Metabolic Response to Injury

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Mediating the Response

- The Acute Inflammatory Response
  - Cellular activation
  - Inflammatory mediators (TNF, IL1, etc)
  - Paracrine Vs endocrine effects

Mediating the Response

- The Endothelium
  - Selectins, Integrins, and ICAMs
  - Nitric Oxide
  - Tissue Factor

Mediating the Response

- Afferent Nerve Stimulation
  - Sympathetic Nervous System
  - Adrenal Gland Medulla

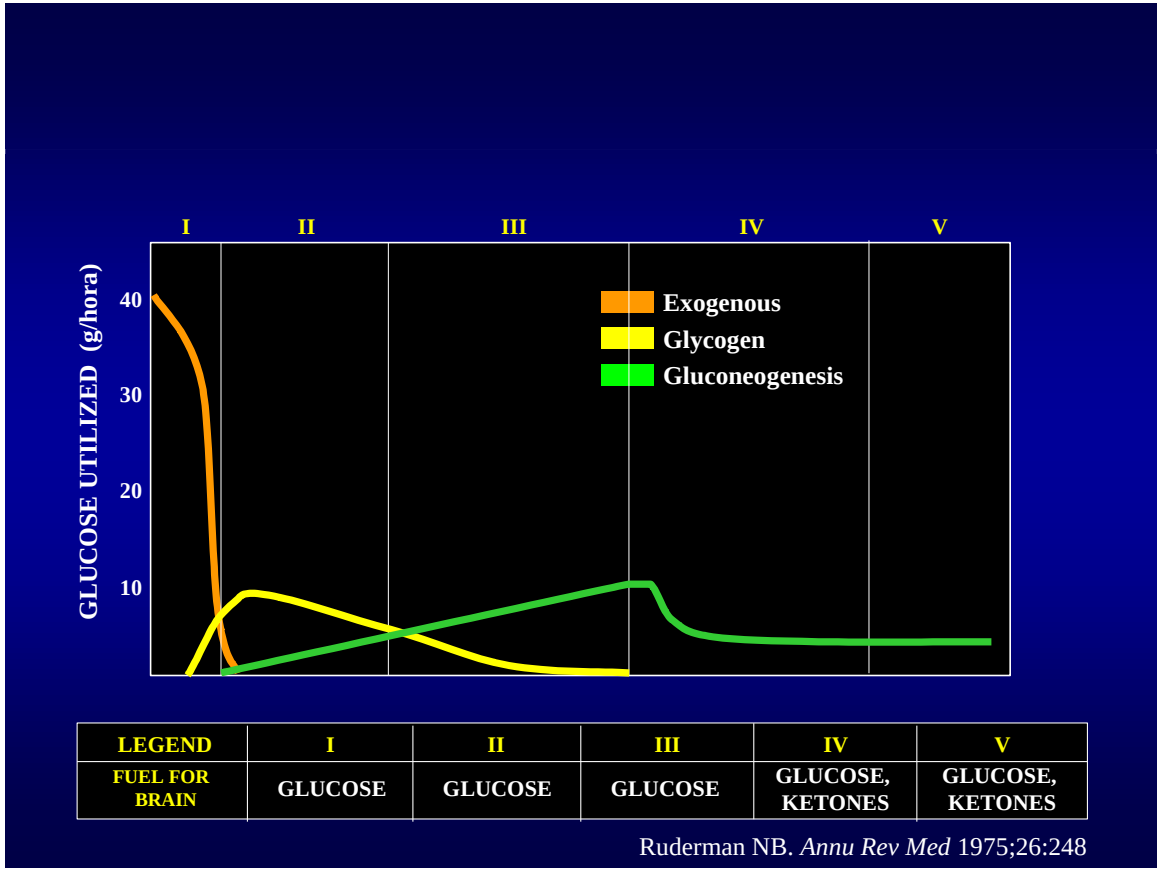
Mediating the Response

- The Endocrine System
  - Pituitary Gland (GH, ACTH, ADP)
  - Adrenal Gland (Cortisol, Aldosterone)
  - Pancreatic (Glucagon, ↓ Insulin)
  - Others (Renin, Angiotensin, ↓ Sex hormones, ↓ T4)

