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Observational Study

# Deep Cervical Plexus Block for the Treatment of Cervicogenic Headache

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**Background:** Cervicogenic headache descriptors include its unilateral nature, "signs and symptoms linking it to the neck," and trauma of the neck. Since the pain often occurs over the C2 or C3 nerve root, we used a modification of the deep cervical block technique for treatment of this refractory type headache.

**Objective:** To determine the efficacy of a modified deep cervical block for treatment of cervicogenic headache.

**Design:** Prospective case study.

**Methods:** Thirty-nine patients referred to our pain clinic participated in this study. All patients had undergone extensive screening/diagnostic testing. The blocks were performed unilaterally, without inducing a risk of invading the neural foramen, and repeat injection of the contra-lateral side occurred at >1 week after initial injection. Patients were followed for a 6-month period using a pain diary and questionnaire. Pain was assessed pre- and post-injection and 3 and 6 months post treatments.

**Results:** The mean treatment period was 59 ± 61 days. The mean values for pre- and post-injection series pain scores (0–10 pain scale) were 9.54 ± 1.53 and 6.75 ± 3.23 respectively ($p < 0.001$). Thirty-three percent (33%) of the patients reported pain scores of ≤ 4 on the 0-10 pain scale after their last treatment. Effectiveness of the therapy following the injection procedure was rated to be 42% effective for all first injections and 40% effective for last injections ($p$ =NS). Six months evaluations showed that return of moderate to severe pain took 6.62 ± 8.1 weeks. At the 3 and 6 months follow up evaluations, mean pain scores had returned to 8.41 ± 2.96 and 8.83 ± 2.78, respectively. Ten patients (24%) had pain scores ≤ 4 at the 3-month evaluation while 7 of the patients (18%) had pain scores ≤ 4 at the 6-month evaluation.

**Conclusions:** These results showed that for some patients this series of blocks provided effective pain relief for 3 months post treatment but by 6 months the pain had returned to pre-treatment levels. This block technique significantly diminished pain after the initial as well as the last treatment. These clinically significant changes in pain relief suggest that more aggressive selective therapy targeting these nerve routes might provide longer lasting relief.

**Key words:** Cervicogenic headache, deep cervical block, chronic pain

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Headache pain arising from disorders of the neck was described as early as 1860 by John Hilton (1804 – 1878) (1), a British surgeon and anatomist. Since that era, cervicogenic headache was further studied and the important descriptors include its unilateral nature and association with "signs and symptoms linking it to the neck" (2). Early on, Jackson (3) claimed that trauma of the neck may be among the most common causes of these type of headaches. A comprehensive review of the cervical spine and headaches is provided by Edmeads (4).

Clearly, trauma, traction, and whiplash-like injuries can result in chronic headache pain. Several regional anesthetic techniques have been utilized in an attempt to treat this pain including greater and lesser occipital nerve blocks, cervical epidural, and cervical trans-foraminal injections (5).

Since the pain often occurs over the C2 or C3 nerve root distributions, we postulated that a modification of the deep cervical block technique used to provide anesthesia to the face and neck might be useful for the treatment of this refractory type headache without inducing a risk of invading the neural foramen.

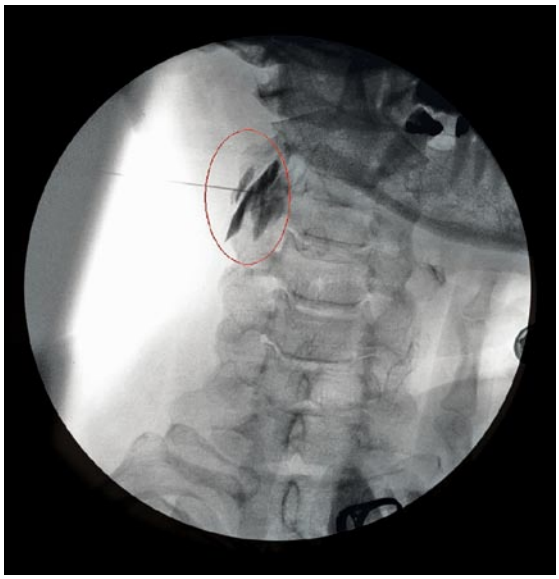

Fig. 1. *Fluroscopic image of needle placement for the deep cervical plexus block. The dark area around the needle represents spreading of the injected dye prior to injection of medication.*

