بسم الله الرحمن الرحيم

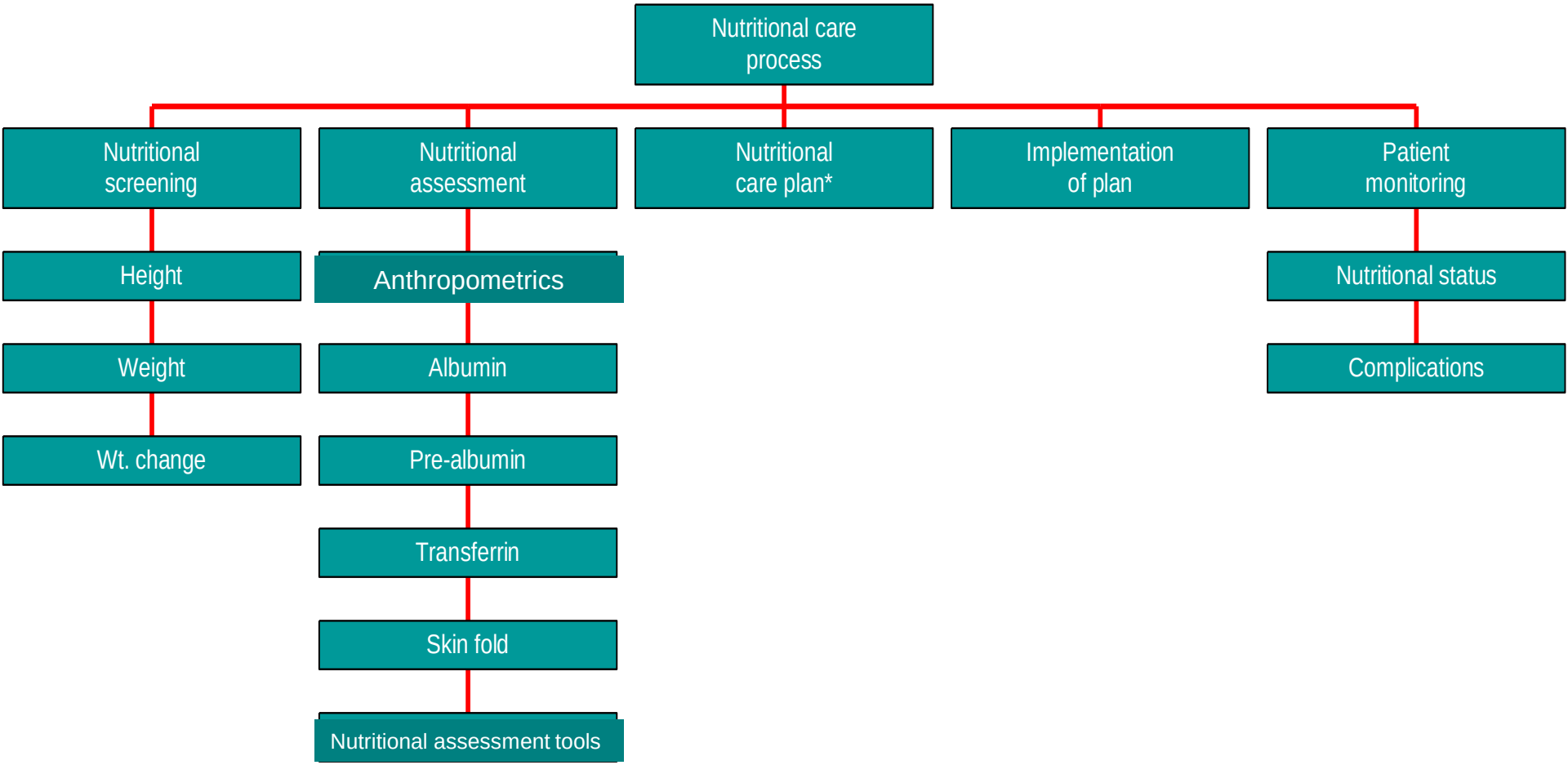
Nutritional assessment in hospitalized patients

M. Safarian, MD PhD.

Nutrition Care Process Steps

- Nutrition Assessment
- Nutrition Diagnosis
- Nutrition Intervention
- Nutrition Monitoring and Evaluation

Nutritional care process



Nutritional Assessment

- Anthropometric assessment
- Clinical evaluation
- Biochemical, laboratory assessment
- Dietary evaluation

ESPEN guidelines

Questions to be answered:

- What is the condition now?
- Is the condition stable?
- Will the condition get worse?
- Will the disease process accelerate nutritional deterioration?

Anthropometric methods in ICU

- Weight
- Height estimation
- Mid-arm circumference
- Skin fold thickness
- Head circumference

Ideal Body Weight (kg)

- Men=48+ 2.3 for each inch over 152 m
- Women=45.3+2.3 for each inch over 152 cm
- Correction for skeletal size:

$$r = \frac{\text{Height (cm)}}{\text{Wrist circumference (cm)}}$$

Ideal Body Weight (kg)

- Add 10% if SS is large
- Subtract 10% if SS is small

اندازه جثه	مرد	زن
کوچک	> ۱۰/۴	> ۱۱
متوسط	۹/۴-۱۰/۴	۱۰/۱-۱۱
بزرگ	< ۹/۴	< ۱۰/۱

Adjusted body weight

- Used when actual body weight is more than 120% of IBW:

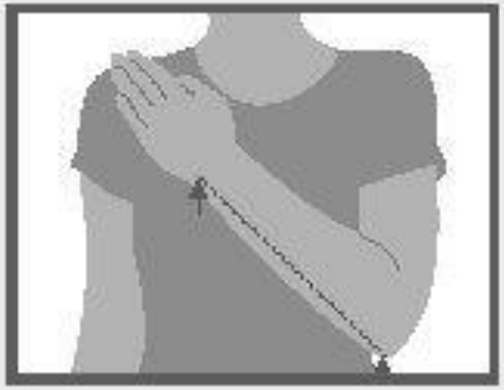
- ABW=IBW+ 25% of (actual body weight - IBW)

Height in ICU patients

Alternative measurements

Estimating Height from ulna length

Estimating height from ulna length

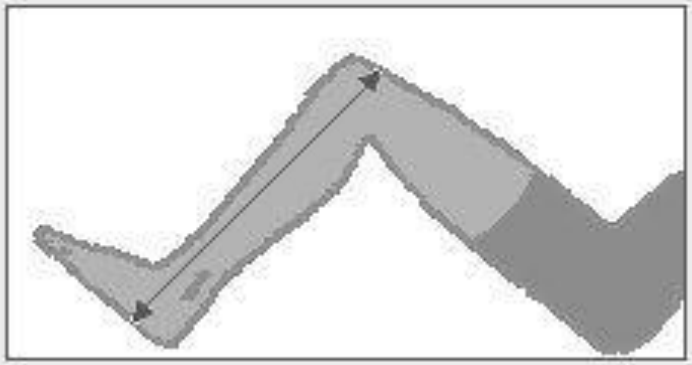


Measure between the point of the elbow and the midpoint of the prominent bone of the wrist (left side if possible). Height in meters is determined from the following chart, based on the ulna length as measured in cm.

Men(<65 years)	1.94	1.93	1.91	1.89	1.87	1.85	1.84	1.82	1.80	1.78	1.76	1.75	1.73	1.71
Men(>65 years)	1.87	1.86	1.84	1.82	1.81	1.79	1.78	1.76	1.75	1.73	1.71	1.70	1.68	1.67
Ulna length(cm)	32.0	31.5	31.0	30.5	30.0	29.5	29.0	28.5	28.0	27.5	27.0	26.5	26.0	25.5
Women(<65 years)	1.84	1.83	1.81	1.80	1.79	1.77	1.76	1.75	1.73	1.72	1.70	1.69	1.68	1.66
Women(>65 years)	1.84	1.83	1.81	1.79	1.78	1.76	1.75	1.73	1.71	1.70	1.68	1.66	1.65	1.63
Men(<65 years)	1.69	1.67	1.66	1.64	1.62	1.60	1.58	1.57	1.55	1.53	1.51	1.49	1.48	1.46
Men(>65 years)	1.65	1.63	1.62	1.60	1.59	1.57	1.56	1.54	1.52	1.51	1.49	1.48	1.46	1.45
Ulna length(cm)	25.0	24.5	24.0	23.5	23.0	22.5	22.0	21.5	21.0	20.5	20.0	19.5	19.0	18.5
Women(<65 years)	1.65	1.63	1.62	1.61	1.59	1.58	1.56	1.55	1.54	1.52	1.51	1.50	1.48	1.47
Women(>65 years)	1.61	1.60	1.58	1.56	1.55	1.53	1.52	1.50	1.48	1.47	1.45	1.44	1.42	1.40

Estimations of height

Estimating height from knee height



While lying supine, both the knee and ankle of the patient are held at a 90-degree angles. One blade of a sliding Mediform caliper is placed under the heel of the foot, and the other blade is placed on the anterior surface of the thigh. The shaft of the caliper is held parallel to the long axis of the lower leg, and pressure is applied to compress the tissue. Height (in cm) is then calculated from the formula below:

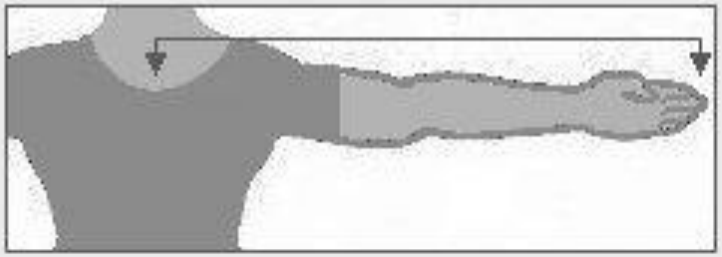
Females

Height in cm = 84.88 - (0.24 X age) + (1.83 X knee height)

Males

Height in cm = 64.19 - (0.04 X age) + (2.02 X knee height)

Estimating height from demispan



Measure the distance from the middle of the sternal notch to the tip of the middle finger (left arm if possible). Check that patient's arm is horizontal and in line with shoulders. Calculate stature (in cm) from the formula below:

Females

Height in cm = (1.35 x demispan (cm)) + 60.1

Males

Height in cm = (1.40 x demispan (cm)) + 57.8

Body composition (BIA)

