Nutritional Support in Burn Patients

Dr.Zeinab Javid

Assistant Professor in Clinical Nutrition

OUTLINES

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- Epidemiology
- Burn classification
- Metabolic alterations following Severe burn injury
- Effect of metabolic response on energy and nutrients
- Nutritional assessment in burn
- Nutritional support in burn
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  - Route of nutritional support
  - Patient monitoring

What is a Burn?

- An injury to tissue from:
  - Exposure to flames or hot liquids
  - Contact with hot objects
  - Exposure to caustic chemicals or radiation
  - Contact with an electrical current

Burn injury is a common type of traumatic injury causing considerable morbidity and mortality.

Epidemiology

- WHO → around 265,000 deaths annually are attributable to fire-related injuries
- The burden of mortality from fire-related injuries in low-income countries 10.2 deaths per 100,000, in higher-income countries 0.8 per 100,000
- 2-3 million thermal injuries per year in USA
- The third leading cause of accidental death in USA
- 100 thousand require admission
- 5-6 thousand die

Burn Classification

- **<u>Superficial (1°)</u>:** epidermis (sunburn)
- **<u>Partial-thickness (2°)</u>:**
  - Superficial partial-thickness: papillary dermis
    - Blisters with fluid collection at the interface of the epidermis and dermis. Tissue pink & wet. Hair follicles intact
  - Deep partial-thickness: reticular dermis
    - Blisters. Tissue molted, dry, decreased sensation.
- **<u>Full-thickness (3°)</u>:** dermis
  - Leathery, firm, insensate.
- **<u>4th degree</u>:** skin, subcutaneous fat, muscle, bone

Burn Classification

Burn Classification(2)

- **Small** : 10-20% TBSA
- **Large** : 20-40% TBSA
- **Major** : 40-60% TBSA
- **Massive** > 60% TBSA

- In the absence of inhalation injuries, which would make the patient dependent <u>on intubation and mechanical ventilation</u> and also nutritionally more vulnerable, patients with burns of < 20% BSA can be managed without artificial nutritional support.

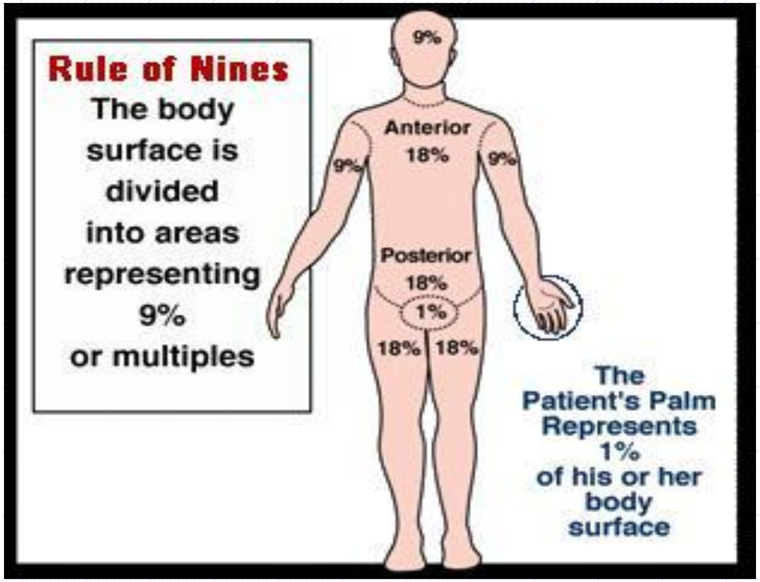
Critical Burn Criteria

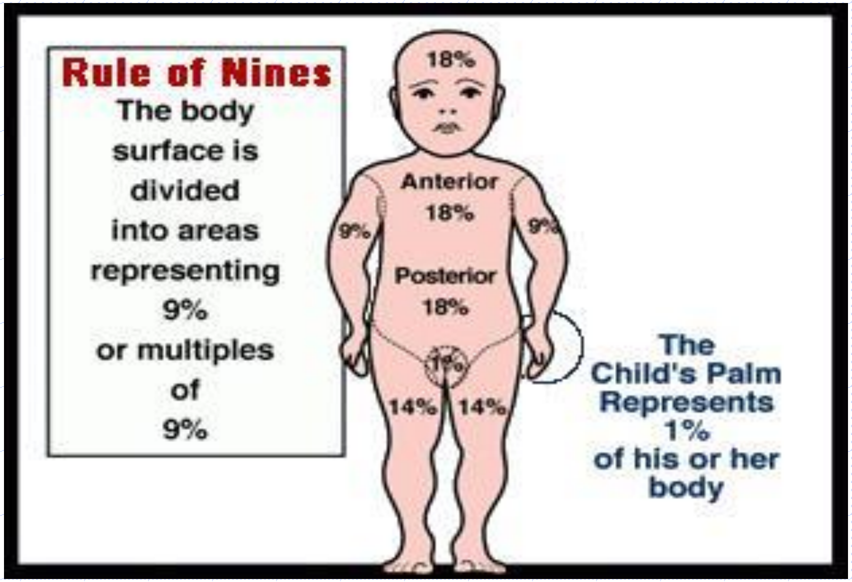
- $3^0 > 10\%$ BSA
- $2^0 > 30\%$ BSA
  - >20% pediatric
- Burns with respiratory injury
- Hands, face, feet, or genitalia
- Burns complicated by other trauma
- Underlying health problems
- Electrical and deep chemical burns

