Each ORGAN has specialized metabolic functions

- Vertebrate cells equipped with Enzymes (E)
- E:
  - -catalyze metabolic pathways
  - -yield energy (ATP)
  - -replace glycogen & lipid stores
  - -maintain protein & nucleic acids

- Cell basic "basic housekeeping" metabolism
- Organs perform & use ATP <u>differently</u>

Skeletal Muscles

1. Accounts for
   - 50% O_2 consumption during rest
   - 90% during active muscle work

2. Specialized metabolism - Generate ATP for contraction/relaxation

3. Adapted to do mechanical work on demand

FUEL USED BY SKELETAL MUSCLES

- Can use glucose, glycogen, FFA, or ketone bodies (KB)
- Type of fuel used depend on the degree of activity

Resting muscles

- FFA & KB - basic fuels
- FFA & KB – carried from liver via blood
- Oxidized to acetyl-CoA
- Acetyl-CoA enters CAC – oxidize to give CO_2
- ETC – oxidative phosphorylation (ATP produced)

Moderately active muscles

- Fuel – FFA, KB, glucose
- Glucose oxidized (glycolysis, CAC)

Maximally active muscles

- High demand for ATP
- Blood cannot provide O_2 & fuel fast
- Stored muscle glycogen used
- Glycogen converted to lactate (anaerobic glycolysis), give ATP also
- Lactate go to liver via blood & converted to glucose (gluconeogenesis)