- Very popular
- Safe
- Noninvasive
- Portable
- Rapid

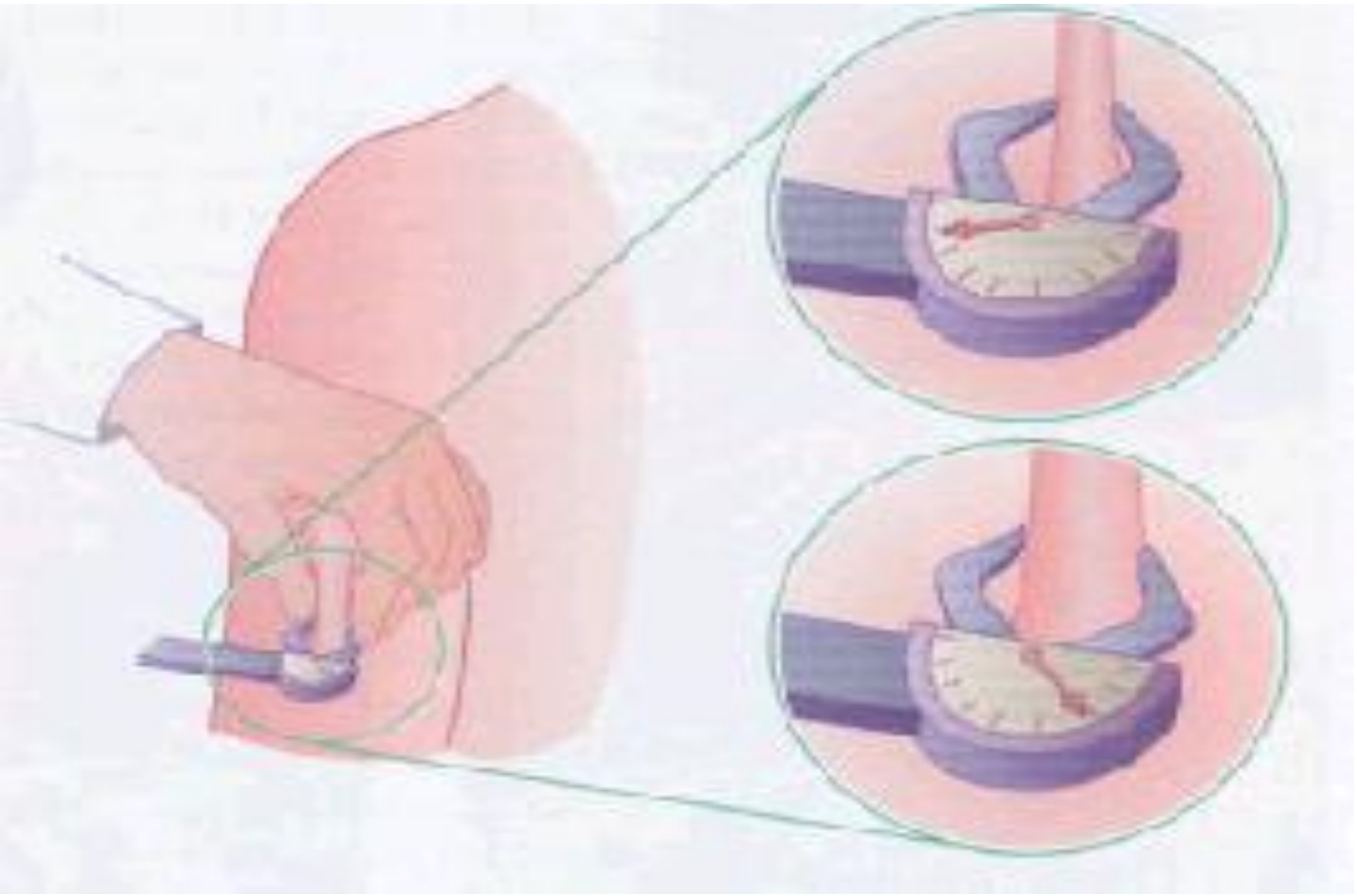
Figure 10-12 Bioelectrical impedance estimates total body fat in less than 5 minutes and is based on the principle that body fat resists the flow of electricity, since it is low in water and electrolytes. The degree of resistance to electrical flow is used to estimate body fatness.

Skin Fold Thickness

- معرف ميزان چربي زير پوستي و درنتيجه ميزان چاقي خواهد بود.
- محلهاي اندازه گيري: تريسپس، بايسپس،زير كتف و بالاي تيغه ايلياک .
- مشكلات عملي:

۱. خطاي در اندازه گيري.
۲. مشكلات اندازه گيري.
۳. واریاسیون توزيع چربي در افراد مختلف (فردي وجمعيتي).
۴. حساسيت كم.

