MALNUTRITION IN CRITICAL CARE

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Objectives

To identify in the adult inpatient population:

- What is malnutrition?
- Why should we care?
- How do we diagnose malnutrition?
- What can be done?
An inadequate intake of protein and/or energy over prolonged periods of time resulting in the loss of fat stores and/or muscle stores. (1)
Malnutrition

Characterized by:

- Presence and degree of inflammation
  - No inflammation
  - Mild – moderate inflammation
  - Severe inflammation

- The severity of malnutrition, based on observation of specific clinical characteristics can be:
  - Moderate
  - Severe
# Malnutrition and Inflammation

| Starvation related | • Chronic starvation without inflammation  
|                    | • I.e. anorexia nervosa, chronic food insecurity |
| Chronic disease-related | • Inflammation is present, chronic, and of mild to moderate degree  
|                        | • I.e. organ failure, cancer, sarcopenic obesity |
| Acute disease- or injury related | • Inflammation is present, acute, and of severe degree  
|                                  | • I.e. major infection, trauma, burns, closed head injury |
Patient must have at least 2 of 6 characteristics to meet definition of malnutrition

- Insufficient food intake compared with estimated nutrition requirements
- Weight loss over time
- Loss of muscle mass
- Loss of fat mass
- Fluid accumulation
- Measurably diminished grip strength

Once at least 2 characteristics are identified, malnutrition is categorized as either MODERATE or SEVERE, depending on the severity of the above characteristics
A Few Examples

- One could say:
  - Criteria is met for:
    - Moderate malnutrition in the context of chronic illness
    - Severe malnutrition in the context of social or environmental circumstances
    - Severe malnutrition in the context of acute illness or injury
So What??

TELL ME AGAIN

WHY I SHOULD CARE
Pop Quiz
Malnutrition is correlated with which of the following?

- A. Impaired immunity
- B. Increased risk of infection
- C. Increased frequency of hospital admissions
- D. Delayed recovery from illness
- E. All of the above
Malnourished patients:
- Have 3 times the risk for surgical site infection (4)
- Are twice as likely to develop pressure ulcers (5)
- Are at increased risk for falls
  - 45% of patients who fall are malnourished (6)

Those with recent, unintentional weight loss are at increased risk for hospital readmission (7)
Hospitalized patients in medical and surgical intensive care units experience increased morbidity and mortality related to poor nutrition status prior to and/or during hospitalization (8).
Negative energy balance during the first 14 days in the ICU is an independent factor of ICU mortality in those needing prolonged mechanical ventilation. (9)

Underfeeding in the ICU has been associated with:
- Increased rate of infection
- Poor wound healing
- Reduced respiratory muscle mass
- Delayed weaning from mechanical ventilation
- Increased ICU LOS
- Increased health care costs (10)
Protein-energy deficit occurs in 43 – 88% of critically ill patients (11, 12)

At least 1/3 of patients are malnourished upon hospital admission (11, 13, 14)
- Without treatment ~ 2/3 of these will experience further nutritional decline during their hospital stay (15)

An estimated 38% of patients admitted well nourished will experience a nutritional decline during their hospital stay (15)
Both those who are malnourished upon admission and those who become malnourished during their hospital stay will have increased healthcare costs.

(15, 16, 17)
Malnourished patients spent an average of 12.6 days in the hospital compared to 4.4 days for well-nourished patients.

- Resulting in hospital costs almost 3 times higher for malnourished patients
  - $26,944 versus $9,485
Hospital infections
  - Cost ~$33 billion per year (19)

30 day readmissions
  - Cost ~$26 billion per year (20)

Treatment of hospital malnutrition has been shown to reduced incidence of both
The Role of CMS

Payment to hospitals can now be withheld for certain preventable conditions including:

- Surgical site infections (5)
- Pressure ulcers (4)
- Falls (6)
All less likely when a patient is adequately nourished.
Hospitals can be penalized for high rates of readmission for:

- Heart attack
- Heart failure
- Pneumonia

In 2013, 2,225 hospitals were penalized $280 million related to excessive readmissions.
Treating hospital malnutrition

