

# Measuring the Influence of Cervical Epidural Steroids on Current Perception Threshold Measures Using a Neurometer®CPT/C - A Case Report

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## Abstract

We investigated cervical epidural steroid injection effects on Current Perception Threshold (CPT) measures in a patient with neuropathic pain using the Neurometer® CPT/C device (Neurotron, Inc Baltimore MD, USA). CPT measures pre injection revealed a significant hypoesthesia in A $\beta$  and C fibers with normal A $\delta$  fiber function. CPT testing 24 hours after a cervical epidural injection at the C7-T1 interspace using methylprednisolone and lignocaine revealed normal measures indicating a reversal of sensory nerve dysfunction. These findings corresponded with a 100% reduction in the patient's neuropathic symptoms.

## INTRODUCTION

The Neurometer® CPT technology has been in routine clinical and research use for decades worldwide. The automated sensory Nerve Conduction Threshold (sNCT) procedure performed by the Neurometer® CPT painlessly evaluates sensory nerve function and is capable of detecting both clinical and subclinical large and small fiber neuropathy by using different frequencies of a constant current sine wave stimulus. The 2000 Hz stimulus evokes responses from the A $\beta$ , the 250 Hz stimulus evokes responses from the A $\delta$  and the 5 Hz stimulus evokes responses from the C fibers. The neuroselectivity of the different frequencies of a sine wave stimulus has been validated from direct cell recordings and pharmacological animal studies<sup>1</sup>. The device provides the ability to measure pain perception and Pain Tolerance Thresholds (PTT) without the possibility of injuring intact skin. Although many studies have indicated the usefulness of this device in the quantification of nerve dysfunction in patients with peripheral neuropathy of various etiologies (eg diabetes, toxicities, HIV)<sup>2</sup> entrapment neuropathies<sup>3</sup>, radiculopathy<sup>4</sup>, genitourinary pathology<sup>5</sup>, as well as, various animal studies<sup>6</sup> we have found no published reports on the effect of epidural steroids on CPT measures. In this case report we investigated the role of sNCT evaluation in objectively measuring sensory changes in response to epidural steroids.

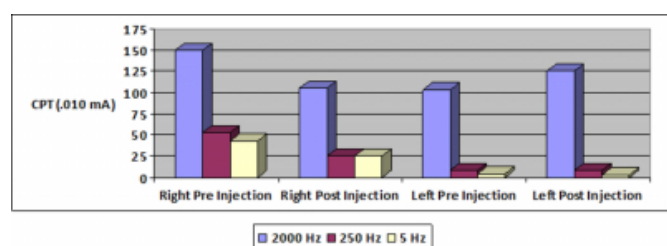
## CASE REPORT

A 40-year-old male patient was diagnosed with right phrenic nerve tumor. As staging showed no metastatic spread, he underwent en bloc resection and right modified neck dissection (MND) with curative intent. After surgery he presented to us with severe neuropathic pain involving the right neck with radiation to the mandibular region. The intensity of the pain was reported as 8 on the 10-point visual analog scale (VAS), with the least pain as 6/10. The pain was constant, and described as shooting, burning, and tingling and itching. He also experienced hyperalgesia, subjective change in temperature and mechano-allodynia. The inability to achieve pain relief resulted in severe depression, insomnia and poor quality of life. His pain-management regimen at that time consisted of Tab. Morphine 60 mg daily in divided doses, Gabapentine, 400 mg every 6 hours, Ibuprofen-paracetamol combination every 8 hours and injection diclofenac for breakthrough pain. Despite this, he rated his pain as 8/10 at rest and "too bad to measure" on any sort of neck movement. MRI of cervical region showed early cervical spondylosis with mild C6-C7 and C5- C6 disc bulge with mild ventral thecal sac indentation. He was given a cervical epidural steroid injection at the C7-T1 interspace consisting of Methylprednisolone 80 mg with 6 ml of 1% lignocaine at daily intervals for 3 consecutive days. His neuropathic symptoms responded with a reduction of 60% in VAS. CPT

measures at 2000 Hz, 250 Hz and 5 Hz were performed pre and 24 hours post injection (Figure 1) using the Neurometer® CPT/C in a method previously described.<sup>7</sup> Prior to Methylprednisolone injection, sNCT testing was performed at a site tested corresponding to the area of maximum pain intensity (right side of neck, C3) and the corresponding contralateral asymptomatic side. The test results revealed significant hypoesthesia in the 250 Hz and 5Hz CPT measures (2-3 standard deviations above the mean).

### Figure 1

Figure 1: CPT measures pre and post cervical epidural steroid injection. The Right Post Injection values at 250 and 5 Hz were significantly lower than the corresponding Pre Injection values ( $p < .05$ ).