Skin Fold Thickness



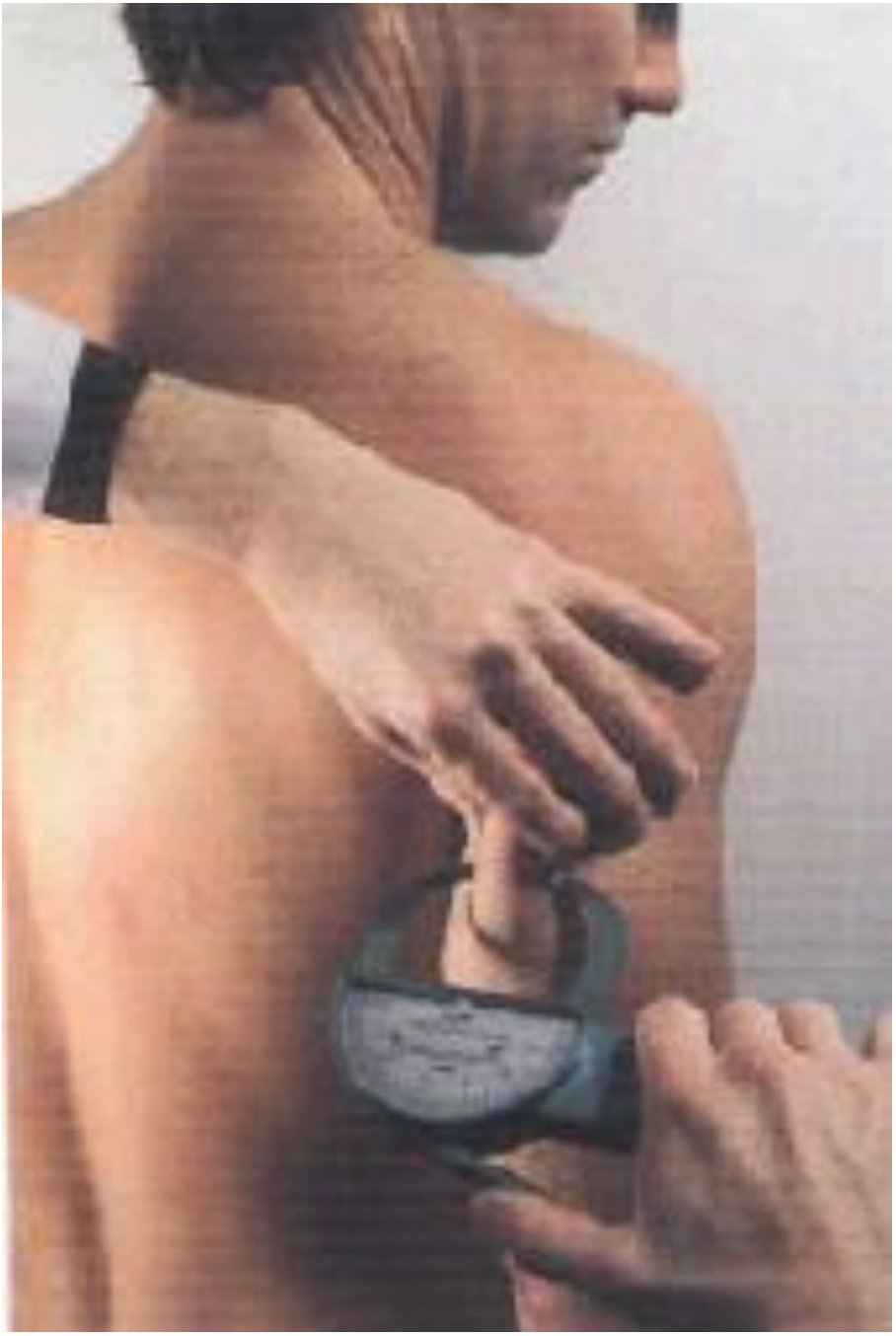


Table E-5
Triceps Fatfold Percentiles (millimeters)

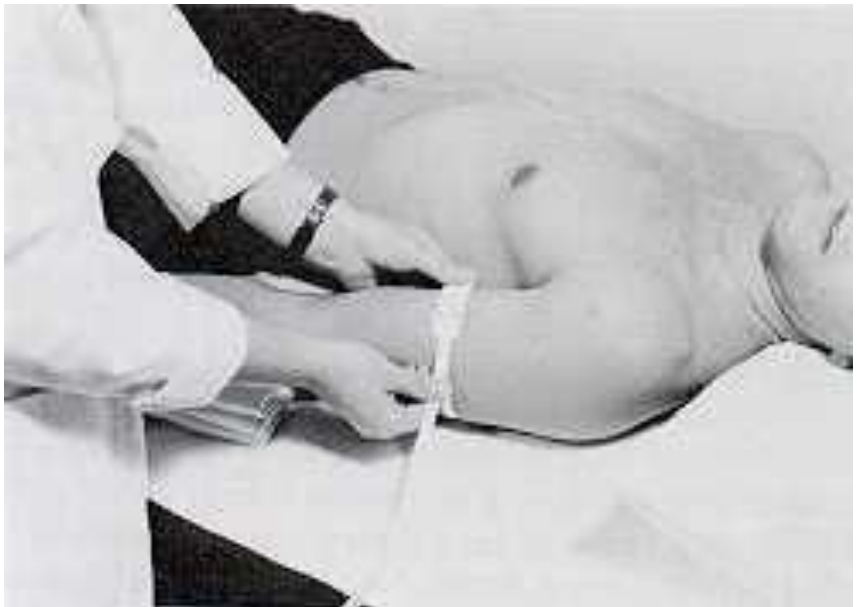
Age	Male					Female				
	5TH	25TH	50TH	75TH	95TH	5TH	25TH	50TH	75TH	95TH
1–1.9	6	8	10	12	16	6	8	10	12	16
2–2.9	6	8	10	12	15	6	9	10	12	16
3–3.9	6	8	10	11	15	7	9	11	12	15
4–4.9	6	8	9	11	14	7	8	10	12	16
5–5.9	6	8	9	11	15	6	8	10	12	18
6–6.9	5	7	8	10	16	6	8	10	12	16
7–7.9	5	7	9	12	17	6	9	11	13	18
8–8.9	5	7	8	10	16	6	9	12	15	24
9–9.9	6	7	10	13	18	8	10	13	16	22
10–10.9	6	8	10	14	21	7	10	12	17	27
11–11.9	6	8	11	16	24	7	10	13	18	28
12–12.9	6	8	11	14	28	8	11	14	18	27
13–13.9	5	7	10	14	26	8	12	15	21	30
14–14.9	4	7	9	14	24	9	13	16	21	28
15–15.9	4	6	8	11	24	8	12	17	21	32
16–16.9	4	6	8	12	22	10	15	18	22	31
17–17.9	5	6	8	12	19	10	13	19	24	37
18–18.9	4	6	9	13	24	10	15	18	22	30
19–24.9	4	7	10	15	22	10	14	18	24	34
25–34.9	5	8	12	16	24	10	16	21	27	37
35–44.9	5	8	12	16	23	12	18	23	29	38
45–54.9	6	8	12	15	25	12	20	25	30	40
55–64.9	5	8	11	14	22	12	20	25	31	38
65–74.9	4	8	11	15	22	12	18	24	29	36

Mid arm circumference

- measured with a nonstretch measuring tape
- midway between the acromion and olecranon of the nondominant arm
- ≤ 15 cm: severe depletion of muscle mass
- 16–19 cm: moderate depletion
- 20–22 cm: mild depletion

Mid arm circumference

MAMC cm = MAC cm − (TSF mm X 0.314).



