Retrospective Evaluation

# Cryoablation for the Treatment of Occipital Neuralgia

Chong H. Kim, MD[1], Wayne Hu, MD, PhD[2], Jeff Gao, MD[1], Kristin Dragan, MD[1], Thomas Whealton, MD[1], and Christina Julian, MD[1]

From: [1]West Virginia University School of Medicine, Department of Neurosurgery, Division of Pain Management; [2]Cleveland Clinic, Department of Psychiatry

Address Correspondence:
Chong H. Kim, MD
West Virginia University School of Medicine
Department of Neurosurgery, Division of Pain Management
1075 Van Voorhis Road
Morgantown, WV 26505
E-mail:
kimc@wvuhealthcare.com

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**Background:** Treatment of occipital neuralgia (ON) can be complex, though many treatment options exist. Cryoablation (CA) is an interventional modality that has been used successfully in chronic neuropathic conditions and is one such option.

**Objective:** To study and evaluate the efficacy and safety of cryoablation for treatment of ON.

**Study Design:** Retrospective evaluation.

**Setting:** Academic university-based pain management center.

**Methods:** All patients received local anesthetic injections for ON. Patients with greater than or equal to 50% relief and less than 2 week duration of relief were treated with CA.

**Results:** Thirty-eight pateitns with an average age of 49.6 years were included. Of the 38 patients, 20 were treated for unilateral greater ON, 10 for unilateral greater and lesser ON, and 8 for bilateral greater ON. There were 10 men and 28 women, with an average age of 45.2 years and 51.1 years, respectively. The average relief for all local anesthetic injections was 71.2%, 58.3% for patients who reported 50 – 74% relief (Group 1) and 82.75% for patients who reported greater than 75% relief (Group 2). The average improvement of pain relief with CA was 57.9% with an average duration of 6.1 months overall. Group 1 reported an average of 45.2% relief for an average of 4.1 months with CA. In comparison, Group 2 reported an average of 70.5% relief for 8.1 months. The percentage of relief ($P = 0.007$) and duration of relief ($P = 0.0006$) was significantly improved in those reporting at least 75% relief of pain with local anesthetic injections (Group 2 vs Group 1). Though no significance in improvement from CA was found in men, significance was seen in women with at least 75% benefit with local anesthetic injections in terms of duration ($P = 0.03$) and percentage ($P = 0.001$) of pain relief with CA. The average pain score prior to CA was 8 (0 – 10 visual analog scale, VAS), this improved to 4.2, improvement of 3.8 following CA at 6 months ($P = 0.03$). Of the 38 patients, 3 (7.8%) adverse effects were seen. Two patients reported post procedure neuritis and one was monitored for procedure-related hematoma.

**Limitations:** Study limitations include the retrospective nature of the study. Additionally, only the percentage of relief, pain score, and duration of relief were collected.

**Conclusions:** CA is safe, and should be considered in patients with ON.

**Key words:** Cryoablation, cryoanalgesia, occipital neuralgia, treatment, adverse effects

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Occipital neuralgia (ON) is defined by the International Headache Society as a paroxysmal stabbing pain in the distribution of the greater or lesser occipital nerves; often associated with tenderness and sometimes associated with dysesthesia in the distribution of the occipital nerve(s) (1). ON is generally unilateral, involving the greater occipital nerve in 90% of patients (2). In many cases

the etiology is unknown and believed to be idiopathic (3). There are however, many conditions that have been associated with the development of ON, including trauma to the occiput, nerve entrapment secondary to muscle spasm, spondylosis of the upper cervical vertebrae, vasculopathies such as giant cell arteritis, and mass lesions such as neuromas (2-6).

Many modalities have been utilized for the management and treatment of ON pain with varying results. The treatment of ON can be complex. Nonsteroidal anti-inflammatories and topical analgesics are commonly considered the first line therapies. Occipital nerve blocks using local anesthetics can produce relief of symptoms. However, limited duration of action can limit their utility in long-term pain management (7,8). Nerve stimulation has also been shown to provide symptom relief; however, it is invasive and can be cost prohibitive (9). More recently, pulsed radiofrequency ablation (RFA) has been proposed as a minimally invasive, reliable, long-term treatment for ON, although significant prospective evidence is lacking (10,11). For intractable cases, when all conservative modalities fail, surgical rhizotomy is considered. Many techniques have been proposed to relieve the pain of ON, each offering variable symptom relief and duration of action. No single therapy has proven superior, and currently no standard of care exists for the treatment of the chronic neuropathic pain associated with ON (12).