Extent of a Burn(1)
Rules of Nines

- **Adult:** 9% head; 9 % arms; 18 % legs ; 18 % chest; 18% back; 1 % perineum

- **Child:** 18% head; 9% arms; 14 % legs; 18 % chest; 18 % back ; 1 % perineum

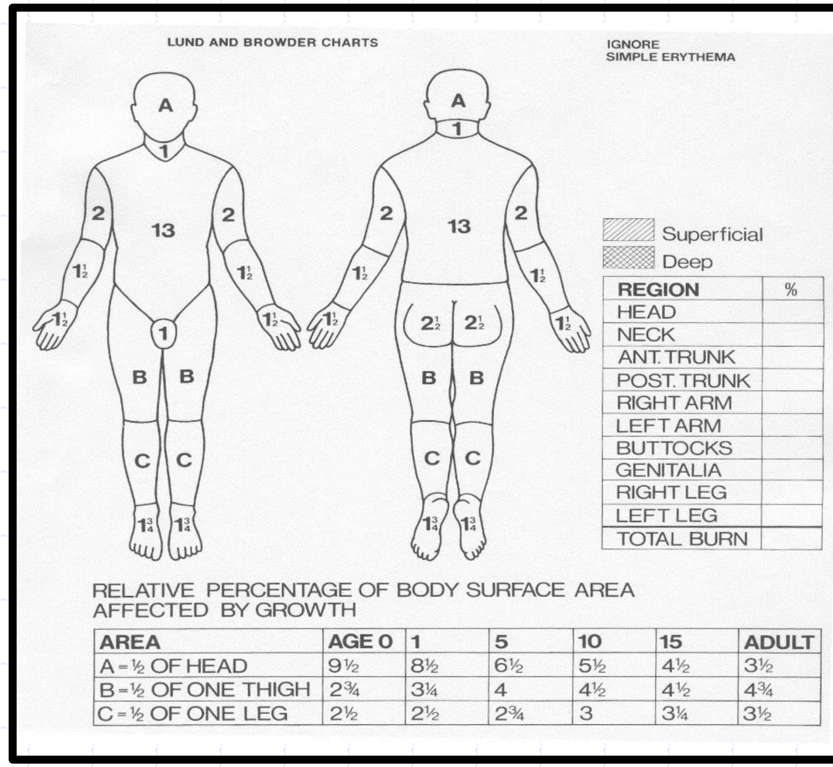




Extent of a Burn(2)

Lund & Browder Chart

- ✓Useful chart for children
- ✓ head size proportion
- ✓More accurate assessment tool



REGION	%
HEAD	
NECK	
ANT. TRUNK	
POST. TRUNK	
RIGHT ARM	
LEFT ARM	
BUTTOCKS	
GENITALIA	
RIGHT LEG	
LEFT LEG	
TOTAL BURN	

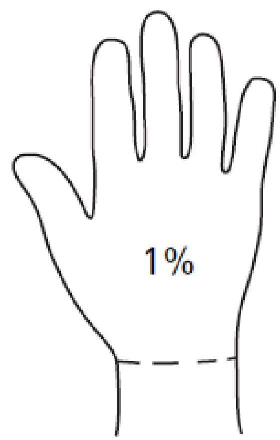
AREA	AGE 0	1	5	10	15	ADULT
A = ½ OF HEAD	9½	8½	6½	5½	4½	3½
B = ½ OF ONE THIGH	2¾	3¼	4	4½	4½	4¾
C = ½ OF ONE LEG	2½	2½	2¾	3	3¼	3½

Extent of a Burn(3)

Rule of Palms:

Good for estimating small patches of burn wound

- The size of the patient´s palm is approximately 1% of TBSA



in small burns estimate the extent of the burn with the palmar surface of the patients hand (from the fingertips to the wrist), it is approximately 1% of the TBSA

The metabolic responses

The metabolic responses of burn patients are similar to those of other trauma patients, but are more intense and prolonged.

A massive **acute phase response** is characteristic.

Like other patients with severe trauma, those with burns suffer additional secondary morbidity from shock, acute respiratory failure, sepsis, and multiple organ dysfunction syndrome.

Patients characteristic

Skin barrier has been destroyed, burn patients experience cutaneous exudative fluid losses containing large quantities of protein, minerals, and micronutrients. This can cause **acute deficiency syndromes**.

- Venous access is more difficult in burn patients due to the destruction of the skin at puncture sites (higher risk of catheter-related infection).
- The surface to be repaired is often extensive and healing may require prolonged nutritional support.
- Burn patients stay longer in intensive care unit (ICU) compared to patients with other forms of trauma, and require prolonged nutritional support.
- The risk of infectious complications is very high due to the above characteristics.

2 Phases of Evolution

- The metabolic derangements after burn injury occur in two distinct patterns that are time-dependent and is followed by a late recovery phase.

"Ebb" phase

(Burn Shock with hypovoluemia)

- Early (**First 48 hours after injury)**

"Flow" Phase

(Hyperdynamic State)

- chronic

“Ebb” phase

- Immediately after injury
- hemodynamic instability
- reduced tissue perfusion
- release of high levels of catecholamines
- lowered total oxygen consumption (VO_2)
- low metabolic rate
- Hypovolemia, edema, hypoalbuminemia, low GFR
- Result is slower rate of drug distribution and

  lower renal clearance

Depending on the severity of injury and on the success of the hemodynamic resuscitation, the ebb phase may be extremely short-lived and last a few hours, or persist for a few days.