BMI estimation

If MUAC is <23.5 cm, BMI is likely to be <20 kg/m2
If MUAC is >32.0 cm, BMI is likely to be >30 kg/m2

Clinical assessment

CLINICAL ASSESSMENT

- Detectiong of physical signs, (specific & non specific), that may be associated with malnutrition.
  - Nutritional history
  - General clinical examination, with special attention to organs like hair, angles of the mouth, gums, nails, skin, eyes, tongue, muscles, bones, & thyroid gland.
  - Detection of relevant signs helps in establishing the nutritional diagnosis

CLINICAL ASSESSMENT

	CLINICAL SIGN OR SYMPTOM	NUTRIENT
General	Wasted, skinny	Calorie
	Loss of appetite	Protein-energy
Head	Temporal muscle wasting	Protein-energy
Hair	Sparse and thin, dyspigmentation, easy to pull out	Protein

Skin	Psoriasiform rash, eczematous scaling	Zinc
	Pallor	Folic acid, iron, vitamin B_{12}
	Follicular hyperkeratosis	Vitamin A
	Perifollicular petechiae	Vitamin C
	Flaking dermatitis	Protein-energy, niacin, riboflavin, zinc
	Bruising	Vitamin C, vitamin K
	Pigmentation changes	Niacin, protein-energy
	Scrotal dermatosis	Riboflavin
	Thickening and dryness of skin	Linoleic acid

Eyes	History of night blindness (also impaired visual recovery after glare)	Vitamin A
	Photophobia, blurring, conjunctival inflammation	Riboflavin, vitamin A
	Corneal vascularization	Riboflavin
	Xerosis, Bitot spots, keratomalacia	Vitamin A

Mouth	Glossitis	Riboflavin, niacin, folic acid, vitamin B_{12}, pyridoxine
	Bleeding gums	Vitamin C, riboflavin
	Cheilosis	Riboflavin
	Angular stomatitis	Riboflavin, iron
	Hypogeusia	Zinc
	Tongue fissuring	Niacin
	Tongue atrophy	Riboflavin, niacin, iron
	Scarlet and raw tongue	Niacin
	Nasolabial seborrhea	Pyridoxine

Neck	Goiter	Iodine
	Parotid enlargement	Protein
Thorax	Thoracic rosary	Vitamin D
Abdomen	Diarrhea	Niacin, folate, vitamin B_{12}
	Distention	Protein-energy
	Hepatomegaly	Protein-energy

Extremities	Edema	Protein, thiamin
	Softening of bone	Vitamin D, calcium, phosphorus
	Bone tenderness	Vitamin D
	Bone ache, joint pain	Vitamin C
	Muscle wasting and weakness	Protein, calorie, vitamin D, selenium, sodium choride
	Hyporeflexia	Thiamin
	Ataxia	Vitamin B_{12}

Nails	Spooning	Iron
	Transverse lines	Protein
Neurologic	Tetany	Calcium, magnesium
	Paresthesia	Thiamin, Vitamin B_{12}
	Loss of reflexes, wrist drop, foot drop	Thiamin
	Dementia, disorientation	Niacin
Blood	Anemia	Vitamins E, B_{12}, folic acid, iron, pyridoxine
	Hemolysis	Phosphorus

Wasting Clavicle

The Shoulder and Elbow

- The shoulder
- Normal: rounded or sloped
- Abnormal: square, can see acromion process
- The elbow well padded and not showing joint

The Arm

- Bend arm and pinch at triceps. Only pinch the fat, not the muscle.
- Normal: fingers don’t meet
- Abnormal: fingers meet

Biochemical, laboratory assessment

The possibilities of biochemical monitoring

- On-line monitoring (cardiosurgery – pH, minerals (K), the electrodes are localized on central cateter, possibility to check parameters on-line.
- bed side monitoring (glycaemia, urine /protein, pH, blood../,oximeter O2 saturation, acidobasis, drugs /dg.strips)
- Biochemical analysis

Biochemical parameters

- Na,K,Cl,Ca,P,Mg, osmolality - blood, urine
- Acidobasis, lactate
- urea, creatinin, creatinin clearence, Nitrogen balance
- bilirubine, ALT, AST, LDH, amylase, lipase
- cholesterol, triglycerides, glucose – blood, urine

Biochemical parameters

- Total protein, albumine, prealbumine
- CRP
- TSH
- Basic analysis are made at the first,must be done within 90minutes

Other biochemical parameters

- Trace elements /Zn,Se../
- Vitamins
- Drugs /methotrexate, antiepileptics, antibiotics.../
- Aminogram /glutamin../
- Interleucins,TNF…
- Hormones /cortisol, glucagone, adrenaline../.

Biochemical markers of nutrition status:

- Plasmatic proteins with short biologic half-life
- Albumin
  - -syntetizate in liver, half-life time is 21 days
  - Normal: 35-45g/l.
  - Decrease of alb: malnutrition
  - Trends of changes alb.levels during realimentation are criterium of succesfull terapy.
  - Acute decrease: acute phase response.