Estimated 28% decrease in avoidable readmissions

BIG SAVINGS
Treating Malnutrition Leads to Better Patient Outcomes

- 25% decrease in incidence of pressure ulcers (23)
- 14% fewer overall complications (24)
- Average reduced LOS of ~2 days (25, 26)
- Decreased mortality (27 – 32)
- Improved quality of life (33)
How Is Malnutrition Diagnosed?
Step 1
Identify at risk patients
Step 2
Is Inflammation Present?
**Laboratory Markers of Inflammation**

- **Albumin/Prealbumin**
  - Patients with low albumin or prealbumin may or may not be malnourished. Both may be reduced by the systemic response to injury, disease, or inflammation.

- **White Blood Cell:**
  - Nonspecific indicators that may suggest inflammatory response

- **C-reactive protein:**
  - Positive acute phase reactant
  - May be measured to help clarify whether active inflammation is present

These are **NOT RELIABLE MARKERS** of NUTRITION
They are indicative of the presence of inflammation, disease severity, morbidity and mortality risk.

In order to diagnose malnutrition – additional evidence is warranted.

(34 – 35)
**Yes, Inflammation Present**

**ACUTE ILLNESS/INJURY**

- Inflammation is: acute and of severe degree
- e.g., major infection, burns, trauma or closed head injury

**CHRONIC ILLNESS**

- Inflammation is: chronic and of mild to moderate degree
- e.g., organ failure, cancer, rheumatoid arthritis

(1)
Social/Environmental Circumstances
(Pure Starvation)

*Chronic starvation without inflammation
* I.e. anorexia nervosa, longstanding food insecurity
Step 3
Nutrition Focused Physical Exam
<table>
<thead>
<tr>
<th>Exam Areas</th>
<th>Tips</th>
<th>Severe Malnutrition</th>
<th>Mild-Moderate Malnutrition</th>
<th>Well Nourished</th>
</tr>
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<tbody>
<tr>
<td><strong>Subcutaneous Fat Loss</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Orbital region—surrounding the eye</strong></td>
<td>View patient when standing directly in front of them, touch above cheekbone.</td>
<td>Hollow look, depressions, dark circles, loose skin</td>
<td>Slightly dark circles, somewhat hollow look</td>
<td>Slightly bulged fat pads, fluid retention may mask loss</td>
</tr>
<tr>
<td><strong>Upper arm region—triceps/biceps</strong></td>
<td>Arm bent, roll skin between fingers; do not include muscle in pinch.</td>
<td>Very little space between folds, fingers touch</td>
<td>Some depth pinch, but not ample</td>
<td>Ample fat tissue obvious between folds of skin</td>
</tr>
<tr>
<td><strong>Thoracic and lumbar region—ribs, lower back, midaxillary line</strong></td>
<td>Have patient press hands hard against a solid object.</td>
<td>Depression between the ribs very apparent; iliac crest very prominent</td>
<td>Ribs apparent, depressions between them less pronounced; iliac crest somewhat prominent</td>
<td>Chest is full, ribs do not show; slight to no protrusion of the iliac crest</td>
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<tr>
<td><strong>Muscle Loss</strong></td>
<td></td>
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<tr>
<td>Temple region — temporalis muscle</td>
<td>View patient when standing directly in front of them, ask patient to turn head side to side.</td>
<td>Hollowing, scooping, depression</td>
<td>Slight depression</td>
<td>Can see/feel well-defined muscle</td>
</tr>
<tr>
<td>Clavicle bone region — pectoralis major, deltoid, trapezius muscles</td>
<td>Look for prominent bone. Make sure patient is not hunched forward.</td>
<td>Protruding, prominent bone</td>
<td>Visible in male, some protrusion in female</td>
<td>Not visible in male, visible but not prominent in female</td>
</tr>
<tr>
<td>Clavicle and acromion bone region — deltoid muscle</td>
<td>Patient arms at side, observe shape.</td>
<td>Shoulder to arm joint looks square, bones prominent, acromion protrusion very prominent</td>
<td>Acromion process may slightly protrude</td>
<td>Rounded, curves at arm/shoulder/neck</td>
</tr>
<tr>
<td>Scapular bone region — trapezius, supraspinus, infraspinus muscles</td>
<td>Ask patient to extend hands straight out, push against solid object.</td>
<td>Prominent, visible bones, depressions between ribs/scapula or shoulder/spine</td>
<td>Mild depression or bone may show slightly</td>
<td>Bones not prominent, no significant depressions</td>
</tr>
<tr>
<td>Dorsal hand — interosseous muscle</td>
<td>Look at thumb side of hand; look at pads of thumb when tip of forefinger touching tip of thumb.</td>
<td>Depressed area between thumb-forefinger</td>
<td>Slightly depressed</td>
<td>Muscle bulges, could be flat in some well-nourished people</td>
</tr>
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## Lower Body Less Sensitive to Change – Muscle Loss

