TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION (TENS)

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OUTLINES

- Definition of TENS and current specifications
- Modes of TENS application in clinical setting
- Physiological effects of TENS
- Uses (indications) of TENS applications
- Contraindications of TENS applications
- Precautions & dangerous of TENS applications
**PAIN**

- Pain is “An unpleasant sensory & emotional experience associated with actual or potential tissue damage, or described in terms of such damage”

- Acute versus chronic pain

- Nociceptive versus neuropathic pain

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**Nociceptive Pain**
Special nerve endings called nociceptors send pain signals to the central nervous system.

**Neuropathic Pain**
Caused by dysfunction in the nervous system or damage to the nerve itself.
WHAT IS TENS?

- **TENS** is a low frequency pulsed current used to stimulate peripheral nerves through surface electrodes aiming to control and relief pain (acute/subacute, chronic and postoperative pain).

- **TENS** is non-invasive anon pharmacological physical therapy modalities used to relief pain (acute & chronic) through stimulation of peripheral nerve using surface electrodes.
TENS/VARIABLES/SPECIFICATION

Asymmetrical biphasic
symmetrical biphasic, Monophasic
Spike-like

Wave form

Pulse intensity
1-150mA
Ideal intensity” = patient perceived comfortable sensation (1-35mAmp)

Pulse frequency
1-250Hz
Low frequency 1-20Hz
High frequency 80-120Hz

Pulse duration (width)
50-500 microseconds
MODES OF TENS APPLICATION

FREQUENCY
- HIGH (250pps)
- LOW (1pps)

PATTERN
- CONTINUOUS
- BURST
- FREQUENCY MODULATED
- RANDOM PULSES

AMPLITUDE
- HIGH
- LOW

DURATION
- SHORT
- LONG
## TREATMENT PARAMETER FOR CONVENTIONAL TENS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Conventional-High-frequency; Sensory TENS</strong></td>
<td></td>
</tr>
<tr>
<td>Frequency (Hz)</td>
<td>80-120Hz</td>
</tr>
<tr>
<td>Pulse duration (µS)</td>
<td>50-150µS</td>
</tr>
<tr>
<td>Intensity (mA)</td>
<td>Sensory (Tangling) Sub-motor</td>
</tr>
<tr>
<td>Pain modulation</td>
<td>Spinal Gait Theory</td>
</tr>
<tr>
<td>Nerve fibers stimulated</td>
<td>Large myelinated (Aβ) fibers</td>
</tr>
<tr>
<td>Treatment time</td>
<td>30-60 minutes/day</td>
</tr>
<tr>
<td>Onset of analgesia</td>
<td>Rapid (≤30min)</td>
</tr>
<tr>
<td>Duration of pain relief</td>
<td>Short (30 minutes to 2h)</td>
</tr>
<tr>
<td>Uses</td>
<td>Acute/postoperative pain</td>
</tr>
</tbody>
</table>
# Treatment Parameters for Low Frequency Acupuncture Like TENS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency (Hz)</strong></td>
<td>1-20Hz</td>
</tr>
<tr>
<td><strong>Pulse duration (μS)</strong></td>
<td>200-300μS</td>
</tr>
<tr>
<td><strong>Intensity (mA)</strong></td>
<td>Sensory(Tangling)+Rhythmic muscles contraction</td>
</tr>
<tr>
<td><strong>Pain modulation</strong></td>
<td>Supra-Spinal (Beta-endorphin / Enkephalin)</td>
</tr>
<tr>
<td><strong>Nerve fibers stimulated</strong></td>
<td>Large myelinated (Aδ) and C fibers</td>
</tr>
<tr>
<td><strong>Treatment time</strong></td>
<td>20-30 minutes</td>
</tr>
<tr>
<td><strong>Onset of analgesia</strong></td>
<td>Slow (30-120 min)</td>
</tr>
<tr>
<td><strong>Duration of pain relief</strong></td>
<td>Long (6-7 h)</td>
</tr>
<tr>
<td><strong>Uses</strong></td>
<td>Chronic pain</td>
</tr>
</tbody>
</table>
## TREATMENT PARAMETERS FOR Brief -intense TENS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frequency (Hz)</strong></td>
<td>80-130Hz</td>
</tr>
<tr>
<td><strong>Pulse duration (µS)</strong></td>
<td>≥ 150µs</td>
</tr>
<tr>
<td><strong>Intensity (mA)</strong></td>
<td>Sensory(Tangling) + Non-Rhythmic muscles contr.</td>
</tr>
<tr>
<td><strong>Pain modulation</strong></td>
<td>Supra-Spinal (Beta-endorphin / Enkephalin)</td>
</tr>
<tr>
<td><strong>Nerve fibers stimulated</strong></td>
<td>Sensory/motor/nociceptive fibers A beta/ A delta/C fibers</td>
</tr>
<tr>
<td><strong>Treatment time</strong></td>
<td>10-30minutes</td>
</tr>
<tr>
<td><strong>Onset of analgesia</strong></td>
<td>Rapid (≤15min)</td>
</tr>
<tr>
<td><strong>Duration of pain relief</strong></td>
<td>Short &lt; 30minutes</td>
</tr>
<tr>
<td><strong>Uses</strong></td>
<td>Painful procedure</td>
</tr>
</tbody>
</table>
# TREATMENT PARAMETERS FOR Burst –TENS