The results from the 2000 Hz measures revealed normal function. The asymptomatic contralateral side had normal measures at all 3 frequencies. The data analysis was performed using the Neuval® software provided with the device (Neurotron, Inc. Baltimore MD USA). This proprietary software performs detailed analyses on the data by comparing them to an established normative database. Repeat testing was performed 24 hours later at the same sites tested previously. The CPT results from this test were entirely normal at all frequencies tested bilaterally. The patient tolerated the procedure and testing without complaints. He then complained of localized pain at C 6 in the neck radiating to right mandibular region 2 days later. It was unfortunate that we were not able to perform a sNCT test at this time. He was also given trial of Pain Shield (low frequency ultrasonic waves) without relief. A mandibular nerve block with 2 ml of 0.25% bupivacaine was performed using a nerve stimulator. He was discharged with pain relief of more than 90% and the total duration of effect of the steroid to relieve pain was about 90 days.

## DISCUSSION

Current thresholds (CTs) assessed at different frequencies have been used in the diagnosis of small and large fiber neuropathies such as post-herpetic neuralgia<sup>13</sup> and diabetic

neuropathy<sup>4</sup>. Differential changes in the CT at 5, 250 and 2000 Hz stimuli have been detected following spinal anesthesia with lidocaine<sup>12, 14</sup> and intravenously administered hydromorphone<sup>15</sup>.

Lignocaine was added for the immediate pain relief of patient. The cervical epidural administration of local anaesthetics in combination with steroids or opioids is useful in the palliation of cancer related pain of head, face, shoulder, upper extremity and upper trunk<sup>16, 17</sup>. Daily cervical epidural nerve block with local anaesthetic or steroid may be required to treat the acute painful conditions<sup>18</sup>. The subsequent injections of steroid were given only for the better efficacy of improvement in neuropathic symptoms.

Nishimura et al<sup>7</sup> assessed the recovery level for sensory function after carpal tunnel release for the treatment of idiopathic carpal tunnel syndrome (CTS) with the current perception threshold (CPT) test. Seventeen CTS patients (21 hands) were followed, and the CPTs at the index finger of each patient were measured preoperatively and at 1, 3, and 6 months postoperatively. After carpal tunnel release, there was significant recovery of CPT at all stimulation frequencies, indicating improvement of all sensory functions including sensations of temperature, pain, touch, and vibration.

Nagakura et al<sup>10</sup> assessed the threshold current (CT) required to evoke a paw withdrawal response in rats with stepwise increases in current delivered as sinusoidal stimulation at frequencies of 2000 Hz (CT2000), 250 Hz (CT250) and 5 Hz (CT5). Intrathecal administration (1–10 lg/rat) of morphine selectively increased CT5 and CT250 (efficacy order was  $CT5 > CT250 > CT2000 = 0$ ), although systemic morphine (1–5 mg/kg, S.C.) affected all three CTs ( $CT5 > CT250 > CT2000 > 0$ ). Intrathecal pretreatment at day 3 of capsaicin (75 lg/rat) increased the thermal nociceptive threshold and selectively increased CT5 ( $CT5 > CT250 > CT2000 = 0$ ). Intraplantar carrageenan injection progressively decreased CT250 and CT5, but increased CT2000 for a 3 h period. Intraperitoneal pretreatment with indomethacin (20 mg/kg) attenuated carrageenan evoked CT alterations as well as progression of paw swelling and thermal hyperalgesia. They concluded that low, but not high, frequency stimulation activated a withdrawal response which appeared mediated by morphine and capsaicin sensitive primary afferents and this threshold was reduced in the presence of inflammation. These data suggested the validity of such stimulation in defining drug action in a nontissue

injurious fashion.

In our patient, the test results revealed significant hypoesthesia in the 250 Hz and 5Hz CPT measures (Figure 1). The decrease of thresholds at low frequency stimuli after carrageenan injection suggested the sensitization of the afferent system involved in pain transmission in the face of inflammation.

## CONCLUSION

The use of sNCT evaluation proved useful by providing an objective quantitative measure to assess block effects. The painless nature of the test makes it an ideal non-invasive tool for long-term surveillance of small fiber involvement in neuropathic conditions. This test modality may be useful for understanding the different roles specific sensory nerve fibers play in maintaining neuropathic pain, as well as, in evaluating antinociceptive agents. The ability to objectively quantify neuroselective pain and non-pain sensations is a powerful new tool for the pain clinician. More clinical and basic research utilizing the sNCT evaluation CPT and PTT measurements in characterizing sensory abnormalities in various chronic pain conditions and assessing the efficacy of various interventional strategies is needed. The sNCT evaluation will continue to provide valuable measures in the objective evaluation of the patient with pain.