“flow” phase(2)

- High VO_2
- Elevated resting energy expenditure (REE) (150%-200%)
- Elevated substrate flows
- Accelerated potassium and nitrogen losses
- Increase visceral blood flow
- Increase splanchnic O_2 consumption
- The body's temperature is generally increased and central thermoregulation is shifted upward

“flow” phase

Nitrogen balance remains negative for several weeks after injury, mainly due to:

• extensive protein losses from the burned skin area

• markedly increased skeletal protein catabolism

- The synthesis of acute phase reactants and some visceral proteins is increased but catabolism persists.
- Net nitrogen balance is therefore negative.
- These changes may be blunted by good overall management including early excision and grafting, pharmacological tools (beta- blockers), and by nutritional support, but not totally suppressed.

Recovery Phase

- This phase starts when the flow phase declines, the burned surface is covered, and the patient starts to mobilize.
- This phase requires high levels of **energy** to address the **physical rehabilitation**, and completion of **wound healing**
- After major burns, this phase may last up till **2 years**

Metabolic alterations following Severe burn injury

Characterization of the response to severe burn injuries covering over 40% of TBSA has shown the association of severe **hypermetabolism** and **inflammatory** and **stress responses** with development of :

- Hyperdynamic circulation
- Altered body temperature regulation
- Glycolysis
- Proteolysis
- Lipolysis
- Inefficient substrate cycling

Metabolic alterations following Severe burn injury(2)

- The severity, duration, and magnitude of the metabolic changes are uniquely different in **burn patients** than in other critically ill patients

- Enhanced secretion of **catecholamines**, **glucocorticoids**, **glucagon**, and **dopamine** is closely associated with the formation of the **acute hypermetabolic response** and the associated **catabolic state**.

Metabolic alterations following Severe burn injury(3)

- However, the **underlying mechanisms** of this complex response to burn injury remain **unclear.**

- Based on current knowledge, a variety of **cytokines** (TNF,PAF, IL-1,IL-6), **endotoxin**, **nitric oxide**, **reactive oxygen species**, and **complement cascades** participate in this multifactorial response to burn.

Metabolic alterations following Severe burn injury(4)

- Catabolic losses in LBM correlate with increased morbidity and mortality

% reduction in LBM	Effect
10	Impaired immunity
20	Decreased wound healing 30% Mortality
30	Pressure ulcers Pneumonia 50% mortality
40	Death

Effect of metabolic response on energy and nutrients (Energy)

- The metabolic rate increased
  - ✓ Multifactorial
  - ✓ Increase in stress hormones and cytokines
  - ✓ Evaporative water loss from the burn wound
  - ✓ Bacterial contamination of the burn wound
  - ✓ Increase in core temperature

Effect of metabolic response on energy and nutrients (Carbohydrates)

- Increase in the formation of glucose precursors,
- Increase in the release of amino acids ,
- Consequent gluconeogenesis by the liver
- Altered glucose oxidation
- Insulin resistance and an increased glucogon:insulin ratio
- The hyperglycaemia is associated with impaired immune function, poor wound healing and exacerbation of protein catabolism.

Effect of metabolic response on energy and nutrients (Proteins)

- The catabolic response
- The stress hormones and cytokine release (TNF-α)
- The increased cortisol levels also stimulate proteolysis, protein breakdown and protein oxidation
- Increased nitrogen excretion and a negative nitrogen balance
- The rate of restoration of lost protein in the burn patient is about one-tenth as rapid as the loss, even with adequate nutrition and progressive exercise

Effect of metabolic response on energy and nutrients (Lipids)

- ✓ Increased lipolysis, with the release of free fatty acids (FFA) and triglycerides, mainly induced by catecholamines
- ✓ Increase in fatty acids metabolised via the cyclo-oxygenase enzyme system, increase in pro-inflammatory intermediates
- ✓ Decreased ketone production
- ✓ Decreased carnitine levels
- ✓ Decrease in HDL, regulates LPL activity, result in an accumulation of triglycerides and a reduction in cholesterol

Effect of metabolic response on energy and nutrients (Micronutrients)

- Altered intestinal absorption
- Altered losses
- Altered protein concentration
- Large trace element losses in the exudates were noted during the first seven days post-injury

- Decrease in serum iron (Fe), zinc (Zn) and selenium (Se),
- Increase in ferritin and ceruloplasmin
- Decrease in **serum Fe and Zn** is a protective response, may restrict the growth of microorganisms

Effect of metabolic response on energy and nutrients(Micronutrients2)

- Common mineral abnormalities include decreased serum **calcium**, **magnesium** and **phosphate**.
- Magnesium is essential for energy production via ATP reactions
- Poor phosphate status is evident early in post-burn injury, due to increased losses and increased use in metabolic pathways
- low levels of serum vitamin C, tocopherol, retinol and vitamin A have been documented after burn injury

Pathophysiology Fluid

- During the first 12-24 hours after a burn injury of > 20% BSA, there is a massive transient increase in **capillary permeability**, with an obligator **plasma loss** from the intravascular space into the extravascular compartment: this causes the generalized **edema**.
- The permeability changes last for about 24 hours, being maximal during the first 12 hours, and are responsible for the **extensive fluid requirements** of burn patients.
- There are evaporative losses of water, and exudative losses such as plasma weeps from the burnt areas of the body surface.