## Methods

Following approval from the Cooper University Hospital Institutional Review Board, 39 patients (11 males, 28 females) gave informed consent to participate in this study. All of the patients were referred to our pain clinic by a single neurologist (RJS) for treatment of atypical headaches. The patients had undergone screening that included a complete history and physical examination followed by diagnostic testing such as MRI, CT scan, and EMG. Inclusion criteria consisted of a history of cervical plexus traction injury (e.g. car accidents, falls) and failure of conservative therapy including physical therapy, medications, and previous nerve blocks.

The blocks were performed unilaterally and repeat injection of the contra-lateral side occurred at approximately one to 2 weeks after the initial injection. If the headache was unilateral in nature, the block was performed only on that side. However, if the headache was global, then the block was performed in consecutive weeks, on opposite sides. The patient was always questioned as to which side was more painful, and the first block was performed on that side. The blocks were usually administered in a series of evenly distributed single injections bilaterally. All procedures were performed in the same fashion by one of 3 physicians under fluoroscopic guidance (6). Briefly, the patients were placed in the supine position and, using external landmarks, a line was drawn from the mastoid process to the cervical tubercle at the C6 level. The C2-C3 inter space was identified with the fluoroscope in the AP projection. The skin was prepped with betadine and draped in the usual sterile fashion. At the region of C2, a skin wheal was raised with a 25-gauge short bevel needle, 1.5 cm perpendicular and posterior to the previously mentioned line. Under fluoroscopic guidance a 25-gauge 3.5-inch spinal needle was introduced into the lateral recess of C2-C3 and its position confirmed in the AP and lateral projections. One mL of omnipaque dye was then injected under live fluoroscopic guidance to obtain a neurogram of the cervical plexus and demonstrating no evidence of intravascular or CSF spread (Fig. 1). Subsequently, 10 mL of 0.25% bupivacaine with 80 mg of methylprednisolone were injected in slow divided doses under fluoroscopic guidance while maintaining continuous communication and questioning of the patient to ensure that the needle was not intravascular or intrathecal. The selection of the site for blockade was determined by first having the patient identify the more painful side.

No bilateral block was ever performed during each visit as most patients had a predominantly one-sided headache.

All of the patients were followed for a 6-month period using a pain diary and questionnaire with items completed by the patient and research staff during follow-up telephone interviews and visits to the pain clinic. Pain was assessed pre and post injection, as well as 3 and 6 months following termination of each subject's treatments. The measurement of pain was obtained by patients' ratings of a 10-point numerical pain scale with zero indicating no pain and 10 being the worst possible pain. The effectiveness of injections was rated by the patient as a yes or no response after being asked whether the injection was effective or ineffective in providing pain relief. It was explained to each subject that a treatment should be rated as ineffective when no meaningful improvement was noted in pain relief compared to their pain before the block. Pain measures were analyzed using one-way ANOVA and ANOVA with repeated measures. Once significant main effects were determined post hoc analyses with Bonferroni correction for multiple comparisons were used to identify significant differences between means. Values are expressed as means ± SD and a $p < 0.05$ was considered statistically significant.

