

Medical Nutrition Therapy Diet: Acute Renal Failure

I. Purpose

A. Nutrition Indicators

- i. Screening patients to identify those at nutritional risk is an important first step in nutritional assessment. The nutritional assessment should include subjective and objective data from the following sources:
 - a. Anthropometric measures/ Physical Examination
 1. Height
 2. Weight (current, ideal and any significant changes)
 3. TSF/MAC, presence of edema
 - b. Biochemical data
 1. GFR
 2. BUN/ Serum creatinine
 3. Serum
 4. Serum albumin
 5. Serum cholesterol and lipid profiles
 6. Serum calcium
 7. Serum phosphorus
 8. Intake and output
 - c. Nutritional history
 1. Usual Food intake
 2. Special diet instruction
 3. Chewing / swallowing ability
 4. Assessment of GI issues
 - d. Medical History
 1. Disease or condition leading to acute renal failure
 2. Treatment modality
 3. Concurrent medical condition
 4. Medical conditions with potential nutritional implications
 5. Medications with food/drug interactions

B. Criteria to Assign the Diet

- i. The Acute Kidney Injury Network (AKIN), an international network of kidney and critical care specialists, has developed a new set of consensus recommendations for the terminology, diagnostic criteria, and staging of acute kidney injury. Currently, there are many preclinical studies of AKI underway. Accordingly, the AKIN recommends five key areas for future research, including studies examining the epidemiology, outcomes, and treatment of the disease. AKIN recommendations include:
 - a. Classification/ Staging System for AKI

Stage	Creatinine Criteria	Urine Output Criteria
1	# Serum Creatinine of >0.3 mg/dl or increase to =150% - 200% from baseline	<0.5ml/kg/hr for > 6hr
2	Increase serum creatinine to > 200%-300% from baseline	<0.5ml/kg/hr for >12 hrs
3	Increase serum creatinine to >300% from baseline (or serum creatinine =4.0mg/dl with an acute rise of at least 0.5 mg/dl)	<0.3ml/kg/hr x 24 hrs or anuria x 12 hr

stic criteria for AKI (Acute Kidney Injury):

1. An abrupt (within 48 hours) reduction in kidney function currently defined as an absolute increase in serum creatinine of > 0.3 mg/dl (>25 micromole/L), a percentage increase of 50% or a reduction in urine output (documented oliguria of < 0.5 ml/kg/hr for > 6 hours)

C. Rationale for Diet

- i. Nutrition consult is indicated if enteral or parenteral nutrition is prescribed
- ii. Risk factors for protein-calorie malnutrition in acute renal failure includes the following:
 - a. Patients are more likely to be catabolic when Acute Renal Failure is caused by:
 1. Shock
 2. Sepsis
 3. Rhabdomyolysis
 4. Infection
 5. Hypotension
 6. Surgery
 - b. Insufficient intake of protein and calories because of gastrointestinal problems and metabolic alterations
 - c. Continuous renal replacement therapy (CRRT) causes nutrition losses and the dialysis procedure is catabolic
 1. CRRT is a form of dialysis used to slowly remove fluids and solutes while correcting the electrolyte and metabolic abnormalities associated with acute renal failure.
 2. Nutrition support is generally required because of the hyper metabolic state and compromised nutritional status
- iii. Preexisting or hospital-acquired malnutrition is an independent contributing factor and needs to be addressed
- iv. Acute Renal Failure causes several nutritional imbalances. These metabolic derangements can include the following:
 - a. Rapid decrease in urine output
 - b. Acidosis
 - c. Electrolyte imbalances (hyperkalemia, hyperphosphatemia)
 - d. Fluid disturbances
 - e. Impaired glucose utilization
 - f. Protein catabolism
 - g. Accumulation of metabolic waste products

