

muscle physiology lecture 31

hypertrophic signaling - endocrine system

testosterone - main effect is steroidal / genomic. it binds to androgen receptors in the cytoplasm. once the hormone receptor complex is formed, it transforms and then is translocated to the nucleus. inside the nucleus, the HRC binds to a short sequence of DNA (a hormone response element or an androgen response element) and regulates gene transcription, secondary effects non-genomic

non-genomic steroid actions - those steroid mediated actions in which gene transcription is not directly implicated, involves second messenger participation.

and are rapid in action (within seconds to minutes.) g-protein androgen receptors at the cell membrane activate phospholipase C \rightarrow increase inositol triphosphate levels \rightarrow diffuse to their receptors on the sarcoplasmic reticulum \rightarrow

causes calcium release from the reticula \rightarrow increases intracellular calcium \rightarrow

seems to activate the MAPK cascade. this can be blocked by g-protein inhibitors.

partly through the facilitation of IGF-1 signaling, testosterone regulates

anabolic cell signaling cascades. testosterone signals through mTOR and

androgen receptors to induce muscle hypertrophy. it activates PKB and MAPK.

and inhibits LKB1. estrogen - primary effects are steroidal / genomic, secondary

effects are non-genomic. it may be likely that both testosterone and

estrogen are able to enhance myosin and actin binding processes due to

modulations in calcium mobilisation. estrogen phosphorylates (deactivates)

tuberin. and promotes LKB1 and AMPK. PKB-dependent effect - effect is

abolished with administration of either rapamycin or wortmannin.

mTOR activated by the endocrine system through insulin (PI3K), thyroid

hormone (PI3K), GH/IGF (mostly PI3K, MAPK, JAK-STAT), testosterone (Ca^{2+}

dependent MAPK activation, increased IGF signaling, inhibition of LKB1),

estrogen (inhibition of tuberin, promotion of mTOR, LKB1, and AMPK)

SLC38A9 - transmembrane protein that senses intra-lysosomal arginine

and lives inside the lysosome and stretches into the cytosol.