Nutrition Support in Specific Clinical Condition II : Renal Disease

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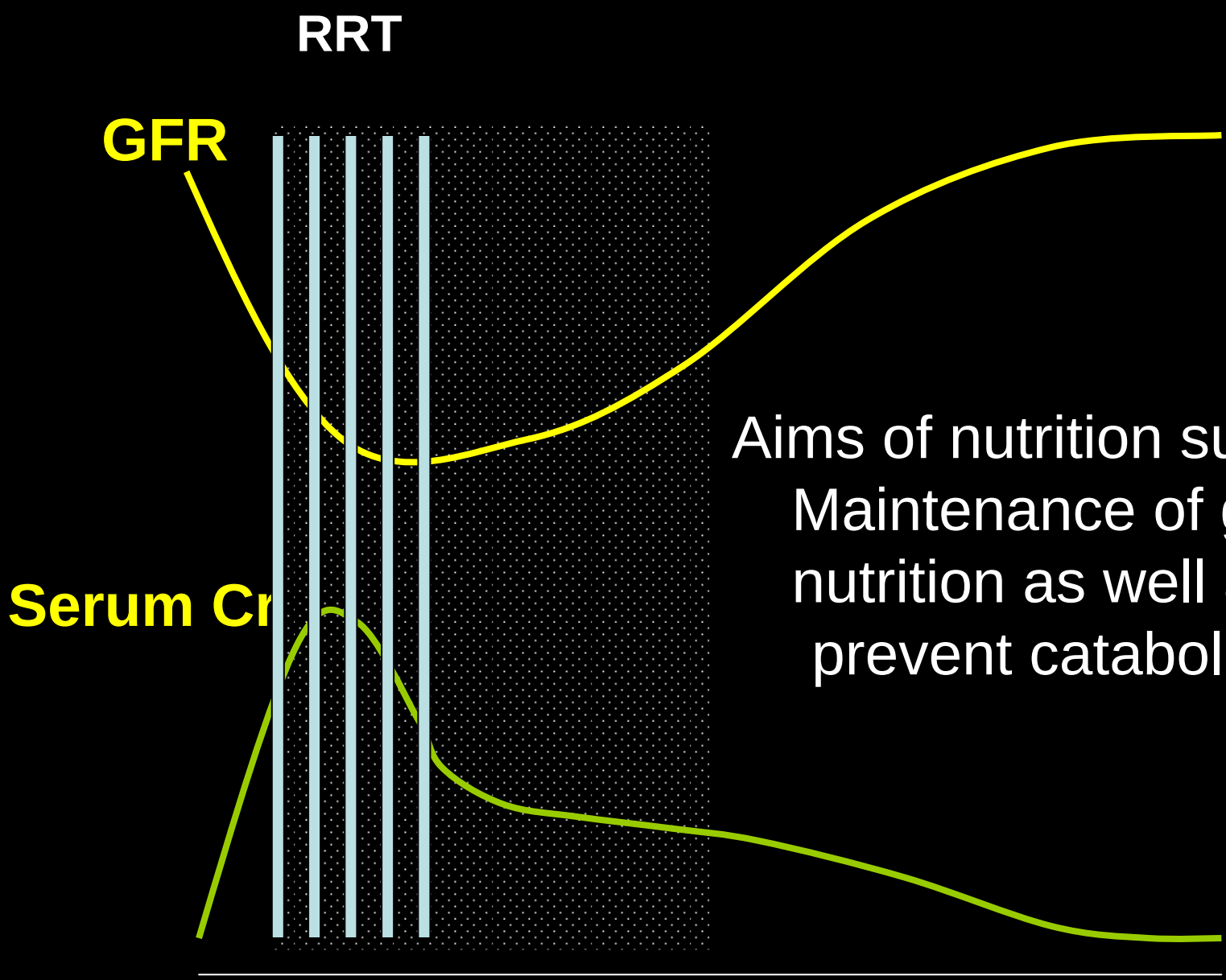
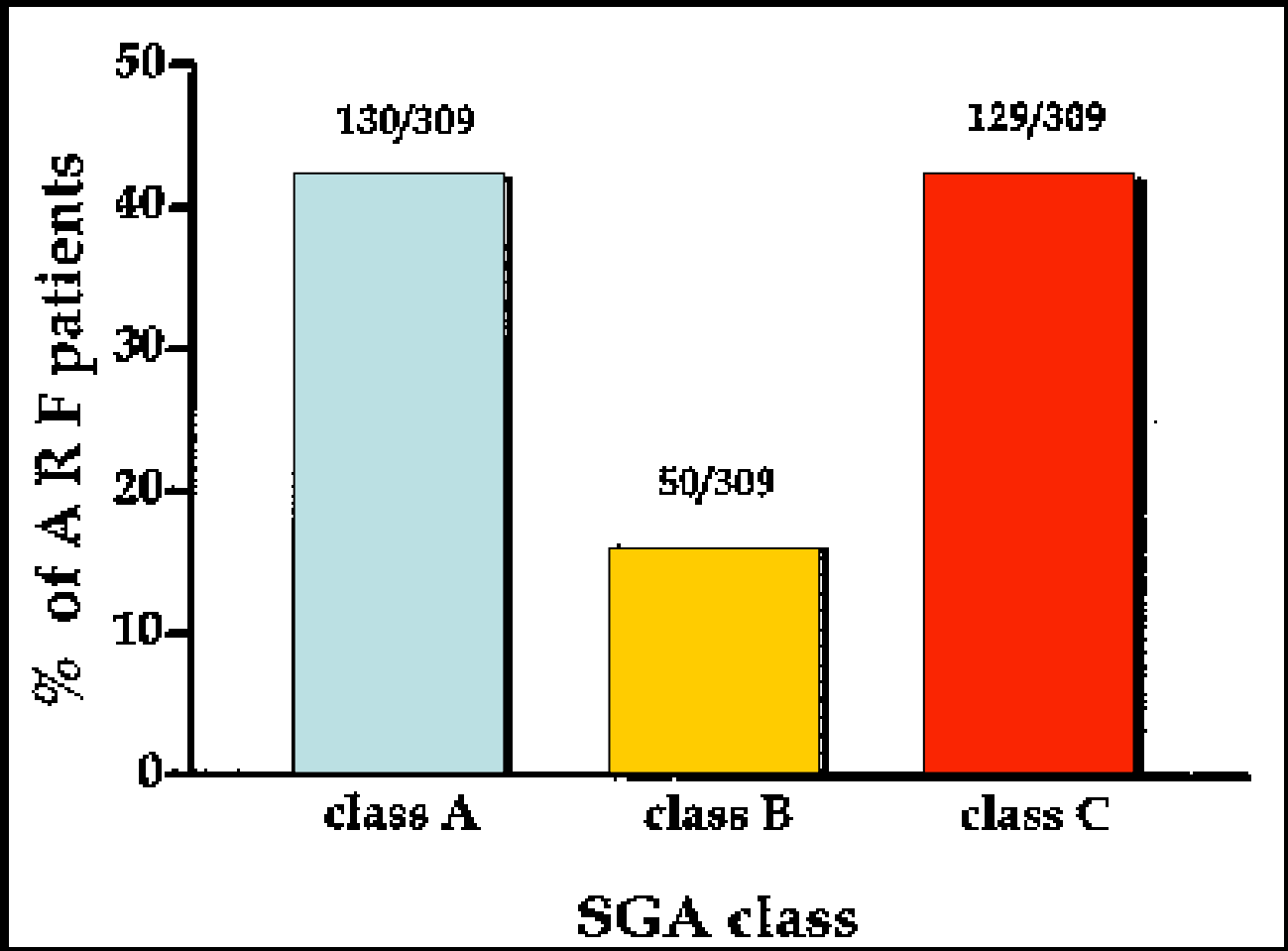


