Clinical Practice Guidelines Nutrition Burn Patient Management

NSW Statewide Burn Injury Service

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Background

The Dietitians at Concord, the Children's Hospital at Westmead and Royal North Shore Hospitals have collaborated to develop the following *Guidelines* for dietitian services in the acute burns setting. The dietitian's role in the multidisciplinary burn team integral. Their role in the assessment, treatment and management of nutrition problems arising from burn and inhalation injuries is now well established in burn units and burns literature

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1. Introduction

The following guidelines were developed by Dietitians working in specialist Burns Units at Concord Repatriation General Hospital, Royal North Shore Hospital and The Children's Hospital at Westmead.

These guidelines reflect the essential role the dietitian has in the provision of specialised nutritional support to promote recovery from burn injuries.

Burn centres provide specialist, multidisciplinary care in the management of burn injuries. It is acknowledged, however, that primary care or follow up management of such an injury may need to occur outside of specialist units. These guidelines are designed, as a practical guide to the relevant clinical knowledge and dietary intervention required for effective patient management.

A multidisciplinary approach to burn management is essential for optimal functional and cosmetic outcome. Serious long-term physical and psychological morbidity may be associated with a burn injury. All members of the burn management team interact throughout the recovery period from admission to scar maturation and beyond to minimise the impact of the trauma long-term. The dietitian, in consultation with the burn surgeon and other team members, contributes to patient care by providing early nutritional assessment, clinical intervention during all phases of management, and ongoing educative support to the patient, family and staff. Dietitians working outside a specialist burn unit are encouraged to liaise closely with their colleagues within the specialist units for advice and support in burn patient nutritional management.

These guidelines run concurrently throughout the acute and rehabilitative management of the patient with a burn injury. Appendices have been included that are intended to be reference guides to burn associations, useful resources, and Burn Unit contact numbers throughout Australia and New Zealand.

This document is reviewed on a yearly basis at present, and updated as required with current information at that time.

Some elements are an integral component in all areas of patient management. In order to avoid repetition, these will be discussed separately.

These elements include:

- Teamwork
- Education
- Continuing professional development
- Treatment complications
- Treatment planning
- Occupational health and safety
- Infection control
- Psychosocial factors

2. Teamwork

It is essential to implement a team approach to burn patient management throughout all phases of the recovery period from admission to scar maturation

The burns team includes the following members (in alphabetical order):

- Anaesthetists / Pain Management Specialists
- Child Life Specialists / Play Therapists
- Dietitians / Nutritionists
- Diet Technicians / Nutrition Assistants
- Domestic Staff
- Indigenous Health Workers / Cultural Support Workers
- Intensivists
- Interpreters
- Medical Specialists
- Music Therapists
- Nursing Practitioners
- Occupational Therapists
- Oral Health Specialists and Dental Health Technicians
- Orthotists / Prosthetists
- Parents / Caregivers / Family
- Pastoral Care / Clergy
- Patient
- Pharmacists
- Physiotherapists
- Psychiatrists, Psychologists and other Mental Health Workers
- Rehabilitation Specialists
- Social Workers
- Speech and Language Pathologist

2.1 The nutrition plan must be compatible with other treatment requirements in the recovery period, from admission to scar maturation. In negotiation with other team members, the dietitian should implement a nutrition plan that considers:

- the status and location of wounds
- the process of skin replacement
- respiratory needs and lung function status
- nutritional and physical status prior to injury
- pyrexia
- gastrointestinal function
- the psychosocial status of the patient and family
- the age and gender of the patient
- the level of alertness of the patient
- pain management and sedation
- individual patient factors, such as compliance and individual priorities, the presence of pre-injury behavioural problems, psychological or psychiatric history, learning disabilities or developmental delay, and previous hospitalisation experiences

- indications for treatment variance, such as reconstructive surgery, psychological changes etc
- cultural background and religious beliefs
- the responses of partners, parents, caregivers and family members
- special dietary needs e.g., food allergies

References

1. American Burn Association. Resources for optimal care of the injured patient (Chapter 14). American College of Surgeons: Committee on Trauma. (1999). (www.ameriburn.org/pub/guidelinesops.pdf)
2. Herndon DN, Muller MJ, and Blakeney PE Teamwork for total burn care: Achievements, directions and hopes. In: D.N. Herndon (Ed.), Total Burn Care Philadelphia: WB Saunders, p.1-4. (1996).
3. Malick MH, and Carr JA Manual on management of the burn patient. Pittsburgh: Harmarville Rehabilitation Centre. (1982).

3. Education

3.1 The dietitian should consistently provide ongoing education and support to patient, staff and care providers, throughout all phases of recovery from admission to completion of scar maturation.

Education may occur using a variety of techniques ie.

- verbal description to patient, family / caregivers and burn team members
- provision of written instructions / information pamphlets to patient, family / caregivers and / or staff
- inquiring of patient, parent / caregiver, family and staff regarding understanding of information presented
- implementation of formal education sessions for family / caregivers and / or staff where necessary (e.g., staff inservices, parent group inservices, family meetings with burn team members)
- use of photography and video for assessment and monitoring of progression
- formal documentation in medical record
- continuous monitoring and updating of requirements throughout the treatment program
- support groups (refer to Appendix Two)
- participation in development of new resources to aid staff awareness to assist in correct implementation of therapy regimens
- teleconferencing / videoconferencing

Patient and family / caregiver has full awareness of the consequences of their choices, including:

- benefits and / or risks of participation in individual program,
- consequences of non-compliance

3.2 The dietitian provides education that is appropriate for the age, developmental, cognitive, and psychological status of the patient, family, and / or caregivers

Understanding of procedure reduces anxiety. Techniques to assist understanding include:

- open discussion with patients and parents / carers

- written literature that is easy to understand
- active assistance by patient with the procedure eg. choosing the body part to be washed first, removing dressings etc.
- goal setting
- procedural play
- story telling

The language of the burns team emphasises the functioning and health of the patient post-burn (positive aspect) with regard to assessment, treatment and the perspective portrayed to the patient (adult or child), parent and / or caregiver.

- To the patient, parent / caregiver, family and / or staff, explain that treatment to minimise impairment (eg. passive stretching, splints etc) are used to allow the patient to play / work / care for themselves independently etc. after physical recovery from the injury.
- Explain the importance of obtaining information regarding the pre-morbid functioning of the patient and their family / support services to the burns team, patient and family, so that services can be provided which maximise functional outcome post-burn injury.

References:

1. American Burn Association. *Resources for optimal care of the injured patient (Chapter 14).* American College of Surgeons: Committee on Trauma. (1999). (www.ameriburn.org/pub/guidelinesops.pdf)
2. Kealey GP, Chang P, Laubenthal KN, and Jensen KL. Physical Therapy: A vital aspect of burn care. *Physical and Rehabilitation Medicine* 199; **2**, 227-41.
3. Tyack Z.F and Ziviani J. What influences the functional outcome of children at 6 months post-burn? *Burns*. 2003 Aug; **29**: 433-44.