<table>
<thead>
<tr>
<th>Burst –TENS</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (Hz)</td>
<td>50-150PPS burst (5-10)</td>
</tr>
<tr>
<td>Pulse duration (µS)</td>
<td>100-300µS</td>
</tr>
<tr>
<td>Intensity (mA)</td>
<td>Sensory Strong-Rhythmic muscles contr.</td>
</tr>
<tr>
<td>Pain modulation</td>
<td>Supra-Spinal (Beta-endorphin / Enkephalin)</td>
</tr>
<tr>
<td>Nerve fibers stimulated</td>
<td>Sensory/motor</td>
</tr>
<tr>
<td>Treatment time</td>
<td>20-30minutes</td>
</tr>
<tr>
<td>Onset of analgesia</td>
<td>Slow onset (within hours)</td>
</tr>
<tr>
<td>Duration of pain relief</td>
<td>Long</td>
</tr>
<tr>
<td>Uses</td>
<td>Chronic neuromuscular pain</td>
</tr>
</tbody>
</table>
**TENS (Pattern) Modes**

- **Conventional**
  - High-frequency

- **Acupuncture**
  - Low-frequency

- **Burst**
  - Large myelinated (Aβ) fibers
  - Large myelinated (Aδ) fibers
  - C fibers
  - A beta/ A delta/C fibers

- **Modulated**
How does TENS modulate pain perception?

1. Blocking ascending pathways - Gate control theory
2. Blocking descending pathway
3. Opiate-mediated pain control
4. Local vasodilatation of blood vessels in ischemic tissues
DUAL PATHWAYS FOR PAIN TRANSMISSION

Transcription of both “fast-sharp” and “slow-chronic” pain signals into and through the spinal cord on their way to the brain.

Transmission of pain signals into the brain stem, thalamus, and cerebral cortex by way of the fast pricking pain pathway and the slow burning pain pathway.
GATE CONTROL THEORY

The "Gate Theory" of Pain

Nociception
Attenuated Pain Signal
Distraction Signal
Transmission Cell

Patrick Wahl and Ronald Melzack, 1965
**BLOCKING DESCENDING PATHWAY**

- Descending neurons are activated by: stimulation of A-delta & C neurons, cognitive processes, anxiety, depression, previous experiences, expectations

- Cause release of enkephalins form PAG and serotonin NRM.

