Physiology Team

430

Musculoskeletal Block

8th lecture

Effects of Training on Muscle Performance

إعداد

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* هذا العمل شامل لجميع نقاط المحاضرة مع بعض الإضافات للتوضيح

Effects of Training on Muscle Performance

هذى النقاط المهمة الي ركز عليها الدكتور طه :

- **تعريف الـــ strength training**
- **الفرق بين الـــ hypertrophy sarcoplasmic reticulam & myofibrillar hypertrophy**
- **تكلم عن انواع الـــ second massenger وقال انها ماهي معكم لانها بايوكمستري وليست فسيو**
- **لو رجل وامرأة عملوا نفس التمرين فان العضلات عند الرجل تنمو اكثر من التي عند المرآة والسبب وجود هرمون التسيستوستيرون عند الرجال**
- **واكد على فوائد التمارين واهمية التغذية في نمو العضلات**

Aerobic versus Anerobic Exercise :

** **Aerobic exercise** is that performed :
(1) at a moderate level of intensity &
(2) over a relatively long period of time.

* For example, running a long distance at a moderate pace is an aerobic exercise (but sprinting is not) , bicycling .

خلاصة هذا الكلام: ان التمارين الهوائية تكون مدة التمرين طويلة من دقيقتين وفوق بالاضافة الى ان الجهد على العضلات يكون متوسط والامثله عليها : الهرولة وركوب الدراجة

** **Anaerobic exercise** is exercise intense enough to trigger anerobic metabolism
* It is used by athletes to promote strength, speed and power and by body builders to build muscle mass.
* Muscles develops differently from the case of aerobic exercise ⟶
* Leading to greater performance in short duration, high intensity activities, which last from mere seconds up to about 2 minutes.
• Any activity after about two minutes will have a large aerobic metabolic component.

قد ياتي سؤال يقول : اي نوع من التمارين التي يستخدمها الرياضيون لبناء اجسامهم ؟

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Benefits of Exercise Training

* When properly performed, strength training can provide significant functional benefits and improvement in overall health and well-being, including :
  - Improves motor skills.
  - Increased bone density & prevention of osteoporosis .
  - Improved joint function .
  - Increased strength of muscles, tendons and ligaments .

* These help to improve posture, provide better support for joints & thereby to reduce the risk of falls & injury during everyday life activities.
* Therefore the potential for injury is reduced .
  - Regular exercise increases metabolism and promotes fat loss .
  - Elevates HDL (good , beneficial) cholesterol.
  - Improves respiratory function .
  - Improves cardiovascular function , & prevents or delays development of atheroscleosis .
  - Prevents or delays development of diabetes .
  - By increasing the levels of dopamine, serotonin and norepinephrine, intense exercise is believed to help improve mood and counter feelings of depression .

* For all the above reasons , properly performed physical exercise is considered beneficial because it produces improvement foroverall health and well-being

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・ Q : What is Strength Training ? مهم

* Strength training :is the use of resistance to muscular contraction to build the strength , anerobic endurance and size of muscle .
* There are many different methods of strength training, the most common being the use of gravity or elastic hydraulic forces to oppose muscle contraction .

فكرتها انك تقاوم انقباض عضلاتك بواسطة اوزان ثقيلة لكي تقويها وتزيد من حجمها .

Muscle Hypertrophy

* Muscle hypertrophyis the increase of the size of musclecells.
* It differs from muscle hyperplasia, which is the formation of new muscle cells.

Types of Hypertrophy :
There are two different types of muscular hypertrophy:

1-sarcoplasmic Hypertrophy : the volume of sarcoplasmicfluidin the muscle cell increases with no accompanying increase in muscular strength.
* Sarcoplasmichypertrophy is characteristic of the muscles of body builders.

هذا النوع بتلقى حجم العضلات كبير ولكن قوة العضلات لا يتناسب مع حجمها و هذا غالبا يكون موجود مع بنائي الاجسام الذين يستخدمون العقاقير

2-myofibrillar Hypertrophy : actinand myosincon increase in number and add to muscular strength, as well as a small increase in the size of the muscle.
* Myofibrillarhypertrophy is characteristic of of the muscles weight lifters

Muscle Hypertrophy & Protein Synthesis

* Progressive overloadis considered the most important principle behind hypertrophy, so increasing the weight, repetitions , and sets will all have a positive impact on growth
* The first measurable effect is an increase in the neural drive stimulating muscle contraction.
* As the muscle continues to receive increased demands, the protein synthetic machinery is upregulated.
* This upregulation appears to begin with the second messenger system (including phospholipases, protein kinase C, tyrosine kinase, and others).