II. Population

A. Overview

- i. Acute renal failure is common in hospitalized patients and occurs in approximately 20% of patients admitted to the intensive care unit. Acute renal failure is often a complication of the following:
 - a. Sepsis
 - b. Trauma
 - c. Multiple organ failure
- ii. The prognosis of acute renal failure remains poor and mortality ranged from 40% to 80%. The choice of dialytic method depends on the clinical situation.
- iii. Client History:
 - a. Minimum baseline data needed for medical nutrition therapy:
 - b. Blood Urea Nitrogen, creatinine: Indicates level of uremic toxins
 - c. Albumin, prealbumin: Visceral protein status, consider hydration status
 - d. Sodium, potassium: Electrolyte balance
 - e. Phosphorus, calcium, magnesium: Abnormal levels resulting from side effects of acute renal failure
 - f. Serum glucose: glycemic control
 - g. Serum chloride: CO₂ (carbon dioxide): Acid/base balance
 - h. Hematocrit/hemoglobin: indicates anemic risk

- i. Urinalysis results (volume, urea, protein, sodium)
- j. Others as appropriate: triglycerides, ferritin

B. Disease Process

- i. Acute renal failure is characterized by rapid decline in kidney function and is defined as an acute elevation in serum creatinine from baseline. It is classically divided into 3 categories according to underlying cause of kidney dysfunction:
 - a. Prerenal:
 - 1. The prerenal stage occurs when an underlying condition deprives the kidney of necessary blood flow, thereby decreasing the glomerular filtration rate. The decrease in the renal perfusion can be the result of the following:
 - i. Volume depletion
 - ii. Hypotension/ shock
 - iii. Congestive heart failure
 - iv. Renal vasoconstriction
 - v. Renal artery occlusion
 - b. Intrarenal:
 - 1. The intrarenal stage occurs when part of the kidney such as the tubule, the interstitium, the glomerulus, or the vasculature are damaged. Underlying conditions include the following:
 - i. Hypertension
 - ii. Interstitial inflammation from an infection
 - iii. Acute tubular necrosis
 - iv. Acute interstitial nephritis
 - v. Nephrotoxicity
 - vi. Intrarenal obstruction
 - c. Postrenal:
 - 1. The postrenal stage is caused when crystals, protein deposits or malignant tumor infiltration obstruct urine flow.

C. Biochemical and Nutrient Needs

- i. Nutrient Expectation to dietary reference intake (DRI):
 - a. Supplementation of water soluble vitamin in acute renal failure patients is necessary to prevent deficiency that can be caused by the following:
 - 1. Dialysis losses
 - 2. Inadequate intake
 - 3. Drug-nutrient interactions
 - 4. Possible needs increase
 - b. Water-soluble vitamin including 1mg folate/day and 10 mg pyridoxine/day may be needed
 - c. Vitamin C should be limited to the Dietary Reference Intakes for age and sex to prevent oxalosis
 - d. Because vitamin A toxicity has been reported in patients with chronic kidney disease, vitamin A should probably not be supplemented in patients with acute renal failure
 - e. Vitamin D supplementation may be needed to prevent secondary hyperparathyroidism as commonly seen in patients with chronic kidney disease and levels have been reported to be low in critically ill patients
 - f. Vitamin K deficiency is of concern in patients on parenteral nutrition receiving antibiotics and should be supplemented
- ii. Laboratory Value norms
 - a. Hospitalized patients
 - 1. Albumin (BD-1.11.1): 3.5-5.0 g/dL
 - 2. Prealbumin (BD-1.11.2): 19-43 mg/dL
 - 3. Sodium (BD-1.2.5): 135-145 mEq/L
 - 4. Potassium (BD-1.2.7): 3.5-5.5 mEq/L

