



Physiology and athletics

IFAC October 2011



*Providing high performance expertise
to sport and athletes in Scotland*

Aims

- What is physiology?
- Dispelling misconceptions
 - Energy System Interactions
 - Lactate – Good vs. Evil
 - Fatiguing Factors
- How we can help



What is physiology?

How the **body functions**, regulates and responds to stress

- Acutely

- Chronically

Physiology

- **Intricate, coordinated and integrative system**
 - Neural and endocrine systems (brain, nerves, hormones)
 - Skeletal and muscular systems
 - Cardiovascular, pulmonary and gastrointestinal systems
 - **Energy system** - fuel stores (PCr, carbohydrate, fat and protein)

Multiple choice

- 1. When an athlete is a running a 100m sprint, energy will be derived**
 - A. Entirely from phosphocreatine breakdown
 - B. Entirely from glycogen and glucose breakdown
 - C. Entirely from anaerobic sources
 - D. Entirely from aerobic sources
 - E. A combination of anaerobic and aerobic sources

- 2. Towards the end of a 800m race, energy will come from**
 - A. Predominantly creatine phosphate
 - B. Predominantly glycolysis (i.e. anaerobic pathway)
 - C. Predominantly aerobic sources
 - D. A 50:50 split between anaerobic and aerobic sources

Energy system

ATP-PCr pathway

- ATP & PCr. Limited fuel supply
- Immediate energy supply

Glycolysis

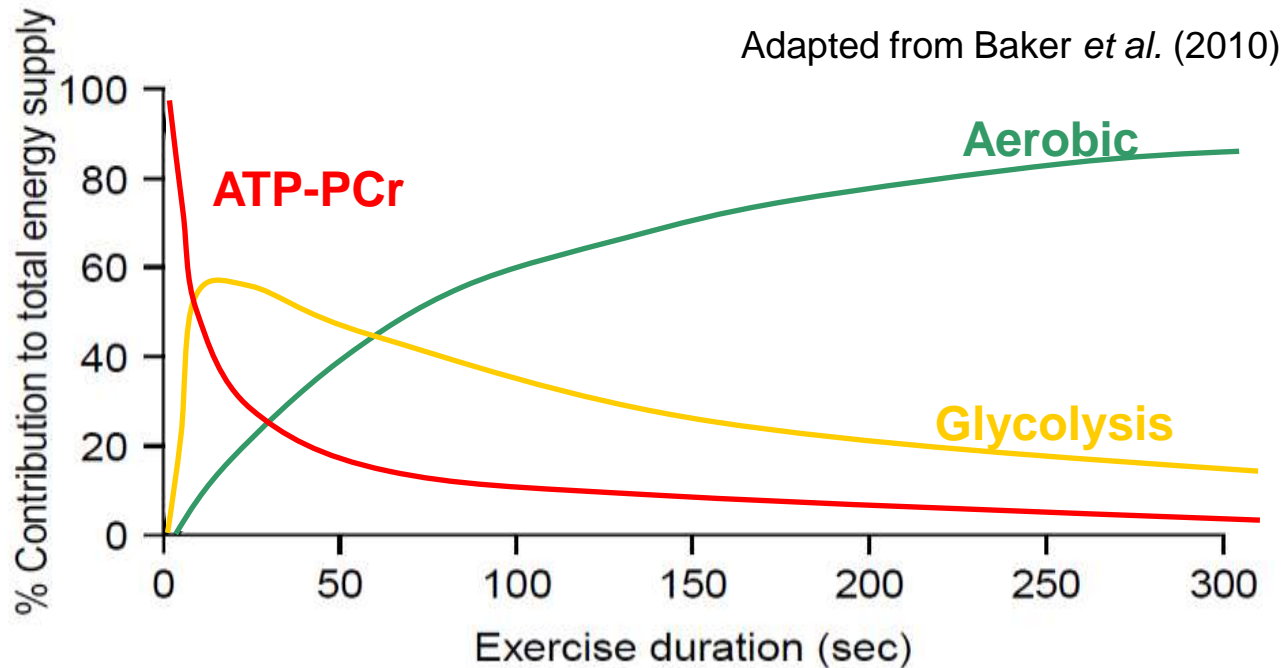
- Glucose, glycogen. Limited fuel supply.
- Short term high intensity energy supply