Consequences of the Response

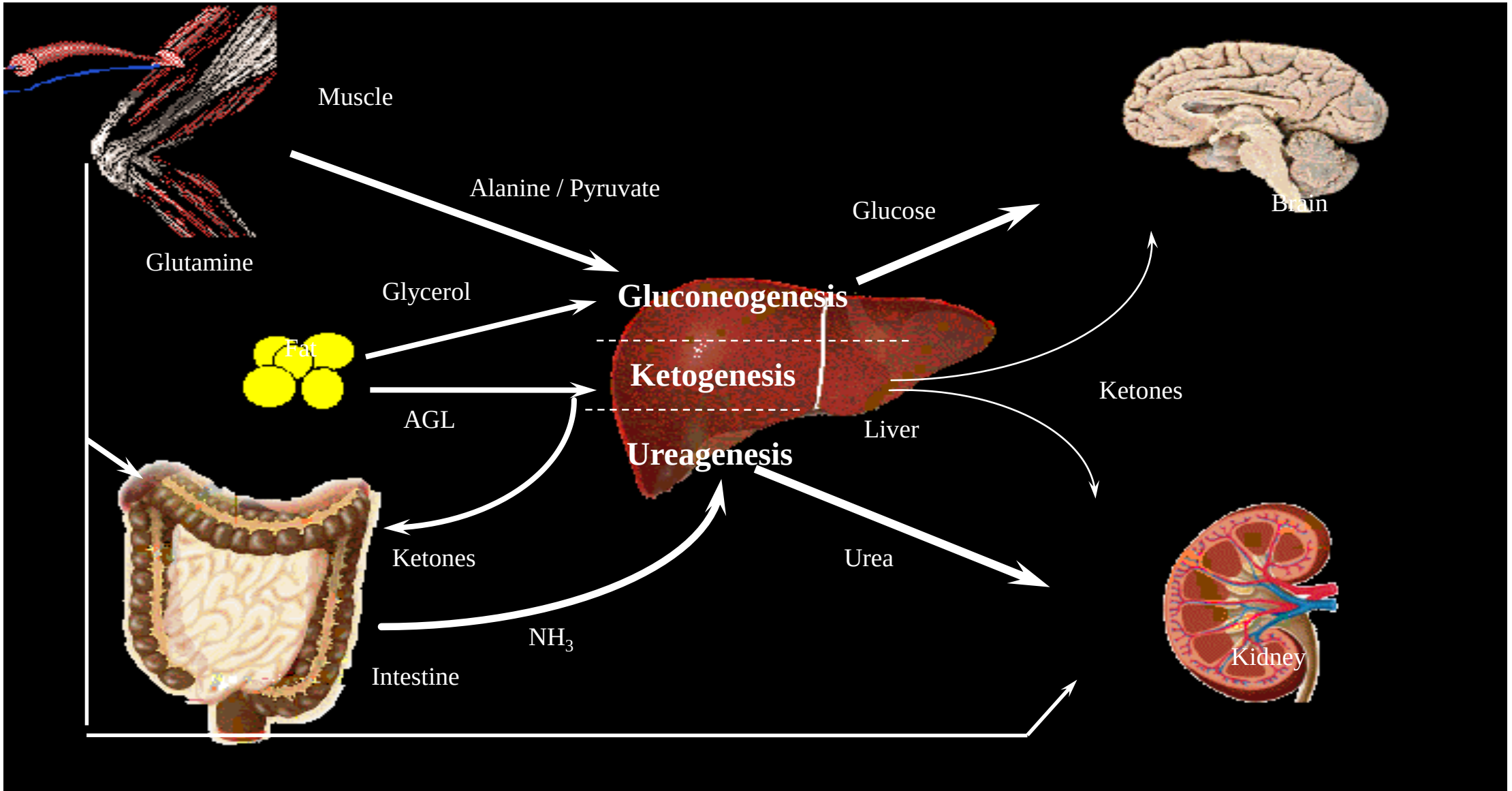
- Limiting injury
- Initiation of repair processes
- Mobilization of substrates
- Prevention of infection
- Distant organ damage

