ATP Production is Increased by Microcurrent Stimulation

ATP (Adenosine TriPhosphate) molecules are the storage and distribution vehicles for energy in the body. The breakdown of ATP into ADP yields energy. It is the cleaving of the phosphate bond that yields the energy. This energy is utilized in almost all energy related cellular reactions.

In addition to recognizing that ATP production is integral to the function of virtually every cell in our body, we may also look at ATP function by categories of activity. Such essential functions include: 1) muscle contraction; 2) protein biosynthesis; 3) nerve transmission; and 4) active transport across cell membranes.

Background Physiology

1) Muscle Contraction

In muscle contraction, the process occurs as follows: each muscle spindle is composed of muscle fibers. Inside the muscle fibers are many muscle fibrils. These muscle fibrils are suspended in a fluid matrix called sarcoplasm. Suspended in the sarcoplasm are thousands and thousands of mitochondria, which contain large amounts of ATP.

It is ATP that energizes the muscle contraction process by the ATPase activity of the exposed myosin head. When ATP is exposed to the myosin head, it is cleaved and energy is released. It should be noted that along with ATP, magnesium is very necessary in ATP energy releasing reactions. Before ATP can become "active ATP," magnesium must bind between the second and third phosphate. Clinically, for this reason, magnesium deficiency may be related to many connective tissue conditions including fibromyalgia and chronic fatigue syndrome.

2) Protein Biosynthesis

Synthesis of almost any chemical compound requires energy. That energy is ATP which is critically important for the biosynthesis of proteins, phospholipids, purines, pyrimidines and hundreds (if not thousands) of other substances. ATP involvement in protein synthesis is a case in point: a single protein may be composed of many thousands of amino acids. It requires the breakdown of four high-energy phosphate bonds to link two amino acids together.

Maximally, two ATP could serve as energy to join two amino acids together, so if our protein is composed of 10,000 amino acids, it may take 20,000 ATP to form just this one protein. It should also be noted that the amino acids themselves utilize ATP indirectly as they are first co-transported into the cells.

3) Nerve Transmission

ATP is necessary for nerve transmission. Nerve transmission entails the release of nerve transmitter substance from the presynaptic terminal into the synaptic cleft, which simply puts a space between one nerve cell and another. The nerve transmitter substance spans the cleft and attaches to the receptor of the next cell. The nerve transmitter substance must be constantly formed anew in the presynaptic terminal for future release; the energy for this formation is supplied by ATP. There are many mitochondria in the presynaptic terminal to form and store the ATP for this process.

The formation of ATP will be discussed later in relation to the stimulatory effects of microcurrent.

4) Active Transport across Cell Membranes

At the post-synaptic terminal, before the next nerve cell down the line, it is through active transport of sodium, potassium and calcium that concentration differences across the nerve cell membrane cause nerve firing and propagation of nerve signals to travel to the next presynaptic terminal. These concentration gradients could not be accomplished without ATPase active transport across nerve cell membranes. Active transport is brought about by the energy release of ATP in the breakdown of its phosphate bonds

Active transport is a means of getting molecules through the cell membrane, either into or out of the cell, against a concentration gradient. That concentration gradient may be electrical or a pressure gradient. Sodium, potassium, calcium, glucose, amino acids and many other compounds are transported into the cell this way; while metabolic waste products are transported out.

To summarize, ATP is the energy currency for our bodies. In reality, virtually every cytological, histological and physiological process is ATP-mediated, which makes ATP clinically important. While our bodies in theory can produce all the ATP we need, the fact is that they don’t.

Discussion

Microcurrent stimulation between 50-600 microamps is a way of “supercharging” the tissue with ATP, which will reside there until needed. Much of the research that shows a 200% increase in the speed of healing can be explained as it applies to a vast number of conditions. In a clinical sense, any tissue repair process takes a great deal of ATP and may be accelerated through a means of increasing ATP in the involved tissue. Microcurrent stimulation accomplishes this as it has been found to increase ATP production by up to 400% (Ngok Cheng, et al).