Aims of nutrition support :
Maintenance of good nutrition as well as to prevent catabolism.

Prevalence and Clinical Outcome Associated with Preexisting Malnutrition in Acute Renal Failure



No PEM

Suspected Mild PEM

Moderate /severe PEM

Fiaccadori E, J Am Soc Nephrol 1999

Clinical outcome of ARF patients stratified by nutritional status (Class C vs. Class A)

	Odd ratio	95% CI	*P value*
Morbidity for sepsis	2.88	1.53 - 5.42	< 0.001
Septic shock	4.05	1.46 -11.28	< 0.01
Hemorrhage	2.98	1.45 - 6.13	< 0.01
Intestinal occlusion	5.57	1.57 -19.74	< 0.01
Cardiac dysrhythmia	2.29	1.36 - 3.85	< 0.01
Cardiogenic shock	4.39	1.83 -10.55	< .001
Acute resp. failure	3.35	3.35 - 8.74	< 0.05

Fiaccadori E, J Am Soc Nephrol 1999

Clinical outcome of ARF patients stratified by nutritional status : use of health care resources

- **Hospital length of stay** was significantly increased ($P < 0.01$), and the presence of severe malnutrition was associated with a significant increase of **in-hospital mortality** (OR 7.21; 95% CI, 4.08 to 12.73, $P < 0.001$).
- Preexisting malnutrition was a statistically **significant, independent predictor of in-hospital mortality** at multivariable logistic regression analysis both with **comorbidities** (OR 2.02; 95% CI, 1.50 to 2.71, $P < 0.001$), and with **comorbidities and complications** (OR 2.12; 95% CI, 1.61 to 2.89, $P < 0.001$).

Scope of Discussion

- Metabolic derangement in ARF
- Nutrients requirement and limitation
- Route of nutrition support
- Effect of nutrition support on the recovery of renal function in ARF
- Role of renal replacement therapy in nutritional management
- Special methods for managing hypercatabolism in ARF

Metabolic Derangement in ARF

- **Hypermetabolism and hypercatabolism**

Influenced more by the nature of the illness causing ARF

- **Acidemia**
- **Increase certain catabolic hormone (glucagon & PTH) due to ARF itself**

Metabolic Derangement in ARF

- Hypermetabolism and hypercatabolism
- Glucose intolerance : insulin resistance
- Protein and amino acids abnormalities : protein catabolism, azotemia

Influenced more by the nature of the illness causing ARF

Protein Catabolism in ARF

- **Average UNA**

  12±7.9 g/D in patients with rhabdomyolysis

  vs.

  3.8±2.4 g/D in ARF from other causes

  Feinstein EI, et al, 1981

- **Net protein degradation 200-250 g/D**

  Feinstein EI, et al, 1983

  Leonard CD, et al, 1975

Metabolic Derangement in ARF

- Hypermetabolism and hypercatabolism
- Glucose intolerance : insulin resistance
- Protein and amino acids abnormalities : protein catabolism, azotemia
- Lipid metabolism : hypertriglyceridemia
- Acid-base disturbance : metabolic acidosis
- Fluid imbalance : hyper- / hypovolemia
- Electrolytes imbalance :hyper- / hyponatremia, hyper- / hypokalemia, hyperphosphatemia, hypocalcemia

- **Metabolic abnormalities in patients with ARF differ from one case to another.**
- **In the same patient, the abnormalities can change from day to day or even hour to hour.**