Cryoablation (CA) is another interventional modality that has been employed in the management of chronic neuropathic pain conditions. CA has been shown to achieve reliable pain relief with long-lasting effects. It has even been proposed as a superior technique to alcohol/phenol neurolysis or surgical rhizotomy (13). CA involves the application of a cryoprobe to tissues, resulting in a drastic temperature decrease, creating a conduction block in the nerve. These extreme low temperatures cause the formation of ice crystals around the nerve, causing damage to the vasa nervorum leading to severe endoneural edema (14-16). This profound local edema alters the nerve structure causing Wallerian Degeneration of the nerve axon, while simultaneously leaving the myelin sheath and endoneurium intact (17). This axonal damage blocks nerve conduction of afferent and efferent pain pathways, decreasing or eliminating the neuropathic pain. The efficacy of CA, including extent of pain relief and duration of effect, is proportional to the achieved cold temperature and the length of exposure to that temperature (18). The goal of this study is to review the efficacy of CA in the treatment of pain associated with ON and to identify patient variables that may predict outcome.

## Methods

### Participants

The study was approved by the West Virginia University Institutional Review Boards for Protection of Human Research Subjects (IRB). All of the included patients were 18 years of age or older and were treated for ON with CA at one institution over a 5 year period.

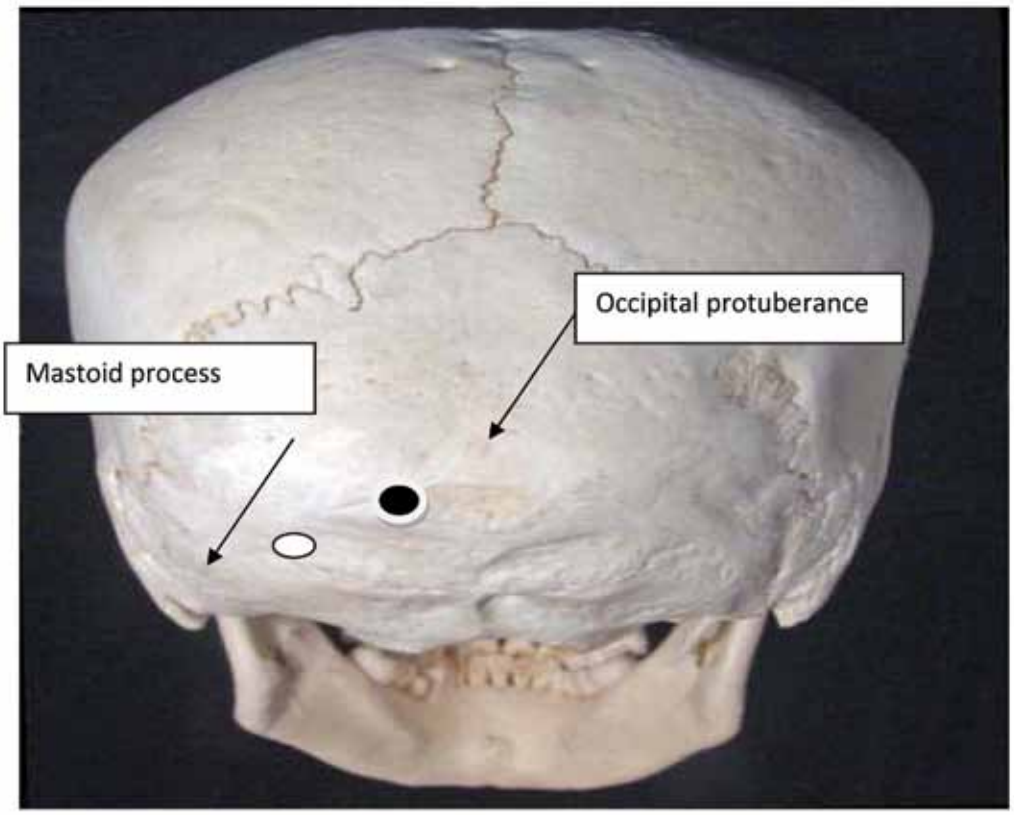
The patients were all referred from the Headache Center with the diagnosis of ON and were refractory, either limited benefit or limited duration of benefit, to conservative medical treatments (heat, cold, gabapentin, and nerve block) for at least 3 months. The patients were all re-evaluated for ON. Diagnosis was confirmed based on patient history, examination, and response to local anesthetic injections. All included patients complained of pain in the distribution of the occipital nerves, with recurring severe attacks with shooting quality. Additionally, patients had reproducible symptoms with palpation and experienced relief with local anesthetic injections.