4. Continuing Professional Development

4.1 The dietitian must continue to update his / her knowledge on burn wound pathophysiology and current trends in burn patient / critically ill patient management

Continuing professional development may include the following:

- regular review of relevant journals, i.e., *Journal of Burn Care and Rehabilitation, Burns, Journal of Wound Care, Journal of Trauma*
- participation in local inservice events related to wound care and burn patient management
- participation in education programs provided by local burn units and burn team members
- participation in on-line discussion groups available through burn associations
- liaison with colleagues within specialist burn and/or intensive care units
- attendance at burn conferences e.g., annual meeting of Australian and New Zealand Burn Association (ANZBA)
- membership of Associations (e.g., ANZBA, International Society of Burn Injuries [ISBI]) which have been established to promote burn research care and prevention
- membership of Associations focussing on specialised nutrition support in the critically ill (eg. AuSPEN, ESPEN)

Reference:

1. American Burn Association. *Resources for optimal care of the injured patient (Chapter 14).* American College of Surgeons: Committee on Trauma. (1999). (www.ameriburn.org/pub/guidelinesops.pdf)

5. Research and best practice

5.1 The Burn Dietitian must adopt an evidence-based approach to care and strive for best practice. Participation in research is encouraged, particularly in a multidisciplinary Burn Unit setting

The Dietitian needs to generate and participate in research

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1. Demling RH. The advantage of the burn team approach. *Journal of Burn Care & Rehabilitation.* 1995; **16**: 569-72.
2. Supple KG, Fiala SM, Gamelli RL. Preparation for burn centre verification. *Journal of Burn Care & Rehabilitation.* 1997; **18**: 58-60.

6. Treatment complications

6.1 The dietitian needs to demonstrate awareness of the potential deleterious effect of dietary regimens if incorrectly applied or not applied in a timely manner. It is important for the dietitian to instigate management compatible with other treatment requirements

Complications are outlined within specific guidelines Swallowing Management

7. Treatment planning

It is important for the dietitian to establish treatment goals in consultation with the patient, the parent / caregivers, and staff members throughout admission and continuing until the scar maturation phase of treatment and beyond. Short term and long term goals should be included, focusing on the functional and cosmetic outcomes of the individual

Treatment plans must be adjusted / prioritised considering:

- signs / symptoms / investigations
- environmental limitations
- input from other team members
- time constraints of team management
- patient priorities for functional outcomes
- patient risk factors for reduced functional outcomes i.e., pre-morbid characteristics, age and gender of patient, socio-economic status of family, previous history of hospitalisations, parental coping and social support

Refer to teamwork, education and treatment complications.

Reference

1. Kealey GP, Chang P, Laubenthal KN, & Jensen KL. Physical Therapy: A vital aspect of burn care. *Physical and Rehabilitation Medicine,* 1991; **2** (4), 227-41.
2. Tyack Z.F and Ziviani J. What influences the functional outcome of children at 6 months post-burn? *Burns*. 2003 Aug; **29**: 433-44.

8. Occupational Health & Safety

8.1 The dietitian must be aware of the occupational health and safety guidelines relevant to the patient setting

These are available from hospital and department managers.

9. Infection control

9.1 The dietitian must have knowledge of, and must implement correct infection control procedures relevant to the patient setting.

- knowledge of universal precautions
- knowledge of elements responsible for transmission of infection
- perform correct hand washing at appropriate times
- use personal protective attire e.g., gowns, gloves, goggles as indicated

Reference:

1. American Burn Association. *Resources for optimal care of the injured patient (Chapter 14).* American College of Surgeons: Committee on Trauma. (1999). (www.ameriburn.org/pub/guidelinesops.pdf)

10. Psychosocial

10.1 The dietitian must attempt to identify psychosocial factors that will impact on successful treatment outcomes.

Identify and understand the impact of pre-morbid patient and family characteristics on treatment outcomes:

- identify presence of behavioural problems, psychological or psychiatric history, learning difficulties or developmental delay prior to burn injury
- identify pre-morbid demographic characteristics that influence functional outcome i.e., age, gender, socio-economic status, previous hospitalisations
- in liaison with burn team members, identify family functioning or patient characteristics that influence functional outcome i.e., coping style, number and satisfaction with social support network, level of depression and anxiety of family members
- participate in early discharge planning with multidisciplinary team members in order to instigate community support networks to assist coping and compliance e.g., community nurses, community mental health worker, respite carer, etc
- liaise with other team members in order to gain further information regarding the impact of pre-morbid factors on patient and caregiver's understanding and ability to complete therapy programs

Be aware of potential litigation situations and your legal requirements:

- maintain appropriate documentation in medical chart
- produce formal, objective legal reports when required

10.2 The therapist must consistently evaluate the impact of psychosocial events on patient and their family.

It is essential to identify psychosocial factors and their impact on the patient and caregivers from admission to scar maturation phase of burn treatment:

- recognise the importance of early referral for psychiatric / psychological management for the patient and family support
- be aware of the normal grieving process and adjustment responses to trauma
- reinforce verbally and in written form the grieving and adjustment responses identified and their observed impact on treatment to patient, family / carers and staff
- be aware of patient's / family's / caregiver's fear of unknown factors and the impact this has on treatment, including compliance
- recognise the loss of occupational performance roles after injury and psychological and emotional response to this e.g., behavioural changes, resistance to treatment, withdrawal
- be aware of the effects of sleep deprivation, medication and psychological stress on a patient's ability to lay down new memory. Be mindful of their reactions to input in this light

It is important for the dietitian to be aware of individual's changes to body image and self concept following a burn injury:

- support patient and family members' adjustment to changes in appearance
- encourage patient and family participation in daily management to assist with acceptance of changes in body image

10.3 The dietitian assists other burn team members in facilitating patient's acceptance of changes to their physical and social function.

Facilitate the process of adjustment to impairment and disfigurement:

- assist attainment of patient driven goals despite the presence of limitations to participation in activities
- encourage patient and family participation in programs that address adjustment and self-concept issues e.g., burns camping programs, support group etc. (refer to Appendix Two)
- commence early education and support of patient and care providers to assist and facilitate adjustment and acceptance
- provide or arrange for long-term follow-up

References

1. Blakeney PE, and Meyer III WJ. Psychosocial recovery of burned patients and reintegration into society. In D.N. Herndon (Ed.). *Total Burn Care*. Philadelphia: WB Saunders, 1996. p556-563.
2. Dise-Lewis JE. A developmental perspective on psychological principles of burn care. *Journal of Burn Care and Rehabilitation* 2001; **13**, 255 - 260.

3. Esselman PC, Ptacek JT, Kowalske K, Cromes GF, deLateur BJ, and Engrav, LH. Community integration after burn injuries. *Journal of Burn Care and Rehabilitation* 2001; **13**, 221 - 227.
4. Pruzinsky T, Rice LD, Himel HN, Morgan RF, and Edlich RF. Psychometric assessment of psychologic factors influencing adult burn rehabilitation. *Journal of Burn Care and Rehabilitation* 2001; **13**, 79 - 88.
5. Warden GD. Functional sequelae and disability assessment. In D.N. Herndon (Ed.). *Total Burn Care*. Philadelphia: WB Saunders, 1996. P 523 – 528
6. Tyack Z.F and Ziviani J. What influences the functional outcome of children at 6 months post-burn? *Burns*. 2003 Aug; **29**: 433-44.