5. Phosphorus (BD-1.2.11): 2.5-6.0 mg/dL
6. Calcium: 8.5-10.5 mg/dL
7. Magnesium (BD-1.2.8): 1.5-2.0 mEq/L
8. Serum glucose: 80-200 mg/dL (enteral), 150-250 mg/dL (parenteral)
9. Triglycerides (BD-1.7.7): <250 mg/dL 4 hours after lipids stopped, <400 mg/dL during continuous infusion
10. Chloride (BD-1.2.6): 100-106 mEq/L
11. CO₂ (carbon dioxide): 24-30 mEq/L
12. Hematocrit (BD-1.10.2): 36% to 45% (women), 38% to 50% (men)
13. Hemoglobin (BD-1.10.1): 12-16 g/dL (women), 14-18 g/dL (men)
14. Ferritin: 100-800 ng/ml
15. Transferrin: saturation 20% to 50%
16. Blood Urea Nitrogen BUN (BD-1.2.1)
17. Creatinine (BD-1.2.2)
18. Glomerular filtration rate (BD-1.2.4)

iii. Protein:

- a. Protein intake should be adjusted according to the following:
 1. Clinical condition
 2. Degree of catabolism
 3. Extent of impairment of renal function
 4. Whether renal replacement therapy has been initiated
- b. The optimal protein requirement is controversial and should be prescribed based of the degree of catabolism and type of renal replacement therapy

iv. Nutrient recommendations for patients with acute renal failure:

Degree of catabolism	None/mild	Moderate	Severe	Burn/ sepsis
Glomerular filtration rate (ml/min)	5-10	-	-	-
Urea Nitrogen appearance	4-5 g/d	5 g N/day +	5 g N/day+	5 g N/day+
Dialysis	None	As needed	Hemodialysis /peritoneal dialysis	CRRT
Protein g/kg/day	0.6-1.0	1.0 - 1.2	1.2 - 1.8	1.5 - 2.0
Carbohydrates (% of Kcal)	60	60	60	60
Fat (% of Kcal)	35	20-30	20-30	20-30
Kcal/kg recommended body weight (RBW)/day	30	35	35-50	35-50

- a. Carbohydrates should not exceed 4-5 mg/kg/min/day
 - b. Basal energy expenditure (BEE) x stress factor is calculated via indirect calorimetry
 1. Energy requirements are unlikely to exceed 130% of the calculated BEE
 - c. Sodium (1.1-3.3 g/day) is individualized in absence of edema; sodium should match urinary losses
 - d. Potassium (2.0-3.0 g/day) individualized
 - e. Fluids (24-hour urine output + 500 ml) depend on urinary sodium, total fluid output including urine, and modality of dialysis if any
 - f. Dietary protein intake recommendations vary from 0.6-2.0 g/kg recommended body weight (RBW)/day; sufficient protein needs to be provided in order to decrease negative nitrogen balance and promote recovery from acute renal failure. Continuous renal replacement therapy (CRRT) can remove amino acids and proteins; therefore, a minimal protein intake of 1.5 g/kg RBW/day is recommended
- v. Electrolytes
- a. Serum electrolytes should be closely monitored as nutritional support will need

to be adjusted accordingly. Hyperkalemia and hyperphosphatemia can occur during acute renal failure. However, hypokalemia and hypophosphatemia are observed with refeeding syndrome because of the intracellular shift of potassium and phosphorus in response to anabolism. Serum magnesium, calcium, and phosphorus should be supplemented as needed. Sodium intake should be prescribed based on hydration status and urinary losses. CRRT causes significant loss of magnesium, calcium, phosphorus, and potassium, which requires careful monitoring

vi. Vitamins

- a. The effects of vitamin and mineral supplementation in amounts exceeding the Dietary Reference Intakes (DRI) during critical illness are not known. Supplementation of water soluble vitamins in Acute Renal Failure patients is necessary to prevent deficiency caused by dialysis losses, inadequate intake, drug-nutrient interaction, and possibly higher needs. The effects of CRRT on vitamin and mineral status in the literature is limited. Marin (2001) reports significantly lower serum concentrations of vitamins and trace elements during the first 24 hours of CVVH (continuous venovenous hemofiltration) and proposed the following water soluble vitamin and mineral supplementation as shown in the following table.
- b. Vitamin/Mineral Supplementation in Acute Renal Failure

