

# Lecture 28

Saturday, July 17, 2021 10:22

## Muscle Physiology Foundations: Anabolic Cellular Signaling

### mTOR part 1

- What is hypertrophy?
  - o Muscle metabolism: muscles are constantly changing in size; they grow and shrink to meet the demands of their environments -- muscle metabolism is based on protein turnover
  - o Protein turnover: the balance of synthesis and degradation
  - o Hypertrophy: synthesis outpaces degradation
- Why does hypertrophy occur?
  - o Your body's method of adapting your muscles to better equip you for your environment
  - o Compatibility with your environment; all geared towards fitness, survival, self-preservation
  - o Specificity of adaptation
- How does it happen?
  - o Cell signaling cascades [generally, the finish line is typically in the nucleus, thus regulating genetic expression]
  - o Relay race
  - o Baton is the phosphate
    - Phosphorylate a protein and change its behavior
  - o Essentially: translate some proteins and link together a bunch of amino acids --> favors anabolism, synthesis outpaces degradation of the proteins
- mTOR: is a kinase [kinase - an enzyme that catalyzes the transfer of a phosphate group from ATP to a specified molecule]
  - o mTOR activation stimulates and executes specific commands for a cell (i.e. cell signaling cascades)
  - o Activates certain processes while inhibiting others because of its activation of one process (give and take system)
  - o How does resistance training cause hypertrophy -- mainly mTOR

- Insulin binds to its receptor
- Some stuff happens, then PI3K gets activated
- " PKB gets activated
- PKB phosphorylates PDE
- PDE converts cAMP to AMP
- Thus PKA does not get activated
- So HSL and perilipin do not get phosphorylated
- And lipolysis doesn't happen
- Akt/PKB is busy enzyme (Akt is PKB)
  - o PKB major domains: proliferation then growth
- [apoptosis - cell death]
- Cells get busy (has many, many cell receptors)
- mTOR is a complex
  - o Complex 1 is hypertrophy
  - o Complex 2 is cell survival stuff
- Transcription: in the nucleus, the cell's machinery copies the gene sequence into messenger RNA (mRNA), a molecule that is similar to DNA and like DNA, mRNA has four nucleotide bases - but in mRNA, the base uracil (U) replaces thymine (T)
  - o Makes a recipe and send the recipe to the kitchen where proteins can be created, link together amino acids in a very specific order
- Translation: the protein-making machinery, called the ribosome, reads the mRNA sequence and translates it into the amino acid sequence of the protein - the ribosome starts at the sequence AUG then reads 3 nucleotides at a time
  - o Each three-nucleotide codon specifies a particular amino acid; the "stop" codons (UAA, UAG, and UGA) tell the ribosome that the protein is complete
- Checkpoint
  - o What is mTOR? It is a kinase [a phosphorylating enzyme], it a critical regulator of protein turnover (growing or shrinking; hypertrophy or atrophy)
  - o How many mTOR complexes? 2 main complexes
  - o How does mTOR signaling work? Phosphorylation cascade; upstream activator and downstream from complex 1
    - Massive metabolic regulator