

Body response to Trauma Stress Sepsis, Burns, Surgery

A photograph showing three paramedics in black uniforms attending to a patient lying on a stretcher on a sidewalk. The patient is covered with a blue blanket. In the background, a red fire truck is parked, and a man and a woman are standing and watching. The scene is outdoors with a building and trees visible.

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Trauma

- **Trauma** is the Greek word mean "wound". Although the Greeks used the term only for physical injuries, generally is psychological & emotional response to an event or experience that is deeply distressing or disturbing .. Among them are complex trauma is PTSD (Post Traumatic Stress Disorder)







Why??



- Restore tissue function & maintain organ perfusion (Homeostasis)
- Eradicate invading Microorganisms.

Response Components



- *Physiological Consequences*
- *Metabolic Manifestations*
- *Clinical Manifestations*
- *Laboratory Changes*

Response Components

PHYSIOLOGICAL

- ↑ *Cardiac Output*
- ↑ *Ventilation*
- ↑ *Membrane Transport*
- *Weight loss*
- *Wound Healing*

METABOLIC

- *Hypermetabolism*
- *Accelerated Gluconeogenesis*
- *Enhanced Protein breakdown*
- *Increased Fat oxidation*

Response Components

CLINICAL

- *Fever*
- *Tachycardia*
- *Tachypnoea*
- *Presence of wound or Inflammation*
- *Anorexia*

LABORATORY

- *Leucocytosis/Leucopenia*
- *Hyperglycemia*
- *Elevated CRP/Altered acute phase reactants*
- *Hepatic/Renal dysfunction*