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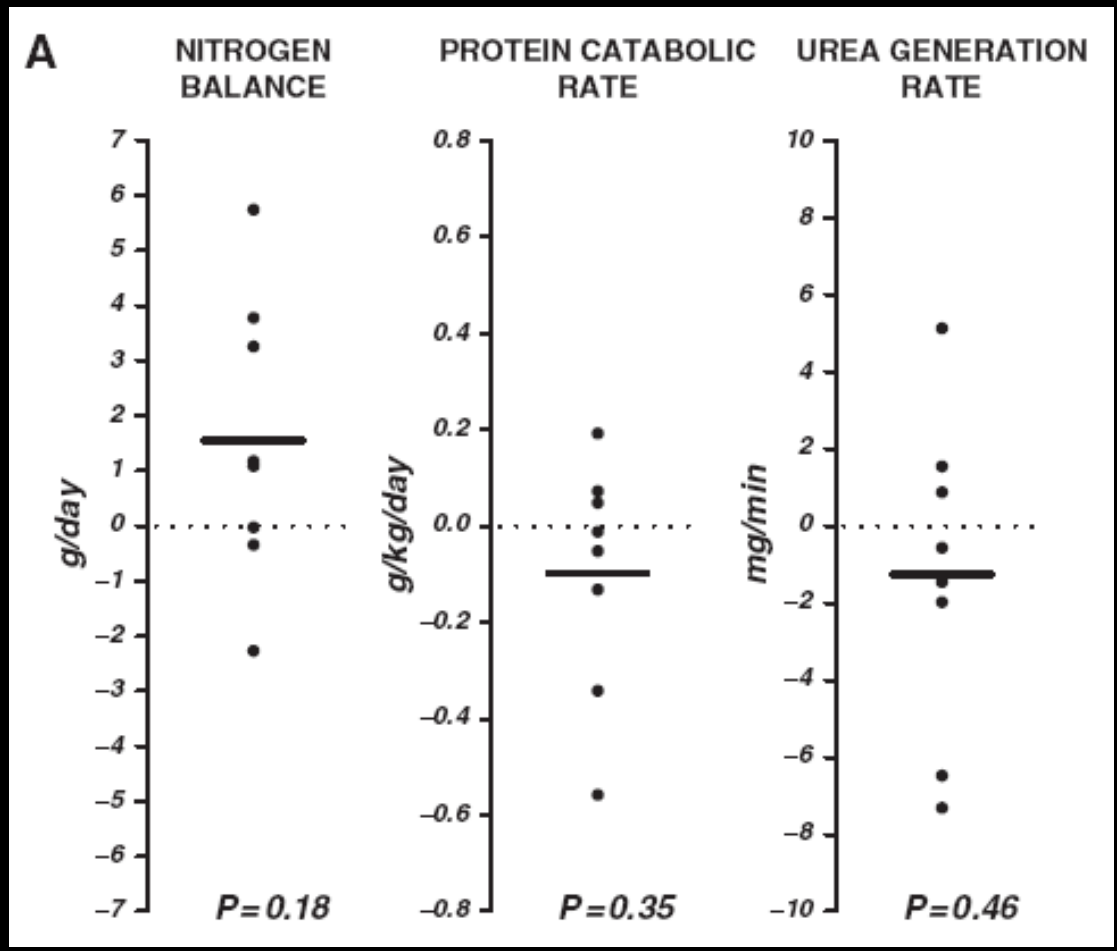
Effects of different energy intakes on nitrogen balance in patients with ARF

- Open label, cross-over design
- 10 ARF patients (7 males; mean age 72 years, range 60–83; mean APACHE II score 27.1, range 23–34, mechanical ventilation 8/10)
- TPN 40 kcal/kg/day vs. 30 Kcal/kg/day
- Nitrogen intake : 0.25 g / kg / day for both regimens.

Fiaccadori E, Nephrol Dial Transplant, 2005

Effects of different energy intakes on nitrogen balance in patients with ARF



Fiaccadori E, Nephrol Dial Transplant 2005

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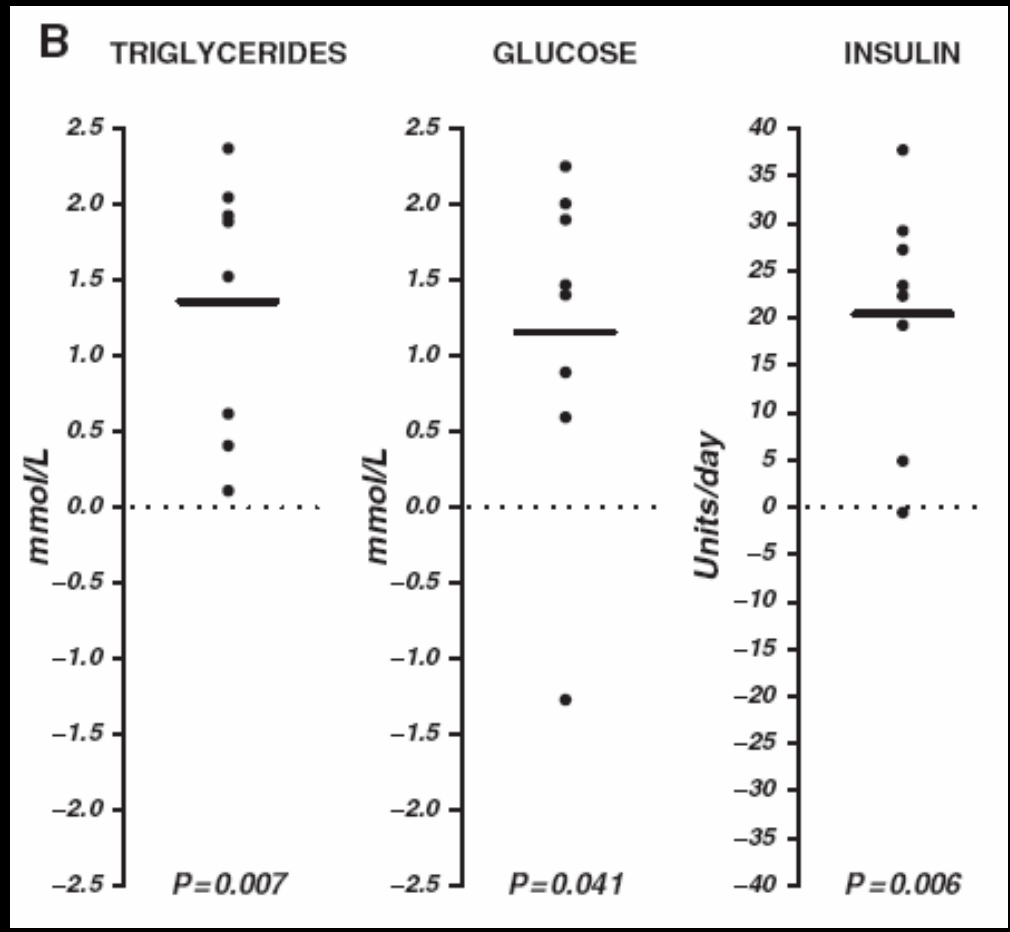

