Case Report

Radiofrequency Ablation of the Sphenopalatine Ganglion Using Cone Beam Computed Tomography for Intractable Cluster Headache

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Percutaneous radiofrequency ablation (RFA) of the sphenopalatine ganglion (SPG) has been shown to be an effective modality of treatment for patients with intractable chronic cluster headaches (CHs). While the use of fluoroscopy for RFA of the SPG is common, to our knowledge there are no documented cases of procedures using cone beam computed tomography (CBCT) for image guidance. We present a case report of a patient suffering from chronic intractable CH with complete long-lasting relief after RFA of the SPG using CBCT. The case reaffirms the potential efficacy of RFA of the SPG in a case of chronic cluster headache as well as the use of CBCT as a superior alternative to bi-plane fluoroscopy for image guidance in the management of chronic CH.

Key words: Cone beam computed tomography, sphenopalatine ganglion block, cluster headache, interventional pain, autonomic cephalalgia, radiofrequency ablation

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Cluster headaches (CHs) are considered one of the most painful primary headaches. CH is a trigemino-autonomic cephalalgia with a relatively low prevalence. Pooled data analysis suggests a lifetime prevalence of one in 1000 people (1). Approximately 10% of patients have chronic symptoms (2). Typical therapies for chronic CH include administration of corticosteroids, ergotamine, lithium carbonate, methysergide maleate, calcium channel blockers, beta blockers, sumatriptan succinate, and oxygen. However, 4% – 15% of sufferers do not obtain relief (2). The sphenopalatine ganglion (SPG) has been implicated in the pathophysiology of CH (3). Therefore, a variety of interventional procedures have been developed to manage refractory cases of CH by blocking the SPG including intra- and trans-nasal lidocaine drops, nerve blocks, surgical resection, cryosurgery, and radiosurgery (4). Percutaneous radiofrequency ablation (RFA) of the SPG has been shown to be an effective modality of treatment for patients with intractable chronic CH (5). While the use of fluoroscopy for RFA of the SPG is common, to our knowledge there are no documented cases of such procedures being performed using cone beam computed tomography (CBCT) for image guidance. We present a case report of a patient with a secondary chronic intractable cluster-like headache with migrainous features who attained long-lasting relief after radiofrequency thermocoagulation of the SPG using CBCT.

Case Presentation

A 30-year-old, right-handed man was referred to our pain clinic with a history of chronic daily headaches. The patient complained of episodic unspecified headaches, which had been progressively increasing for 2 – 3 years prior to presentation, eventually becoming daily and prompting a visit to the emergency department. A magnetic resonance image (MRI) of the brain demonstrated a pituitary macroadneoma with extrasellar extension. He was referred to neurosurgery but was deemed to not be a candidate for surgical intervention. He was then referred to endocrinology and was started on medication management for a presumed prolactinoma. His headaches did not abate, and he continued to have daily headaches.

He described the headache as a continuous dull ache behind the right eye and temple, which also spread down the right side of his face to the right side

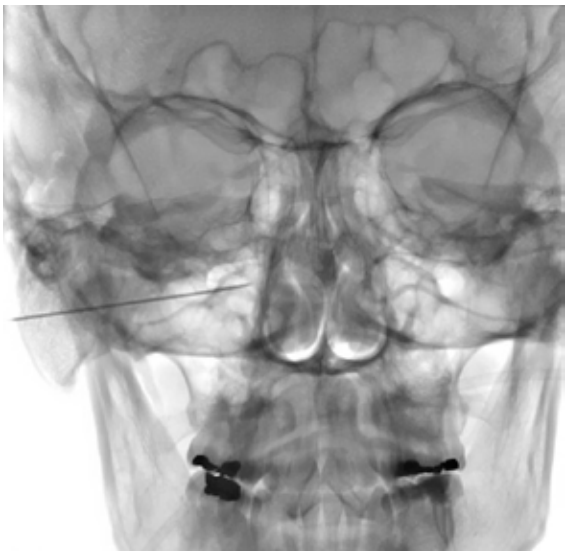

Fig. 1. *Confirmation of radiofrequency cannula tip placement for SPG ablation via CBCT scan.*