### Procedure

All the patients were treated for ON with local anesthetic injections, for confirmation of diagnosis and for possible therapeutic benefit. Those with greater than or equal to 50% benefit with limited duration of benefit (less than 2 weeks) were offered CA. All the included patients underwent CA for ON.

The nerve blocks were performed by 3 different providers using the same technique with the patients in a seated position. The greater occipital nerve block was performed with the general landmark being ~2 cm lateral and ~1.5 cm inferior to the occipital protuberance and after reproduction of symptoms on palpation. The lesser occipital nerve block was performed with the general landmark around the lateral two-thirds point from the occipital protuberance and mastoid process and after reproduction of the symptoms on palpation (Fig. 1). One mL of 1% lidocaine was injected using a 25 gauge 1.5 inch needle. The patients had received 3 mL nerve blocks, containing 1 mL of 40 mg/mL of triamcinolone with 2 mL of 0.5% bupivicaine, at the Headache Center.

The CA was performed using the same technique by the same providers. No sedation was used until con-




White oval – Target area for lesser occipital nerve injection.
Black oval – Target area for greater occipital nerve injection.

Fig. 1. *Landmarks for greater and lesser occipital nerve blocks.*

firmation of sensory and motor testing. With the patient in a supine position, general landmarks were used for a reference starting point. The skin was marked at the point of most tenderness. After the skin was infiltrated with minimal local anesthetic with epinephrine, the 14 gauge introducer catheter was advanced until the bone was contacted. Then a 1.4 mm probe was inserted. Stimulation was checked, sensory stimulation (100 Hz), at 1 volt then lowered to 0.5 volts or less and motor stimulation (2 Hz), to 1 volt, to isolate the nerve. Once the nerve was isolated, 0.5 mL of local anesthetic with epinephrine was injected. Then the probe was reinserted and CA was performed for 3 minutes, at 800 psi ($N^2O$) with 30 seconds of thawing interval. This was repeated for a total of 3 cycles. Then 2 mL of 1% lidocaine were injected through the introducer needle prior to removal.

## Data Collection

Forty-seven patients treated for ON with CA were identified via electronic medical records using diagnosis and procedure codes. Thirty-eight patients were included. Five patients were lost to follow-up while 4 patients had incomplete medical records. All of the patients treated with CA for ON had undergone occipital nerve blocks and were noted to have at least 50% benefit with limited duration (less than 2 weeks) of benefit. Information such as gender and age were obtained. Additionally the pain score, percentage, and duration of relief following the local anesthetic injections were collected by medical chart review. All the data had been collected by one provider during scheduled office evaluations, prior to the CA, ~3 weeks post procedure, ~6 months, and ~12 months. For those requiring interval visits related to ON, data from those

visits were also reviewed and collected. Percentage and duration of relief were also collected after CA with any adverse reactions.

### Statistical Analysis

Data were analyzed with SPSS statistics 22 (New York, NY). Averages were calculated and compared. Mixed model with repeated measures was used for analysis of pain data except that Students't-test was used to analyze duration of relief. $P < 0.05$ was considered significant.

## Results

The average age was 49.6 years for the 38 patients. Of the 38 patients, 20 were treated for unilateral greater ON, 10 for unilateral greater and lesser occipital neuralgia, and 8 for bilateral greater occipital neuralgia. There were 10 men and 28 women, with an average age of 45.2 years and 51.1 years, respectively. The average relief for all local anesthetic injections was 71.2%, 58.3% for patients who reported 50 – 74% relief (Group 1) and 82.75% for patients who reported greater than 75% relief (Group 2). The average improvement of pain relief with CA was 57.9% with an average duration of 6.1 months overall (Fig. 2). Group 1 reported an average of 45.2% relief for an average of 4.1 months with CA. In comparison, Group 2 reported an average of 70.5% relief for 8.1 months (Table 1). The percentage of relief ($P = 0.007$) and duration of relief ($P = 0.0006$) were significantly improved in those reporting at least 75% relief of pain with local anesthetic injections (Group 2 vs Group 1). Though no significance in improvement from CA was found in men, significance was seen in women with at least 75% benefit with local anesthetic injections in terms of duration ($P = 0.03$) and percentage ($P = 0.001$) of pain relief with CA (Table 2). The average pain score prior to CA was 8 (0 – 10 visual analog scale, VAS), this improved to 4.2, improvement of 3.8 following CA at 6 months ($P = 0.03$). Of the 38 patients, 3 (7.8%) adverse effects were seen. Two patients reported post procedure neuritis and one was monitored for procedure-related hematoma.