Metabolic Response to Fasting

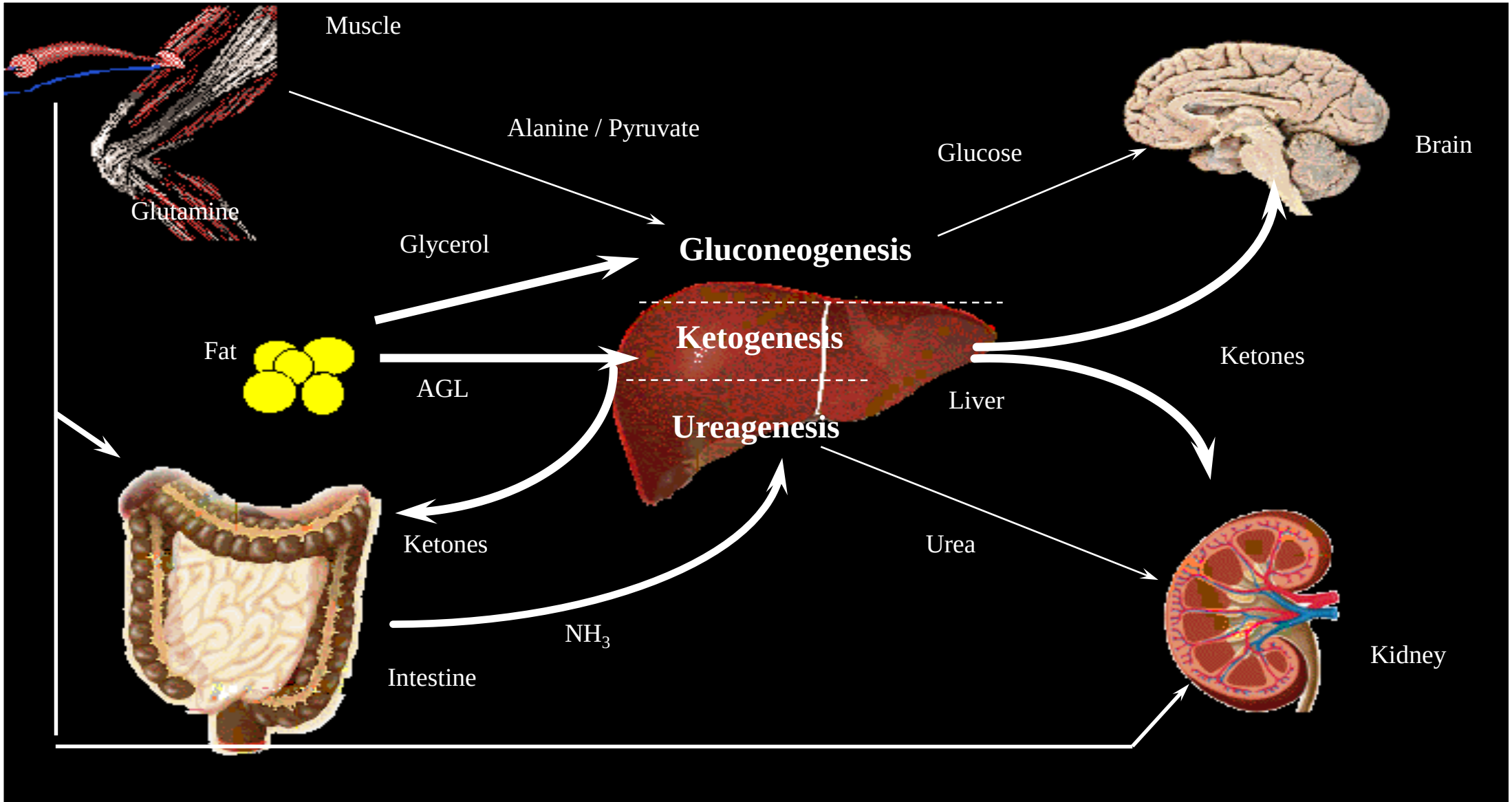


- The carbohydrate deposits of the body last about 18 to 20 hours and new glucose is produced through gluconeogenesis of amino acids from the lean body mass