11. Management of adult burn patients

11.1 Adult service delivery

11.1.1 Referral Policy/ Target Group

There is blanket referral for all the patients admitted to the Adult Burns Units at Concord and Royal North Shore Hospitals.

Adults with a TBSA greater than 20%, are assessed for nutrition support. They may meet their requirements orally, however this often depends on the depth and severity of the burn. (1)

Patients with burns to the face or hands, or inhalation injuries also require assessment for nutrition support.

11.1.2 Assessment of the Severity of the Burn

Dietitians are not responsible for assessing the severity of the burn. The assessment is made by an experienced medical/surgical team to avoid over or under estimations. The Lund – Browder Burns Chart is used for assessment.

11.1.3 Definition of Severe Burn

The following are the guidelines for admission to a Burns Unit in NSW. (2)

- Partial/ full thickness burns in adults >10% TBSA.
- Partial/ full thickness burn in children > 5% TBSA.
- Burns to the face, hands, feet, genitalia, perineum, or major joints.
- Chemical burns
- Electrical burns
- Burns with concomitant trauma.
- Burns with inhalation injuries
- Burns with pre-existing medical disorders which may adversely affect care or outcomes.

Adults with a burn greater than 20% of TBSA likely to have significant hypermetabolism. They are unlikely to be able to meet their nutrition requirements orally.

11.1.4 Management of Non-severe Burn

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.

Intake is monitored and the diet reviewed as necessary. Enteral feeds 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.

References

1. Deitch EA. Nutritional support of the burn patient. *Critical Care Clinics* 1995; **11**(3) 735-750.
2. NSW Severe Burn Injury Service Model of Care. NSW Department of Health, 2004.

11.2 Nutrition Assessment of adults

Assessment of all patients is mandatory in order to provide baseline data so that continual appraisal of progress can be made.

An initial nutrition assessment should be undertaken as soon as possible after admission to hospital. It is recommended that appropriate feeding be initiated within the first 24-48 hours after the burn injury. (1)

Assessment

Nutrition assessment should include:

- 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

11.3 Energy requirements

11.3.1 Introduction

Indirect calorimetry (IC) is considered the gold standard for estimating energy requirements as nutrition support can be individualised and matched to the energy expenditure. However, fluctuations in energy expenditure due to dressing changes, activity and infection etc must be accounted for and measurements taken on a regular basis. Access to IC is limited and there is no clinical evidence for the superiority of IC over formulas in burns patients (2).

There are a variety of predictive formulas designed to estimate energy requirements of burns patients (3). All have limitations, the older formulas are reported to overestimate requirements as they were developed before improvements in burn care which have reduced the hypermetabolic response (2). Others do not account for environmental conditions such as temperature, skin grafting, dressing changes and variations in activity (4). There is limited

evidence for the commonly used injury factors (5). These limitations of predictive formulas increase the need for regular monitoring and follow up of patients to ensure both adequate nutrition and avoidance of overfeeding (5).

11.3.2 Formulae for Assessment

The formulas should be used as guidelines and a number of formulas could be used to provide a range of estimated requirements. Energy requirements should be reassessed on a regular basis. The acute hypermetabolic phase can last at least three weeks (2,3). As this tapers off the more standard equations and injury/ activity factors can be used to avoid overfeeding. The following are examples of the formulas used in NSW Severe Burns Service.

- When calculating requirements, it is important that the following points are considered:
    - use of ideal / usual body weight (except with use of Ireton-Jones equation for spontaneously breathing patients)
    - reassessing as wounds are closed and healed
    - ensuring at least twice weekly re-evaluation
    - consider graft mesh size
    - consider the impact and continuum of physiotherapy and occupational therapy using the activity factors

- The **Toronto Formula** (6) (below) is useful in the acute stages of burn injury, but must be assessed against monitoring parameters, and adjusted with changes in those parameters.

TORONTO FORMULA:

For all patients:
REE (kcal) = -4343 + (10.5 x TBSA burned) + (0.23 x kcals) +
(0.84 x Harris Benedict) + (114 x T (^{o}C)) - (4.5 x days post-burn)

TBSA = total body surface area burned;
kcals = calorie intake in past 24 hours;
Harris Benedict = basal requirements in calories using the Harris Benedict equation with no stress factors or activity factors;
T = body temperature in degrees Celsius;
days post-burn = the number of days after the burn injury is sustained using the day itself as day zero.

*11.3.2.1.1 **Activity factors: Ventilator-dependent: 1.2** (7)*

11.3.2.1.2

There are no activity factors for non-ventilated patients. The activity factors for the Harris Benedict and Schofield equations could be used in these patients.

- The **Modified Harris Benedict** (8) and **Modified Schofield** (9) have also been used with patients with burn injury. Ongoing monitoring and assessment are still required.

MODIFIED HARRIS BENEDICT EQUATION:

Male:
BEE (kJ) = 278 + (57.5 x kg Wt) + (20.9 x cm Ht) – (28.3 x age)
Female:
BEE (kJ) = 2741 + (40 x kg Wt) + (7.7 x cm Ht) – (19.6 x age)

EER = BEE x IF

***Injury Factor (IF)*:**

% Burn	**<10**	**11-20**	**21-30**	**31-50**	**50+**
1.1.1.1.1.1	**1.2**	**1.3**	**1.5**	**1.8**	**2.0**

These are the injury factors commonly used in the hospitals of the NSW Severe Burns Hospital. Their origin is unclear and it appears they are a modification

MODIFIED SCHOFIELD EQUATION:

Female kcal/d BMR		**Male kcal/d BMR**	
15-18 years	**13.3W + 690**	**15-18 years**	**17.6W + 656**
18-30 years	**14.8W + 485**	**18-30 years**	**15.0W + 690**
30-60 years	**8.1W + 842**	**30-60 years**	**11.4W + 870**
Over 60 years	**9.0W + 656**	**Over 60 years**	**11.7W + 585**

W = weight in kg

EER = BMR x IF x AF

Injury Factor (IF) (11)

Up to 10% burn	1.0-1.1
10-25%	1.1-1.3
25-90%	1.2-1.7

These injury factors appear to be based on expert opinion or consensus only. (5)

Activity Factor (AF) – including diet induced thermogenesis

Bed bound immobile	1.1
Bed bound mobile/ sitting	1.15-1.2
Mobile on ward	1.25

IRETON-JONES EQUATION (12) is used in the Intensive Care setting, and is as follows:

<u>For spontaneously breathing patients:</u>

EEE (kcal) = 629 – 11(A)+ 25(W) – 609(O)

where EEE = estimated energy expenditure;
A = age in yrs,
W = weight in kg,
O = presence of obesity > 30% above IBW: 0 = absent; 1 = present

<u>Ventilator-dependent patients:</u>
EEE (kcal) = 1784 – 11A + 5W + 244G + 239T + 804B
where A = age in yrs,
W = weight in kg,
G = gender: 0=female, 1=male,
T = diagnosis of trauma: 0=absent; 1=present,
B=diagnosis of burn: 0=absent, 1=present.