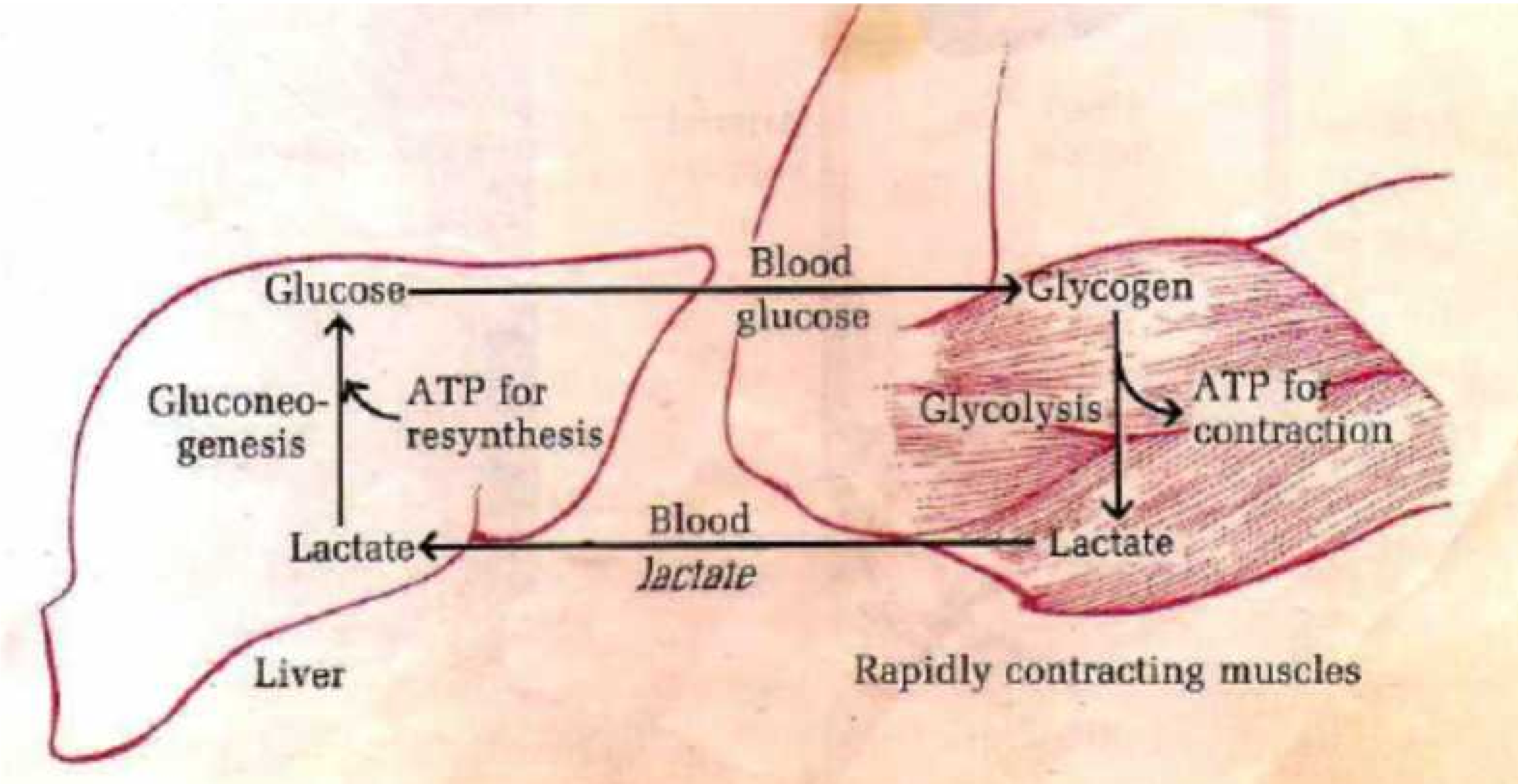

Figure 24-12
Metabolic cooperation between skeletal muscles and the liver. During extremely active muscular work skeletal muscle uses its glycogen as energy source, via glycolysis. During recovery some of the lactate formed in the muscles is transported to the liver and rebuilt to form blood glucose, which returns to the muscles to replenish their glycogen stores.

Role of adrenaline

- Enhance the use of glucose & muscle glycogen as emergency fuel for muscular activity
- Stimulate blood glucose synthesis from glycogen (liver)
- Stimulate glycogen breakdown to lactate (muscles)

Adrenaline or epinephrine: hormone, neurotransmitter, secreted by adrenal glands

Glucose-6-phosphatase

- Skeletal muscle lack this E
- So, skeletal muscle glycogen - provide energy via glycolytic breakdown

Glucose 6-phosphatase: hydrolyzes glucose-6-phosphate, resulting in the creation of a phosphate group and free glucose. This catalysis completes the final step in gluconeogenesis and glycogenolysis and therefore plays a key role in the homeostatic regulation of blood glucose levels

- Skeletal muscles - Limited glycogen storage
- So, limited glycolytic energy available

- Skeletal muscles becomes less efficient due to:

  -lactic acids production

  -low pH

  -rising temp.

Recovery period-fast breathing (athletes) give extra O2

- O_2 oxidize pyruvate, lactate & other fuels to produce ATP & phosphocreatine in muscles
- Extra O_2 in fast breathing restores normal metabolic state
- In restoration, liver & muscles cooperate

Phosphocreatine (PC)

- ✓ Another way to get ATP in emergency
- ✓ Muscles have PC

$$\text{Phosphocreatine} + \text{ADP} \overset{Mg^{2+}}{\rightleftharpoons} \text{creatine} + \text{ATP}$$

- ✓ Give ATP as reaction goes to right during muscle contraction
- ✓ PC resynthesized during recovery period

Muscle contraction (MC)

- Requires ATP
- MC initiated by motor nerve impulse, transmitted to transverse tubules & sarcoplasmic reticulum (SR)
- SR release Ca^{2+}
- Ca^{2+} binds to troponin (a regulatory protein)
- Troponin translates signal into actin filament sliding (using ATP)

Muscle relaxation (MR)

- Ca^{2+} sequestered for MR

- Ca^{2+} Transported back to SR by Ca^{2+}-transporting membrane ATPase

- 2 Ca^{2+} for 1 ATP hydrolyzed

- Same ATP consumption in MC & MR