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<td>Patellar region — quadriceps muscle</td>
<td>Ask patient to sit with leg propped up, bent at knee.</td>
<td>Bones prominent, little sign of muscle around knee</td>
<td>Knee cap less prominent, more rounded</td>
<td>Muscles protrude, bones not prominent</td>
</tr>
<tr>
<td>Anterior thigh region — quadriceps muscles</td>
<td>Ask patient to sit, prop leg up on low furniture. Grasp quads to differentiate amount of muscle tissue from fat tissue.</td>
<td>Depression/line on thigh, obviously thin</td>
<td>Mild depression on inner thigh</td>
<td>Well rounded, well developed</td>
</tr>
<tr>
<td>Posterior calf region — gastrocnemius muscle</td>
<td>Grasp the calf muscle to determine amount of tissue.</td>
<td>Thin, minimal to no muscle definition</td>
<td>Not well developed</td>
<td>Well-developed bulb of muscle</td>
</tr>
</tbody>
</table>

### Edema

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<tr>
<th>Rule out other causes of edema, patient at dry weight</th>
<th>View scrotum/vulva in activity-restricted patient; ankles in mobile patient.</th>
<th>Deep to very deep pitting, depression lasts a short to moderate time (31-60 s), extremity looks swollen (3-4+)</th>
<th>Mild to moderate pitting, slight swelling of the extremity, indentation subsides quickly (0-30 s)</th>
<th>No sign of fluid accumulation</th>
</tr>
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</table>
Muscle Wasting

Result of:

- Aging (Sarcopenia)
- Acute or chronic inflammatory condition
- Neurologic impairment
- Pure starvation
- Lack of physical activity
Sarcopenia: loss of muscle tissue as a natural part of the aging process

- Associated with frailty, mortality, and worse surgical and nonsurgical outcomes

- Significantly more expensive to care for
  - For Patients undergoing major general or vascular surgery, decreasing lean core muscle size is associated with increasing cost.
    - Mean Payer Cost:
      - Sarcopenia: $34,796
      - Nonsarcopenia: $21,380
Muscle Loss
Depressed area between thumb and forefinger
Severe Muscle Loss = Obvious depression / line on thigh; thin

Little sign of muscle around the patella

Severe Muscle Loss = Thin, minimal to no muscle definition and firmness
Temple Region
Severe Muscle Loss = Hollowing, scooping depression

Severe Fat Loss = Hollow look, depressions, dark circles, loose skin
Severe fat loss =
Ribs very apparent.
iliac crest very prominent

Severe fat loss = very little space between folds, fingers touch

Severe muscle loss
Shoulder appears square with sharp angle

Severe Muscle Loss
Scapular bone/upper back
Prominent bones with definitive angles. Depressions easily seen.