- The **Curreri Formula** (13) is well known to overestimate requirements. This may be due to advances in the medical management of burns which have reduced the hypermetabolism associated with a burn injury, e.g. early excision and grafting, wound dressings and environmental temperature control. (4)

CURRERI FORMULA

For all patients:
25kcal/kg actual BW + 40kcal/%TBSA burn

References

1. Deitch EA. Nutritional support of the burn patient. *Critical Care Clinics* 1995; **11**, 735-750.

2. Saffle JR and Hildreth M. Metabolic support of the burned patient. In: Herndon DN, ed. *Total Burn Care*, 2nd ed. London: Saunders, 2002, p271-287
3. Dickerson RN, Gervasio JM, Riley ML, et al. Accuracy of predictive methods to estimate resting energy expenditure of thermally-injured patients. *JPEN* 2002; **26**: 17-29.
4. Rodriguez DJ. Nutrition in patients with severe burns: State of the Art. *Journal of Burn Care & Rehabilitation* 1996; **17**: 62-70.
5. Reeves MM and Capra S. Predicting energy requirements in the clinical setting: are current methods evidence based? *Nutrition Reviews* 2003; **61**: 143-151.
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7. Royall D, Fairholm L, Peters WJ, Jeejeebhoy KN, Allard JP. Continuous measurement of energy expenditure in ventilated patients: An analysis. *Critical Care Medicine* 1994; **22**: 399-406.
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9. Schofield WN. Predicting basal metabolic rate, new standards and review of previous work. *Human Nutrition - Clinical Nutrition* 1985; **39** Suppl 1:5-41.
10. Wilmore DW. *The Metabolic Management of the Critically Ill*. New York: Plenum Publishing Corporation, 1977.
11. Elia M. Artificial nutritional support. *Med Int.* 1990; **82** :3392-3396.
12. Ireton-Jones CS, and Jones JD. Should predictive equations or indirect calorimetry be used to design nutrition support regimens? *Nutrition in Clinical Practice* 1998; **13**:141-145.
13. Curreri PW, Richmond D, Marvin J, Baxter CR. Dietary requirements of patients with major burns. *Journal of American Dietitians Association* 1974; **65**: 415-417.

11.4 Over feeding

Over feeding the burn patient can cause serious complications such as hyperglycaemia, fatty liver, and respiratory insufficiency. (1) Excessive carbohydrate feeding can increase oxygen production, effect hyperglycaemia, and fatty liver. Overfeeding protein can result in uraemia, dehydration, and metabolic acidosis. Overfeeding fat can result in hypertriglyceridaemia, and compromise immunity. (2)

Hart et al found that increasing caloric energy beyond 1.2 x resting energy expenditure results in increased fat mass without changes in lean body mass. (3)

Hence there is no rationale for feeding at intakes greater than estimated energy requirements.

References:

1. Ireton-Jones CS, and Jones JD. Should predictive equations or indirect calorimetry be used to design nutrition support regimens? *Nutrition in Clinical Practice* 1998; **13**: 141-145.
2. Klein CJ, Stanek GS, Wiles CE. Overfeeding macronutrients to the critically ill adults: Metabolic complications. *J American Dietetic Assoc.* 1998; **98**: 795-806.
3. Hart DW, Wolf SE, Herndon DN, et al. Energy expenditure and caloric balance after burn: Increased feeding leads to fat rather than lean mass accretion. *Annals of Surg* 2002; **235**: 152-161.

11.5 Macronutrient requirements

Protein
High protein delivery of 1.5-3.0 g/kg ideal body weight/day or 20-25% of total energy is required for burn patients. Non-protein calorie to nitrogen ratio should be maintained between 150:1 and 100:1 whilst in the Burn Unit, according to the percentage TBSA and each stage of injury, as follows: (1)

% 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**

Carbohydrate
Glucose infusion or delivery should be no more than 5-7 mg/kg/min (about 50% CHO as energy). (2)

Fat:
Fat should constitute no more than 25-30% as energy, but in fact 15-20% of non-protein energy as fat is optimal. (1,2)

Fluid:
Fluid requirements are determined by the Medical Burn Team using the Parkland Formula as it is the crux of burn resuscitation and treatment. The Dietitian only needs to document the total amount of fluids the patient is receiving via artificial nutrition, and to inform the Team of this amount.

References

1. Deitch EA. Nutritional support of the burn patient. *Critical Care Clinics* 1995; **11**: 735-750.
2. Rodriguez DJ. Nutrition in patients with severe burns: State of the Art. *Journal of Burn Care & Rehabilitation* 1996; **17**: 62-70.

11.6 Micronutrient requirements

Criteria for prescribing vitamins/minerals include pre-burn nutrition status, associated co-morbidity, burn severity and age, post burn dietary intakes, wound healing, biochemical indices. Specific requirements have not been established for patients with severe burns, however, provision of at least the RDI of nutrients that are known to be beneficial for wound healing (zinc, vitamins A and C) has been suggested. This would be met by enteral feeds and the composition of the feeds should be taken into account when determining further supplementation. The level of trace elements required in burn patients is undefined. (1)

Demling and Seigne (2000) (2) outline certain recommendations for minerals such as copper, selenium, zinc, vitamins A, C, E, and the B group vitamins, see table below. More research is required in this area.

Consideration of possible interactions between micronutrients also needs to be considered when supplementing with high doses. For example, high doses of zinc supplements may lead to copper deficiency. (3)

		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

References

1. Rodriguez DJ. Nutrition in patients with severe burns: State of the Art. *Journal of Burn Care & Rehabilitation* 1996; **17**:62-70.
2. Demling, RH and Seigne, P. Metabolic Management of Patients with Severe Burns. *World Journal of Surgery* 2000; **24**: 673 – 680.
3. Prelack K and Sheridan RL. Micronutrient Supplementation in the Critically Ill Patient: Strategies for Clinical Practice. *Journal of Trauma Injury Infection and Critical Care* 2001; **51**: 601 – 620.

11.7 Monitoring

Patient Monitoring:	
Parameter	**Suggested Frequency**
Fluid Balance	Daily while Acute then PRN
Blood Glucose Levels	Daily while Acute then PRN
Observations (T/RR/HR/BP)	Daily while Acute then PRN
Gastric Residuals	Daily while Acute then PRN
Bowels	Daily while Acute then PRN
Healing rate	Daily while Acute then PRN
Functional parameters	Daily while Acute then PRN
Nutrient intake (enteral, parenteral & oral)	Daily while Acute then PRN
Weight	Weekly (without dressings)

Biochemical Monitoring:	
Parameter	**Suggested Frequency**
Urea & Electrolytes	Daily
Serum Ca, PO4, Mg	Every second Day
ABG's	Every second Day
Nutritional Markers- ie pre-albumin	Twice Weekly
Inflammatory markers (CRP)	Twice Weekly
LFT's	Twice Weekly

Other:

Definitive guidelines for the monitoring of serum Copper, Zinc & Selenium have not been determined. For BSA > 20% the UK Burns interest group recommend monitoring plasma levels at days 7,14,21.