Starvation – Early Stage



Starvation – Late Stage



Metabolic Response to Starvation

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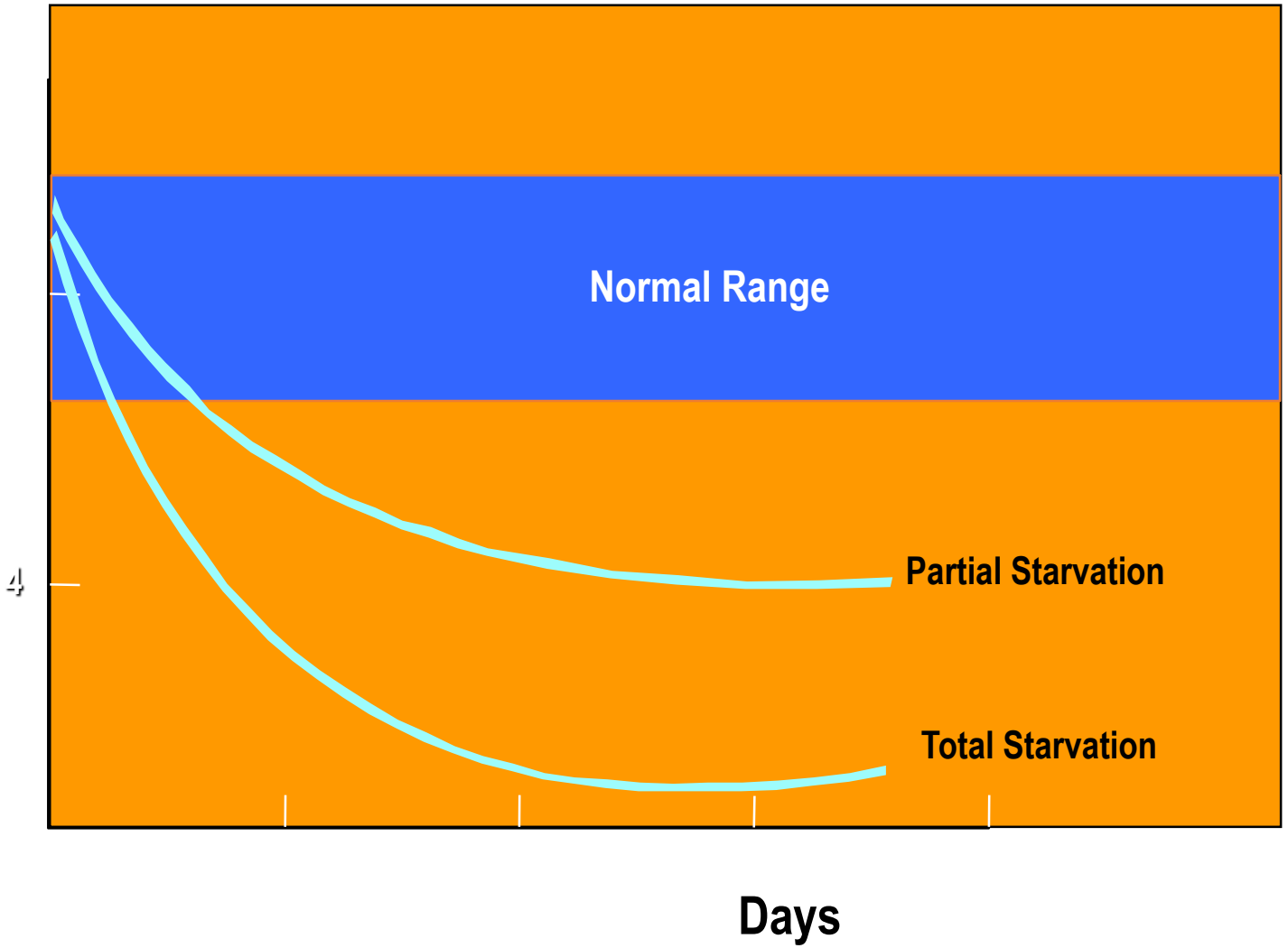
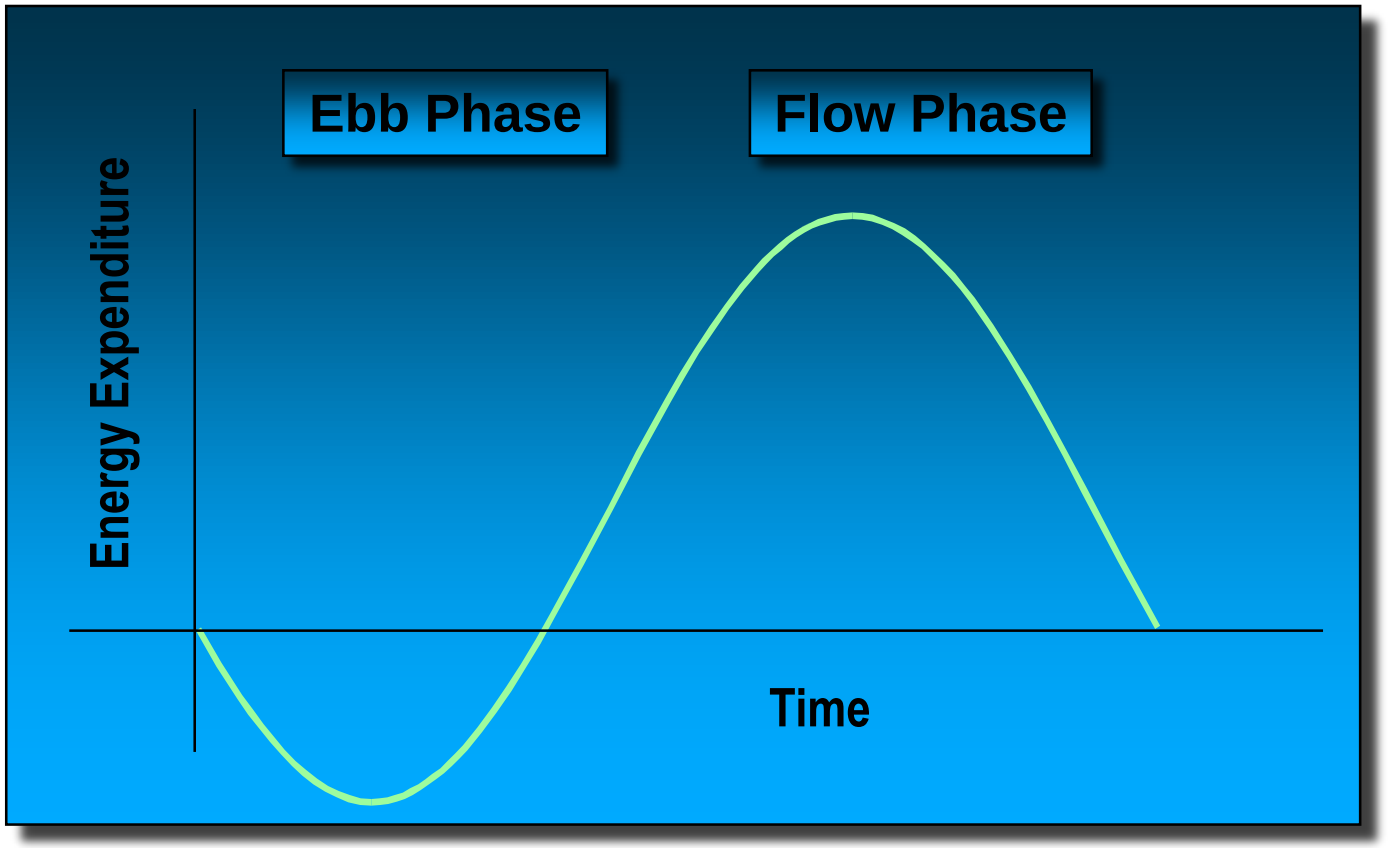
Hormone	Source	Change in Secretion
Norepinephrine	Sympathetic Nervous System	↓↓↓
Norepinephrine	Adrenal Gland	↑
Epinephrine	Adrenal Gland	↑
Thyroid Hormone T4	Thyroid Gland (changes to T3 peripherally)	↓↓↓