Severe muscle loss
Protruding/Prominent clavicle bone

Severe fat loss
= very little space between folds, fingers touch
Step 4
Presence of 2 or More Characteristics?
Six Characteristics for Malnutrition Assessment

- **Weight Loss**
  - Amount
  - Time Frame
- **Nutritional Intake**
  - <50%
  - <75%
  - Time Frame
- **Functional Status**
- **Muscle Wasting**
  - Mild, Moderate, or Severe
- **Fat Loss**
  - Mild, Moderate, or Severe
- **Edema**
  - Mild, Moderate, or Severe
Step 5
Malnourished??
Yes or No?
Step 6

Moderate or Severe?
Moderate Protein Energy Malnutrition
Weight loss:

- 1-2% -- 1 week
- 5% -- 1 month
- 7.5% -- 3 months

Energy intake:

- <75% for >7 days

Body fat: Mild depletion
Muscle mass: Mild depletion
Fluid accumulation: Mild
Weight loss:
- 5% -- 1 month
- 7.5% -- 3 months
- 10% -- 6 months
- 20% -- 1 year

Energy intake:
- <75% for >1 month

Body fat: Mild depletion
Muscle mass: Mild depletion
Fluid accumulation: Mild
Moderate Protein Energy Malnutrition
Social or Environmental-Related

- **Weight loss**
  - 5% -- 1 month
  - 7.5% -- 3 months
  - 10% -- 6 months
  - 20% -- 1 year

- **Energy intake** - <75% for ≥3 months

- **Body fat** - Mild depletion
- **Muscle mass** - Mild depletion
- **Fluid accumulation** – Mild
Severe Protein Energy Malnutrition
Severe Protein Energy Malnutrition
Acute Illness or Injury-related

- **Weight loss**
  - >2% -- 1 week
  - >5% -- 1 month
  - >7.5% -- 3 months

- **Energy intake** - ≤50% for ≥5 days

- **Body fat** - Moderate depletion
- **Muscle mass** - Moderate depletion
- **Fluid accumulation** – Moderate to severe
Weight loss
- >5% -- 1 month
- >7.5% -- 3 months
- >10% -- 6 months
- >20% -- 1 year

Energy intake - <75% for >1 month

Body fat - Severe depletion
Muscle mass - Severe depletion
Fluid accumulation – Severe
Severe Protein Energy Malnutrition
Social or Environmental

- Weight loss
  - >5% -- 1 month
  - >7.5% -- 3 months
  - >10% -- 6 months
  - >20% -- 1 year

- Energy intake - ≤50% for ≥1 month

- Body fat - Severe depletion
- Muscle mass - Severe depletion
- Fluid accumulation – Severe
Nutrition Risk Identified

Inflammation Present?

- Yes
  - Acute Illness or Injury
    - Presence of 2 or More Characteristics?
      - Yes: Malnourished
        - Moderate
        - Severe
      - No: Not Malnourished
  - Chronic Illness
  - Social/Environmental

- No
Pop Quiz
Mr P is a 51 year old male admitted to the CVICU for heart failure exacerbation. Found to have a stage 3 pressure ulcer to his left heel – present on admission.

PMH: ESRD on HD, HTN, DM type 2
Height: 183cm / 72in
Admit Weight: 123kg
Dry Weight (per patient report): 117kg
BMI: 34.9 – class 1 obesity (based on dry weight)
Weight History: Pt reports significant weight loss a few months back during a hospitalization at an OSH.
01/12/16 123.5kg
09/08/15 149.19kg
Oral Intake History: Pt reports good appetite / intake currently

Labs:
BUN: 46
Creat: 7.37
GFR: 8
K+: 5.9

Nutrition Focused Physical Exam
Moderate to Severe Temporal Wasting and depletion of orbital fat pads. Clavicle is quite prominent. Unable to visualize other muscle wasting secondary to body habitus/edema.
Skin Breakdown: Stage 3 Pressure Ulcer - left heel
What kind of malnutrition does Mr P. have??

- A. Severe malnutrition in the context of chronic illness
- B. Moderate malnutrition in the context of chronic illness
- C. Moderate malnutrition in the context of social/environmental situation
- D. Does not meet criteria for malnutrition
What Can Be Done?