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12. Mode of nutrition support

12.1 Enteral nutrition

Early Enteral Feeding (within the first 24-48 hours) is the preferred mode of artificial feeding over total parenteral nutrition (TPN), and should be maintained while patients remain in the flow or catabolic phase of their injury regardless of their state of oral intake.(1,2,3) Observational monitors of the flow phase include tachycardia, hypertension, hyperventilation, and hyperthermia. Current literature suggests that bowel sounds do not have to be present to successfully commence enteral feeding as bowel sounds are not a good indicator of the small intestines' capacity to absorb nutrients.(4) This remains controversial and thus patients will require monitoring to see if they are tolerating the regime.

A policy of immediate enteral feeding may be superior to delayed enteral feeding, even though a limited amount of enterally administered nutrients are absorbed during the first few days after burn injury. (2) Early nutrition supplementation in burned patients is associated with less time taken to achieve positive nitrogen balance, and reduced urinary catecholamine excretion and lower plasma glucagon concentrations during the first two weeks on enteral nutrition. (5) Early enteral feeding reduces caloric deficits and may stimulate insulin secretion and protein retention (6). Additional benefits are maintenance of mucosal integrity; decreased incidence of diarrhoea and decrease length of hospitalisation is also supported. (7) Early enteral feeding may decrease intestinal permeability, preserve the intestinal mucosal barrier and reduce enterogenic infection. (8) Increased wound healing and decreased length of care in patients with severe burns has also been shown with enteral feeding commenced before the third day. (9) Delayed enteral feeding (>18 hours) results in a high rate of gastroparesis and need for intravenous nutrition (10).

Regimes using diluted enteral formula are not recommended due to the lack of evidence enteral nutrition tolerance is increased and when used result in patient's receiving less of assessed nutritional requirements. (8)

The use of nasojejunal feeding is recommended in patients that fail nasogastric feeding due to gastric stasis or persistent vomiting. Nasojejunal feeding has been supported as a safe and well-tolerated method of feeding in other critically ill patients and in patients with severe burn injury. (11,12) The use of trans-pyloric feeding tubes allow commencement of enteral nutrition within 24 hours of admission and can be continued during surgery aiding to ensure continuous caloric and protein supply. (4) Andel et al 2001 investigated the effects of early high caloric enteral nutrition on the intestinal oxygen balance of severely burned patients. Results indicated that high caloric duodenal feeding in the early hypodynamic post-burn phase does not result in adverse effects on the oxygen balance of the intestine. (13)

Adults sustaining 20% or more total body surface area burn (TBSA) should have a nasoenteric feed via a fine bore tube, and an appropriate enteral feed for use in Burn patients, delivered in a continuous delivery mode over 24 hours. Guidelines for appropriate enteral feeds for use in adult burn patients are listed below (1,14):

- 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)

References

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12.2 Parenteral nutrition

Parenteral nutrition may be difficult to implement and to maintain because of extensive skin loss and the risk of the potential complications of septic and thrombotic complications. (1) As parenteral nutrition is less effective in maintaining the gut barrier and host immune function than enteral feeding, use of parenteral nutrition in the case of a functioning gut is not justified.

(1) Patients who do not tolerate enteral feeding should have parenteral nutrition started immediately while continuing attempts are made to re-establish enteral nutrition. (2)

Parenteral nutrition would be administered in consultation with the hospital TPN team or TPN pharmacist, as per hospital protocols.

Overfeeding should be avoided. It can result in metabolic complications, including increased carbon dioxide production, leading to difficulty in ventilatory weaning, high glucose levels, raised triglyceride levels and hepatic steatosis.

Guidelines for appropriate TPN for use in adult burn patients are listed below:

Glucose – Glucose can not be utilised above a rate of approximately 5mg/kg/min. Glucose should supply 50% of calories. (3,4)

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. (1,3)

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. (3)

It is difficult to meet these 'ideal" proportions with current TPN solutions available. An example of a suitable TPN solution is:

Synthamin 17	1000mL	425 Cal	18%
Glucose 25%	1000mL	950 Cal	40%
Lipid 20%	500mL	1000 Cal	42%

Premixed TPN solutions are available which could meet patient's requirements. They may need some modification with electrolytes, vitamins and minerals.

Vitamins, minerals and trace elements - Also essential components of parenteral nutrition with the 1999 AuSPEN Adult guidelines for water soluble and fat soluble vitamins listed below. Proprietary Vitamin Solutions exist for use in parenteral nutrition.(5)

Vitamin	Unit	AuSPEN
Thiamin	Mg	3.0
Riboflavin	Mg	3.6
Niacin	Mg	40
Pyidoxine	Mg	4
B12	µg	5
Pantothenic Acid	Mg	15
Folic Acid	µg	400
Biotin	µg	60
C	Mg	100
A	µg	1000
D	µg	5
E	mg	10
K	µg	None

AuSPEN (1999) have also published recommended daily requirements for the addition of trace elements to parenteral formulas as follows. (5) Premixed trace element solutions are available for adding to parenteral nutrition.

Trace Element	AuSPEN µmols / day
Iron (Fe)	20
Zinc (Zn)	50-100
Manganese (Mn)	5
Copper	5-20
Chromium	0.2-0.4
Selenium	0.47-1.5
Molybdenum	0.4
Iodide	1.0

TPN specific Monitoring:

It is important to ensure glucose levels are maintained at less than 10mmol/L and monitoring of urea to ensure that it does not increase above 20mmol/L.(6)

Electrolytes should be monitored daily to ensure maximum benefits from parenteral nutrition are achieved. General guidelines listed in the table below exist for parenteral nutrition however individual monitoring and adjustments are required to maintain electrolyte and fluid balance.(3)

Electrolyte	Estimated Adult Requirements for Parenteral Nutrition (mmol)
Sodium	45-145
Potassium	30-40
Calcium	5-7.5
Magnesium	5-10
Chloride	Varies with acid-base balance
Phosphate	20-45

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12.2.1Peripheral

Peripheral veins are the easiest veins to access when administering Parenteral Nutrition. Peripheral parenteral nutrition can be used for months at a time when a fat imulsion is included in the parenteral solution and special care is taken at the infusion site. The fat

imulsion acts to decrease the incidence of thrombophlebitis as the reduced amount of carbohydrate needed to meet energy requirements and subsequent lower osmolarity of the solution. The fat emulsion also provides protective properties on the endothelial lining of the vein. Compared with the problems that occur with central venous complications, severe complications arising through the use of peripheral parenteral nutrition are rare. (1)

Limitations of peripheral nutrition is that only lower osmolarity solutions can be given to avoid thrombophlibitis and fluid overload. Thus Peripheral parenteral nutrition is not the optimal access route in situations of severe metabolic stress, where there are large nutrient or electrolyte needs (especially potassium which is a strong vascular irritant), with fluid restrictions or if prolonged intravenous nutrition is required. It is appropriate to use peripheral nutrition as a supplement to enteral intake to ensure adequate nutrition support. (2)

References

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2. A.S.P.E.N Board of Directors, Guidelines for the Use of Parenteral and Enteral Nutrition in Adults and Paediatric Patients. *Journal of Parenteral and Enteral Nutrition* 1993; **17**, No. 4, Supplement.