Vitamin/Mineral	Dose
Vitamin K	4 mg/week
Vitamin E	10 IU/day
Niacin	20 mg/day
Thiamin	1.5 mg/day
Riboflavin	1.5-1.7 mg/day
Pantothenic acid (B-6)	5-10 mg/day
Vitamin C	60-125 mg/day
Biotin	150-300 mcg/day
Folic acid	1 mg/day
Vitamin B-12	4 ug/day
Zinc	20 mg?*
Vitamin A	Avoid

III. General Guideline

A. Nutrition Rx

- i. Protein:
 - a. 0.8-1.2 g/kg of body weight noncatabolic, without dialysis
 - b. 1.2-1.5 g/kg of body weight catabolic and/or initiation of
- ii. Energy:
 - a. 25-35 kcal/kg of body weight depends on stress/status of nutrition and include kcal from continuous renal replacement therapy
- iii. Sodium:
 - a. 2-3.0 g/day based on blood pressure, edema; replace loss in diuretic phase
- iv. Potassium:
 - a. 2.0-3.0 g/day, replace loss in diuretic phase
- v. Phosphorus:
 - a. 8-15mg/kg
- vi. Calcium:
 - a. Maintain serum value within normal limits
- vii. Fluid:
 - a. 500 cc + urine output which depends on urinary sodium, total fluid output including urine, and modality of dialysis, if any
- viii. Vitamins/Minerals:

- a. Dietary Reference Intakes, adjust to level of catabolism

B. Adequacy of nutrition Rx

- i. Nutrition support may improve prognosis in Acute Renal Failure, but it has not been definitively confirmed. The presence of negative nitrogen balance strongly suggests that patients should be supplied with an optimal amount of nutrients.
- ii. It has not been clearly shown that nutrition therapy in Acute Renal Failure improves recovery of renal function or improves survival. However, based on evidence supporting nutrition intervention in acutely ill patients, it is likely that nutritional support in Acute Renal Failure is beneficial. The goal is to provide adequate amounts of protein, calories, and other nutrients to prevent or minimize malnutrition.
 - a. The management of Acute Renal Failure is focused on the following:
 - 1. Treating the underlying causes
 - 2. Preventing complications such as nutrient deficiencies
 - 3. Correcting fluid, electrolyte, and uremic abnormalities
 - b. The poor prognosis is related mainly to the severity of the underlying illness and associated hypercatabolism. Nutrition therapy should be viewed as a means of supporting the patient until the underlying illness is controlled.

C. Goals

- i. Eliminate cause of kidney failure
- ii. Prevent further kidney damage
- iii. Support kidney functions and other affected organ systems
- iv. Provide adequate calories and protein
- v. Preserve lean body mass
- vi. Prevent nutritional deficiencies
- vii. Maintain and improve electrolyte and fluid imbalance
- viii. Manage anemia
- ix. Reassess use of nephrotoxic drugs
- x. Promote recovery from acute renal failure

D. Does it Meet DRI

- i. Nutrients Below Target Due to Nutrition Prescription:
 - a. Supplementation of water-soluble vitamins in patients with Acute Renal Failure is necessary to prevent deficiency caused by the following:
 - 1. Dialysis losses
 - 2. Inadequate intake
 - 3. Drug-nutrient interactions
 - 4. Possibly higher needs
 - b. The effects of continuous renal replacement therapy (CRRT) on vitamin and mineral status in the literature is limited. Reported significantly lower serum concentrations of vitamins and trace elements during the first 24 hours of CVVH (continuous venovenous hemofiltration). Also eliminated during CRRT are water-soluble vitamins, such as the following:
 - 1. Folic acid
 - 2. Vitamin B-6
 - 3. Vitamin C
 - 4. Vitamins A, D and E

IV. Education Material

A. Nutrition Therapy

- i. Obsolete Diets Associated with Acute Renal Failure:
 - a. Renal Diet (a single diet for all renal diseases)
 - b. Low-protein diet

