THE ANALGESIC EFFICACY OF THE COMPLEX NEUROELECTROMAGNETIC PULSE (CNP) AS COMPARED TO ORAL OPIOID ANALGESIA

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ABSTRACT

Exposure to a complex neuroelectromagnetic pulse (Cnp) has been shown to produce analgesic (antinociceptive) effects in many organisms. In a randomized, double-blind, placebo controlled protocol, patients with chronic pain of musculoskeletal origin were exposed to Cnp (400 μT) through portable devices fitted to their head during twice-daily 40 min treatments for 7 days. Literature contains studies which assess the efficacy of opioid analgesics in the treatment of non-cancer pain of musculoskeletal origin. The magnitude of pain relief achieved by exposure to Cnp as measured by Visual Analogue Scale compares favorably to the effects of opioid analgesia.

INTRODUCTION

Chronic pain is an inordinately common cause of morbidity and disability in the adult population of North America. Over 50 million Americans suffer from chronic pain and the lost productive time from common pain conditions cost an estimated $ 61.2 billion/year to the U.S. economy [1]. The musculoskeletal system is a prominent source for chronic pain as there is an estimated 20 million Americans affected by osteoarthritis which is just one of many causes [2].

Chronic pain is routinely treated with pharmacologic measures such as acetaminophen and non-steroidal anti-inflammatory drugs (NSAID) such as ibuprofen, naproxen and the cyclooxygenase-2 inhibitors. NSAID's are commonly associated with gastrointestinal and renal side effects and consequently their use may be contraindicated in many individuals. Opioid analgesics is a group of drugs that demonstrate a high level of potency for pain relief and can be used as alternative treatment for patients with severe pain or who are intolerant to other pharmacologic means. The major drawback to opioid analgesics is the side effect profile, which includes gastrointestinal side effects, drowsiness, anxiety and potential for addiction. The efficacy of opioid analgesics in chronic musculoskeletal pain has been documented in many publications.

Complex neuroelectromagnetic pulse (Cnp) is a potentially new modality of therapy for chronic pain. It consists of cranial exposure to pulsed low-frequency magnetic fields of extremely low strength (+/-400uT head surface to +/-40uT deep brain). The therapy is applied for 40 minutes twice a day by means of a headset containing coils that is positioned bilaterally over the cranium. While there is an extensive literature describing the effects of Cnp in various animal models, it has recently come to light that Cnp can be extremely effective in reducing chronic pain in humans. A randomized controlled trial was carried out at St. Joseph's **Hospital (London, Ontario, Canada) Outpatient Pain Clinic** in which 34 patients with chronic pain from musculoskeletal causes were randomized to Cnp therapy or placebo for 7 days.

Based upon these results, a comparison is made between the efficacy of Cnp and that observed in the opioid studies.

MATERIALS AND METHODS

Cnp was studied in a randomized double-blind placebo controlled trial. 50 patients were randomized of which 34 entered the trial. Patients were treated with either active treatment or placebo for 40 minutes twice daily for 7 days. Pain was assessed both before and after each treatment using a 14 cm Visual Analogue Scale (VAS). Patients were allowed to continue their medications and hence there was no washout. Data for opioid efficacy were taken from 5 previously published papers [3-7] and they were compared to the results of Cnp.

For Cnp and the opioid studies, efficacy was assessed by means of numeric rating scale. The ranges varied throughout the studies and hence standardization was achieved by expressing the treatment and placebo effect as a percent change from baseline. The net percent change was arrived at by subtracting placebo percent change from that of the treatment.

The opioid studies were conducted using morphine, codeine and oxycodone. A conversion was effected such that an equivalent morphine dose was calculated for each drug. The conversion was based on data from the Compendium of Pharmaceuticals and Specialties – The Canadian Reference for Health Professionals and is presented in abridged format in Table 1.

Table 1. Comparison of Opioid Drug Potency.