12.2.2 Central

Central venous catheters are widely used to administer Parenteral Nutrition especially in long term nutrition. As hyperosmolar solutions are harmful to the intima of the veins, central veins with a high blood flow enable hypersomolar solutions to be given, such as glucose and amino acid solutions.(1) This enables nutritional requirements to be given in smaller volumes than is possible with Peripheral parenteral nutrition.(2) Severe complications that may occur during central venous infusion of parenteral nutrition include sepsis, air embolism, and thrombosis, with these complications more likely to occur compared with the infusion of parenteral nutrition peripherally. (1)

References

1. Baxter Healthcare, *Guide to Parenteral Nutrition*, Sweden.
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12.2.3 Dual Feeding

Enteral and Parenteral

Parenteral Nutrition should be given when enteral nutrition fails to meet nutritional requirements. The early use of parenteral nutrition ensures estimated nutritional requirements are met. (1)

Enteral / oral

Oral feeding should be encouraged as soon as patient is enabled to eat and drink. Patients sustaining an inhalation injury need Speech Therapy assessment before introduction of any oral substances.

The Oral diet must constitute high protein and energy choices, in similar proportions to the above requirements. High protein supplements are manipulated to increase protein further as per requirements.

Enteral feeding given in combination with oral intake of food and having an optimally balanced ratio of nutrients as found in commercial enteral formulas assists in normalising

metabolic processes as early as possible after burn injury through inhibition and reduction in catabolic processes, stabilization of biological membranes and encouragement of anabolic processes. Supplementary enteral feeding used in conjunction with oral intake should continue until all abnormal metabolic processes have been normalised as the burn patient's metabolism remains elevated until wound coverage and healing are complete. This results in an improved general clinical condition and the most efficient surgical treatment of wounds. (2,3) If increased metabolic needs are not met, visceral protein loss, impaired antibacterial host defences and delayed wound healing result. (3)

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12.2.4 Peri and intra-operative Nutrition Support in Adults

Burn patients may be malnourished prior to surgery, with malnutrition an important determinant of increased post-operative illness, complications, and mortality in surgical patients. Nutrition intervention in the pre-surgical patient aims to prepare and replenish nutrient reserves, if the patient is malnourished for the post operative period where nutritional requirements are increased due to factors which include stress and wound healing. (1)
It is important to consider that many Hospitals 'fast' patients as standard from 12 midnight the night prior to surgery. This can mean that many burns patients, who are on evening surgical lists, are repetitively without nutrition for over 12hrs at a time, furthering their risk of malnutrition and delayed wound healing.

Supportive peri-operative nutrition should be considered as a crucial part of the patients' treatment. Enteral feedings can be continued throughout excision and grafting procedures with close monitoring required of feeding tube placement and gastric reflux during surgery. If feeds are ceased, resumption of the enteral feeding regime post surgery is a priority with the aim to minimise the number of hours lost to enteral feeding post surgery. (2) Continuous enteral nutrition throughout the operative and peri-operative period via a nasojejunal tube has been shown to be feasible, safe and clinically effective with reduced infection rates and increased caloric intake. (3,4) Continuation of enteral feeding during these periods should be discussed and agreed with the surgical and anaesthetic teams.

In summarising the data on perioperative TPN, a worse outcome for patients has been demonstrated with the use of TPN. Preoperative TPN for a period of 7-10 days, particularly in patients who are severely malnourished may reduce postoperative morbidity. The use of perioperative enteral feeding is supported, with enteral feeding well tolerated and more consistently benefiting postoperative morbidity and mortality. (5)

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12.2.5 Post-operative Nutritional Support

Post-operative nutrition intervention objectives are to replenish protein and glycogen stores, vitamin and minerals and protein and iron lost through blood loss & prevents infection. Provision of a high energy, high protein diet is the most effective nutrition intervention in both burn and surgical patients. The diet regime recommended is an oral intake of a high energy, high protein diet supplemented with a high energy/high protein formula provided enterally (nasogastric or naso-jejunal tube), or parenterally (peripheral or central line). (1,2)

References

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12.2.6 Immunonutrition

Although there are many theories and promising research into nutritional immunomodulators such as glutamine, arginine, n-3 fats (1,2), and RNA (3), the evidence remains inconclusive particularly because it is difficult to separate the many factors involved when testing each substance. (1,4,5)

Early studies supported the inclusion of arginine, and glutamine as conditionally essential amino acids in burns patients. (1,2,3). A recent meta-analysis has recommended the use of glutamine supplemented enteral nutrition in burns patients (6). Reductions in mortality (7) and infectious complications (8) have been shown. However the role for arginine remains controversial and the same meta-analysis did not recommend using enteral formulas supplemented with arginine in the critically ill due to the potential for increased mortality in septic patients (6). Further research is required in this area.

References

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12.3 Evaluation

12.3.1 Reassessment of Nutrition Requirements

In adults, re-calculation of nutritional requirements using an equation should occur on a routine basis as wound size, and thus metabolism changes with skin grafting, re-epitheliazation and graft loss. (1)

Mechanical ventilation of a patient reduces the energy required for breathing by up to 20%. In contrast energy and protein requirements may increase during the recovery phase, when the patient's activity level increases and catabolism is replaced by anabolism. (2)

Weekly serum transferrin and prealbumin should be tested, as they are indicators of visceral protein status. Both serum transferrin and prealbumin are negative acute phase reactants and thus decline markedly in the acute post burn phase. Monitoring C-reactive protein may provide an indication of the level of inflammatory reaction and improve interpretation of visceral protein levels. (3) However they are useful markers in the evaluation of nutritional status into convalescence. (1)

References

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12.3.2 Aspirates

To check absorption of the enteral formula regular aspiration of the enteral formula via the enteral feeding tube should occur to ensure tolerance to the suggested regime. Fourth hourly monitoring is suggested initially and may decrease to sixth hourly in high-risk patients and even daily in more established enterally fed patients. (1)

Maynard and Bihari (1991) suggest aspirates of greater than 150-200mls or aspirates twice the enteral feeding rate indicate delayed gastric emptying. (1). The individual medical team decides whether to return the gastric aspirate to the gut or discard. There is no consensus within the literature about whether the aspirate should be returned or discarded.

