Mitochondria and its functions

Science, Biology

If muscle biopsies (sample of tissue) were taken from the legs of a world marathon runner and a typical couch potato which would you expect to have a higher density of mitochondria Why

The mitochondria (singular form is mitochondrion) are the principal energy source of the cell. Aside from doing other specialized tasks, mitochondria convert nutrients into energy. They are normal structures responsible for energy production in cells. They are located in the cytoplasm outside the nucleus of the cell. Consisting of two sets of membranes, one a smooth continuous outer coat and the other an inner membrane arranged in tubules or in folds, these two sets form plate-like double membranes. Mitochondrial chromosomes are inherited from our mothers (" Definition of Mitochondria, n. d.").

Although minutely small, mitochondria are of major importance to athletic activities because the increase in their density is associated with enhanced performance capacity (" Mitochondria Functions" n. d. para. 1).

To answer the question on which between a world-class runner and a typical couch potato would have a much higher density of mitochondria from their sample muscle biopsies, it would definitely be the world-class runner because mitochondria is concomitant with exercise and physical activity. Furthermore, mitochondria are the only places inside the muscles where carbohydrate, fat and protein can be broken down in the presence of oxygen to create energy needed for exercising. As a consequence, the more mitochondria an individual has, the more energy that individual can generate during exercise resulting in faster and longer time doing running, swimming and other physical activities (" Mitochondria Functions" n. d. para. 2).

Several studies have been done to document or otherwise prove that increased exercise generates higher density of mitochondria. There are differences from these findings as to what type of physical activity generates more mitochondria such as intensity, faster but shorter duration or longer but slower duration.

How would the density of mitochondria in a muscle biopsy from the biceps of a weightlifter compare with those of the runner and the couch potato

There are three types of human muscles: the cardiac, smooth and skeletal. The skeletal muscle is further classified into three types, which are the Type I, Type IIA and Type IIB fibers. Type IIB Fibers are white and geared to generate ATP or Adenosine triphosphate-an important carrier of energy in cells in the body-that is not able to supply skeletal muscle fibers continuously with sufficient ATP and have a fast concentration velocity. Type IIB fibers are found abundantly in the muscles of the arms (" Muscle", n. d.). In one of the studies dealing with mitochondria, researchers were able to differentiate its effects depending on the type of muscle.

Findings showed that increased mitochondria density vary depending on the muscle affected. It also showed that leg muscles are the better beneficiary of intense training which results in more density of mitochondria compared to other muscles such as those in the arm (Dudley, Abraham, & Terjung, 1982). Additionally, further findings by Dudley and his colleagues state that an increase in the intensity of training results in greater adaptive response to mitochondria. As the intensity of exercise is increased, the length of day by day exercise needed to bring about the change becomes less (Dudley et al., 1982).

Based on the results of these studies, it can be said that the density of mitochondria in the weightlifter's biceps is lower compared to that of the world-class runner but is higher compared to that of a couch potato. This is simply because the muscles in the arms have less concentration of mitochondria than that of a runner's legs. Although compared to a couch potato, the density of mitochondria in a weightlifter's biceps is higher because of the exercise and physical activity a weightlifter does while mitochondria density in the biceps of a couch potato remains stagnant because of inactivity.

References

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