## Results

Thirty-nine patients diagnosed with atypical headaches (8 males, 31 females) ages 21–70 (mean 51.0 ± 12.0) participated in this study. The patients had various underlying pre-existing conditions that had been present for 4–5 years (mean 5.7 ± 5.0, median 4 years). The data for each patient have been included in Table 1. A total of 112 injections were performed with an average of 3 ± 1.7 (range 1–8, mode and median = 2) injections over the patients' treatment course (Fig. 2). The time period from the first to last treatment ranged from one injection in 23% of the patients (n = 9), to 222 days with a mean treatment period of 59 ± 61 days. Seventy percent of the injections were performed using a right-sided approach and 30% on the left side. The mean values for pre- and post-injection series pain scores (0-10 pain scale) were 9.54 ± 1.53 and 6.75 ± 3.23 respectively ($p < 0.001$). Thirty-three percent (33%) of the patients reported pain scores of 4 or less on the 0–10 pain scale after their last treatment. Those evaluations were performed 72 hours post treatment by the pain nurse who contacted the patients by tele-

Table 1. *Demographic data for gender and failed therapies are presented as number of patients with corresponding percentages in parentheses. Age, height, weight, and number of years from original injury to current treatment are presented as means ± SD with mode and median for the latter. Original and current diagnoses made by the study neurologist have been listed with the corresponding total number of patients and percentages in parentheses.*

| | N (%) | Means ± SD |
|---|---|---|
| Males | 8 (20) | |
| Females | 31 (80) | |
| Patients with previously failed therapies | 39 (100) | |
| Age (yrs) | --- | 51.0 ± 12.5 |
| Height (in) | --- | 65.4 ± 3.0 |
| Weight (lbs) | --- | 159.4 ± 34.0 |
| Orginal injury to current treatment (yrs) | | 3.3 ± 1.7<br>Mode & Median = 3 |
| **Original diagnosis:** | | |
| - Injury | 15 (38.5) | |
| -Headache | 13 (33.3) | |
| -CRPS | 6 (15.4) | |
| -Seizure disorder | 3 (7.7) | |
| -Cervical DDD | 2 (5.1) | |
| -Concussion | 2 (5.1) | |
| -Thoracic outlet syndrome | 2 (5.1) | |
| -Trigeminal neuralgia | 2 (5.1) | |
| -Other | 11 (28.2) | |
| **Current diagnosis:** | | |
| -Atypical headache | 39 (100.0) | |
| -Brachial plexus traction injury | 27 (69.2) | |
| -Cervical plexus traction injury | 25 (64.1) | |
| -CRPS | 18 (46.2) | |
| -Atypical facial pain | 3 (7.7) | |

CRPS = Complex Regional Pain Syndrome, Cervical DDD = Cervical Disc Degenerative Disease