Treatment Fluid resuscitation

The most common predictive equation for fluid resuscitation requirement is the **Parkland formula:**

Fluid requirement during first 24 hours (ml) =

2-4 ml* body weight (kg) * total burn area(%)

- ✓ This predicted volume is only indicative, and should be refined by hemodynamic monitoring.
- ✓ Urinary output should remain > 0.5 ml. kg^{-1}. h^{-1}.

Treatment Fluid resuscitation(2)

- **Saline** resuscitation should be used, and all formulae result in delivering roughly 0.5 mmol sodium per kg body weight per percent burned area.
- **Colloids** may be started after about 12 hours.
- Over the second 24 hours, fluid requirements decrease to about 50%.
- From the third day, the oedema fluid starts to be reabsorbed into the intravascular compartment, at which time the need for intravascular fluid support further decreases.
- The oedema affects all body compartments, including the splanchnic region, and has deleterious side effects on organs, the gut in particular.

Treatment Fluid resuscitation(3)

Among strategies that attempt to reduce early fluid resuscitation requirements, mega-doses (**66 mg• kg • h**) of **ascorbic acid** delivered intravenously during the first 24 hours after injury have been shown to stabilise capillary leakage through antioxidant mechanisms in animal and human studies.

Nevertheless, this treatment has not yet gained acceptance and requires further validation before its clinical Introduction

Treatment Fluid resuscitation(4)

- After the initial resuscitation period, free water requirement may remain high (an additional **2-3 liters** beyond normal hydration).
- This can be delivered as **5% dextrose** or as water with the feeds (the latter is preferred so as to avoid glucose overload).

Albumin

- Albumin should only be considered when blood levels are **< 18 g/dl** and in burns> **40% BSA.**
- The patient should be weighed every day.
- These large fluid shifts will impact the intestinal compartment, causing gut edema and increasing the risk of abdominal compartment syndrome.
- These factors can complicate the installation of efficient enteral feeding

Nutrition Assessment

Height and pre-burn weight : Fluid resuscitation can cause significant oedema and make assessing pre-burn weight difficult

- ✓Details of previous nutritional status
- ✓%TBSA of burn and site of injury
- ✓Gastrointestinal function
- ✓Pain control
- ✓Pre-existing medical conditions
- ✓Usual diet and any specific dietary needs

Nutritional Support

- **<u>The goals of nutritional support include:</u>**
- Maintain body mass, particularly lean body mass
- Prevent starvation and specific nutrient deficiencies
- Improve wound healing
- Manage infections
- Restore visceral and somatic protein losses
- Avoid or minimise complications associated with enteral and parenteral nutrition
- Provide the correct amount and mix of nutrients to limit or modulate the stress response and complications

Nutritional Support(2)

All patients with burns exceeding 20% TBSA should receive nutritional support, as should those with less severe burn wounds but with pre-existing malnutrition and/or diseases such as TB or HIV/AIDS.

Nutrient requirements

Factors that may influence the burn patient's requirements include:

- ✓Age
- ✓Pregnancy and lactation
- ✓Nutritional status prior to the burn
- ✓Underlying diseases such as TB, HIV/AIDS, diabetes
- ✓Electrolyte disturbances
- ✓Renal failure
- ✓Fever/infection/sepsis

Energy and substrate requirements

- Several formulas were devised to predict the energy requirements of burn patients.
- These formulas overestimate the nutritional needs of burn patient and causes overfeeding.
- The **dynamic Toronto equation** is the most precise and is the only one to take into account the principal factors which affect energy requirements such as sex, weight, height, burn percentage, fever, previous days' caloric intake, and time elapsed since injury.

Energy and substrate requirements(2)

- EE changes over time, with a peak **lasting 2-6 weeks** depending on burn severity and complications.
- As both underfeeding and overfeeding have deleterious consequences, accurate assessment of EE is highly desirable to regulate individual caloric intake, particularly in patients with a prolonged and complicated evolution.
- **Indirect calorimetric** determination of EE should be done in the fed state, rounded up to the upper 100 value and repeated at regular intervals, every week.

Formulas for calculating nutritional needs in burn cases

Author	Gender	Formula
Harris & Benedict BMR	 Male Female	<u>Estimated Energy Requirements: BMR x Activity factor x Injury factor</u> 66 + (13.7 x weight in kg) + (5 x height in cm) - (6.8 x age) 665 + (9.6 x weight in kg) + (1.8 x height in cm) - (4.7 x age) ***Activity factor*** Confined to bed: 1.2 Minimal ambulation: 1.3 ***Injury factor*** < 20% TBSA: 1.5 20-40% TBSA: 1.6 > 40% TBSA: 1.7
Curreri	For all patients	Estimated Energy Requirements: (25 kcal x w) + (40 x %TBSA)
Pennisi	Adults	Estimated Energy Requirements: Calories (20 x w) + (70 x %TBSA) Protein (1 g x w) + (3g x %TBSA)
ASPEN	For all patients	25 - 35 kcal/kg/day

Formulas for calculating nutritional needs in burn cases (2)