The fine bore tubes, especially nasojejunal tubes collapse easily and this makes them unsuitable for monitoring gastric aspirates. Alternative means of monitoring enteral feeding tolerance should be used. Refer to the Complications section of enteral feeding below. (1)

Reference

1. Maynard, ND. Bilhari, DJ. Post Operative Feeding. Time to Rehabilitate the Gut, *British Medical Journal* 1991; **303**:1007-1008.

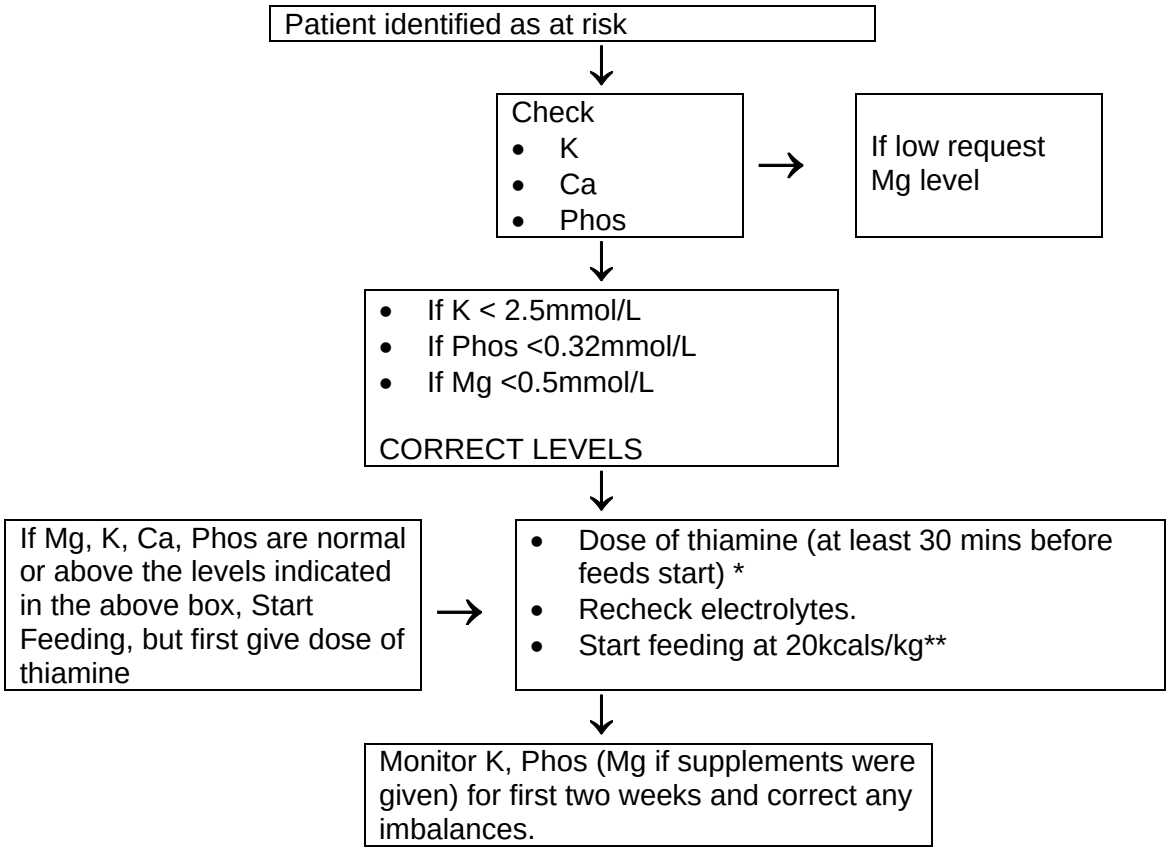
12.4 Complications

12.4.1 Enteral Feeding

Refeeding Syndrome

This potentially lethal syndrome of severe electrolyte and fluid shifts associated with metabolic abnormalities in malnourished patients undergoing feeding orally enterally, or parenterally has been well defined in the malnourished free-living and sick populations alike. The prerequisite for risk of refeeding is recent dramatic or chronic nutrition depletion. The burn patient is at risk if pre-burn nutrition has been compromised.

If the patient is identified as at risk of refeeding syndrome, nutrition support will need to be modified. (1) The flow chart below outlines the steps that should be taken to reduce the risk of the refeeding syndrome



* Large amounts of thiamine are required to correct possible deficiencies. (Reference) suggests 250mg of IV thiamine. Administration of thiamine should be discussed with the medical team and given according to the hospital pharmacy procedure.

** 20cals/kg for the first 24hours, then increase gradually within the first week to full feeding, with careful monitoring and replenishing of electrolytes as required

Flow Chart adapted from the British Dietitians Association Handbook

Non-obstructive Bowel Necrosis

Although rare, several case reports have defined this syndrome of diffuse or defined areas of full-thickness necrosis of small bowel due to aggressive enteral feeding, without obstruction.

For high-risk patients, it is recommended that initial cautious feeding is effected, with a fibre-free enteral feed. Bowel function and GIT symptoms need to be monitored closely. (2)

Burn patients at risk include those experiencing severe trauma shock, ventilator dependence, anaesthetic and analgesic medications, general vasoconstriction (including pharmacological), hypovolaemia, bowel dysmotility. (2)

Diarrhoea (3,4,5)

Possible causes:

- use of antibiotics (particularly I.V.)
- medications in the form of high-osmolarity elixirs
- drug/nutrient interaction, eg sorbitol, antacids or Mg containing medication
- persistent and severe hypoalbuminaemia
- allergy/intolerance/infection
- feed administration too rapid
- feed is hyperosmolar
- excessive fluid intake
- excessive glucose polymer or MCT used as additive to boost energy
- feed/system contamination, although risk is minimal if a closed enteral feeding system is used

Management:

- Do not cease feeds.
- Check the frequency of bag and line changes, feed hanging time.
- Follow hospital protocol for feed hanging time and line changes.
- Ensure the feed is iso-osmolar and reduce the feeding rate.
- Correct hypoalbuminaemia.
- Consider addition of probiotics.
- Consider a fibre containing feed or the addition of a fibre supplement.
- Review fluid intake including any IV fluids.

Steatorrhoea

A thorough assessment of the patient is required, including treatment modes, assessment of diagnoses, prognosis.

Tube blockages (3,4,5)

Possible causes:

- Irregular and inadequate flushing of tubes
- Use of viscous medications, or inadequately crushed tablets
- Feed issues: viscous, high protein content, low flow rate. *Do not use feed just taken from the fridge!*
- Type of tube

Management:

First determine type of blockage, then:

- Attempt to clear any blockage first using plain water, and plunge the syringe several times.
- Avoid using small syringes that offer resistance and minimal force.
- Use Ural (for non-proteinous blockages): dissolve 2 sachets in 180ml water, syringe gently into blocked tube, aspirating back to remove plug. Once cleared slowly syringe rest of ural solution into the tube, then flush with 50ml water before recommencing feed
- Viokase (for proteinous blockages): dissolve 3-4 Viokase tablets in 50ml water, syringe into blocked tube, wait 5 minutes before aspirating back to remove plug. Once cleared, slowly syringe rest of Viokase solution into tube, then flush with 50ml water before restarting feed.