Biochemical markers of nutrition status:

- Transferin: syntesized in liver,
  - biolog HL: 8days.Fysiolog.
  - Value 2-4g/l,

- RBP: syntesized in liver
  - Biolog half-life : 12h.,
  - Normal value: 0,03-0,006g/l.
  - Acute phase reactant (negative)

Biochemical markers of nutrition status:

- Prealbumin-syntesized in liver,
  - biolog.half-life:1,5 days.
  - Normal Value 0,15-0,4g/l.
  - Decrease in failure of proteosyntesis-indicator of acute protein malnutrition.

NUTRITIONAL ASSESSMENT

- Urine urea nitrogen (UUN): to evaluate degree of hypermetabolism (stress level):
  - 0 –5 g/d= normometabolism
  - 5 – 10 g/d = mild hypermetabolism (level 1 stress)
  - 10 – 15 = moderate (level 2 stress)
  - >15 = severe (level 3 stress)

Test	Healthy population or chronic disease without an acute phase reaction	Acute or chronic disease with an acute phase reaction
Protein – Energy Status		
BMI Anthropometry Bioelectrical impedance	Useful markers of overall p-e status	Some value but limited by acute changes in fluid balance and distribution
Serum albumin	Little value except in very long-standing p.e.m	No value
Serum transferrin	Some value, but complicated by iron status	No value
Serum prealbumin	Useful – responds to short-term changes in p-e intake	No value
Nitrogen balance	Useful for short-term adequacy	Useful for short-term adequacy
Electrolyte Status		
Serum Na/K/Mg/P	Useful in stable patients	Variable value
Trace Element Status		
Serum zinc	Moderately useful	Little value
Serum iron	Moderately useful	No value
Ferritin	Useful	Little value
Serum selenium	Useful for recent intake	Moderately useful
Rbc glutathione peroxidase	Useful	Useful
Vitamin Status		
Serum folate	Useful for recent intake	Useful
Serum ascorbate	Useful for recent intake	No value
25OH vit D	Useful	Useful if liver function normal

Nutrition Monitoring and Evaluation

- Monitor progress and determine if goals are met
- Identifies patient/client outcomes relevant to the nutrition diagnosis and intervention plans and goals
- Measure and compare to client's previous status, nutrition goals, or reference standards

Other Outcomes

Food and Nutrient Intake (FI)

- Energy intake
- Food and Beverage
- Enteral and parenteral
- Bioactive substances
- Macronutrients
- Micronutrients

Physical Signs/Symptoms

- Anthropometric
- Biochemical and medical tests
- Physical examination

Monitoring

Some Lab tests

Na serum levels

Hypernatremia: Na over 150 mmol/l

- hyperaldosteronism hypovolemia renin-angiot-aldost.
- Hypothalamic damage
- Hypertonic hyperhydration
- Diabetes insipidus
- Brain death

Na serum levels(136-145$_{mEq/L}$)

- Hyponatremia: Na under 130 $_{mEq/L}$
- Na in the third space - ascites, hydrothorax
- Cardiac failure – increase of extracellular volume
- Application of solutions without electrolytes
- Hypersecretion of ADH – water retention

K serum levels (3.5-5.3$_{mEq/L}$)

- Hyperkalemia: K over 5,0 - 5,5 $_{mEq/L}$
  - pH dependent /acidosis increases K level
  - Bigger intake, low output or both
  - Acute renal failure
  - Acute metabolic acidosis
  - Infusion with K

K serum levels

Hypokalemia: K under $3,5_{mEq/L}$

- Low intake, bigger uptake, or both
- Emesis, diarrhoe / intestinal loss/
- Diuretics
- Chemotherapy, antimycotics /renal tubules failure/
- Anabolic phasis
- Hyperaldosteronism
- Acute metabolic alcalosis

BUN (5-20 mg/dl)

- Consider hydration and Nutrition.
- High level of urea
  - high intake of N,
  - increase catabolism
  - polytrauma-muscele loss
  - GIT bleeding
  - dehydration
  - low output- renal failure,
- Low level – malnutrition,serious hepatic failure- ureosyntetic cycle and

BUN (5-20 mg/dl)

- Low level –
  - malnutrition,
  - serious hepatic failure-
  - ureosyntetic cycle and gluconeogenesis dysfunction,
  - pregnancy-
  - increase ECF

Urea

- Urea in urine
- Increase – catabolism, prerenal failure
- Decrease – chronic malnutrition, acute renal failure

Creatinine(0.5-1.1 mg/dl)

- Serum levels of creatinine evaluation together with muscle mass, age, gender
- Increase
  - bigger offer- destruction of muscle mass,
  - low output-renal failure
- Decrease-
  - low offer-low muscle mass
  - malnutrition
- Creatinine clearence, excretion fraction - renal function

ALT(SGPT)

- N V: M: 7-46 F:4-35 U/L
- High level –
  - hepatopathologia,
  - steatosis,
  - hepatitis,
  - cell damage,

AST(SGOT)

- High level –
  - hypoperfusion,
  - hepatitis,
  - cell necrosis,
  - muscles damage
- both aminotransferases increase during damage of hepatic cells during inf.hepatitis.

