

Metabolic Response
to
Trauma (Injury)

Lecture 2

Objectives

1. To describe the endocrine response during the metabolic response to injury.
2. To illustrate the biochemical changes during the metabolic response.
3. To study the factors modifying the metabolic response.
4. To illustrate the consequences of prolonged catabolic state.
5. To verify changes during the anabolic phase.

Contents

1. Endocrine response during the metabolic response to injury.
2. Biochemical changes during the metabolic response.
3. Factors modifying the metabolic response.
4. Consequences of prolonged catabolic state.
5. Changes during the anabolic phase.

Endocrine Response

The endocrine response (an **increased catecholamines, glucocorticoids and glucagon**) causes the release of tissue energy reserves, including:

1. Fatty acids and glycerol from adipose tissues.
2. Glucose from hepatic and muscle glycogen. However, glycogen in the muscle can only provide glucose for the muscle).
3. Amino acids from muscles serving as substrates for gluconeogenesis.

Endocrine Response

1. Glucocorticoids:

Glucocorticoids (cortisol) enhances gluconeogenesis, and also the release of amino acids from skeletal muscles.

2. Catecholamines:

Catecholamines stimulate hepatic glycogenolysis, gluconeogenesis, lipolysis and fatty acid mobilization.

Endocrine Response

3. Insulin

A: During the ebb phase:

Immediately following trauma, the sympathetic discharge causing an inhibition of insulin release.

However, Insulin level gradually increases within days and reaches a maximal level up to 3 folds of the pre-injury level.

B: During the flow phase:

There is hyperinsulinaemia , however, there is insulin resistance (high insulin levels fail to suppress glucose production). Glucocorticoids has been thought to be involved in the development of insulin resistance.

Endocrine Response

4. Mineralocorticoids

Aldosterone causes sodium retention by the distal convoluted tubules of the kidneys and increase in BP

5. Antidiuretic hormone (ADH)

ADH stimulates water reabsorption by the distal renal tubules and collecting ducts of the kidneys.

Biochemical changes

Carbohydrate metabolism:

1. Increased glycogenolysis.
2. Increased gluconeogenesis in the liver.
3. Hyperglycaemia.
4. Insulin resistance.

Plasma glucose levels subsequently decreases during flow phase.

Biochemical changes

Protein metabolism:

1. Increased skeletal muscle breakdown
2. Utilization of amino acids in the liver for gluconeogenesis and the production of acute-phase proteins.
3. Negative protein balance

Biochemical changes

Fat metabolism:

1. Increased lipolysis.
2. Free fatty acids are used as the main energy source for body tissues except the brain.
3. Increased production of ketone bodies in the liver.
4. Utilization of glycerol for hepatic gluconeogenesis

Factors modifying the metabolic response to trauma

1. Site of injury.
2. Nature of injury.
3. Severity of injury.
4. Rapidity and adequacy of resuscitation.
5. The presence of co-existing infection.
6. The presence of systemic diseases.
7. Malnutrition.
8. Exposure to anesthetic agents.
9. Drug administration.

Complications of a prolonged catabolic state

A prolonged catabolic state with excessive breakdown of muscle protein and profound weight loss results in:

1. Cardiovascular compromise.
2. Respiratory insufficiency.
3. Defective immune mechanisms.
4. Impairment of tissue regeneration and wound healing.

Turning phase

This occurs in an adequately resuscitated and haemodynamically stable patient , and lasts for:
1-2 days or more.

It is characterized by:

- 1.** Reduction of the inflammatory response
- 2.** Inhibition of the neuroendocrine response

Turning phase

However, in an inadequately resuscitated patient, the catabolic phase persists, thus hindering or slowing the turning phase which points the commencement of the anabolic phase.

The anabolic phase

- ❑ Occurs following cessation of the catabolic phase and the inflammatory response, and the reduction of the release of inflammatory mediators.
- ❑ During this phase, body weight is regained, and the muscle mass and fat stores are restored.

The anabolic phase

The anabolic phase requires suitable and effective oral or parenteral nutrition.

The anabolic phase is mediated by anabolic hormones including:

- ❖ **Insulin**
- ❖ **Growth hormone**
- ❖ **Testosterone**

The anabolic phase

The anabolic phase usually lasts for **1 – 3 months or longer**.

It is characterized by:

- 1. An increase in muscle mass and strength.**
- 2. Positive nitrogen balance.**
- 3. Replenishment of body fat.**
- 4. Weight gain.**

Thank You