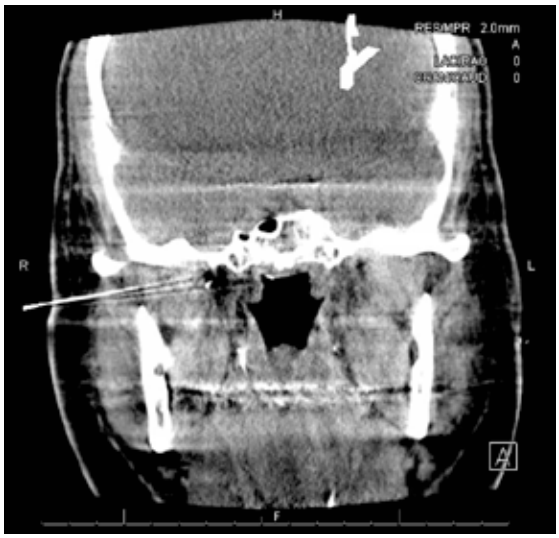

Fig. 2. *Needle placement as viewed on coronal view on cone beam CT.*

of his neck. He rated his headache as a 3/10 on the visual analog scale that worsened with exercise and exertion to 6 – 7/10 in severity; associated with nausea, photophobia, right nasal congestion, and right conjunctival injection.

The patient was assessed by the neurology department several times and consistently had an unremarkable physical examination. Because of the component of the daily unilateral headache, the patient was started on a therapeutic trial of indomethacin to rule out hemicrania continua but this did not help relieve his headaches.

The patient was eventually deemed to suffer from right-sided headaches with some migrainous and CH-like features, most likely secondary to the pituitary microadenoma and right cavernous sinus involvement. Other failed therapies included over-the-counter non-steroidal anti-inflammatory agents, loperamide, valproic acid, verapamil, home oxygen, and prednisone.

He was eventually referred to our pain clinic where he had 5 right transnasal SPG blocks with local anesthetic providing 50% – 100% relief for between 2 – 4 weeks on each occasion. Due to the consistent relief he obtained from the SPG blocks, the decision was made to attempt a RFA of the SPG to provide more long-term relief.

Procedure

For the procedure, the patient was placed in the supine position with the head inside the biplane fluoroscopy, and a true lateral view was obtained. Both the C-arm and the head of the patient were rotated until both rami of the mandible were superimposed on each other to better visualize the pterygopalatine fossa as an "inverted vase." The skin entry site overlying the fossa was marked just inferior to the zygoma and anterior to the mandible.

This area was then anesthetized with 1% lidocaine. A curved 100 mm radiofrequency cannula with a 10-mm active tip was introduced and advanced in the supero-medial direction towards the pterygopalantine fossa using lateral and antero-posterior fluoroscopy views. The tip of the needle was advanced until it was positioned just lateral to the lateral nasal wall. On contact with the lateral pterygoid plate, the needle was walked off anteriorly and cephalic to slip into the fossa. At this point, the interventional radiologist performed a CBCT scan to assess the location of the tip of the radiofrequency cannula (Figs. 1, 2). Sensory stimulation was started with 50 Hz to produce deep paresthesias behind the root of the nose at < 0.3 V. Once stimulation was achieved and prior to ablation, 0.5 mL of contrast agent was injected under real time fluoroscopy to rule

out intranasal or intravascular spread. Continuous RFA was then performed at 80° centigrade for 60 seconds.

The patient tolerated the procedure well. He had no immediate complications from the procedure. He had good pain relief for over 4 months, and underwent a repeat procedure at that time. On a 6 month follow-up since the last procedure, he reported near complete resolution of his symptoms and has been able to resume working full-time. He has not developed any major side effects including permanent or temporary hypesthesia, dysesthesia, and deafferentation pain in the oropharynx.