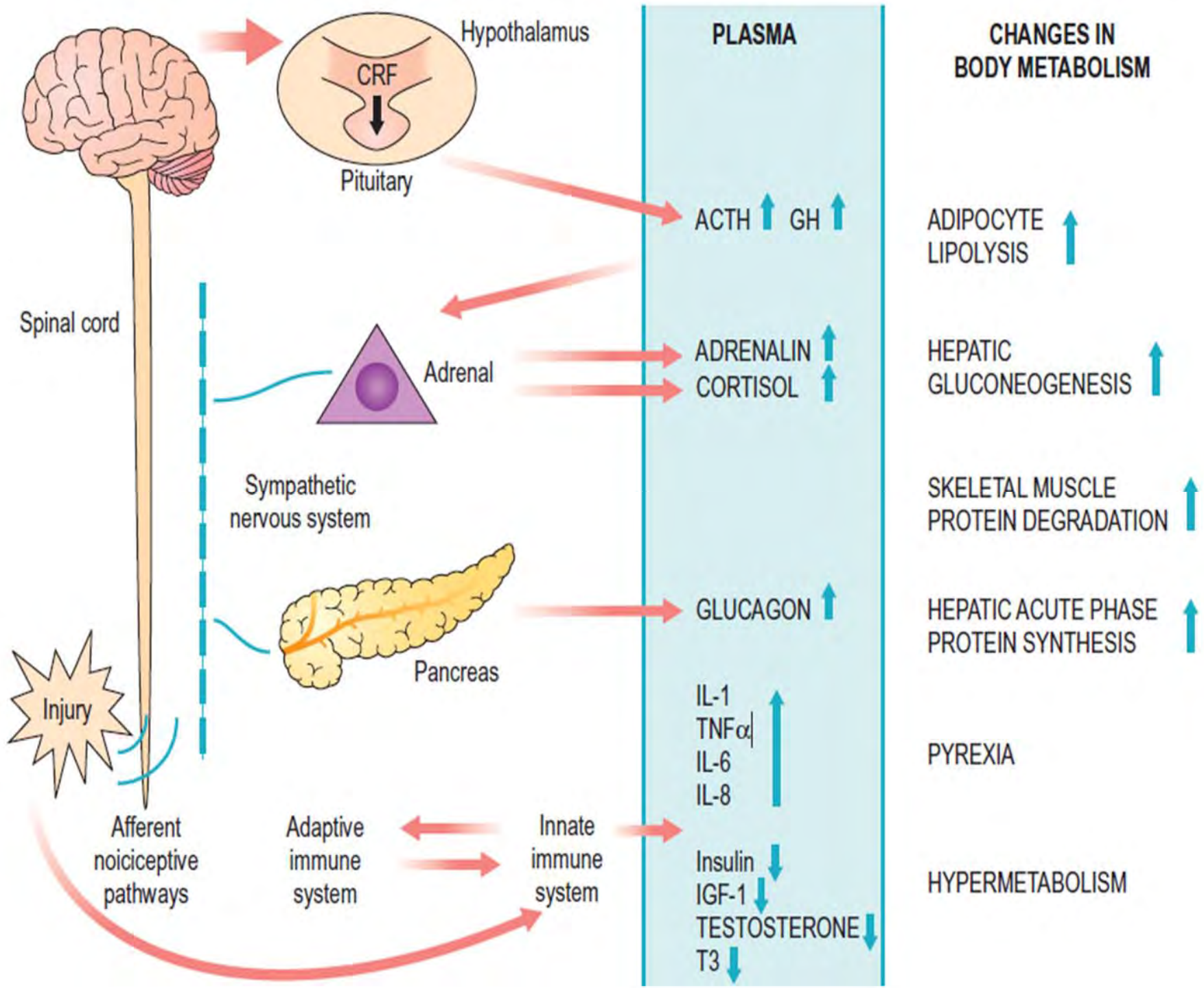
Mediators of Injury Response

- *Neuro – Endocrine [Hormonal]*
- *Immune System [Cytokines]*

Neuro-endocrine response to injury/critical illness

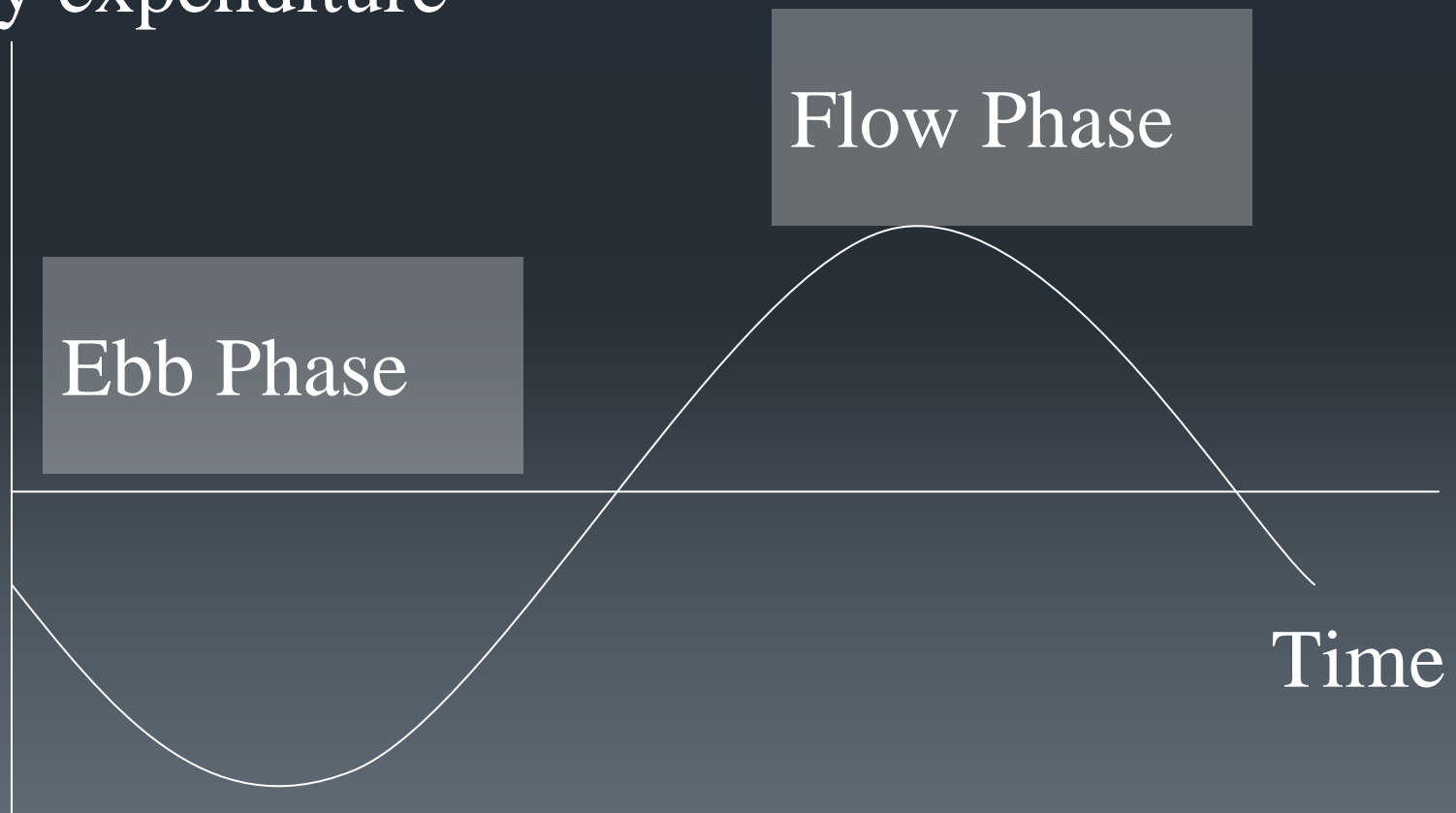
Biphasic :