TG(10-190 mg/dl)

- TG-increase
  - during sepsis, mainly on the begining,
  - monitorate during parenterál nutrition with lipid emulsion

- Glycemia, serum, urine,
- Hypoglycemia below 2,5mmol/l-vital danger
- hyperglycemia- insulin.rezistence, recomendation level of glycemia 4,5-8,2

Glucose

- Glycemia, serum, urine,
- Hypoglycemia below $2,5_{mmol/l}$-(45 $_{mg/dl}$) vital danger
- hyperglycemia- insulin.rezistence

- Recomendation level of glycemia 4,5-8,2 (80-150 $_{mg/dl}$)

P– serum levels(2.7-4.5 mg/dl)

- Hypophosphataemia: under 1,9 mg/dl
  - Acute wastage of energy after succesfully resuscitation, overfeeding sy, anabolism (energetic substrates without K,Mg,P).
- Hyperphosphataemia – over 5,8 mg/dl
  - Renal failure
  - Cell damage

Mg – serum levels (1,3-2,5 mEq/L)

- Mg – together with potassium
- Hypomagnesaemia – under 1,2 mEq/L /
  - renal failure
  - low intake.

Monitoring of EN

- For formula intolerance,
- Hydration status,
- Electrolyte status,
- Nutritional status,

Monitoring

Table V. Laboratory Test Recommendations for Patients Receiving Nutrition Therapy

Parameter		
PN and Tube Feeding	Baseline	Follow up
Mini panel (Na, K, Cl, CO_2, Glu, BUN, Creat)	x	daily until stable
Albumin	x	weekly
Transthyretin	x	weekly
C-Reactive protein	x	as needed
PO_4*	x	q o d until stable
Mg*	x	q o d until stable
Vitamin C	x	as needed
Zinc	x	as needed
24 hour TUN	as needed	as needed

Table III: *Complications of Enteral Nutrition Therapy: Possible Causes & Management*

Complication	Possible Cause	Suggested Management
Gastrointestinal		
diarrhea (> 4 BM per day or large loose stool)	medications	◆ eliminate antibiotics or antacids if possible ◆ eliminate liquid formulations containing sorbitol
	fat intolerance	◆ change to low fat formula
	bacterial overgrowth	◆ stool culture for pathogens ◆ Rx L. acidophilus/L. bulgaricus (Lactinex™) if patient receiving antibiotics
	contaminated formula	◆ DC current formula ◆ replace bag and tubing using aseptic techniques ◆ adhere to clean standard when changing or manipulating feeds

Complication	Possible Cause	Suggested Management
Gastrointestinal *cont.*		
	osmotic overload	◆ decrease concentration of formula ◆ change to isotonic formula ◆ further dilute hypertonic medications ◆ administer medications by alternate route
	decreased bulk	◆ change to high fiber formula ◆ administer bulking agents (e.g. psyllium) but not through small bore (<10 French) feeding tubes

nausea or vomiting	patient position	◆ position patient on right side to facilitate passage of gastric contents through pylorus
	volume overload	◆ decrease total volume ◆ decrease delivery rate to one tolerated previously ◆ advance delivery rate slowly over 12 to 24 hours
	delayed gastric emptying	◆ stop feeding for 2 hours & check residuals ◆ change to low-fat formula ◆ administer prokinetic agent (metoclopramide, cisapride) to stimulate GI motility
	specific nutrient intolerances	◆ change to lactose-free or low-fat formula
	GI tract obstruction	◆ stop feeding
constipation (no stool x 3 days)	dehydration & impaction	◆ provide free water ◆ remove impaction
	decreased fiber	◆ change to high fiber formula ◆ administer bulking agents (e.g. psyllium) but not through small bore feeding tubes (<10 French)

Complication	Possible Cause	Suggested Management
Gastrointestinal *cont.*		
	GI tract obstruction	◆ stop feeding
Mechanical		
pulmonary aspiration	patient lying flat	◆ elevate head of bed 30 to 45° during continuous feeds or for 30 to 60 minutes after bolus feeds
	absent or depressed gag reflex	◆ infuse feedings into duodenum or jejunum
	reflux	◆ change to smaller bore tube (<12 French) (large bore tubes can reduce LES competence) ◆ infuse feedings into duodenum or jejunum

	improper tube placement	◆ confirm proper placement by X-ray after insertion, after severe coughing, vomiting, or seizure ◆ reconfirm placement prior to each feeding by checking residuals ◆ tape tube in place & mark tube at exit point for reference ◆ restrain patient if unable to keep from pulling
tube obstruction	acid precipitation of formula	◆ flush tube with water before & after check gastric residuals ◆ infuse feedings into duodenum or jejunum ◆ do not mix medications with enteral formula
	insufficient tube irrigation	◆ flush tube with warm water before & after each bolus feeding, every 8 hours during continuous feeding, or whenever feeding is stopped

Complication	Possible Cause	Suggested Management
Mechanical *cont.*		
	medications	◆ adequately crush medications and mix powder with water ◆ use liquid medications where possible or administer by alternative route ◆ flush tube before & after medication administration with at least 20 mL warm water ◆ avoid administering bulk forming agents via small bore tubes
mucosal damage	extended use of large bore tubes	◆ alternate nares ◆ change to small bore tube (<10 French) ◆ change to a permanent gastrostomy or jejunostomy tube for extended enteral support ◆ tape in place to minimize rubbing

Metabolic		
overhydration	refeeding	◆ decrease delivery rate
	fluid overload	◆ restrict free water ◆ change to concentrated formula ◆ administer diuretics
dehydration	high osmolality formula	◆ change formula
	diarrhea	◆ change formula ◆ see above management of diarrhea
	excessive protein intake with inadequate fluid intake	◆ change decreased protein content formula ◆ provide additional water

