High Voltage Pulsed Current (HVPC)

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Objective

To review the core concepts and terminology used in high voltage pulsed current (HVPC)

To identify and discuss the physiological effects and therapeutic benefits of HVPC

To describe HVPC formats and methods of application used in physiotherapy

To review the fundamentals of safety with respect to HVPC
History of HVPC

- In 1940 this current originally developed by Haslip in USA, and known as Dyna-wave.
- In 1970s this current become popular and known as HVPC.
- The first published paper on use of this current was by Young 1966, on edema reduction.
Characteristics of HVPC

1-Wave form

Pulse frequency

HVPC

2-Pulse duration

Intensity

inter-pulse interval

Twin-peak monophasic pulse

very short (5-200µS), usually 200µS

Very long inter-pulse interval = 9800µS

1-200Hz

Range(0-500V), maximum voltages (100V).
Wave form characteristics of HVPC
Potentially Advantage of HVPC

1. Not stimulate denervated muscles as it cannot depolarize membrane.

2. Selectively stimulate motor rather than sensory nerves, so used for reduction of disuse atrophy.

3. No chemical effects. Stimulation is safe & comfortable than Faradic current. Maintained for longer periods of time (60 minutes).

HVPC penetrates deeper than that of low-voltage currents.
4-Main indications (physiological) for HVPC

- **Wound Healing**: Pressure ulcer, Diabetic foot ulcer and Burn wound
- **Edema reduction**: Posttraumatic Edema e.g. Sprains & Strain
- **Pain Modulation**: Chronic low back pain, Osteoarthritis,
- **Muscles stimulations**: innervated MS to increase strength endurance
### 1-Wound Healing

<table>
<thead>
<tr>
<th>Inflammation Phase</th>
<th>Proliferation Phase</th>
<th>Remodeling Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Improves blood flow</td>
<td>Stimulates fibroblasts and epithelial cells</td>
<td>Stimulates epidermal cell reproduction &amp; migration</td>
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<tr>
<td>• Promotes phagocytosis</td>
<td>• Stimulates protein synthesis</td>
<td>Reduces scar tissue</td>
</tr>
<tr>
<td>• Enhances tissue oxygenation</td>
<td>• Improves membrane transport</td>
<td></td>
</tr>
<tr>
<td>• Reduces edema</td>
<td>• Stimulates wound contraction</td>
<td></td>
</tr>
<tr>
<td>• Attracts and stimulates fibroblasts and epithelial cells to the site of injury</td>
<td></td>
<td></td>
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<tr>
<td>• Stimulates DNA synthesis</td>
<td></td>
<td></td>
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<tr>
<td>• Controls infection</td>
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</tbody>
</table>

- Increases macrophages
- Promotes epithelial growth

- Increases vascularity
- Stimulation of fibroblastic growth
- Increase collagen production
- Increase epidermal cell migration
- Inhibits bacterial growth
Post Traumatic Edema Reduction

What makes HVPC more effective for edema management?

**Muscle pump**
Repeated muscle (pumping) contraction *(motor level stimulation)* increase venous return & blood flow.

**Fluid Repulsion Theory**
Repulsion of protein rich fluid through microvascular exchanges *(negative polarity).*
Edema Control: 5-20 Hz *(muscle twitch)*
Pain modulation

Gate control theory

Supra spinal stimulation

Improve circulation

High frequency (80-120Hz)
Low intensity HVPC C-TENS

Low frequency (10-20Hz)
High intensity HVPC AL-TENS

Increase blood flow
Removal of waist product
Reduction of inflammatory process,
Increase joint mobility

Reduction of pain

Direct effect on circulation

Reduction of inflammation/edema
CONTRAINDICATIONS and PRECAUTIONS

- Over malignant tumor.
- Over area of extreme edema.
- Over hemorrhagic area.
- Over osteomyelitis.
- Over anterior cervical area.
- Over transcranial area.
- Over electronic implants.

1. Be cautious when using HVPC over an area with:
   a. Impaired sensation
   b. Extensive torn tissue
   c. Hemorrhagic area

2. Patients with epilepsy should be monitored during treatment.
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>(motor and/or sensory)</td>
</tr>
<tr>
<td>Frequency</td>
<td>(pulse rate); high or low pulse frequency.</td>
</tr>
<tr>
<td>Modes</td>
<td>(continuously, reciprocal)</td>
</tr>
<tr>
<td>Polarity</td>
<td>(positive, negative)</td>
</tr>
<tr>
<td>Electrodes Placement</td>
<td>(monopolar/bipolar)</td>
</tr>
<tr>
<td>Treatment time</td>
<td>(10-60 minutes)</td>
</tr>
<tr>
<td>Frequency of treatment</td>
<td>(daily/3 time per week)</td>
</tr>
</tbody>
</table>
HVPC Application for Wound Healing

Cleaned and debrided the wound before application of HVPC.
Cover the wound with several layers of sterile gauze soaked in saline.

Active electrodes soaked in antiseptic solution
Active electrodes will be applied either
- Directly over the wound
- Directly in the wound periphery

Dispersive electrodes are placed proximal to active electrode so that the current passes through the wound.
HVPC Application for Wound Healing

**Frequency**: 100 pps  
**Pulse duration**: 100 μsecs  
**Intensity**: 150 - 200 V  
**Treatment duration**: 30 – 60 minutes  

**Polarity**  
Negative (cathode) infected wound  
Positive (anode) clean wound  

**Frequency of treatment**  
Daily infected wound  
Day /day clean wound  

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Before TTT

During TTT

After TTT
HVPC Parameter for Edema Reduction

Technique:
- Intensity: Sensory level (strong buzzing (90% of visible muscle contraction))
- Pulse duration: 5-20 μsecs
- Frequency: 100 pps
- Polarity: Negative (-)
- Time: 20-30 minutes

Technique of electrodes placement:
- One active electrodes (negative polarity) were placed over the median nerve in the antecubital fossa, while another electrodes over the ulnar nerve, at medial epicondyle
- One active electrodes (negative polarity) were placed over the median nerve in the wrist crises, while another electrodes over dorsum of the hand
HVPC application for Pain

**Technique:**

**Intensity:**
- Sensory level (acute pain)
- Motor or Nociception level (chronic pain)

**Frequency:**
- 80 pps (acute pain)
- 1-10 pps (chronic pain)

**Polarity:**
- Positive (+) for acute pain
- Negative (-) for chronic pain

**Time:** 20-30 minutes
Self Questioning?

- Describe the waveform characteristics of HVPC
- What are the 4 main indications for HVPC?
- Describe the parameters for targeting edema reduction
- Describe the parameter of HVPC for treating wound
- What makes HVPC more effective for edema management?
- How does the sensation of HVPC compare to TENS?
- Pulse duration for HVPC
- How is HVPC beneficial for wound healing?