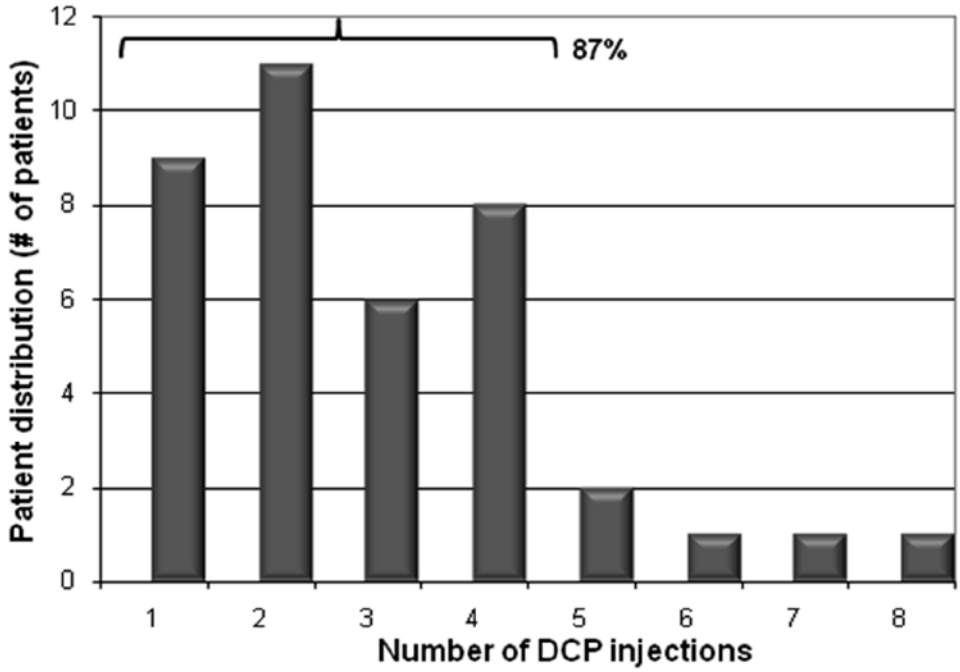


Fig. 2. *This graph illustrates the number of deep cervical plexus (DCP) injections performed per subject in this study population. The number of blocks (X axis) plotted against the number of patients (Y axis) are represented as categorical variables. The patient distribution shows 87% of the patients having received 1– 4 injections with a median of 2 injections.*

phone. There were no significant differences in pain assessment between males and females in the pre and immediately (1–2 hours) post series pain measures ($p$ = 0.25). Effectiveness of the therapy following the injection procedure was rated as effective 42% of the time for all first injections, and 40% effective for last injections ($p$ = NS).

The long-term pain relief (6 months) evaluations, following completion of treatments, showed that return of moderate to severe pain (pain rating of ≥ 5 on the pain scale) took 6.62 ± 8.1 weeks. At the 3- and 6-month follow-up evaluations, mean pain scores had returned to 8.41 ± 2.96 and 8.83 ± 2.78 respectively. At 3 months pain scores were significantly lower than baseline ($p$ = 0.032), while the 6-month evaluation showed pain scores returning to baseline levels ($p$ = 0.48). Three and 6 months pain scores were not significantly different ($p$ = 0.19) from one another. Ten patients (24%) had pain scores ≤ 4 at the 3-month evaluation while 7 of the patients (18%) had pain scores ≤ 4 at the 6-month evaluation (Fig. 3).

## Discussion

Cervicogenic headache is a known clinical syndrome with multiple causes but with the common thread of presenting somewhere in the C2-C3 distribution. Treatment has most often consisted of blockade of the greater occipital nerve with attempts at supra-orbital nerve block, transforaminal block, stellate ganglion block, and other various blocks including botulinum toxin injections (7-10). None of the current treatment modalities have targeted what may be the root (11) of the problem that is a traction injury to the upper part of the cervical plexus.

Anthony (5) showed that injection of depot methylprednisolone into the greater and lesser occipital nerve region produced complete headache relief in 169 out of 180 patients for a period of 10–77 days. A possible explanation of this finding was first reported by Selby (12) who described demyelination of nerves in animals that received an injection of methylprednisolone near the nerve trunk. Inan and Ates (13) showed that repeated C2/C3 and occipital nerve blocks pro-