Complication	Possible Cause	Suggested Management
Metabolic *cont.*		
hyperglycemia	insulin deficiency	◆ give insulin (insulin drip used more successfully for enterally tube fed patients) ◆ change formula to higher fat/ lower carbohydrate content ◆ change to high fiber formula
hypoglycemia	sudden cessation of feedings	◆ taper feedings ◆ monitor blood sugar if feeding interrupted
hyperkalemia	metabolic acidosis	◆ reduce K intake/use reduced K formula ◆ Rx Kaexalate™
	renal insufficiency	◆ reduce K intake/use reduced K formula ◆ Rx Kaexalate™ ◆ assess renal function

hypokalemia	refeeding syndrome	◆ monitor serum K daily and replete until stable
	insulin administration	◆ lower dose or discontinue
	diuretics	◆ discontinue if possible
	diarrhea	◆ see management above
hyperphosphatemia	renal insufficiency	◆ use reduced PO_4 formula ◆ administer phosphate binder
hypophosphatemia	refeeding syndrome, insulin administration	◆ monitor serum PO_4 daily and replete until stable
hypomagnesemia	refeeding syndrome, alcoholism	◆ monitor serum Mg daily and replete until stable
hyponatremia	fluid overload	◆ restrict free water ◆ Use NS to flush tube and provide hydration instead of water

Complication	Possible Cause	Suggested Management
Metabolic *cont.*		
elevated BUN	renal failure excess protein (nitrogen) intake dehydration medications (diuretics, steriods)	◆ reassess medications ◆ increase free water ◆ reassess renal function ◆ reassess protein needs
rapid, excessive weight gain	excess calories, excess fluid, electrolyte imbalance	◆ change formula or decrease delivery rate ◆ evaluate electrolytes
insufficient weight gain	inadequate calories	◆ change formula or increase delivery rate
	malabsorption	◆ change to semi-elemental formula

Monitoring in PN therapy

- Weight
  (on a daily basis,initialy and)
- Blood

  Daily

  Electrolytes (Na^+, K^+, Cl^-)

  Glucose

  Acid-base status

  3 times/week

  BUN

  $Ca^{+,}$ P

  Plasma transaminases

Monitoring in PN therapy

Variable to be monitored	Initial	Later period
Clinical status	Daily	Daily
Catetheter site	Daily	Daily
Temperature	Daily	Daily
Intake &Output	Daily	Daily

Monitoring in PN therapy

Variable to be monitored	Initial	Later period
Weight	Daily	Weekly
serum glucose	Daily	3/wk
Electrolytes (Na^+, K^+, Cl^-)	Daily	1-2//wk
BUN	3/wk	Weekly
Ca^+, P,mg	3/wk	Weekly
Liver function Enzymes	3/wk	Weekly
Serum triglycerides	weekly	weekly
CBC	weekly	weekly

Problems

1. Catheter sepsis
2. Placement problems
3. Metabolic complications

Complications

- **Dehydration**
- Possible cause:
  - Inadequate fluid support;
  - Unaccounted fluid loss (e.g. diarrhea, fistulae, persistent high fever).
- Management:
  - Start second infusion of appropriate fluid, such as D5W, 1/2NS, NS.
  - Estimate fluid requirement and adjust PN accordingly.

Complications

- **Overhydration**
- Possible cause:
  - Excess fluid administration;
  - Compromised renal or cardiac function.
- Management:
  - Consider D70 (can’t use with PPN) or 20% lipid as calorie source
  - Initiate diuretics.
  - Limit volume.

Complications

- **Alkalosis**
- Possible cause:
  - Inadequate K to compensate for cellular uptake during glucose transport
  - Excessive GI or renal K losses.
  - Inadequate Cl- in patients undergoing gastric decompression.
- Management:
  - KCl to PN.
  - Assure adequate hydration.
  - Discontinue acetate.

Complications

- **Acidosis**
- Possible cause:
  - Excessive renal or GI losses of base
  - Excessive Cl^- in PN.
- Management:
  - Rule out DKA and sepsis.
  - Add acetate to PN.

Complications

- **Hypercarbia**
- Possible cause:
  - Excessive calorie or carbohydrate load.
- Management:
  - Decrease total calories or
  - CHO load.

Complications

- **Hypocalcemia**
- Possible cause:
  - Excessive PO4 salts
  - Low serum albumin.
  - Inadequate Ca in PN.
- Management:
  - Slowly increase calcium in PN prescription.

Complications

- **Hypercalcemia**
- Possible cause:
  - Excessive Ca in PN
  - Administration of vitamin A in patients with renal failure.
  - Can lead to pancreatitis.
- Management:
  - Decrease calcium in PN.
  - Ensure adequate hydration.
  - Limit vitamin supplements in patients with renal failure to vitamin C and B vitamins.

Complications

- **Hyperglycemia**
- Possible cause:
  - Stress response. Occurs approximately 25% of cases.

  Management:
  - Rule out infection.
  - Decrease carbohydrate in PN.
  - Provide adequate insulin.

Complications

- **Hypoglycemia**
- Possible cause:
  - Sudden withdrawal of concentrated glucose.
  - More common in children.
- Management:
  - Taper PN. Start D10.

Complications

- **Cholestasis**
- Possible cause:
  - Lack of GI stimulation.
  - Sludge present in 50% of patients on PN for 4-6 weeks;
  - resolves with resumption of enteral feeding.
- Management:
  - Promote enteral feeding.

Complications

- Hepatic tissue damage and fat infiltration
- Possible cause:
  - Unclear etiology.
  - May be related to excessive glucose or energy administration;
  - L-carnitine deficiency.
- Management:
  - Rule out all other causes of liver failure.
  - Increase fat intake relative to CHO.
  - Enteral feeding.

Points to remember

- Nutritional status changes slowly
- Single time points data may be misleading – serial measurements are essential
- It is often difficult to assess the degree of malnutrition with acceptable certainty
- Integrate data from diet assessment, anthropometry, biochemistry and clinical assessment