B. Nutrition Support

- i. Enteral Nutrition
 - a. Enteral Nutrition a safe and effective route to deliver nutrition support to patients with acute renal failure. The enteral route is the preferred route for nutrition support because it can preserve gut function, possibly enhance

immunity, and decrease episodes of bacteremia and infection. Small bowel enteral access is preferred as this population is prone to gastroparesis and may not tolerate the elevation of the bed >30 degrees. The hypercatabolic patient may require more protein than standard concentrated formulas provide and a modular protein supplement may need to be added. Considerations regarding enteral formulas need to include total fluid, electrolyte, and mineral content in addition to protein and calories as restrictions become unnecessary during continuous renal replacement therapy.

ii. Tube Feeding Guidelines

a. The following tube-feeding guidelines are based on special considerations for chronic kidney disease

1. Concentrated formulas are used to minimize fluid load if the patient is oliguric. They may be diluted at initiation or started at full strength at a slow rate of 20 cc/hour.
2. Flush volumes normally used may not be tolerated. Fluid status must be followed closely.
3. Minerals and electrolyte levels need to be monitored carefully when renal formulas are used as the only source of nutrition.
4. Administration rates should address the actual number of hours that a tube feeding can be employed because of constraints of dialysis or continuous renal replacement therapy (CRRT) and other therapies the patient may be receiving.

b. The tube-feeding formula choice is based on the underlying cause of Acute Renal Failure and the type of treatment. If the patient is receiving CRRT, a standard, high-protein formula may be the optimal choice. However, if potassium, phosphorus, or magnesium levels are high, a specialized renal formula with added protein powder may be indicated.

iii. Parenteral Nutrition

a. The parenteral nutrition formulation depends on treatment, underlying cause of illness, the catabolic response, and nitrogen balance. Amino acid losses in continuous renal replacement therapy (CRRT) are approximately 15 g/d and recommendations for protein vary (Barco, 2003). Mixed amino acid solutions can be used instead of those with only essential amino acids. Parenteral nutrition solutions should be compounded using 20% amino acids, 50% to 60% dextrose, and 20% to 30% lipids to reduce volume. Parenteral nutrition should not be used to correct electrolyte abnormalities, and additional intravenous supplementation may be needed for electrolyte abnormalities. Trace elements are administered 2-3 times per week. Dietary Reference Intakes for vitamins would be provided daily. Glucose, potassium, blood urea nitrogen, creatinine, sodium, amylase, lipase, magnesium, phosphorus, chloride, and liver function tests must be closely monitored and reassessed frequently when the patient is receiving parenteral nutrition/

C. Ideas for Compliance

i. Nutrition Monitoring & Evaluation

a. Hospitalized patients should be monitored by a RD daily or as indicated. The follow-up includes review of clinical data and eating plan evaluation.

1. Close monitoring of fluid and electrolyte balance, nutrition support, and medical treatments to alter the nutrition care plan. Assessments of functional ability and behavioral outcomes is also necessary

b. Follow up of nutrition intervention includes evaluation of medical progress, metabolic status, nutrition support, and review of nutrition prescription and tolerance of nutrition therapy.