Fiaccadori E, Nephrol Dial Transplant 2005

Nutrients Requirement and Limitation

Goals :

Energy	25-35 Kcal/kg/D
Protein	1.5-2 g/kg/d

Potential nutrients restriction in early phase

- Water
- Potassium
- Sodium
- Phosphate

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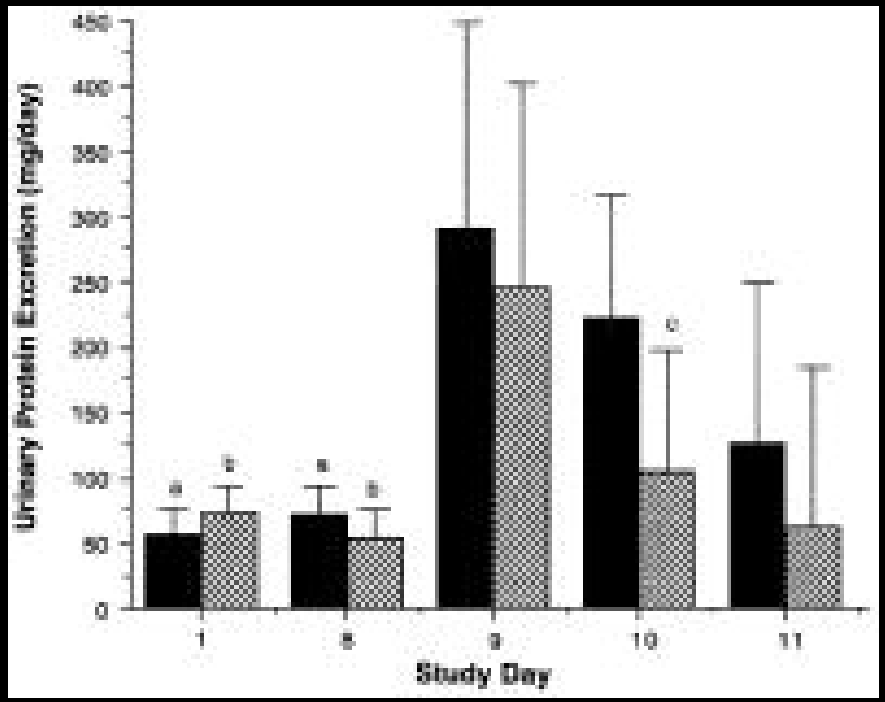
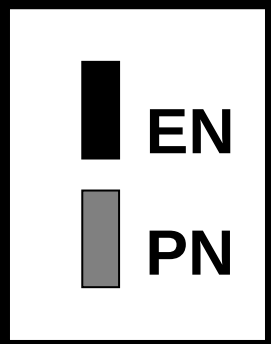
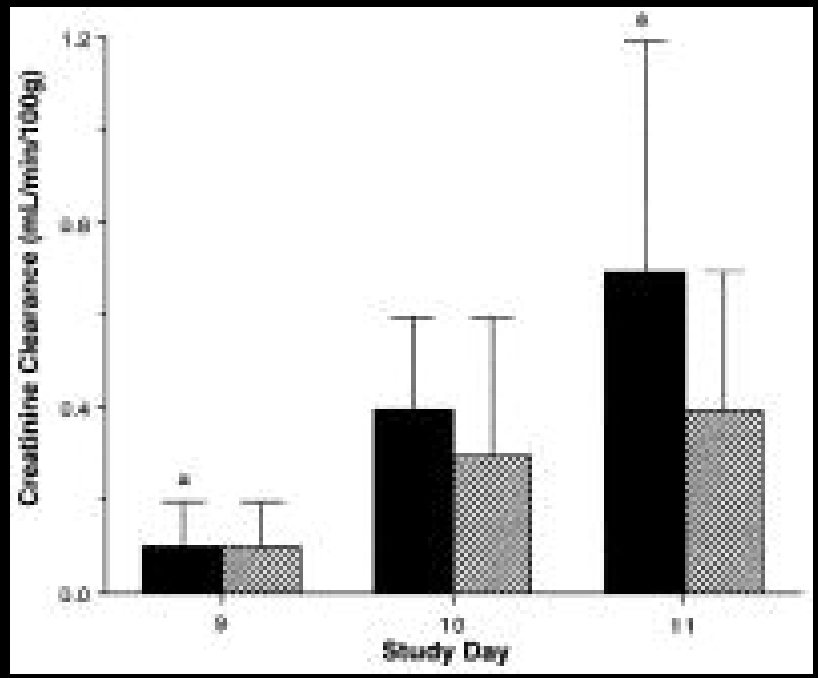
Recovery from Ischemic ARF EN *vs.* PN in Mice