## References

1. Koga K, Furue H, Rashid M, Takaki A, Katafuchi T, Yoshimura M. Selective activation of primary afferent fibers evaluated by sine-wave electrical stimulation. *Molecular Pain* 2005;Vol.1:13.
2. Fujiuchi A., Toga T. Pharmacological effect of capsaicin on rat avoidance behaviours elicited by sine-wave electrical stimulation of different frequencies by Neurometer. *Journal of Pharmacy and Pharmacology* 2008; Vol. 60(4):467-71.
3. Kiso T, Nagakura Y, Toya T, Matsumoto N, Tamura S, Ito H, Okada M, Yamaguchi T. Neurometer measurement of current stimulus threshold in rats. *The Journal of Pharmacology and Experimental Therapeutics* 2001; Vol. 297(1):352-56.
4. Matsutomo R, Takebayashi K, Aso Y. Assessment of Peripheral Neuropathy Using Measurement of the Current Perception Threshold with the Neurometer® in Patients with Type 2 Diabetes Mellitus. *Journal of International Medical Research* 2005;Vol.33(4):442-53.
5. Baker B.A, Topliff A.R, Messing R.B, Durkin D. Johnson J. Persistent Neuropathy and Hyperkeratosis from Distant Arsenic Exposure. *Journal of Agromedicine* 2005;Vol.10(4):43-54.
6. Khatri R, Zagury J, Ananthan S, Heir C, Heir G, Benoliel R, Eliav E. Pain and sensory changes in HIV+ patients. *World Congress of Pain, IASP Poster 083, Glasgow, 2008.* New Jersey Dental School, Newark, NJ PT
7. Nishimura A, Ogura T, Hase H, Makinodan A, Hojo T, Katsumi Y, Yagi K, Kubo T. Evaluation of sensory function after median nerve decompression in carpal tunnel syndrome using the current perception threshold test. *Journal of Orthopedic Science* 2003;Vol.8:500-504.
8. Yamashita T, Kanaya K, Sekine M, Takebayashi T, Kawaguchi S, Katahira G. A quantitative analysis of sensory function in lumbar radiculopathy using current perception threshold testing. *Spine* 2002;Vol.27(14):1567-70.
9. Lee W-C, Wu H-P, Tai T-Y, Yu H-J, Chiang P-H. Investigation of Urodynamic Characteristics and Bladder Sensory Function in the Early Stages of Diabetic Bladder Dysfunction in Women with Type 2 Diabetes. *Journal of Urology* 2009; Vol.181:198-203.
10. Nagakura Y, Malkmus S, Yaksh T. Determination of current threshold for paw withdrawal with sine-wave electrical stimulation in rats: Effect of drugs and alteration in acute inflammation. *Pain* 2008;Vol.134:293-301.
11. Wallace M.S, Dyck J.B, Rossi S.S, Yaksh T.L. Computer Controlled Lidocaine Infusion for the Evaluation of Neuropathic Pain after Peripheral Nerve Injury. *Pain* 1996;Vol.66:69-77.
12. Liu S, Kopacz K. J, Carpenter R. L: Quantitative Assessment of Differential Sensory Nerve Block after Lidocaine Spinal Anesthesia. *Anesthesiology* 1995;Vol. 82(1):60-63.
13. Sakai T, Tomiyasu S, Yamada H, Sumikawa K. Evaluation of allodynia and pain associated with postherpetic neuralgia using current perception threshold testing. *Clin J Pain* 2006;22:359-62.
14. Sakura S, Sumi M, Yamada Y, Saito Y, Kosaka Y. Quantitative and selective assessment of sensory block during lumbar epidural anaesthesia with 1% or 2% lidocaine. *Br J Anaesth* 1998;81:718-22.
15. Angst MS, Drover DR, Lotsch J, Ramaswamy B, Naidu S, Wada DR, et al. Pharmacodynamics of orally administered sustained-release hydromorphone in humans. *Anesthesiology* 2001;94:63-73.
16. Waldman SD, Portenoy RK. Recent advances in the management of cancer pain. Part I. *Pain Management* 1991;4: 23-29.
17. Watts RW, Silagy CA. A meta-analysis on the efficacy of epidural corticosteroids in the treatment of sciatica. *Anaesth Intensive Care* 1995;23:564-569.
18. Waldman SD. Cervical epidural nerve block. In; *Atlas of Interventional Pain Management*, 2nd ed. Philadelphia, WB Saunders, 2004, p129.

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