## Discussion

This retrospective study reviews the use and efficacy of CA for the treatment of ON. Various studies have investigated interventional techniques for treatment of ON, including local and steroid infiltrations, with limited duration of benefit (2,11,19). With local and steroid injections, most of the patients experienced return of

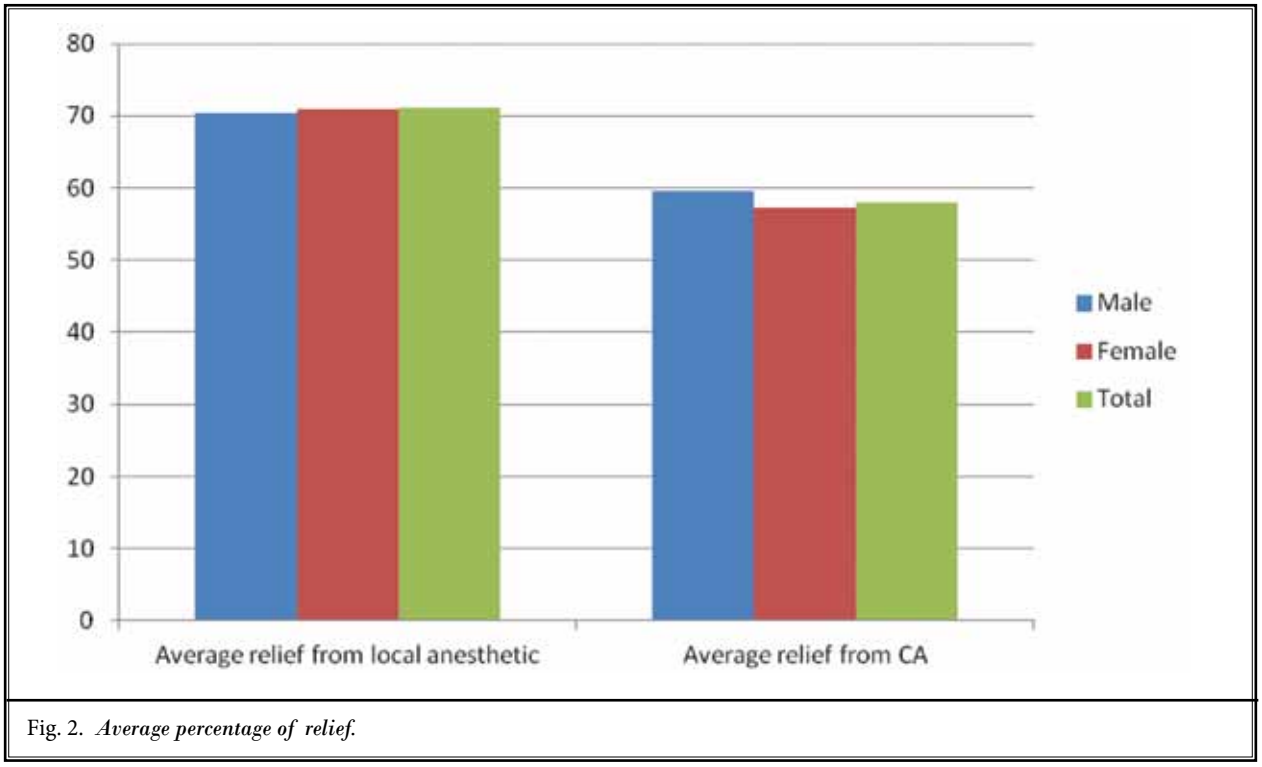



Fig. 2. *Average percentage of relief.*

Table 1. *Summary of results.*

| | Group 1* | Group 2** | *P* value | Total |
|---|---|---|---|---|
| Average relief from local anesthetic injection (%) | 58.3 (SD 9.3) | 82.75 (SD 11.0) | 0.02 | 71.2 (SD 17.7) |
| Average relief from cryoablation (%) | 45.2 (SD 25.4) | 70.5 (SD 28.5) | 0.007 | 57.9 (SD 29.6) |
| Average improvement of pain score (VAS) | 3.9 (SD 2.2) | 3.7 (SD 2.0) | 0.71 | 3.8 (SD 2.1) |
| Average duration of relief from cryoablation (months) | 4.1 (SD 3.1) | 8.1 (SD 3.8) | 0.0006 | 6.1 (SD 3.9) |

*Relief of 50% – 74% from local anesthetic injection
**Relief of > 75% from local anesthetic injection