Author	Gender	Formula
Toronto Formula	For all patients	Estimated Energy Requirements: [- 4343 + (10.5 x %TBSA) + (0.23 x kcals) + (0.84 x Harris Benedict) + (114 x T (°C)) - (4.5 x days post-burn)] x Activity Factors ***Activity factors non-ventilated:*** Confined to bed: 1.2 Minimal ambulation: 1.3 Moderate act: 1.4 ***Ventilated-Depedent:*** 1.2
Ireton–Jones Formula	For spontaneously breathing patients Ventilated Dependent	Estimated Energy Requirements: 629 – (11 x yrs) + (25 x w) – (609 x O) 1784 – (11 x yrs) + (25 x w) + (244 x S) +(239 x t) + (804 x B)

Formulas for calculating nutritional needs in burn cases(3)

Author	Gender	Formula
Modified Schofield	**female**	Estimated Energy Requirements: BMR x Injury factor 15-18 yrs = (13/3 x w) + 690 18-30 yrs = (14/8 x w) + 458 30-60 yrs = (8/1 x w) + 842 60 yrs = (9 x w) + 656
	Male	15-18 yrs = (17/6 x w) + 656 18-30 yrs = (15 x w) + 690 30-60 yrs = (11/4 x w) + 870 60 yrs = (11/7 x w) + 585 **Injury Factors:** < 10% TBSA = 1.2 11-20% TBSA = 1.3 21-30% TBSA = 1.5 31-50% TBSA = 1.8 > 50% TBSA = 2.

Energy requirements

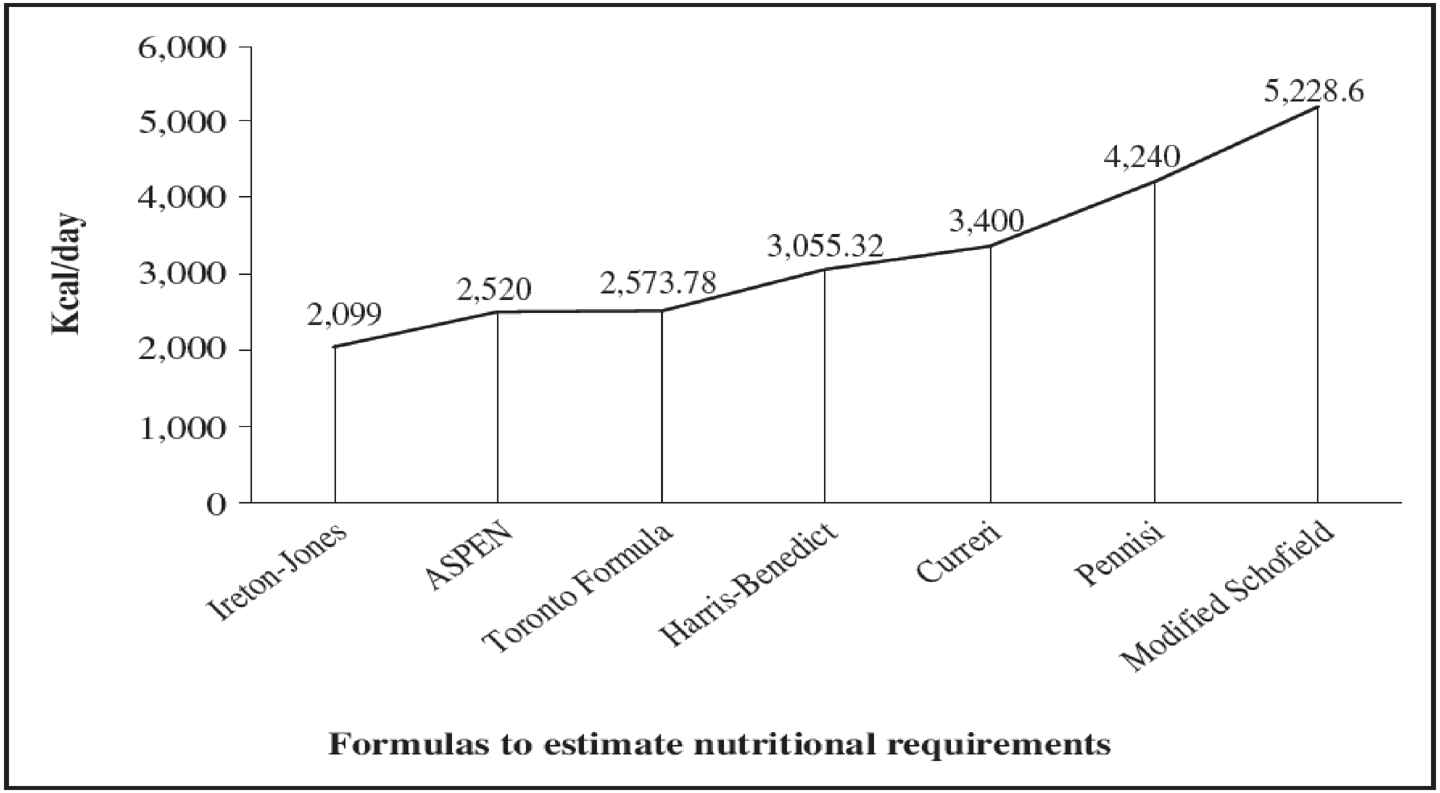


Fig. 2.—Distribution of nutritional requirements estimated by mathematical formulas for one adult burned patient. Electronic archive study, 2010.

Energy requirements(2)

- During the first few days, and in the absence of an indirect calorimeter, a rough estimation of energy requirements can be used, by giving 30-35 kcal/kg per day for burns < 40% BSA, and 35-50 kcal/kg per day for burns ≥ 40% BSA

Energy requirements(3)

- Daily weight determination is crucial in monitoring the subsequent adequacy of nutritional support.
- During the resuscitation phase and in the presence of massive edema, only the preadmission weight should be used.

