Versatile Electrotherapy With the High-Voltage Pulsed Stimulator

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Electrical stimulation is widely used in the management and rehabilitation of athletic injuries. There are a variety of electrical stimulators on the market today. In an ideal setting the athletic trainer or therapist will have access to several types of stimulators, each designed for a particular treatment goal, or a combination of units capable of delivering different electrical currents.

However, many settings such as high school and some college athletic training rooms lack the resources for comprehensive electrical therapy. Needed in these situations is an inexpensive yet versatile electrical stimulator. The high-voltage pulsed stimulator (HVPS) could be that unit of choice (Photo 1).

The HVPS provides a monophasic current with a twin peak wave form, a relatively short pulse duration with a long interpulse interval, and an amplitude range above 150 mVolts (Lake, 1992). With these units, the current can be modified for the desired treatment effect by adjusting the intensity, frequency, and pulse duration.

This current can be delivered in various modes: continuous, alternating, or with a duty cycle. It is typically delivered with a monopolar electrode arrangement where the active electrodes can be assigned either a negative or positive polarity (Holcomb, 1997).

Edema Reduction

The HVPS was specifically designed for the management of edema via sensory level stimulation. Sensory level stimulation with the HVPS is thought to reduce edema by decreasing microvascular permeability to plasma proteins, which will maintain the osmotic gradient usually lost during the inflammatory response and prevent fluid from escaping into extracellular tissue (Bettany et al., 1990; Reed, 1988; Voight, 1984).

In addition, negatively charged blood cells and plasma proteins will be repelled from the negative electrode, which creates a concentration gradient; fluid movement will follow (Newton, 1987). Because this movement is away from the negative electrode, the electrode should always be placed over the area of edema. Electrode arrangement and other

Key Points

- The high-voltage pulsed stimulator (HVPS) is ideal for use in many settings, due to its versatility, portability, and relative low cost.
- The HVPS was designed to manage edema, but it can also be used for neuromuscular stimulation and pain management.
Nomenclature

- **Monophasic:** A pulsatile current that flows in a single direction but is periodically interrupted.
- **Interpulse Interval:** The period of time between two pulses of current, when the current is not flowing.
- **Pulse Duration:** The length of a single pulse of monophasic or biphasic current.
- **Duty Cycle:** The ratio of the amount of time that current is flowing (“on” time) to the amount of time current is not flowing (“off” time).
- **Monopolar Electrode Placement:** The use of two types of electrodes, an active electrode in which the treatment effect occurs and a dispersive electrode that completes the circuit (Starkey, 1993).
- **Sensory Level Stimulation:** A level of intensity that reaches the threshold for sensory fiber stimulation without reaching the threshold for muscle, or pain fiber stimulation.

useful parameters are listed in Table 1.

The HVPS can also provide neuromuscular stimulation and pain management, although it is not specifically designed to do so.

**Neuromuscular Stimulation**

The HVPS provides a sufficient intensity, appropriate pulse duration, and interpulse interval for motor level stimulation (Bowman & Baker, 1985). Electrically stimulated muscle contractions can be used to retard atrophy, decrease strength loss, re-educate the neuromuscular apparatus, and reduce muscle spasticity. However, this is only possible if the unit provides a duty cycle (on time/off time) that will enable repeated contractions with intermittent relaxation.

Even though the HVPS can elicit muscle contractions, the force of contraction provided by the HVPS will be less than that provided by a neuromuscular stimulator or Russian current. When using the HVPS for neuromuscular stimulation, athletic trainers and therapists are encouraged to refer to Table 1 for appropriate parameters.

**Pain Management**

The HVPS can also be used to manage pain by activating the gate control mechanism, or by stimulating the release of endogenous opiates (beta-endorphins) (Bechtel & Fan, 1985). However, the effectiveness of gate control for pain management with the HVPS is limited because these units are not typically equipped to prevent accommodation of the peripheral nervous system to the electrical current.

Transcutaneous electrical nerve stimulators (TENS) (Photo 2) usually accomplish this through the use of a modulated mode. With this mode, either the current intensity or frequency is constantly altered during the treatment so that the