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Stimulation-Produced Analgesia

I. Know different peripheral stimulation techniques used to produce analgesia (Pan et al. 2000; White et al. 2001).
   A. Transcutaneous electrical nerve stimulation (TENS) (Kalra et al. 2001).
   B. Acupuncture-like TENS (Melzack and Wall 1984; Gadsby and Flowerdew 2000).
   C. Acupuncture, dry needle (Karakurum et al. 2001), or electroacupuncture (Ulett et al. 1998).
   D. Vibration (Lundeberg et al. 1987), acupressure (Kurland 1976; Weaver 1985).

II. Understand the postulated mechanisms of peripheral stimulation-induced analgesia.
   A. Segmental
      1. Low-intensity, high-frequency electrical stimulation selectively activates large-diameter, low-threshold A-beta afferent fibers, to produce segmental inhibition of dorsal horn neurons, thus reducing nociceptive afferent evoked responses (Levin and Hui-Chan 1993).
      2. Know about the inhibitory interneurons in the substantia gelatinosa and the chemical mediators, including gamma-butyric amino acid (GABA) (Chakrabarti et al. 1988), glycine, etc.
      3. Know the historical contribution of the spinal gate control theory in pain perception and modulation (Melzack and Wall 1965).
   B. Extrasegmental
      1. Stimulation of small-diameter, higher-threshold A-beta, A-delta (and part of C) fibers activates descending inhibitory pathway, and also inhibits the descending facilitatory pathway from the brain stem, to suppress the excitability of the dorsal horn neurons (Liu et al. 1986; Takeshige et al. 1992).
      2. Know about the synaptic pharmacology of descending inhibition and facilitation systems, the on/off cells in the medulla, and diffuse noxious inhibitory controls (Takeshige et al. 1992; Kalra et al. 2001).
      3. Know about the endogenous opioid peptides and anti-opioid peptides in pain control (Chen and Han 1992; Sluka et al. 1999; Cutler 2001; Han 2001; Kalra et al. 2001).
   C. Cortical
      1. Know that high-level cognitive/emotional inputs initiate poorly understand mechanisms at different levels of the neuraxis to control nociceptive sensory processing (Hennig et al. 2000).
      2. Know that this is likely to contribute to the efficacy of suggestion, placebo, and many folk medicine therapies.
      3. Know about the use of brain-imaging techniques to study the contribution of higher nervous activities in pain control (Wu et al. 1999).
   D. Peripheral
      1. Limited evidence suggests that peripheral stimulation alters blood flow and peripheral chemicals (Cramp et al. 2002).
III. Be aware of the parameters of stimulation (Gopalkrishnan and Sluka 2000)

A. Conventional TENS (Carroll et al. 2001)
   1. High frequency (50–100 Hz), low intensity (paresthesia, not painful), small pulse width (50–200 µs).
   2. Electrode localization: cover the painful region.
   3. Duration: about 30 minutes.

B. Acupuncture-like TENS (Levin and Hui-Chan 1993; Gadsby and Flowerdew 2000)
   1. Low frequency (2–4 Hz), higher intensity (to tolerance threshold), longer pulse width (100–400 µs).
   2. Alternating low (2–4 Hz) and high (50–100 Hz) frequency, each lasting for 3 seconds (Hamza et al. 1999a, b).
   3. Electrode localization: usually at traditional Chinese acupuncture points, or trigger points, but one can also use it at the painful region.
   4. Duration: about 30 minutes.

C. Acupuncture, dry needling, or electroacupuncture
   1. For dry needling, the needle is manipulated by rotation and multiple insertion (Gunn et al. 1980; McMillan et al. 1997).
   2. For electroacupuncture, the needle shafts are connected to an electrical stimulator.
   3. Localization: traditional Chinese acupuncture points, or trigger points.
   4. Duration: variable.

D. Vibration (Guieu et al. 1991)
   1. Electro-mechanical, high-frequency (100–200 Hz) and low-intensity (strong but not painful).
   2. Localization: over the painful area.
   3. Duration: usually 30 minutes, shorter than 45 minutes (Hamza et al. 1999a, b).

IV. Be familiar with the clinical applications of neuroaugmentative therapies.

A. Conventional TENS or vibration
   1. TENS reduces pain in different acute and chronic pain conditions including low back pain (Marchand et al. 1993; Brosseau et al. 2002), deafferentation pain, causalgia (Meyer and Fields 1972), pain during delivery (Allaire 2001; Gentz 2001), acute orofacial pain (Hansson and Ekblom 1983), acute and chronic arthritic pain (Roche et al. 1984; Hardware and Lacey 2002).
   2. The analgesic effect of TENS is generally not sufficient to manage for intense acute pain such as in dental surgery but can reduce anesthetic requirement during surgery (Bourke et al. 1984).
   3. Similar results are reported for vibration analgesia (Lundeberg 1984; Ter Riet et al. 1990; Guieu et al. 1991).
   4. Even if analgesic effects of TENS are generally reported as brief and fading over time, some long-term benefits are reported, for some patients (Junnila 1987a, b; Johnson et al. 1991; Thomas et al. 1999).

B. Acupuncture-like TENS or hyperstimulation
   1. As for TENS, hyperstimulation has been successfully used for different chronic and acute pain conditions (Wang et al. 1997), but its painful character may limit patients’ acceptance (Marwick 1997).
   2. The diffuse quality of hyperstimulation may be useful in some pain conditions where the stimulation can not be applied to the painful site.
C. Acupuncture

1. As for TENS and vibration, several studies report good results with acupuncture for different pain conditions. However, a meta-analysis of the literature reveals highly contradictory results. Most clinical trials are poorly designed. Efficacy is still debatable (Xi et al. 1992; Thomas and Lundberg 1994; Ernst et al. 2002).

2. The neurobiological rationale for this type of treatment has been explored extensively (Han 1989; Ulett et al. 1998), but much work remains to be done.

V. Efficacy

A. Know that the results of treatment are variable in clinical and experimental studies. Be aware that no clear criteria have been identified to decide whether a patient will benefit from neuroaugmentative treatment (Halbert et al. 2002).

B. Understand that the analgesic effect of TENS may be potentiated by repetitive use and that the efficacy of treatment may improve over time (Johnson et al. 1991; Marchand et al. 1993).

C. Know that even if the suggestibility and predisposition of the patients are important contributors, TENS and vibration are better than placebo in some studies, but failures are common. Be aware of the difficulty in designing placebo treatments to compare with neuroaugmentative therapy (Marchand 1993; Marchand et al. 1993; Sanchez 1998; Shen 2001; Vickers 2001; Ernst et al. 2002).

D. Be aware of the relatively short duration of the effects, and the possibility of development of tolerance over time (Han 2001).

REFERENCES