Proteins requirements

- Persistent muscle protein catabolism remains an issue in major burns.
- The net result is devastating.
- In the first 21 days after traumatic injury, critically ill patients <u>lose up to 16% of their total body protein</u> content despite full nutritional support.
- During the <u>first 10 days,</u> close to <u>two thirds</u> of this protein loss comes from skeletal muscle and, thereafter, also from the viscera.
- Severe burn injuries result in a worse scenario.

Proteins requirements(2)

- Accurate nitrogen balance in burn patients is difficult to achieve because of exudative wound losses, which are estimated at approximately 10 g nitrogen per 10% BSA during the first week.
- These losses cannot be compensated for by nutrition.
- Measurement of total urinary nitrogen or urea nitrogen gives a useful reflection of prevailing net catabolism.
- Nitrogen excretion may be as high as 30 g per day in severely burned patients compared to 12-13 g per day in fasted normal subjects

$$NB = \frac{\text{protein intake}}{6.25} - \left[\frac{UUN}{0.8} + 2.5g\right]$$

Proteins requirements(3)

- In Europe current practice is to provide **1.3- 1. 8 g protein** kg. day (0.2-0.3 g nitrogen Kg. day).
- Higher intake only results in oxidation, contributing to increased urea production rates rather than being used for anabolic purposes.
- As in health, nitrogen balance depends not only on nitrogen intake (or protein) but also on energy supply.

% burn	protein/kgBwt/d	NPC:N ratio
<15	1.0-1.5	150:1
15-30	1.5	120:1
31-49	1.5-2	100:1
50+	2-2.3	100:1

Albumin supplementation

- There is no rationale for providing albumin to burn patients on a systematic basis, but oncotic pressure decreases with serum albumin **< 18 g / l**
- During the early phase after injury, serum concentrations are frequently below 20 g / 1 due to increased capillary permeability, fluid dilution, and increased catabolism.
- With inflammation, plasma albumin concentrations decrease despite increased fractional synthesis.

Carbohydrates requirements

- Injury causes a strong increase in endogenous glucose production and turnover.
- Glucose serves preferentially as the cellular fuel for healing wounds and inflammatory tissues.
- After trauma, glucose oxidation rates increase to 130% above those of control subjects
- Administration of glucose, even in large amounts, <u>fails to suppress endogenous glucose production</u>, gluconeogenesis, and protein breakdown.

Carbohydrates requirements(2)

- Fatty liver infiltration resulting from increased de novo lipogenesis is commonly observed in major burns.
- This probably results from hypercaloric feeding with excessive amounts of carbohydrate.
- It seems reasonable to avoid a glucose supply exceeding 5 mg/kg/min (7g/kg/day) and to include lipid in feeds (enteral or parenteral.

Glucose Control

- Tight glucose control aimed at maintaining 4-6.1 mmol / 1 has not been shown to be beneficial in major burns.
- A Cochrane review has shown that reasonable glucose control **(target < 8 mmol / 1)** is safe, and is associated with fewer infections and better tolerance of skin grafts.

Lipids Requirement

- Increased lipolysis is part of the metabolic response to injury, providing high free fatty acid levels for oxidation and increasing glycerol release for gluconeogenesis.
- Results from elevated counter-regulatory hormone levels (mainly catecholamines and glucagon), along with decreased insulin sensitivity.
- It is recommended that the fat supply should not exceed **30%** of energy. (about 1 g/kg/day of intravenous lipids in TPN)
- The sedative drug propofol (widely used in critical care) is diluted in an LCT emulsion and this should be included in the calculation of the total fat dose administered each day

Vitamins, trace elements, and minerals

- Bum patients suffer from significant trace element deficiencies involving predominantly **copper, iron, selenium, and zinc**.
- These patients lose biological fluids with their cutaneous wound exudates, and through drains and haemorrhage, which cause profound negative balances during the first week after injury.
- The alterations in trace element metabolism are reflected by low plasma concentrations that persist for many weeks after injury

Vitamins, trace elements, and minerals(2)

- The precise requirements of trace elements and vitamins have yet to be determined for burned patients, but all recent data confirm that there are increased requirements.
- Repletion with quantities of trace elements, restores close to normal serum concentrations as well as related enzymatic activities, such as those of the glutathione peroxidases which are dependent on selenium and significant reduction in infectious complications.
- Because of antioxidant functions, supplements should be provided early on, starting during the first hours after injury.