Four Part Action Plan
1) Recognize At Risk Patients

- Improve recognition of at risk patients
  - Malnutrition is:
    - under-recognized
    - under-treated (33)

- Screen, assess, and diagnose patients at malnutrition risk
  - Difficulty chewing/swallowing
  - Age > 70 years
  - History of decreased appetite
  - History of unintentional weight loss
  - Regular use of oral nutrition supplements
  - Dependence on enteral/parenteral nutrition support
  - History of gastric bypass
Implement interventions without delay

For example:
- Early initiation of enteral nutrition support
- Minimizing cessation of enteral nutrition/NPO status
- Liberalization of diet order to encourage p.o. intake
- Addition of snacks
- Assistance with meal set up and feeding
- Educating patients on the importance of eating enough
- Addition of oral nutrition supplement
ONS are consistently shown to have beneficial clinical effects with economic implications (38)

- Significant increase in total protein/energy intake with little suppression of normal food intake (38)

- Use of high protein ONS is associated with improved functional outcomes (handgrip strength), decrease LOS, reduction in hospital readmission rates (39)
  - Readmission reductions
    - 26 - 29% readmission rate with ONS vs 40- 48% without ONS (40, 41)
  - 19% reduction in complications – including infection rates, healing of surgical wounds, pressure ulcers (42)
3) Redefine Clinician Roles

- Empower all clinicians to address patients’ nutritional needs
  - Educate all clinicians on the recognition and diagnosing of malnutrition
  - Engage nurses in understanding malnutrition risk factors and create policies that allow nurses to help provide nutrition care
  - Initiate a nutrition care plan within 48 hours of admission for patients with or at risk of malnutrition

- Integrate the dietitian into the interdisciplinary ICU team
  - Consult the dietitian immediately if malnutrition is suspected
  - Consider allowing registered dietitians to have ordering privileges for diet orders, oral nutrition supplements, and vitamins/minerals
Create culture where nutrition is seen as a priority for improving:
- Care
- Quality
- Cost

Create an open dialogue on potential institutional changes
- For example:
  - Easier availability of snacks/supplements
  - Designated and protected meal times
  - Improved quality of hospital food
  - Enhanced menu selection
  - Use of standardized written instructions for nutrition care at home post-discharge and/or prior to admission for elective procedures
Case Study
Mr K is a 70yo Male admitted to the Neuro ICU for rule out CVA.

PMH: CAD, HTN, HLD, Chronic Alcoholism, and previous strokes. Height: 68in
Current Weight: 80.8kg  
BMI: 26.99 (adequate for age)
Weight History:
87.9kg 08/04/16 – 1 month ago
102kg 01/03/16 -7 months ago
Oral Intake: Pt’s wife reports that he has been in and out of the hospital 6 times over the past 8 months. Pt dislikes hospital food. His oral intake is fair at home (eating ~50% of his meals) but very poor during his admissions. This has resulted in weight loss.

Labs:
WBC 11.8

Physical Exam:
No pressure ulcers indicated
Mild Muscle Wasting at temporal and clavicle regions
Does Mr. K. meet criteria for malnutrition?
For what kind of malnutrition does Mr.K. meet criteria?

- A. Moderate malnutrition in the context of chronic disease
- B. Moderate malnutrition in the context of social/environmental situation
- C. Severe malnutrition in the context of chronic disease
- C. Severe malnutrition in the context of acute illness/injury
Possible Interventions Might Include:

- Liberalization of diet order to regular diet
- Addition of oral nutrition supplement
- Assistance with tray set up/feeding
- Addition of daily MVI, thiamine, folic acid (given history of ETOH)
Malnutrition is under-recognized and often untreated although it is associated with increased:
- Complication rates
- Length of stay
- Readmission rates
- Mortality

Diagnosis and treatment of malnutrition has been consistently shown to improve patient outcomes.
We need to look at changing the attitude about the importance of hospital nutrition in both patients and providers (43)
- Consider nutritional status an essential part of the patient’s condition
- Make nutrition interventions a core component of medical therapy (33)

Better nourished patients translate to:
- Improved care
- Improved quality of life
- Decreased costs (33)
Ultimately ... 

We Can’t Afford Not To
Questions?


References