Table 2. *Results.*

| | Men | Women | *P* value |
|---|---|---|---|
| Average relief from local anesthetic injection (%) | 70.7 (SD 14.8) | 71.4 (SD 17.7) | 0.10 |
| Average relief from cryoablation (%) | 59.5 (SD 23.6) | 57.3 (SD 31.8) | 0.42 |
| Average improvement of pain score (VAS) | 3.9 (SD 2.2) | 3.8 (SD 2.0) | 0.79 |
| Average duration of relief from cryoablation (months) | 6.4 (SD 4.1) | 6.0 (SD 4.0) | 0.22 |

pain within 2 weeks. In this study, all the patients experienced relief from the local injections, averaging 71% pain improvement overall. All of the patients included in this study noted return of pain within 2 weeks. Use of botulinum toxin type A has also been studied and shown to provide longer duration than local or steroid injections, with a mean duration of ~4 months (20,21). Pulsed radiofrequency ablation has been recently studied and has shown promising results, with benefit in the majority of patients (52.6%) at 6 months (11). In comparison, 68% of the patients noted > 50% benefit at 6 months. Overall, this study shows that CA provides significant pain relief for those who receive benefit (> 50%) with local anesthetic blocks.

On further analysis, percentage of relief from the local injection correlated strongly with the percentage and duration of relief from CA. No difference was seen in the change in pain score in the 2 groups. In Group 1 (patients who reported 50 – 74%), the average relief was 45.2% benefit with ~4 months in duration compared to 70.5% and ~8 months for Group 2 (patients who reported greater than 75% relief). However, the relief obtained with local anesthetic injection was not maintained with CA. In comparison to the CA, in terms of percent relief, local anesthetic injection provided significantly improved pain relief overall, 71% vs 58%. This was consistent in both sub-groups ($P = 0.05$ for Group 1, = 0.06 for Group 2, and $P = 0.02$ overall).

There was a significant improvement of the pain score (change from 8 to 4.2 on VAS) following CA ($P = 0.03$). Interestingly, of the 38 patients, 28 (73.7%) patients had a history of chronic headaches, such as migraines, in addition to ON. In those with isolated ON, post CA pain score was 1.9 compared to 4.2 ($P = 0.04$) with significantly improved percentage ($P = 0.03$) and duration of relief ($P = 0.04$).

All of the patients who received > 50% relief for at least 6 months were offered repeat CA upon return of symptoms. Fourteen patients underwent repeat CA, however the data is incomplete. Four patients were lost to follow-up. Six patients reported similar results from the first CA at 6 months and 2 were treated with a third CA.

Of the 38 patients, 3 (7.8%) experienced adverse effects, albeit minor, related to the procedure. Two patients (5.3%) noted neuritis, complained of sensitivity of the scalp to light touch, and were treated with gabapentin. Both patients were seen within 10 days post procedurally. At 4 weeks, both patients experienced resolution and were able to taper off the gabapentin. It is unclear if the symptoms would have resolved without treatment, as seen in radiofrequency ablation studies (22,23). Both patients noted at least 50% relief from CA for at least 6 months. Neuritis with the use of CA has been reported, though there is limited data (24). Currently, 0.5 mL of 40 mg/mL of triamcinolone is injected prior to removal of the introducer needle at the end of the CA. No reports of neuritis have been reported since. One patient was monitored for a hematoma. This patient was observed without any treatment. The hematoma resolved on subsequent follow-up a week later. Despite the adverse effects, all 3 patients noted

benefit from the CA, averaging 60% for 7 months. Overall, all 3 events were minor and without lasting sequelae. Nevertheless, the risks should be considered with the use of CA and may be a disadvantage in using CA, though more studies are needed to reach a definitive conclusion.

Due to the retrospective nature, the study is limited. Additionally, only the percentage of relief, pain score, and duration were collected. Questionnaires and validated tools in the quantification of pain and function, though dependent of subjective personal interpretations and variations, would have provided more robust data. The local anesthetic injection was performed without nerve stimulation or aid of visualization, while the CA was performed only with the aid of nerve stimulation. Finally, though the same technique was used for all the patients, 3 different practitioners performed the procedures over the 5 year period.

This study supports the use of CA for treatment of ON. The study also provides evidence for CA for ON treatment, particularly in patients who perceive greater than 75% benefit with local anesthetic injections. Additionally, the patient history of chronic headache in addition to ON is correlated to decreased prognosis. Although CA has been linked to lower incidence of neuritis, the rates may be higher. Fortunately, the symptoms were mild in severity and limited in duration.

## Conclusion

Various treatments are available for treatment of ON. CA is an effective treatment, and should be considered in patients with ON.

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