Upregulate = is the process by which a cell increase the quantity of a cellular component ،such as RNA or protein

لا تحفظ اسماء الـــ second messenger بس اعرف انها من اوائل الاشياء التي تزيد استجابة للتمارين

* Repeated exercise increases the number of contractile proteins (actin & myosin filaments) within each muscle fiber.
* When number of contractile proteins increases sufficiently, myofibrils split within each muscle fiber ⟶ to form new myofibrils ⟶inrease in the number of additional myofibrils ⟶hypertrophy.
• Because skeletal muscle cells are unique in being multinucleate , the number of nuclei can also increase.

Factors Affecting Hypertrophy

(1) Age : During puberty , in males particularly ,hypertrophy occurs at an increased rate.
* Natural hypertrophy normally stops at full growth in the late teens.

(2) Exercise :
* strength training , short duration, high intensity anaerobic exercises considerablyincreases hypertrophy .,
* Lower intensity , longer duration aerobic exercise generally does not result in very effective hypertrophy .

(3) Dietary protein : An adequate supply of amino acids is essential to produce muscle hypertrophy.

(4**) Cortisol decreases** amino acid uptake by muscle tissue, and inhibits protein synthesis⟶ prevents hypertrophy . .

(5) Testosteroneis one of the body's major growth hormones ⟶promotes Anabolism ⟶ consequently promotes hypertrophy .
* That is why exercising males can grow bigger muscles more easily and much faster than exercising women
* Therefore , in during sport competition events , testosterone is prohibited , because it is considered a performance-enhancing anabolic drug that interfers with fair & just competition .

Aerobic & Anerobic Training

* Each muscle is composed of combination of 2 types of muscle fibers but one is usually dominant

(1) Fast-Twitch (white) and (2) Slow-Twitch(red, oxidative) fibers .

1) Fast-twitch (white , mostly glycolytic) fibers :

- Have lower capillarity& few mitochondria because oxidative metabolism is of secondary importance
- Are deficient in myoglobin & capable of anerobic metabolism
- Are larger in size for strong & powerful contraction ,
- Have extensive sarcoplasmicreticulum for rapid release of calcium
- Have many glycolytic enzymes for rapid release of energy
- Anaerobic fibers uses its fuel faster than the blood and intracellular restorative cycles can resupply it & the muscle fail (fatigues) fast& more easily than slow-twitch .

(2) Aerobic , Slow-twich (red) fibers :

- are rich in capillaries and myoglobin , which binds oxygen , and gives the muscle as a whole its red color . These fibers rely on aerobic metabolism .
- Have higher capillarity & largenumber of mitochondria to support high level of oxidative metabolism .
- Have smaller fibers & innervated with small nerve fibers
- Fibers are adapted for prolonged muscle activity and do not fatigue quickly

* When the goal of the exercising person is lifting heavier weights ⟶ anaerobic strength training will produces hypertrophy + increased muscle
* When the goal of the exercising person is not merely lifting heavier weights , but another goal such as body shaping ⟶ aerobic exercise , and lower weights can be used , if desired .
* At higher loads, the muscle will recruit all muscle fibres possible, both anaerobic ("fast-twitch") and aerobic ("slow-twitch"), in order to generate the most force.
* However, at maximum load, the anaerobic fibers contract so forcefully that the aerobic fibers are completely shut out, and all work is done by the anaerobic processes.
* In the aerobic regime, the blood and intracellular processes can maintain a supply of fuel and oxygen, and continual repetition of the motion will not cause the muscle to fail (fatigue) easily

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Nutrition & Training

* Muscular training must be matched by good diet
* Adequate proteinis ⟶ for building skeletal muscle .
* High-protein diet does not impair kidney function , unless the person has pre-existing kidney diseases . An adequate supply of carbohydrates (5- 7g per kg) is also needed as a source of energy and for the body to restore glycogen levels in muscles.
* Wateris consumed throughout the course of the workout to prevent poor performance due to dehydration