Micronutrient functions of particular importance to patients with major burns

- The water-soluble vitamins of **the B complex** are not stored in appreciable amounts and will rapidly be depleted. Their requirements are strongly increased for carbohydrate metabolism **(vitamin B1).**
- **Vitamin C** is crucial in collagen synthesis and also has an important antioxidant effect. Therefore, a total daily intake of 1-2 g is highly recommended for several weeks.
- **Vitamins A and E** are involved in tissue repair

Micronutrient functions of particular importance to patients with major burns(2)

- **Vitamins D and K** are stored in fat deposits and are slowly depleted during prolonged disease: vitamin D deficiency has regularly been described in burns.
- **Copper** is of special importance in burns as collagen is dependent on it for maturation.
- **Selenium** is essential for glutathione peroxidase activity
- **zinc** for immunity and cell replication.
- **Magnesium and phosphorus** losses through exudates are extensive, and this explains to a large extent, their increased requirements in burns

Micronutrient requirements

Nutrient	Amount
Vitamin A (total) Beta-carotene	10 000 IU/d[33] At least 30 mg/d[29]
Vitamin C	66 mg/kg/h during resuscitation[52] 5 to 10x RDA thereafter[33]
B vitamins, folic acid	2 to 3x RDA[33]
Vitamin E	At least 100 mg/d[31]
Trace elements	Copper 2.5 to 3.1 mg/day, selenium 315 to 380 μg/day, and zinc 26.2 to 31.4 mg/day IV for eight to 21 days. No recommendation thereafter, but oral supplementation would probably be appropriate[3]
Vitamin D	Unknown, but probably essential as 1,25-dihydroxyvitamin D

		Daily Dose
Vitamin B Complex		
	Thiamine	10mg
	Riboflavin	10mg
	Niacin	200mg
	Vitamin B6	20mg
	Folate	2mg
	Vitamin B12	20μg
Vitamin C		2g
Minerals		
	Selenium	100 μg
	Copper	2 – 3mg
	Zinc	50mg
	Manganese	25-50 mg

Nutraceuticals in burns

Glutamine and arginine

- Both amino acids are conditionally essential.
- They support immune function and the gut mucosa, and this may play a role in reducing septic complications in burn patients.
- Glutamine supplementation is logical because measured plasma concentrations are nearly always below the normal range.
- The enteral route is efficient in major burns and daily doses should aim at 30 g / day.

Nutraceuticals in burns(2)

Glutamine and arginine

- **Ornithine a-ketoglutarate** (0KG), a precursor of glutamine, have shown positive results, in both animal and human settings, in terms of improved wound healing and improved immunity
- Up to 30 g / day of **arginine** has also been recommended, but without conclusive data in burns. Based on current evidence, only glutamine should be part of the routine nutritional therapy of critically ill burn patients.

Nutraceuticals in burns(3)

w-3 ***polyunsaturated fatty acids (PUFA)***

- These fatty acids are potential immuno-modulatory and anti-inflammatory agents in doses of **3-5 g/day.**
- There are some data that show that they may improve outcomes.
- Preliminary data from a trial including w3-PUFA in a low fat-diet seem promising, but must be confirmed .
- The role of other fatty acids remains to be established

Nutraceuticals in burns(4)

Immune-enhancing diets (IED)

- The use of IED containing arginine is controversial in the critically ill patient.
- Patients suffering major burns belong to this category, and are frequently septic.
- There is probably a role for diets combining glutamine with antioxidant micronutrients, but conclusive trials supporting extrinsic provision are lacking.

Nutraceuticals in burns(5)

Taurine :

- **50 mg/kg /d for 10 days** showed a positive outcome on anti-inflammatory cytokine **IL-10** in burn patients.
- This effect was even more significant in patients with **higher percentage of burn area**.

Routes of Nutrition Support

- Oral intake
- Entral nutrition
- Paranteral nutrition

Oral intake

- Adults with burns **less than 20% TBSA** may be able to meet their requirements orally.
- They are encouraged to eat and drink as soon as possible following the injury.
- **A high protein, high energy diet** which includes mid-meal snacks and high protein drinks (milk drinks or commercial supplements) should be offered, particularly if they have been assessed as having other nutritional risk factors.

Oral intake(2)

- **Enteral feed**s may be needed if oral intake is inadequate.
- Adults with burns to the face, airway or hands may need closer nutritional monitoring to ensure they are have the ability to eat and drink.
- About major burns oral alimentation are often unsustainable because of the frequency of altered mental status, inhalation injuries, endotracheal intubation, GI dysfunction, and feeding intolerance
- Difficult to sustain because of the large and often intolerable amounts of food necessary to manage severe catabolism

Enteral nutrition

- Burn-injured patients clearly benefit from enteral nutrition. The fluid shifts that occur in the early shock-phase following severe burns cause significant oedema in the gut wall and favour gastrointestinal paresis.
- It is important to initiate enteral feeding before this occurs, meaning very early after injury and definitely within the first 12 hours.
- Using the gastric route early after injury is associated with higher overall success with enteral feeding.

Enteral nutrition(2)

- Enteral nutrition (EN) is recommended in burn management as in other critically ill patients .
- Early enteral administration of nutrients can improve splanchnic ,blunt the hypermetabolic response, stimulate intestinal IgA production and maintain intestinal mucosa integrity and gut motility.
- By the end of the first week after injury, the patient's full energy requirements should be supplied enterally, and there is no evidence in favour of early parenteral nutrition

Enteral nutrition(3)

- Delayed gastric emptying is sometimes observed in burn patients, in connection with heavy sedation and analgesia.
- In severely burned patients, post-pyloric feeding solves these problems.
- Nutrition may even be continued during long surgical procedures in those patients who remain intubated, to avoid lagging behind in energy delivery.
- Careful monitoring is required to prevent pulmonary aspiration.
- Constant gastric or post -pyloric infusion (60-150 ml/hr) is better tolerated than bolus administration.

