	11	15	19	23	Temp
	°C																																											°F
180	42.0																																											108
170	41.5																																											107
160	41.0																																											106
150	40.5																																											105
140	40.0																																											104
130	39.5																																											103
120	39.0																																											102
110	38.5																																											
100	38.0																																											101
90	37.5																																											100
80	37.0																																											99 98.6
70	36.5																																											98
60	36.0																																											97
50	35.5																																											96
40	35.0																																											95
	34.5																																											94
	34.0																																											
	33.5																																											93 92.1
RESP.																																												
WEIGHT KG																																												
STOOLS																																												
DIET																																												

Centigrade Scale each dot or line = .1°C. Fahrenheit Equivalent Approximated in column at right side of page.

INTAKE - OUTPUT

		INTAKE			OUTPUT			
DATE	HOURS	ORAL	I.V. FLUID	OTHER (SPECIFY)	URINE	VOMITUS or GASTRIC SUCTION	STOOLS	OTHER (SPECIFY)
	6 - 14							
	14 - 22							
	22 - 6							
	24hr. Total							
	6 - 14							
	14 - 22							
	22 - 6							
	24hr. Total							
	6 - 14							
	14 - 22							
	22 - 6							
	24hr. Total							
	6 - 14							
	14 - 22							
	22 - 6							
	24hr. Total							
	6 - 14							
	14 - 22							
	22 - 6							
	24hr. Total							
	6 - 14							
	14 - 22							
	22 - 6							
	24hr. Total							
	6 - 14							
	14 - 22							
	22 - 6							
	24hr. Total							

FINAL
BURN ESTIMATE AND DIAGRAM
AGE vs. AREA

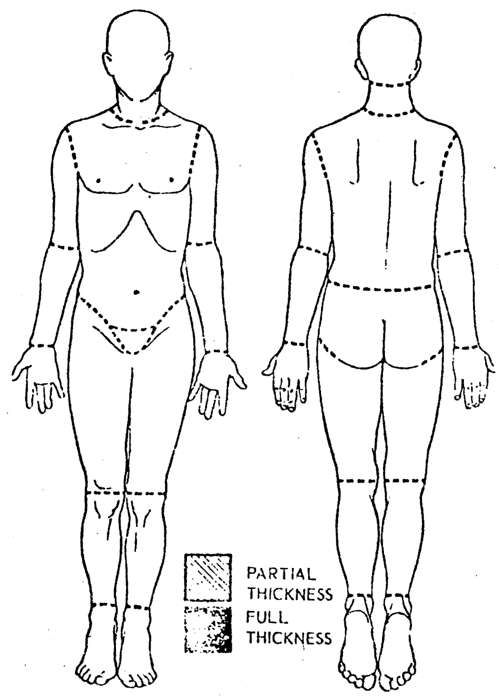
AREA	inf	1-4	5-9	10-14	15	adult	part	full	total	Donor areas
Head	19	17	13	11	9	7				
Neck	2	2	2	2	2	2				
Ant Trunk	13	13	13	13	13	13				
Post Trunk	13	13	13	13	13	13				
R. Buttock	2½	2½	2½	2½	2½	2½				
L. Buttock	2½	2½	2½	2½	2½	2½				
Genitalia	1	1	1	1	1	1				
R U. Arm	4	4	4	4	4	4				
L U Arm	4	4	4	4	4	4				
R.L Arm	3	3	3	3	3	3				
L L Arm	3	3	3	3	3	3				
R. Hand	2½	2½	2½	2½	2½	2½				
L. Hand	2½	2½	2½	2½	2½	2½				
R. Thigh	5½	6½	8	8½	9	9½				
L. Thigh	5½	6½	8	8½	9	9½				
R. Leg	5	5	5½	6	6½	7				
L. Leg	5	5	5½	6	6½	7				
R. Foot	3½	3½	3½	3½	3½	3½				
L. Foot	3½	3½	3½	3½	3½	3½				
						TOTAL				

BURN DIAGRAM

AGE ____________

SEX ____________

WEIGHT ________



APPENDIX D

RECORDS USED TO COLLECT

RESEARCH DATA

OKLAHOMA CHILDREN'S MEMORIAL HOSPITAL
DIETARY INTAKE SHEET
BURN UNIT

Shift	Food	Offered	Taken	Calorie Count
7-3				
TOTAL				
3-11				
TOTAL				
11-7				
TOTAL				

PEDIATRIC BURN PATIENT NUTRITIONAL RECORD

NAME______________________________ AGE________________

CHART NUMBER________________________

ADMISSION DATE_______________________

PREBURN WEIGHT______________________ PERCENTAGE OF BURN ______

DESIRED WEIGHT______________________

DESIRED CALORIC INTAKE________________
(60 Kcal. x Kg. body weight + 35 Kcal. x % Burn)

DAILY CALORIE INTAKE

DATE	DIET FOR AGE	ORAL SUPPLEMENTS TYPE:______	TUBE FEEDING TYPE:______	HYPERAL.	DAILY TOTAL

TOLERANCE PARAMETER RECORD SHEET*

Patient Chart Number ____________________

Tube Feeding ____________________________

Day	Vomiting[1]	Stools[2] Consistency	Stools[2] Frequency	Abdominal Distention[3]
1	_	_	_	_
2	_	_	_	_
3	_	_	_	_
4	_	_	_	_
5	_	_	_	_
6	_	_	_	_
7	_	_	_	_
8	_	_	_	_
9	_	_	_	_

1. Vomiting: 1 = nausea, 2 = one episode of emesis, 3 = two or more episodes of emesis, 4 = excessive vomiting requiring d/c or G.I. input.