- ***Acute phase*** - *An actively secreting pituitary & elevated counter regulatory hormones (cortisol, glucagon, adrenaline). Changes are thought to be beneficial for short-term survival.*
- ***Chronic phase*** - *Hypothalamic suppression & low serum levels of the respective target organ hormones. Changes contribute chronic wasting.*



- Metabolic response during stress:
 - Metabolic response to stress (tissue injury, infection) is divided into the *ebb* and *flow* phase

Energy expenditure



Phases – Physiological response [David Cuthbertson – 1930]

Injury



EBB

FLOW

RECOVERY

Hours

Days

Weeks



SHOCK



**CATABO
LISM**

BREAKING DOWN
ENERGY STORES




**ANABO
LISM**

BUILDING UP
USED ENERGY

Ebb and Flow Phases

| Phase | Duration | Role | Physiological | Hormones |
|-----------|--------------|--|--|--|
| Ebb | 24 - 48 hrs | Conserve - blood volume & energy reserves - Repair | ↓ BMR, ↓ temp, ↓ CO, hypovolaemia, lactic acidosis | Catecholamines, Cortisol, aldosterone |
| Flow | | | | |
| Catabolic | 3 – 10 days | Mobilisation of energy stores – Recovery & Repair | ↑ BMR, ↑ Temp, ↑ O ₂ consump, ↑ CO | Cytokines + ↑ Insulin, Glucagon, Cortisol, Catechol but insulin resistance |
| Anabolic | 10 – 60 days | Replacement of lost tissue | +ve Nitrogen balance | Growth hormone, IGF |

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- In the **ebb phase**, the body 'shuts down' and the metabolic rate decreases
 - Leads to hypovolemic shock:
 - ↓ Blood pressure
 - ↓ Cardiac output
 - ↓ Body temperature
 - ↓ tissue perfusion
 - ↓ O₂ consumption
 - ↓ metabolic rate
 - Body's protective response (eg to blood loss)

- However, once the blood pressure is stabilized, the **flow (recovery) phase** begins

- Divided into 2 response:

- Acute Response:

- catabolism predominates
- ↑ glucocorticoids
- ↑ glucagon
- ↑ catecholamines
- Release cytokines, lipid mediators
- Acute phase protein (CRP)
- ↑ N₂ excretion
- ↑ metabolic rate
- ↑ O₂ consumptions
- Impaired fuel utilization

- Adaptive Response:

- Anabolism predominates
- Hormonal response gradually diminished
- ↓ hypermetabolic rate
- Assoc with recovery
- Restore body protein
- Wound healing

Key catabolic elements of flow phase

- *Hypermetabolism*
- *Alterations in skeletal muscle protein*
- *Alterations in Liver protein*
- *Insulin resistance*

1. Hypermetabolism

- *Majority of trauma pts - energy expenditure appr. 15-25% > predicted healthy resting values.*
- *Factors which increases this metabolism :*
 - * *Central thermodyregulation*
 - * *Increased sympathetic activity*
 - * *Increased protein turnover*
 - * *Wound circulation abnormalities*

2. Skeletal muscle – Metabolism

- *1. Muscle wasting – result of \uparrow muscle protein degradation + \downarrow muscle protein synthesis. Cardiac muscle is spared.*
- *2. Lead - Increased fatigue, reduced functional ability, & \uparrow risk of morbidity & mortality.*

3. Hepatic acute phase response

- Cytokines – IL- 6 \longrightarrow \uparrow Synthesis of Positive acute phase proteins : Fibrinogen & CRP
- Negative acute reactants : Albumin decreases

4. Insulin resistance

- *Hyperglycaemia is seen – \uparrow glucose production + \downarrow glucose uptake – peripheral tissues. (transient induction of insulin resistance seen)*
- *Due – Cytokines & decreased responsiveness of insulin- regulated glucose transporter proteins.*
- *The degree of insulin resistance is ∞ to magnitude of the injurious process.*

Factors - ↑ severity of injury (2H,2S,IP)

- *Hypothermia*
- *Pain*
- *Starvation*
- *Immobilisation*
- *Sepsis*
- *Hypotension*

Avoidable factors that compound the response to injury

- *Continuing haemorrhage*
- *Hypothermia*
- *Tissue oedema*
- *Tissue underperfusion*
- *Starvation*
- *Immobility*

Avoidable Factors

- **Volume loss** : Careful limitation of intra operative administration of colloids and crystalloids so that there is no net weight gain.
- **Hypothermia** : maintaining normothermia by an upper body forced air heating cover ↓ wound infection, cardiac complications and bleeding and transfusion requirements.

Avoidable Factors

- **Starvation** : *During starvation, the body is faced with an obligate need to generate glucose to sustain cerebral energy metabolism(100g of glucose per day).*
- *Provision of at least 2L of IV 5% dextrose for fasting patients provides glucose as above.*

Avoidable Factors

- **Tissue oedema** : is mediated by the variety of mediators involved in the systemic inflammation. Careful administration of anti-mediators & reduce fluid overload during resuscitation reduces this condition.
- **Immobility** : Has been recognized as a potent stimulus for inducing muscle wasting. Early mobilization is an essential measure to avoid muscle wasting.

- Diagnosis of Systemic Inflammatory Response Syndrome (SIRS):
 - Site of infection established and at least two of the following are present:
 - Body temperature $>38^{\circ}\text{C}$ or $<36^{\circ}\text{C}$
 - Heart rate >90 beats/minute
 - Respiratory rate >20 breaths/min (tachypnea)
 - $\text{PaCO}_2 <32$ mm Hg (hyperventilation)
 - WBC count $>12,000/\text{mm}^3$ or $<4000/\text{mm}^3$
 - Bandemia: presence of $>10\%$ bands (immature neutrophils) in the absence of chemotherapy-induced neutropenia and leukopenia
 - May be caused by bacterial translocation



THANK YOU