- Enkephalin interneuron in area of the SG blocks A-delta & C neurons
OPIATE-MEDIATED PAIN CONTROL

- Stimulation of A-delta & C fibers causes release of B-endorphins from the PAG & NRM

- ACTH/B-lipotropin is released from the anterior pituitary gland in response to pain – broken down into B-endorphins and corticosteroids

- Mechanism of action–similar to enkephalins to block ascending nerve impulses
Descending neurons are activated by: stimulation of A-delta & C neurons, cognitive processes, anxiety, depression, previous experiences, expectations.

- Cause release of enkephalins form PAG and serotonin NRM.
- Enkephalin interneuron in area of the SG blocks A-delta & C neurons.
EVIDENCE BASED OF TENS APPLICATIONS FOR PAIN MANAGEMENT

- Application of TENS electrodes at acupoint sites may increases analgesia.
- The use of TENS during movement or activity may be most beneficial.

- TENS is effective for postoperative pain, osteoarthritis, painful diabetic neuropathy and some acute pain conditions.

- Emerging evidence suggests TENs may be helpful for peoples with fibromyalgia and spinal cord injury.
FACTORS AFFECTING TENS EFFICACY

- Population and the outcome assessed,
- Timing of the outcome measures,
- Negative interaction of opioid use
- The parameters of the TENS dose.
  1. Tolerance to repeated TENS,
  2. Intensity of the stimulation and
  3. Electrode placement.
FACTORS AFFECTING TENS EFFICACY

- Outcome
- Population
- Parameters of the TENS dose.
  - Tolerance to repeated TENS,
  - Intensity of the stimulation and
  - Electrode placement.
- Negative interaction of opioid use
INDICATION (USES) OF TENS

- Abdominal surgery  
  (e.g. inguinal hernia)
- Thoracic surgery  
  (e.g. Thoracotomy & CABG)
- Urological surgery  
  (e.g. Prostatectomy)
- Orthopedic surgery  
  (e.g. Total & hip replacement, Amputation, & Spinal surgery)
- Obstetrical & gynecological surgery  
  (e.g. Hysterectomy & Cesarean)
- Dental surgery  
  (e.g. Molar distraction)

- Post traumatic pain.
- Low back & neck pain.
- Osteoarthritis/Rheumatoid arthritis.
- Ankylosing spondylitis.
- Temporomandibular pain.
- Myofascial pain.
- Peripheral nerve injuries with radiculopathies
- Reflex sympathetic dystrophy
- Neuropathic pain
**CONTRAINDICATIONS OF TENS APPLICATIONS**

- Cardiac a pacemaker
- Undiagnosed pain.
- Epilepsy
- Over Venous or arterial thrombosis or thrombophlebitis
- Near operating diathermy device
- Over the anterior-lateral aspect of neck/eyes/mucosal surfaces
- Using electrodes on infected (inflamed) skin
- Electrodes across the chest of a patient with cardiac disease

**Contraindication:** A condition(s) that could be adversely affected if TENS is used.
PRECAUTIONS TO TENS

For patients with diagnosed malignancies that have been diagnosed as terminal, TENS can be used for pain control with informed consent of the patient. Otherwise, TENS should not be used when malignancies are present.

Areas of skin irritation,
Areas with impaired sensation
Over abdominal, or pelvic regions during pregnancy other than for labor/delivery

 Extreme caution is needed with patients taking narcotic medication or who are known to have hyposensitive areas.
Incompetent patients may not be able to manage the device and it must be kept out of reach of children.
EVIDENCE FOR ELECTRODES PLACEMENT

There is considerable variations on site of stimulation and electrodes placement was reported across different studies.
 Negative Electrodes should be placed distal to the positive electrodes
 The negative electrodes may be located at

1. On and /or Around the painful area.
2. Over specific dermatome of painful area.
3. Over specific myotomes of painful area.
4. Spinal cord segment.
5. Course of peripheral nerve
6. Over trigger point./Acupuncture point.
7. Par incisional
ELECTRODES PLACEMENT: NECK
ELECTRODES PLACEMENT: BACK
ELECTRODES PLACEMENT: SHOULDER

1) Shoulder Pain
2) Shoulder Subluxation
ELECTRODES PLACEMENT: KNEE & ANKLE PAIN