Urinary protein excretion

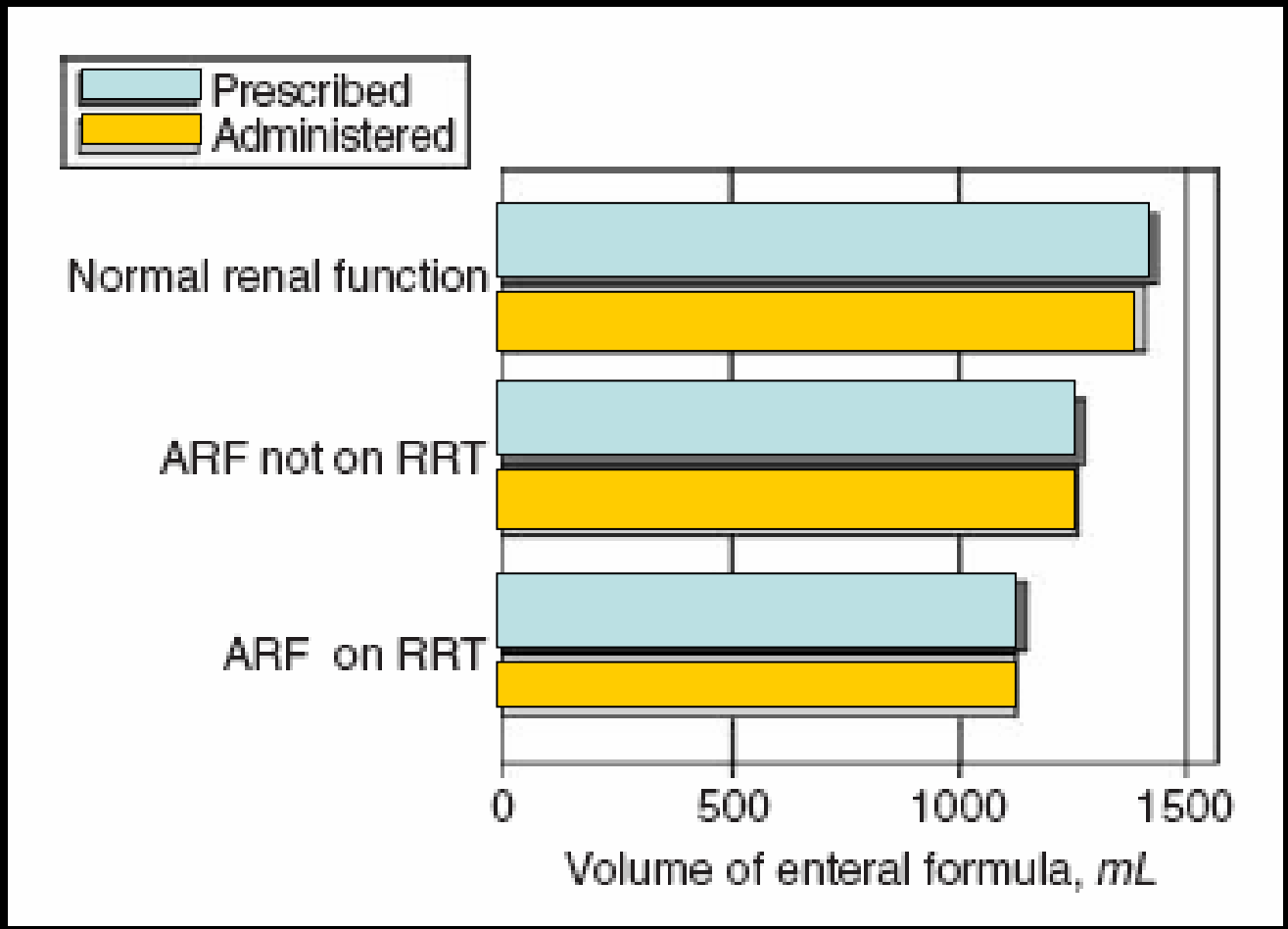




Creatinine clearance

Mouser JF, et al, 1997

Is it safe to use EN in ARF?



- **247 cases**

Fiaccadori E, Kidney Int 2004

ESPEN Guidelines for EN in ARF

- A nasogastric tube is the standard access
- Jejunal tube placement may be indicated in severe impairment of GI motility.
- In cases where requirements cannot be met, supplementary PN may be needed.
- In uncomplicated ARF, when spontaneous alimentation is insufficient, ONS may be useful.

Cano N et al, Clin Nutr 2006

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Effect of Nutrition Support

	Design	Outcome	Results
Lee, 1967	Open-ended, fructose, casein	Reduction of weight loss	+
Dudrick, 1969,1970	Open-ended, AA & glucose	Weight gain, wound healing	+
Baek, 1975	TPN vs. glucose	Morbidity & mortality	+

Effect of Nutrition Support

McMurray et al, 1978

Design :TPN with EAA/NEAA (12 g N_2/D) vs. 200-400 mg of glucose

Outcome : Survival rate

Results : In non-complicated case, no difference in survival rate