Energy Expenditure in Starvation



Long CL et al. *JPEN* 1979;3:452-456

Metabolic Response to Injury

- 

Cutherbertson DP, et al. *Adv Clin Chem* 1969;12:1-55

Metabolic Response to Injury: Ebb Phase

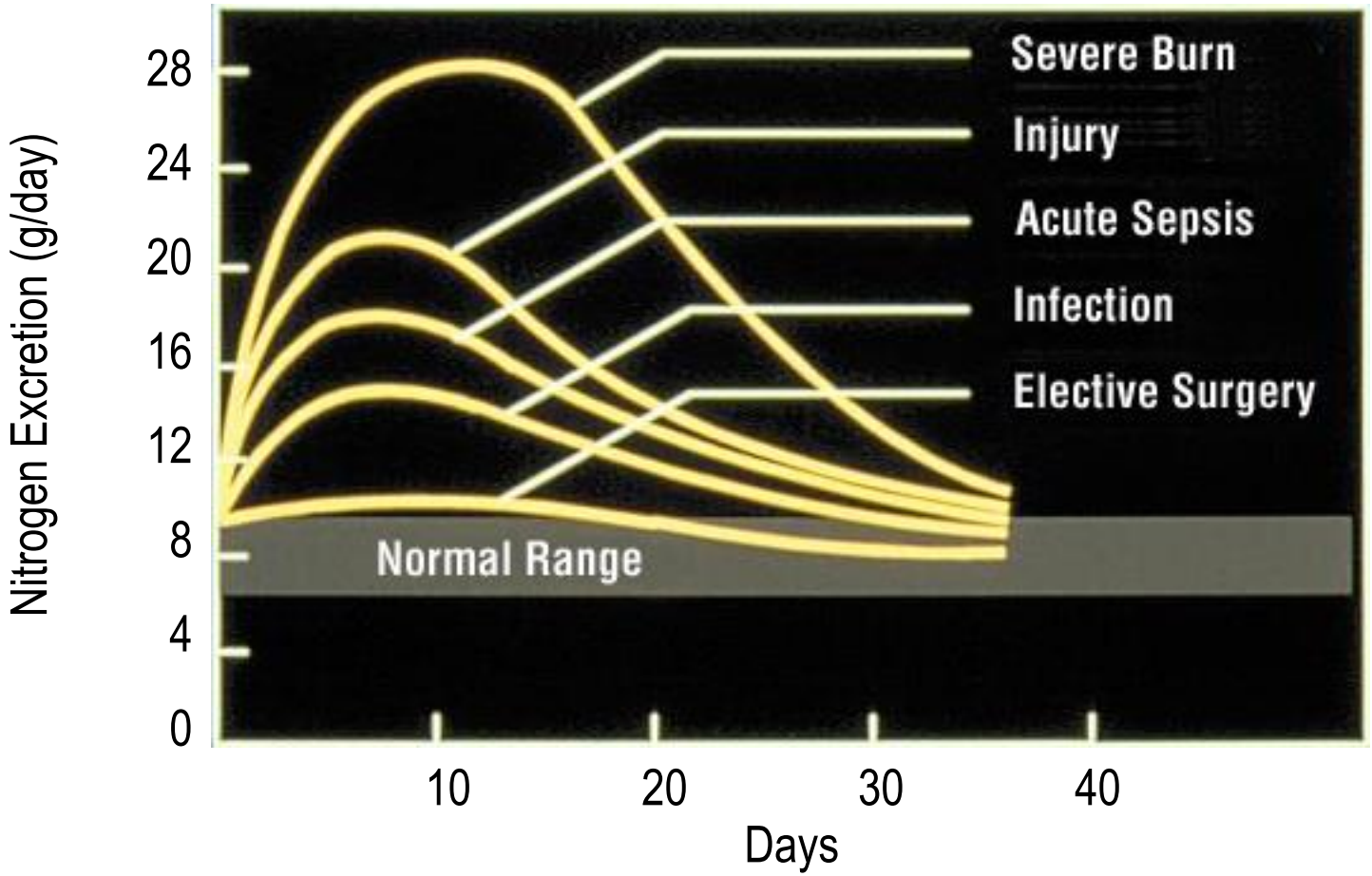
- Characterized by hypovolemic shock
- Priority is to maintain life/homeostasis
- ↓ Cardiac output
- ↓ Oxygen consumption
- ↓ Blood pressure
- ↓ Tissue perfusion
- ↓ Body temperature
- ↓ Metabolic rate