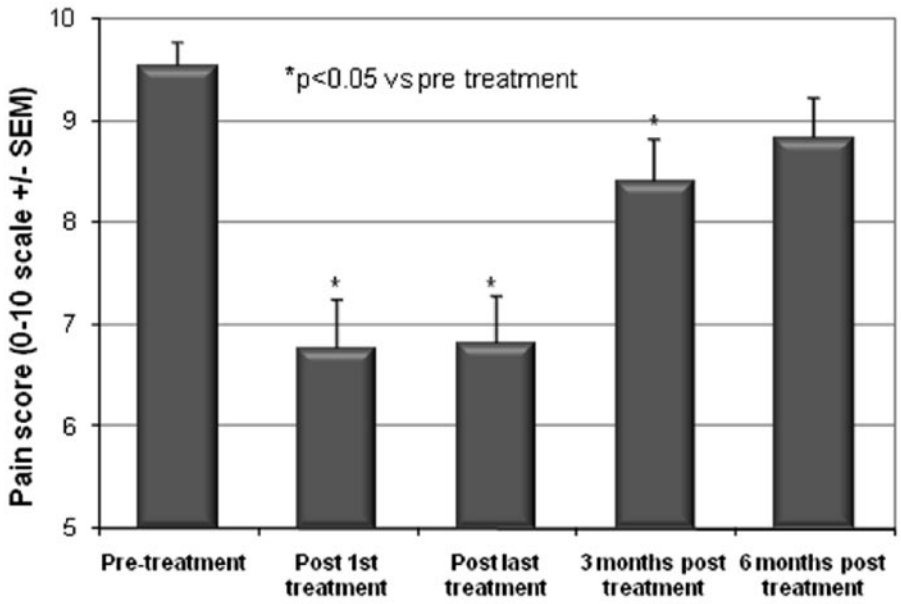


Fig. 3. *The figure illustrates the patients' mean ± SEM pain levels obtained using a 0–10 point numerical pain scale. The pain assessments were obtained by the pain nurse before treatment, post treatment (day of the first procedure), post treatment (day of the last procedure), and at 3 and 6 months post treatment.*

vided long-lasting relief and were equally efficacious in treating cervicogenic headaches. Govind et al (14) showed profound relief of limited duration with radiofrequency ablation of the C3 nerve root.

Deep cervical plexus block is in effect a paravertebral nerve block of the C2 to C4 spinal nerves. Cousins and Bridenbaugh (15) describe a 3-needle technique as the traditional approach in which insertion occurs at the levels of C2, C3, and C4. The sites of insertion are located by reference to a line that joins the tip of the mastoid process with Chassaignac's tubercle of C6, which can be palpated at the level of the cricoid cartilage. The C2 tansverse process is commonly located approximately one finger breadth caudad to the mastoid process on this line, and the C3, C4 are at similar intervals caudad to the same line. A 22-gauge spinal needle is directed medially and caudad to avoid inadvertent entry into the intervertebral foramina. The endpoint is contact with the lateral portion of the transverse process after which 3–4 mLs of local anesthetic are injected at each level. Injection of 6–8 mLs of local anesthetic at one level can achieve the same block since the paravertebral space communicates freely within the cervical region allowing adequate spread of solution to multiple levels (15).

Our block technique is a modification of the deep cervical plexus block that has been utilized to provide anesthesia to the head and neck region. The cervical foramen was not entered as demonstrated by fluoroscopy and continuous needle contact of the lateral portion of the transverse process. The block that we performed occurred more peripherally compared to a transforaminal block. It should be noted that this study was performed during a period of time when the literature was beginning to show evidence of complications after transforaminal injections with particulate steroids however this practice was not abandoned until 2006.

We therefore performed a C2-C3 deep cervical plexus block under fluoroscopic guidance to provide relief to patients with this type of atypical headache. Since the headaches were often more severe on a par-

ticular side, the number of blocks performed in each patient was generally higher for the right side as our approach was to begin treatment according to the most painful area indicated by the patient. Judging by our clinical experience, it is unlikely that results and conclusions could have differed based on treatment order as we do not believe that an interaction exists between those variables (effectiveness of treatment and right- or left-sided approach).

Our patients were referred to the pain clinic by a single neurologist who had diagnosed the traction injury and these patients had undergone conservative therapy as well as block treatments. It is apparent that for some patients this series of blocks provided effective pain relief for 3 months post-treatment but by 6 months the pain had returned to pre-treatment levels. The block had also significantly diminished the pain after the initial injection (mean pain scores of 6.75 vs 9.54 pre vs post treatments), as well as the last treatment with a mean pain score of 6.80. These clinically significant changes in pain relief suggest that more aggressive selective therapy targeting these nerve routes might provide longer lasting relief. An outpatient ketamine infusion in combination with a block might be such a technique that could be explored.

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