: In patients with $\geq$ 3 clinical complications, the survival of cases received TPN was greater than those received glucose alone

No Clear Beneficial Effect!

- Variable and complex clinical course
- Many previous studies were retrospective or not randomly controlled
- Many previous studies did not examine whether TPN is beneficial but compare the response to different TPN formula
- The optimal nutrient composition of the TPN solution has not been defined
- Route of nutrition support may be important
- Patients may need both nutrient intake and metabolic intervention

No Clear Beneficial Effect!

Is that mean no nutrition support?

No!

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Renal Replacement therapy

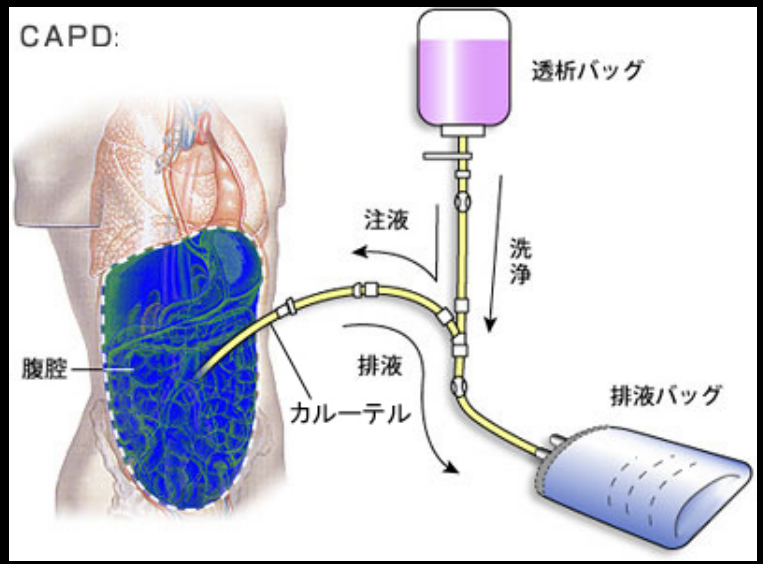
- **Renal replacement therapy is recommended to keep BUN below 80-100 mg/dL**
- **Program to Improve Care in Acute Renal Disease (PICARD) : an increased risk of death at 60 days for those begun on dialysis at the high BUN level (BUN < 76 vs. > 76 mg/dL) RR 1.97, 95% CI 1.21 to 3.2).**