Drug	Equivalent Dose (mg) compared to morphine 10 mg i.m.		Duration of Action (hrs)
	Parenteral	Oral	
Strong Opioid Agonists			
Morphine	10	60	3-4
Oxycodone	15	30	2-4
Weak Opioid Agonists			
Codeine	120	200	3-4

RESULTS AND DISCUSSION

Efficacy assessment of the Cnp study was carried out at the 7 day mark by taking the average of the 4 VAS scores obtained on that day. The average of both before and after treatment scores provides a good estimate of the average pain level of the patient on day 7. The baseline score was the first measurement on day 1 before the first treatment of the trial. Percent change is calculated by dividing the difference between baseline and the day 7 average by the baseline value. Net percent change is the difference in percent change between active treatment and placebo. For all patients that initiated the study (N=34), the net percent change for Cnp was 20%. This corresponded to a percent change of 24% and 4% for treatment and placebo respectively. A subset analysis on patients (N=15) who reasonably complied with the protocol (used device $\geq$ 12/14 applications) and whose intake VAS $\geq$ 7 revealed a net percent change of 38%. Comparison of efficacy observed in the Cnp and opioid studies is presented in Table 2.

Efficacy with opioids is seen to parallel daily morphine equivalent (DME) dose. Reference [3] and the low dose oxycodone arm of reference [5] had DME values of 40 mg or less and this corresponded to the net percent change being less than 20% for all interventions. The remainder used higher doses in the range of 80-95 mg DME and while they all achieved a net percent change of greater than 20%, the greatest effect (34%) was achieved in [4], which also used the highest dose of drug (95 mg DME).

Cnp is shown to have a net percent change of 20% over all subjects which compares favourably to low to moderate dose opioids. In order to make a more equitable comparison with the opioids, two selection criteria were applied. The first removed all patients who did not comply with the protocol and received less than half the number of the required applications. This is in line with the opioid studies in which they removed all patients from the analysis who withdrew due to lack of efficacy, adverse events or other reasons. The second

excluded patients whose intake VAS score was less than 7 out of 14. This is in line with the general requirement that opioid medications are generally used on patients with moderate to severe pain as is reflected in the inclusion criteria of some of the opioid studies. With these selection criteria applied, Cnp effected a net percent change of 38% (33% active, -5% placebo). Discounting the negative placebo effect, Cnp still demonstrates efficacy equal or superior to high dose opioid analgesia. No major adverse events were reported with Cnp and all reported events resolved spontaneously.

Table 2. Net **Analgesic Efficacy of Opioids in Chronic Musculoskeletal Pain**

Medication	Dosage	Daily Morphine Equivalent (mg)	Treatment Percent Change	Placebo Percent Change	Net Percent Change	N= (for treatment group)	N= (for placebo group)	Follow -up period (days)	Reference
Avinza	30 mg qam	30	27%	15%	12%	46	50	28	[3]
Avinza	30 mg qpm	30	23%	15%	8%	40	50	28	[3]
MS Contin	15 mg bid	30	23%	15%	9%	48	50	28	[3]
CR Codeine	159 mg bid	95	44%	10%	34%	31	35	28	[4]
CR Oxycodone	10 mg bid	40	28%	13%	16%	20	18	14	[5]
CR Oxycodone	20 mg bid	80	35%	13%	23%	25	18	14	[5]
CR Codeine	273 mg/day	82	26%	-2%	28%	30	30	7	[6]
CR Oxycodone	40 mg/day	80	25%	2%	23%	34	36	28	[7]
IR Oxycodone	40 mg/day	80	23%	2%	21%	37	36	28	[7]
Cnp	40 min bid	N/A	24%	4%	20%	17	17	7	[8]
Cnp	40 min bid	N/A	33%	-5%	38%	7	8	7	[8]

Cnp demonstrates the potential for analgesic efficacy equal or superior to opioid analgesics without significant side effects. In light of this data, further studies are required to assess the efficacy of Cnp on a larger number of patients and with a longer treatment period consistent with those typically seen in opioid studies.

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