Enteral nutrition(4)

Enteral nutrition has one major limitation:<u>underfeeding</u>

- Insisting on pure EN may cause prolonged insufficient energy delivery.
- Many patients require repeated surgical sessions, with the nutritional consequences of repeated fasting, and short times available for nutrient delivery.
- If nutritional requirements are not met using the enteral route, **supplementary parenteral feeding** may be given.
- The two techniques are complementary

Enteral access

- **Nasogastric feeding** tubes are the simplest to place, but also the easiest to pull out.
- **Nasojejunal tubes** are generally well tolerated, and enable feeding around the clock.
- with severe <u>burns to the face</u>, it may be very difficult for surgical reasons to leave a nasogastric tube, and percutaneous endoscopic gastrostomy or jejunostomy feeding tubes **(PEG or PEJ)** may be an appropriate Alternative.

Guidelines for appropriate enteral feeds for use in adult burn patients

- Nutrient dense (eg. 1.2 – 2 kcal/mL)
- High protein (NPC:N ratio of 100 – 120: 1)
- Low fat (25 – 30% of energy)
- Fibre free (in the acute phase)

Parenteral nutrition

- While total parenteral nutrition (TPN) should be considered a rescue option, the intravenous route is the only way to deliver the large amounts of trace elements that are required during the first 2-3 weeks after injury.
- TPN may nevertheless prove lifesaving in cases of insufficient energy delivery associated with intestinal failure.

Parenteral nutrition(2)

- Central venous access carries the risk of infection and sepsis.
- There is no place for peripheral nutrition in the burn patient. Excessive caloric and carbohydrate intakes are, however, easily achieved with TPN (rarely with EN), and should be avoided.
- Special attention should be paid to non-nutritional calories (e.g. from propofolor 5% dextrose).
- The daily monitoring of energy delivery is particularly important in burn management.

Guidelines for appropriate TPN for use in adult burn patients

- **Glucose** – Glucose can not be utilised above a rate of approximately 5mg/kg/min. Glucose should supply 50% of calories
- **Lipid** – 20-30% of calories from fat has protein sparing effects and minimises the problems associated with high glucose loads. Using a TPN solution containing lipid also ensures supply of essential fatty acids required for wound healing
- **Nitrogen** – A TPN solution containing a high level of nitrogen is appropriate to meet burns patients elevated protein requirements. The maximum daily level of Nitrogen provision in patients with severe catabolism is approximately **0.3g/kg**

Non-nutritional measures

The hypermetabolic response, and hence the nutritional requirements, can be reduced by important non-nutritional tools, including:

- Nursing in a warm environment using radiant heat (25-31 °C)
- Treatment of infection, pain, and anxiety
- Early surgical debridement and grafting
- Pharmacological tools

Pharmacologic tools

- Administration of the non-specific blocking agent **propranolol** is one of the most successful pharmacological means of reducing REE, and carries limited risks.
- The use of an **anabolic steroid, oxandrolone**, has been shown to maintain lean body mass, reduce muscle protein catabolism, and decrease length of stay in both adults and children.
- The use of **recombinant human growth** hormone has proven beneficial in children with extensive burns, but not in adults, in whom it may even be associated with increased mortality.

Monitoring the response to nutritional therapy

- The most important variables to follow are the daily blood glucose values and weight changes (especially after the initial fluid resuscitation period), and the weekly changes in prealbumin.
- weekly determinations reflect adequacy of protein and energy intake.
- Twice-weekly determinations of liver tests and triglyceride values serve to detect overfeeding.
- In settings where it is possible to measure trace elements within 2-3 days, a weekly determination of copper, selenium, and zinc will be helpful in adjusting the repletion therapy.

Another Treatment

- **Calendula** may be used topically as an ointment or a tea.
- **Gotu kola and bee resin (propolis**) may also be useful.
- **Aloe vera** has some merit but should never be taken orally.
- **Probiotic supplements** containing *Lactobacillus acidophilus* can help restore GI and immune health.
- **Honey, propolis** ,and **royal jelly** have antibacterial, antioxidant, antitumor, anti-inflammatory, and antiviral compounds that have phenolic flavonoid properties. They have been proposed for burn therapy

QUESTION

آقای 35 ساله با سوختگی 75% با نفت، آلبومین 2.1، روز پنج بستری که در این مدت فقط ده درصد از غذا های ارائه شده را دریافت نموده است، چه راه تغذیه ای را برای ایشان پیشنهاد می کنید؟

A 35 year old man with 75% TBSA burn in the fifth day of admission with albumin=2.1, that hast eaten 10% of his diet, what nutritional approach do you suggest?

ANSWER

If we consider that our patient has 175 cm height and 70 Kg weight, Estimated Energy Requirements based on **Toronto Formula** is 2400 Kcal.

- ✓ Protein requirement:140 g
- ✓ Glutamine:28 g(cap-powder)
- ✓ Arginin:21 g g(cap-powder)
- ✓ Taurine:3.5 g (cap-powder)
- ✓ Vial albumin %20
- ✓ Tab zincsulfate
- ✓ Tab selenium
- ✓ Tab vit B1
- ✓ Tab vit C

ANSWER(2)

By considering that, this patient can have orally, about 1000 kcal by oral intake with high calories high proteins diet and 1400 kcal supplemental powder for example fortimel by enteral route(Nasogasteric tube)will receive.

- ✓3 major meals
- ✓8 scope + 150 cc water=200 cc → every 3 hours

ANSWER(3)

- This order can supply protein needs for patient
- If the patient consumes homemade or hospital gavage, we should use extra protein for example whey protein powders.

Thanks for Your Kind Attention