HSE303 Exercise Metabolism

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Exercise Metabolism Exam Revision

Topic 2 – Carbohydrate Metabolism During Exercise

1. Understand and apply the processes involved in carbohydrate metabolism during prolonged exercise Including the regulation of:
    a. Muscle Glycogenolysis
    b. Muscle Glucose Uptake
    c. Liver Glucose Output
    d. Pyruvate production during Exercise
2. Understand and apply factors influencing carbohydrate metabolism during exercise including
    a. Exercise Intensity
    b. Exercise Duration
    c. Training Status
    d. Environmental Conditions (Heat)
    e. Nutritional Status (CHO ingestion)

Lecture 1 and 2

Circulating levels at 5mmol (4g) at rest

Gluconeogenesis

- Produce new glucose from pyruvate, lactate amino acids, glycerol

An increase in exercise intensity increases muscle glycogen utilisation

- Cause of fatigue

At very intense exercise there is a much heavier increase in glycogen utilisation and glucose uptake from circulation

- Fatigue results from other factors, not just glycogen utilisation

Carbohydrate Metabolism

1. Glycogen breakdown
    a. Occurs in muscle fibre or liver cell
    b. Glycogen is broken down by an enzyme

    Phosphorylase
    - Breaks glycogen to glucose 1-phosphate
    - Hexokinase breaks down glucose 1 to glucose 6-phosphate
        - The increase in glucose 6-phosphates, inhibits hexokinase
            - Reduces glucose uptake into the cell if enough glycogen
    - Can go down glycolytic pathway or converted back to glycogen

Liver has glucose 6-phosphatase enzyme that muscle does not have

- Can convert glucose 6-phosphate to glucose and released into bloodstream
- How liver creates glucose from glycogenolysis

When glucose 6-phosphate is in muscle cell it is trapped, must be used or turned back to glycogen

Phosphorylase

1. Enzyme that breaks down glycogen to glucose 1-phosphate
2. Exists in two forms
    1. **A** active form and **B** less active form
    2. In resting conditions phosphorylase is in its **B** less active form
3. Three ways to regulate phosphorylase activity
    1. Allosteric Regulation
        i. Turning less active **B** form into more active **A** form
        ii. In times of energy demand
        iii. Increase in ADP, AMP, IMP, Pi

        Allosteric Regulation for inhibition
        iv. Making **B** form more active
        v. ATP and Glucose 6-phopshate
        vi. Illustrating sufficient environment, no need for phosphorylase
    2. Phosphorylase kinase (calcium)
        i. Phosphorylate phosphokinase
        ii. convert **B** form into **A** form
        iii. calcium directly activates phosphorylase kinase
    3. Phosphorylase kinase (adrenaline)
        i. Through cyclic AMP pathway
        ii. Really only work when calcium is present
        iii. Makes phosphorylase kinase more sensitive to adrenaline impacts

Muscle glycogenolysis in training

- Regulated by allosteric regulators
- The more trained incur less glycogenolysis
- Less phosphorylase
- Less AMP, IMP, Pi therefore less activation of phosphorylase

Muscle glycogenolysis and CHO ingestion

- Blood glucose higher
- Increases exercise duration
- Increases oxidation of glucose
- Has little influence on muscle glycogen levels