Aerobic pathways

- Carbohydrate, fats
- Long term moderate to low intensity energy supply



Energy continuum



- Event specific
- Dependent upon training status, repetition number, W:R

Energy system in action

- Training based on event requirements (e.g. sprinters versus long-distance specialists)
- Consideration of training outcome
 - Cardiovascular
 - Cardiorespiratory
 - Neural
 - Muscular/metabolic *

Multiple choice questions 3 and 4

3. Lactate is produced in muscles when

- A. The muscle has enough oxygen
- B. There is a shortage of oxygen to the muscle
- C. There is no oxygen in the muscle
- D. All of the above
- E. None of the above

4. Lactate produced during exercise

- A. Is an important energy source
- B. Is a 'dead-end' waste product
- C. Is a 'dead-end' waste product which causes fatigue
- D. All of the above
- E. None of the above

Lactate – Good vs. Evil

“swimming in a sea of lactic acid!” (Ron Pickering)

- Waste product?
- Causes muscle pain?
- Causes muscle damage?

Lactate - the goodie

- Where does it come from?
 - By-product of glycolysis
 - Breakdown of glucose and glycogen
 - La production occurs even at rest!
 - La accumulation occurs when rate of production exceeds the rate of disappearance

Lactate - the goodie

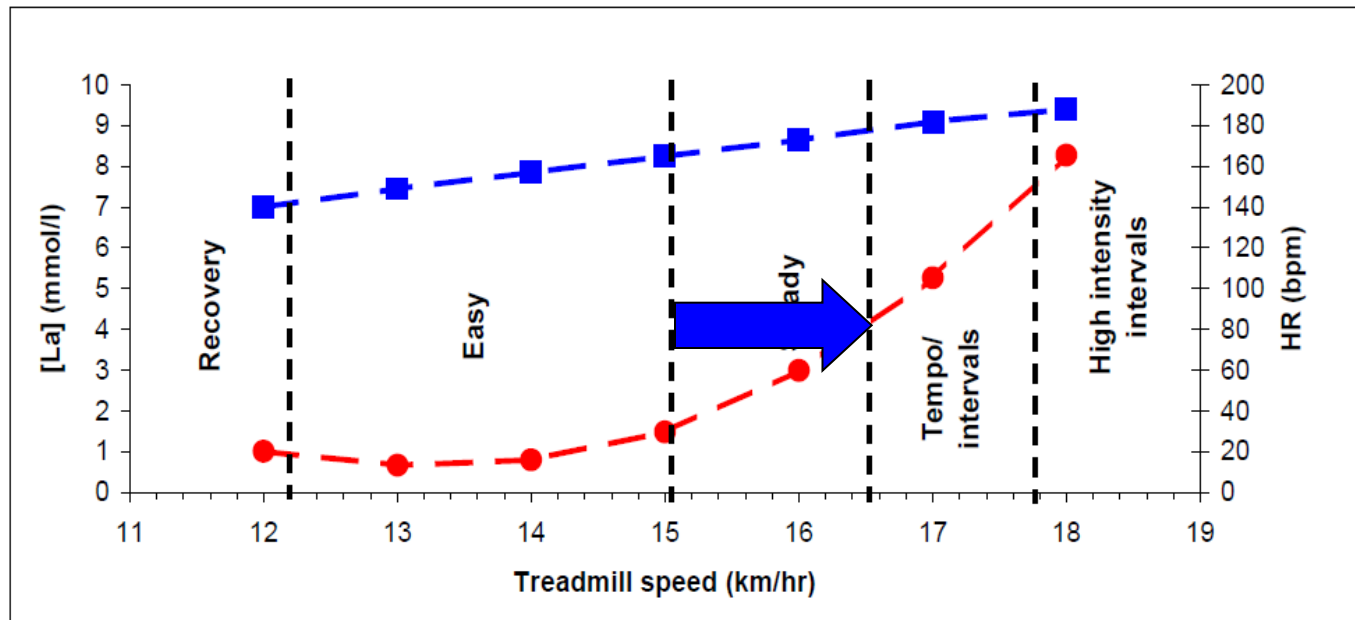
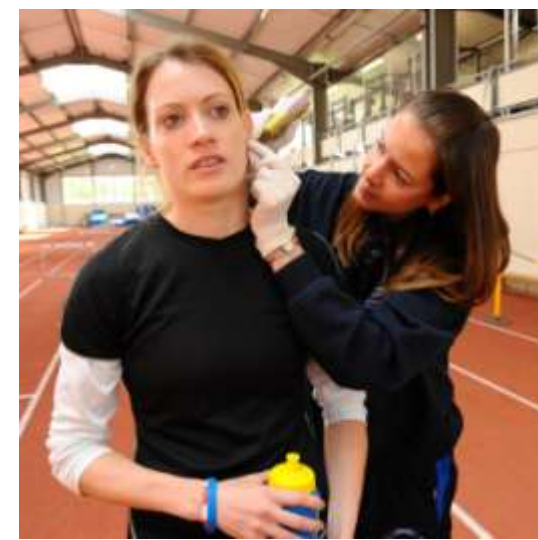
- What does it do?