2. Stools: S = solid, SS = semi-solid, L = liquid or loose.

3. Abdominal distention: 1 = slight distention, 2 = one temporary episode of marked distention, 3 = two or more temporary episodes of marked distention, 4 = distention accompanied by abdominal pain.

*Patient tolerance of a dietary program in which part of the calories were derived from a tube feeding. Adapted from: Orgain, C., Marvin, J. A., and Yantis, K.: An evaluation of an improved high calorie liquid dietary supplement in thermally injured patients. Proceedings Ann. Meeting Am. Burn A. (1977).

WEIGHT RECORD SHEET

Patient Chart Number ______________________

Date	Weight	Date	Weight	Date	Weight

RESEARCH GRAPHIC SHEET

Patient Number ______________________

Name ________________________________

Date	T. F.	I. V.	Hyperal.	Stools	Vomitus

TOLERANCE QUOTE RECORD

Patient Number ____________________________

Date	Chart Page	Tolerance Quote

APPENDIX E

INCIDENCES OF INTOLERANCE

TABLE VIII

INCIDENCES OF INTOLERANCE IN GROUP I (ENSURE)

Day	Vomiting 1	Vomiting 2	Vomiting 3	Vomiting 4	Diarrhea	Abdominal Distention 1	Abdominal Distention 2	Abdominal Distention 3	Abdominal Distention 4	Number of Patients with Intolerance	Number of Incidences per Day
1				1	4			1		4	6
2		1	2		4			1		6	8
3		1	2		1			1		3	5
4		3	1		1					3	5
5	1	3			1	1				4	6
6		4			2					4	6
7		2			1					3	3
8										0	0
9					1					1	1
10		1								1	1
11	2									2	2
12	1									1	1
13										0	0
14		1								1	1

TABLE IX

INCIDENCES OF INTOLERANCE IN GROUP II (HOSPITAL PUREED TUBE FEEDING)

Day	Vomiting 1	Vomiting 2	Vomiting 3	Vomiting 4	Diarrhea	Abdominal Distention 1	Abdominal Distention 2	Abdominal Distention 3	Abdominal Distention 4	Number of Patients with Intolerance	Number of Incidences per Day
1					1					1	1
2		1			1				1	3	3
3		1								1	1
4		2			1					3	3
5		3			1					3	4
6		2	1		1				1	4	5
7		1								1	1
8					1					1	1
9		1			1					2	2
10				2	1					3	3
11		1								1	1
12					1					1	1
13		2								2	2
14										0	0

TABLE X

INCIDENCES OF INTOLERANCE IN GROUP III (VIVONEX)

Day	Vomiting				Diarrhea	Abdominal Distention				Number of Patients with Intolerance	Number of Incidences per Day
	1	2	3	4		1	2	3	4		
1		1	2		3					4	6
2		1			2	2	2			5	7
3		1			3	2	1			6	7
4					1					1	1
5		1		1	5					5	7
6		1			5		1			7	7
7					2		1			3	3
8		2			2		1			4	5
9			1							1	1
10					2		1			2	3
11					2					2	2
12					1					1	1
13					1					1	1
14					1					1	1

APPENDIX F

DISTRIBUTION OF CALORIES

TABLE XI

DISTRIBUTION OF CALORIES

Group	Patient No.	T.F.	I.V.	Hyperal.	Food	Total
I	0040955	1500	40	–	588	2128
	0032312	400	–	–	799	1199
	0048979	270	–	–	1008	1278
	0044577	630	–	180	262	1072
	0054777	53	484	–	–	537
	0043367	1540	–	–	877	2417
II	0436258	500	–	–	1198	1698
	0029572	1150	–	–	1211	2361
	0034997	1100	–	–	90	1190
	0030407	2400	56	–	?	2456+
	0456135	750	–	–	1209	1959
	0032967	1630	40	–	–	1670
	0041677	1200	285	–	820	1223
	0024989	1600	186	–	?	1786+
III	0045607	900	–	–	1113	2013
	0046993	120	208	–	–	328
	0025614	100	123	–	?	223+
	0045577	500	109	372	789	1770
	0041677	1160	25	–	128	1313
	0043367	1365	–	366	1064	2796
	0030557	400	–	–	1433	1833
	0333608	2700	–	–	–	2700

VITA

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Master of Science

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