Discussion

CH is described as an attack of severe, unilateral, orbital, and/or supraorbital pain, lasting 50 to 180 minutes and occurring once every other day to as many as 8 times per day. The attacks are characteristically associated with one or more of the following symptoms: conjunctival injection, lacrimation, nasal congestion, rhinorrhea, forehead and facial sweating, miosis, ptosis, or eyelid edema. Attacks occur in series that typically last weeks to months (so-called cluster periods) separated by remission periods that usually last months to years (2). There are 2 types of CHs: episodic and chronic. Episodic CH occurs over periods ranging from 7 days to one year with at least a one-month pain-free period. Chronic CH occurs over the interval of more than one year without remissions or with remissions lasting under one month (6). The chronic form of CH is notorious for being resistant and for developing a loss of response to therapy.

Neuroimaging studies have shown that the hypothalamus is the primary generator in CH. Activation of parasympathetic outflow from the superior salivary nucleus of the facial nerve via the SPG, which has a rich autonomic (pre- and post-parasympathetic ganglionic axons, as well as postganglionic sympathetic axons) innervation, explains the many autonomic features associated with CHs (7). The second-order postganglionic parasympathetic neurons travel with branches of the maxillary nerve to their final destination, whereas the postganglionic sympathetic fibers pass through the SPG without synapsing and innervate blood vessels (7). The SPG can be blocked using RFA via the infrazygomatic approach under fluoroscopic guidance (8).

Sanders and Zuurmond (2) performed a retrospective analysis of patients with refractory CHs treated by RFA of the SPG. In this study, 60.7% of the episodic CH group experienced complete pain relief, whereas only 30% of the chronic CH group achieved complete pain relief (2). This study suggests RFA of the SPG may be effective for episodic CHs but not chronic CHs. However, Narouze et al (5) reported favorable results for RFA of the SPG in cases of chronic CHs and improvements in mean attack intensity and frequency for up to 18 months in 15 patients. Potential adverse effects of RFA of the SPG include hypesthesia, dysesthesia, or deafferentation pin in the palate, maxilla, or posterior pharynx. The incidence of these aforementioned adverse effects is reduced by precise needle placement prior to RFA (5).

Our presented case reaffirms the potential efficacy of RFA of the SPG in a case of chronic CH. In addition to the use of RFA for ablation of the SPG, this case demonstrates use of CBCT for image guidance. CBCT is a relatively newer technique for near real time 3-dimensional volume imaging guidance of percutaneous interventional procedures (9). CBCT consists of a cone shaped x-ray which captures a cylindrical volume of data which is also known as the "field of view" (FOV) (10). Hundreds of planar projection images are obtained from the FOV and immediate and accurate 3D radiographic images are obtained (10). This provides comprehensive appreciation of anatomy and the spatial relationships of the anatomical structures (11). Because the CBC voxels are isotropic, the produced images are geometrically accurate and image measurements are free from distortion (12).

In comparison to bi-plane fluoroscopy, CBCT offers improved anatomic visualization allowing highly accurate instrumentation placement (9). This can greatly improve accurate needle placement and thus reduce complications from RFA of the SPG. Furthermore, CBCT is relatively inexpensive and offers a safer option as it exposes less radiation to the operator and the patient compared to conventional CT. The CBCT x-ray beam is pulsatile and therefore the patient is often exposed to radiation for only a small portion of the overall scan time. In addition, the x-ray source can be collimated so that the radiation is limited to the area of interest (13,14).

Conclusion

This case demonstrates the efficacy of a RFA of the SPG as well as the use of CBCT as a superior alternative to bi-plane fluoroscopy for image guidance in the management of chronic CHs. More reports of CBCT use for image guidance are needed to eventually create guidelines on when to use CBCT during interventional pain procedures, thus aiding the decision on when it is appropriate to take a CBCT scan.

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