Metabolic Response to Injury: Flow Phase

- ↑ Catecholamines
- ↑ Glucocorticoids
- ↑ Glucagon
- Release of cytokines, lipid mediators
- Acute phase protein production

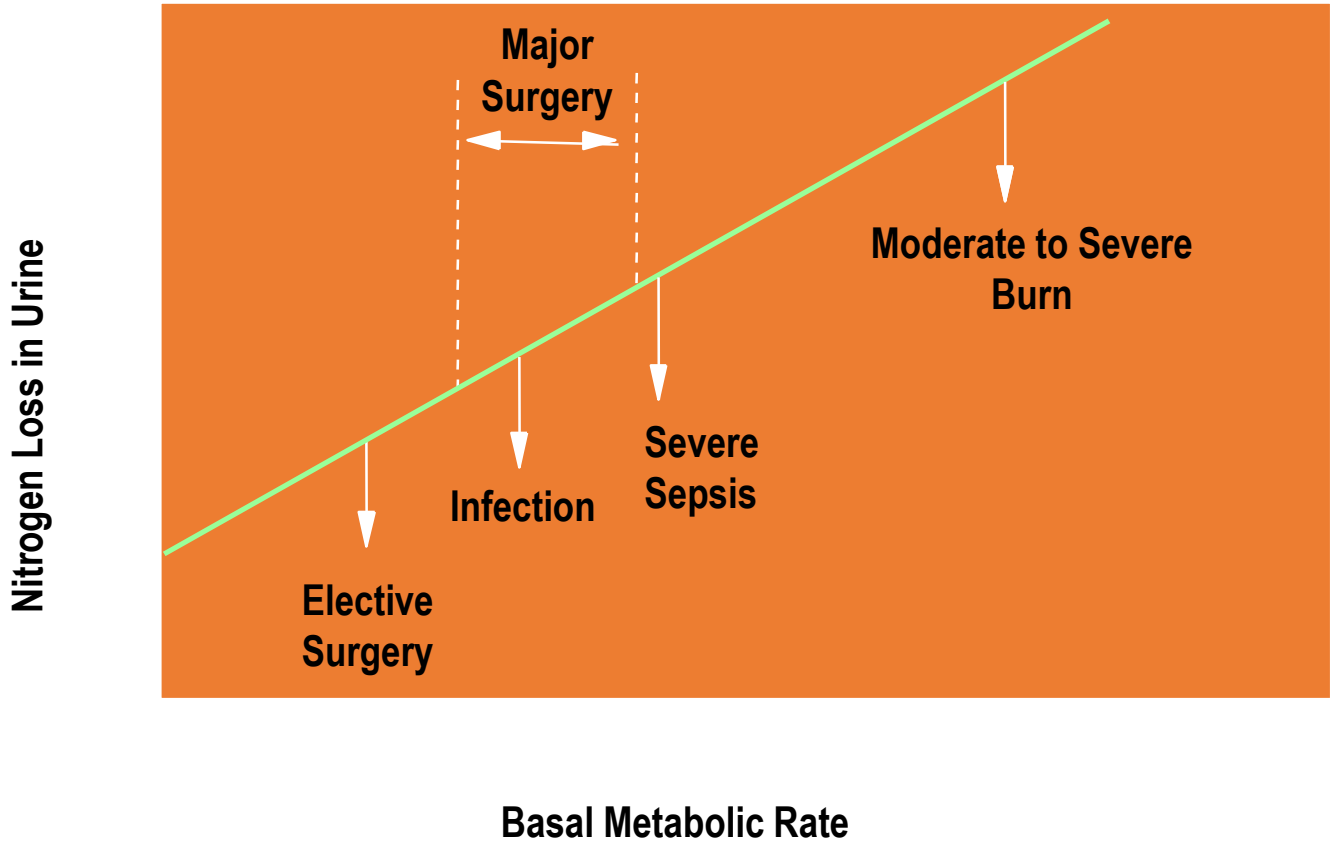
Metabolic Response to Injury

Metabolic Response to Injury

- 

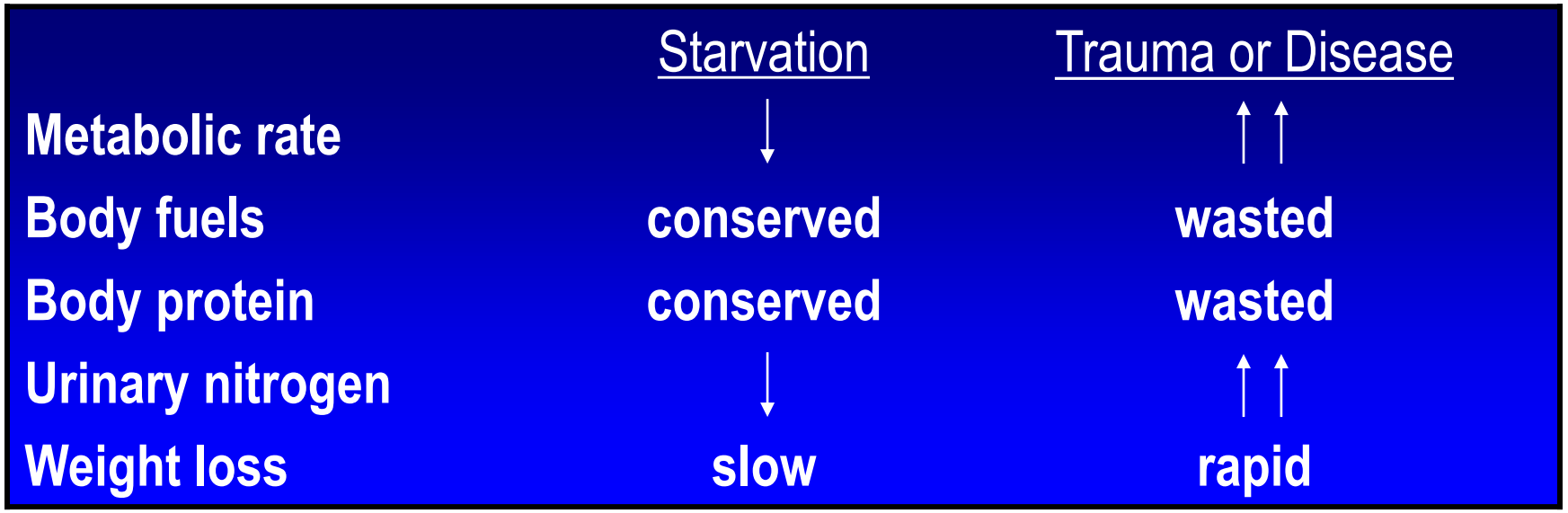
Long CL, et al. *JPEN* 1979;3:452-456

Severity of Injury: Effects on Nitrogen Losses and Metabolic Rate

- 

Adapted from Long CL, et al. JPEN 1979;3:452-456

Comparing Starvation and Injury

- 

The body adapts to starvation, but not in the presence of critical injury or disease.

Popp MB, et al. In: Fischer JF, ed. *Surgical Nutrition*. 1983.

Modifying the Response

- Medication (before or after injury)
- Nutritional status
- Severity of injury
- Temperature
- Anesthetic technique

Summary

- Injury (Trauma or Surgery) leads to a metabolic response
- Metabolic response to injury is an adaptive response
- Metabolic response could overwhelm the body and lead to increased morbidity and mortality
- We can modify the metabolic response before and sometimes after injury

Metabolic Response to Injury

Questions