Aspiration (4,5)

Possible causes:

- Delayed gastric emptying
- Tube dislodgement or incorrect positioning
- Use of a large bore nasogastric tube (>14 F)
- Use of medications affecting gut motility such as opiates
- Positioning of patient

Management:

- Place a nasoenteric tube past the Ligament of Treitz
- Change to a fine bore tube (10-12F)
- Decrease feed rate by 10-20ml/hour
- Consider use of a prokinetic agent
- Elevate bed head at least 45^0

Vomiting (4,5)

Possible causes:

- Tube positioning
- gut immotility
- use of opiates
- intracranial pressure
- respiratory status
- feeding rate too fast
- hyperosmolar feed
- obstruction

Management:

- Correct tube positioning

- assess feed for modification
- decrease feed rate by 20-30mls
- elevate bed head at least 45^0
- consider use of a prokinetic agent or reassess type already in use
- consider fine bore nasoenteric tube placed past Ligament of Treitz – transpyloric feeding

Constipation (5)

Possible Causes:

- Dehydration
- Concentrated formula
- Insufficient fibre
- Effect of pain killers – opiates

Management:

- Monitor fluid intake and output – check is meeting fluid requirements
- change to a fibre containing feed or use a fibre supplement.

Dehydration

Possible Causes:

- Inadequate fluid intake
- Concentrated feed
- Diarrhoea

Management:

- Review total fluid intake
- include water flushes
- For management of diarrhoea see above.

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Parenteral Feeding

There are four main categories of TPN complications (1):

- Inadequate Nutrition Delivery
- Mechanical Complications
- Metabolic Complications
- Infectious Complications.

Inadequate delivery refers to complications of underfeeding and overfeeding, and these have been discussed or obviated.

With mechanical complications such as pneumo- or haemo- thorax, air embolism, or misplacement, skill and caution is required. A thrombosed vein or clotted catheter can be

avoided by requesting a radiograph before infusing fluids, and intermittent flushing and stabilisation of catheters can help with maintenance care. (1)

Metabolic complications are common. They include electrolyte imbalance, glucose intolerance, and respiratory effects as short-term complications, and are especially seen in the critically ill, burn patient. Starting TPN at a lower rate and increasing cautiously allows for adjustment. (1,2)

Long-term complications include hepatic dysfunction and hypertriglyceridaemia. (1,2)

Replacement of vitamins and minerals should be followed according to site protocol, as should monitoring of TPN parameters.

Burn patients are more likely to develop infectious complications due to the absence of skin as a barrier, and their increased susceptibility to infection generally. (3) TPN in burn patients confers more complications than any other patient group due to the patho-physiological nature of the burn injury. If possible, TPN in burn patients should be avoided or at least involved in dual delivery whereby the gut is also being fed, even if only in a “trickle” fashion to minimise bacterial translocation. (4)

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Transitional Feeding

The process of weaning is important for the adjustment of both metabolic and morphological systems. Enteral nutrition delivery is reintroduced when signs of gut function returns or improves. Continuing TPN while initiating enteral feeding avoids the risk of energy deficit and allows for gradual adjustment and tolerance. (1)

The same remains true for the introduction of oral feeding. Patients will be able to adjust to oral intake while enteral and/or TPN continues, without the distress of knowing that they are not meeting their requirements orally due to problems of altered appetite.

Transitional feeding can be complicated by overfeeding or overhydration through continued administration of extra fluid, extra calories or continued delivery of macro- and micro-nutrients via the enteral and/or parenteral routes.

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12.5 Discharge Planning

12.5.11. Rehabilitation

Assessment and monitoring continues throughout this phase. The standard Harris Benedict equation or the Schofield equation is better suited to this phase for assessment of requirements. These formulae, however, are only estimations, and need to be used in conjunction with monitoring parameters. (1,2)

Protein has been shown to be the key nutrient required in continuous delivery over the rehabilitation phase in order to restore body weight and muscle function. Demling and DeSanti found that providing a protein intake of 1.3 to 1.5 g/kg/day to burn patients sustaining 30-50% TBSA, effected a modest increase in weight per week (about 0.5 to 0.75 kg) and an improvement in muscle strength and endurance, whereas adding protein of 1.7 to 2.0 g/kg/day increased weight by about 1.25 to 1.5 kg per week, and improved strength and endurance significantly more. (3)

12.5.2Home

Burn patients are reviewed on an outpatient basis. The regularity of nutritional follow-up is tailored to the patient's recovery process, and patients are reviewed as issues come up when they return for outpatient physiotherapy or occupational therapy.

At this stage the issue of central fat adiposity and metabolic consequences of over-nutrition may arise. (4)

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13. Management of Paediatric Burn Patients: Paediatric Service Delivery

14. Orofacial Contracture Management

This area of burn management requires close collaboration between the Speech Pathologist, Occupational Therapist and Physiotherapist. Individual site policies should be consulted to determine specific roles and responsibilities for each team member within this domain.

14.1.1 The Speech Pathologist demonstrates an understanding of the effect of severe orofacial burns on oral and facial range of movement, and consequently the impact upon communicative (Fricke et al 1999, Pallua et al 2002) and swallowing function as well as aesthetic appearance.

14.1.2 The Speech Pathologist assesses orofacial range of movement and functional limitations, in consultation with the Occupational Therapist and Physiotherapist as per site policy.

The Speech Pathologist evaluates:
- orofacial range of movement
- presence of contractures
- presence of hypertrophic scar tissue
- presence of oedema
- presence of grafting and specific dressing materials
- communicative ability via facial expression
- oral phase swallowing ability

14.1.3 The Speech Pathologist formulates a treatment program designed to prevent or minimise contracture formation and hypertrophic scarring, in consultation with the Occupational Therapist and Physiotherapist (Fraulin et al 1996).

The Speech Pathologist demonstrates knowledge and uses a variety of treatment modalities to prevent and minimise the effect of contracture and hypertrophic scarring formation (Patino et al 1999). These treatment modalities may include:
- microstomia splints
- pressured massage
- passive range of motion exercises
- active range of motion exercises
- active-assisted range of motion exercises

The Speech Pathologist conducts treatment with consideration to medical and surgical procedures. For example: use of splints and range of motion exercises are not appropriate until 5 days post grafting.

The Speech Pathologist designs and implements a treatment plan focussing on:
- oral and facial mobility to maintain the use of facial expression for communication of affect, and supra-segmental linguistic elements such as humour, irony etc.
- oral and facial mobility to maintain the use of oral structures required for articulatory movements and therefore speech intelligibility
- mouth range of movement to facilitate oral feeding and mouth care.

This may include tasks aimed at:
- reducing oedema

- maintaining joint mobility
- assisting with ROM of oral and facial muscles
- preventing or minimising scar contracture and hypertrophic scarring
- reducing potential onset of articulation disturbance
- evaluating the need for passive, active and active-assisted movement
- maintaining mouth opening to prevent microstomia and trismus
- using microstomia splints appropriately.

15. References / Bibliography

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