Renal Replacement Therapy

- Intermittent hemodialysis
- Continuous AV / VV hemodialysis (CAVHD, CVVHD)

Renal Replacement Therapy

- Intermittent hemodialysis
- Continuous AV / VV hemodialysis (CAVHD, CVVHD)
- Peritoneal dialysis



Effect of Various Renal Replacement Therapy on Nutrients

Type	Clearance of nutrients				
	Urea (mL/min)	Electrolytes	Protein	AA	Cal.needs
PD	20	++	+	+++	⬆
HD	100-250	++	+	++	⬇
CA/VVHF	5-15	+	++	+	variable
CA/VVHD	20	+	++	+	variable

Renal Repalcement Therapy and Its Impact on Nutritional Support

- Acute peritoneal dialysis
- Continuous peritoneal dialysis
  - loss of protein 5-9 gm/D in dialysate,
  - glucose absorbed from dialysate
- Hemodialysis
  - Loss of amino acids 6-9 gm/dialysis
  - Increase energy expenditure during dialysis
- Continuous hemodiafiltration (VV, AV)
  - Glucose absorbed from dialysate (5.8 gm./Hr for 1.5% glucose 1 L/Hr.)
  - loss of amino acids ~13-24 gm. /D

Renal Replacement Therapy and Vitamins

- Vitamins lost from HD & CVVHD/CAVHD
  - Water soluble vitamins : folic acids, vitamin C, thiamin, pyridoxine
  - Protein-bound vitamins : vitamin A, vitamin B12
- Vitamins not cleared by HD : riboflavin, biotin, niacin, panthotheic acids

Renal Replacement Therapy and Trace Elements

- Trace elements requirement in ARF on renal replacement therapy are not well established
- Apart from excreted by kidney, many trace elements can be losses through GI tract
- Trace elements are protein-bound, but usually are not cleared by HD/CAVHD/ CVVHD
- Aluminium toxicity was reported

Daily Recommendation of Patients with ARF

	ARF (GFR 5-10) non stress	ARF HD 3/wk	CVVH / CVVHD CAVH high stress ARF
Protein/AA (g/kg/d)	0.55-0.6 of mixed AA	1.2 of mixed AA	1.5-2.5 of mixed AA
Energy (kcal/kg/d)	30-45	30-45	30-45
Fat (% of total energy)	20-30	20-30	20-30
	(-- --- --- --- -- if not sepsis -- --- --- --- --)		
Water	--- --- --- --- --- as tolerate --- --- --- --- --- --		

ASPEN Guidelines 2001

Type of formula

- **Standard formulae are adequate for the majority of patients.**
- **In case of electrolyte derangements formulae specific for chronic renal failure can be advantageous**

ESPEN Guideline 2006

Assessment of Adequacy of Nutrition Support

- Energy
- Protein

: Urea Nitrogen Appearance (UNA)

$$UNA\ (gm/D) = UUN + 0.6BW_i\ (BUN_f - BUN_i) + BUN_f\ (BW_f - BW_i)$$

: Total Nitrogen Appearance (TNA)

$$TNA\ (gm/D) = 1.27 + 1.19UNA$$

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Special Methods for Managing Hypercatabolism in ARF

- Growth or anabolic factors
- Immune-enhancing nutrients
- Tyrosine-dipeptides

Conclusions

- Patients with ARF have high mortality rate, hypercatabolism, and high risk of malnutrition
- Nutrition support may have some benefit in spite of lacking evidence
- Nutrition support should be tailor-made to fit each patient’s condition
- Alteration in nutrition support formula in patients received renal replacement therapy depends on type of renal replacement therapy


Thank you for your attention
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