“In fact, lactate may be one of the most important energy fuels in the body. Let us banish once and for all the bad publicity that lactic acid has attracted for so long and elevate it to its rightful place as one of the most important of the body’s fuels”. (Prof. Tim Knoakes)

- Used as an energy source
- Used to re-form glucose and glycogen
- Consumes H⁺
- Allows glycolysis to continue

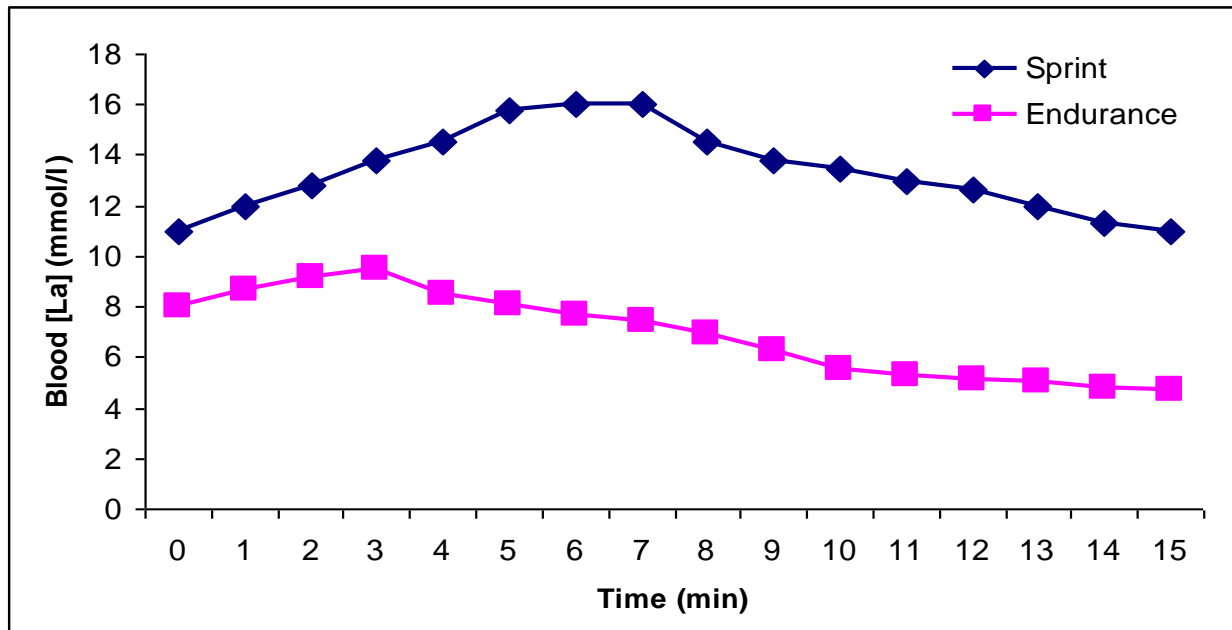
Why do we use lactate?

- Assessment and monitoring tool
- Increases with increasing intensity of exercise
- Measure of aerobic capacity



Why do we use lactate?

- Assessment and monitoring tool
- Crude measure of anaerobic capacity
- Recovery kinetics



Multiple choice question 5

- 5. When doing high-intensity exercise, which one of the following will NOT cause fatigue?**
- A.** A build up of lactic acid within the muscle
 - B.** A build up of metabolites within the muscle
 - C.** A lack of glycogen within the muscle
 - D.** A lack of oxygen

What causes fatigue?

- Fatigue is the inability to maintain power output and therefore a decline in performance occurs
- Peripheral
 - Accumulation of metabolites (K^+ , P_i , Ca^{2+} , H^+)
 - A shortfall in energy provision (ATP, PCr, glycogen)
- Central?
- Psychological



Coaching Process

Physiotherapy

Medicine

Lifestyle

Nutrition

Physiology

S & C

Biomechanics

Psychology

Solid & supportive foundations