V. Sample Menu (*Foods Recommended, Foods to Avoid, & Example of a Meal Plan*)

A. Fluid Control (500 cc + urine output)

- i. Kidneys help control the amount of fluid that leaves your body. With acute renal failure the kidneys are unable to regulate the removal of fluid from your body. Too much fluid may cause swelling, shortness of breath, or high blood pressure.
 - a. Limit fluid intake: Water, coffee, tea, sodas, soups, popsicles, ice cream, sherbets, ice cubes, gelatin, watery vegetables/fruits, milk, liquid creamer, wine/beer
 - 1. Tips:
 - i. Drink only when thirsty
 - ii. Eat less salt – feel less thirsty
 - iii. Brush your teeth 3-4 times a day – prevent mouth from drying out
 - iv. Suck on lemon wedge
 - v. Chew sugarless gum or suck on sugarless hard candy
 - vi. Measure how much fluid your favorite cup or glass holds to be able to better monitor fluid intake
 - vii. After measuring how much total fluid you can drink for the day – place in a container and drink only from it.
- B. Phosphorus: maintain a serum value within normal limits
 - i. When kidney function declines, the body has a difficult time keeping phosphorus and calcium in balance. As a result, the body cannot get rid of excess phosphorus.
 - ii. Low phosphorus diet
 - a. High phosphorus foods to Avoid:
 - 1. cola drinks
 - 2. peanut butter
 - 3. cheese
 - 4. sardines
 - 5. chicken/beef liver
 - 6. nuts
 - 7. caramels
 - 8. beer
 - 9. ice cream
 - b. Low phosphorus foods (Choose):
 - 1. Broccoli
 - 2. non-dairy substitutes
- C. Potassium: 2 grams/2000 mg
 - i. The kidneys are responsible for helping to keep the correct amount of potassium in your body. High levels of potassium are very dangerous.
 - ii. Most foods contain potassium. A serving size will determine which as low, moderate, or high potassium levels.
 - iii. High potassium foods to Avoid:
 - a. Bananas
 - b. Broccoli
 - c. Chocolate
 - d. Oranges
 - e. Potatoes
 - f. Coffee
 - g. Cantaloupe
 - h. Tomatoes
 - i. salt substitutes
 - j. prunes
 - k. mushrooms
 - l. bran products
 - m. raisins
 - n. greens
 - o. apricots

iv. Low potassium foods to Choose:

- a. Apples
- b. beans (green)
- c. rice
- d. grapes
- e. cucumber
- f. noodles
- g. pears
- h. onions
- i. watermelon
- j. lettuce
- k. cereal
- l. cranberries
- m. carrots
- n. bread products
- o. cherries

D. Protein (80 grams)

- i. Protein is needed to maintain muscles, aid in building resistance to infections, and repair/replace body tissue. As protein is broken down in the body, waste products called urea are formed. As kidney function declines, urea builds up in the blood.
- ii. Eating too much protein may cause urea to build up too quickly – this will cause a sick feeling.
- iii. Eating less protein may be helpful in reducing your blood urea levels.
- iv. Need both high quality and low quality protein in diet – choose wisely
- v. Low protein diet
 - a. High protein foods (limit consumption):
 1. Meat
 2. Poultry
 3. milk products
 4. eggs
 - b. Low protein foods (consume more):
 1. fresh beans (pinto, kidney, navy)
 2. grains
 3. vegetables

E. Sodium (2 grams/2000 mg)

- i. Sodium is needed for many functions such as controlling muscle contractions, balancing fluids, and controlling blood pressure. Healthy kidneys remove excess sodium in the urine. As kidney function declines, sodium and fluids may accumulate in your body. May cause swelling in eyes, hands, and/or feet/ankles.
- ii. To keep sodium level in balance – limit sodium in diet.
- iii. Low sodium diet
 - a. High sodium foods:
 1. table salt
 2. bouillon cubes
 3. potato chips
 4. nuts, bacon
 5. cold cuts
 6. cheese
 7. canned or instant soups
 8. canned vegetables
 9. processed meals
 - b. Low sodium alternatives:
 1. season with a variety of spices like garlic or oregano, use lemon

Source: Diet for Renal Patient. *Medical College of Wisconsin*.
<http://www.mcw.edu/Nephrology/ClinicalServices/DietforRenalPatient.htm>

Source: Acute Renal Failure. Nutrition Care Manual. *Academy of Nutrition and Dietetics*.
<http://www.nutritioncaremanual.org/index.cfm>

VI. Websites

A. Organizations with Websites

- i. Mayo Clinic: <http://www.mayoclinic.org/diseases-conditions/kidney-failure/basics/definition/con-20024029>

B. Government Websites

- i. MedlinePlus: <http://www.nlm.nih.gov/medlineplus/ency/article/000501.htm>

VII. References

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