Thus, it has been discovered that microcurrent stimulation to the body causes radically increased production of ATP levels thereby helping the body to perform whatever healing process it has undertaken in a greatly accelerated fashion. It may be said to cause one to get over the proverbial "healing hump" that becomes unachievable, due to insufficient ATP concentrations. Since ATP is a necessity to perform the changes needed for cellular mechanisms to function optimally, it may be said that microcurrent assists the human body in its ability to self-repair,

ATP is the dynamic reservoir of energy in our body. Glucose serves as a more long-term reservoir but in itself does not actually fuel the body, it acts as a precursor. Glucose is first converted to ATP. The ATP itself is the storage and distribution vehicle for energy.

From the moment an ATP molecule is produced, it is typically consumed within one minute. The turnover rate very high; the body does have a vast capacity to store ATP, yet it can build ATP reserves. This is one reason that, unlike other forms of electric therapy such as interferential, or higher amperage TENS and galvanic, microcurrent stands unique in that it has a positive cumulative effect, rather than a diminishing effect. Other electric stimulation devices decrease ATP levels. Moreover, these devices cannot even be thought of in the realms of ATP generation. It has been shown that any stimulation over 1,000 microamps causes plateauing and then reduction in ATP (Ngok Cheng, et al).

Microcurrent therapy, which is typically used from 25 uA to 600 uA clinically, is the modality of choice for quicker tissue healing and restoring cellular mechanisms to normal function. Research and clinical trials have shown that with microcurrent stimulation, there is a 40-50% reduction in the time it takes for skin ulcerations to resolve; sprain/strains to diminish; connective tissue injury to heal, strength/range of motion and functionality to return. Even deep adhesions and scar tissue have been found to remodel, becoming healthier again by the application of microcurrent stimulation. Other microcurrent stimulatory effects include decreased inflammation, edema and swelling, and increased physical endurance in sports.

Conclusion and Afterthoughts

ATP can be produced by the body by many means other than those mentioned above. However, it is a very dynamic energy source, and at the site of injury or at a site of overuse and microinjury, the available supply of ATP can become diminished. Microcurrent therapy offers a unique and potent answer to the problem of tissue inability to self-repair.

Clinically, microcurrent therapy is also a therapy of choice for hyperacute injuries in that it causes little if any sensation to the patient being treated. In addition to its uniqueness in contrast to ordinary E-Stim (TENS) and muscle stim that tetanizes contractile tissue, microcurrent therapy has broad application in pain control that does not simply mask the pain signal (Pain Gate Theory); it provides muscle restoration (without fatiguing the contractile tissue); it results in nerve re-education rather than disruption; and delivers stress reduction (by its profoundly relaxing influence on the Nervous System).

Microcurrent also stands somewhat unique in its ability to increase vascular permeability and in its use as a means of electroacupuncture (see other research articles for documentation). Bio-feedback-modulated microcurrent instruments (the Electro-Acuscope and Myopulse) have the ability to detect the bioelectric state of the human body, and have proven a standard of technical excellence unsurpassed in other clinical modalities.

References:

Guyton AC, Hall JE. *Textbook of Medical Physiology.* W.B. Saunders Company.

Insel PM. *Perspectives in Nutrition.* Mosby.

Kroschwitz JI, Winokur M. *Chemistry - General, Organic, Biological*. McGraw-Hill, Inc.

Giancoli DC. *Physics: Principles with Applications.* Prentice Hall.

Cheng, et al. The effects of electric current on ATP generation, protein synthesis, and membrane transport in rat skin. *Clinical Orthopaedics and Related Research* Nov/Dec 1982;171.

Carley and Wainapel. Electrotherapy for acceleration of wound healing: low intensity direct current. *Archives of Physical Medicine and Rehabilitation* July 1985; vol. 66.

Becker RO. *Cross Currents: The Perils of Electropollution, the Promise of Electromedicine.* G.P. Putnam's Sons.