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Cryoneuromodulation of the sphenopalatine ganglion via transnasal approach in Sluder's syndrome: a case report

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Abstract

Sluder's neuralgia is a rare form of facial pain associated with autonomic symptoms and often refractory to conventional therapies. Cryoneuromodulation provides a minimally invasive approach capable of temporarily interrupting nociceptive transmission without permanent neural damage. We describe the case of a 41-year-old male with a 15-year history of left-sided migraine-like facial pain radiating to the nasal ala and supraorbital, frontal, and occipital regions. Symptoms included lacrimation, rhinorrhea, photophobia, and tactile hyperalgesia. A diagnostic transnasal sphenopalatine ganglion (SPG) block using 2% lidocaine resulted in complete pain remission. Due to partial recurrence, fluoroscopy-guided transnasal cryoneuromodulation at −78°C was performed for 4 minutes. Immediate and sustained relief (Numerical Rating Scale [NRS] 0) was achieved and maintained at 120-day follow-up. Fluoroscopy-guided transnasal cryoneuromodulation is a safe, effective, and well-tolerated therapeutic option for Sluder's neuralgia, offering sustained relief without neural injury. It may represent a less invasive alternative to infrazygomatic radiofrequency (RF) or stimulation approaches, with potentially improved tolerability in selected patients.

Key words: cryoneuromodulation; sphenopalatine ganglion; Sluder's neuralgia; chronic facial pain; cluster headache.

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Introduction

Sluder's neuralgia, described in 1908, is a rare but clinically significant craniofacial pain syndrome characterized by unilateral pain involving the periorbital, nasal, maxillary, and occipital regions, often accompanied by autonomic manifestations such as lacrimation, conjunctival injection, rhinorrhea, and nasal congestion.[1,2]

Although Sluder's neuralgia shares several clinical features with other trigeminal autonomic cephalalgias (TACs), including cluster headache and migraine with cranial autonomic symptoms, important distinctions exist. Cluster headache is typically characterized by strictly unilateral attacks of severe orbital or temporal pain with circadian periodicity and prominent agitation. In contrast, Sluder's neuralgia often presents with more diffuse facial radiation involving the nasal, maxillary, and occipital regions, frequently accompanied by a persistent interictal discomfort. Migraine with autonomic features may mimic these presentations but usually retains typical migrainous characteristics such as pulsatile quality, longer attack duration, and sensitivity to routine physical activity. Recognition of these differences is essential for accurate diagnosis and for identifying patients who may benefit from targeted sphenopalatine ganglion (SPG) interventions.

The SPG, located in the pterygopalatine fossa, contains autonomic, sensory, and motor fibers. It receives parasympathetic fibers from the facial nerve via the greater petrosal nerve and sympathetic fibers from the deep petrosal nerve, converging into the Vidian nerve. Its close anatomical and functional relationship with the maxillary division of the trigeminal nerve (V2) explains its pivotal role in head and facial pain syndromes.[2,3]

SPG-targeted interventions have been successfully used in cluster headache, chronic migraine, trigeminal neuralgia, Sluder's neuralgia, and neuropathic facial pain.[4-6] Available treatments include pharmacological SPG block, radiofrequency (RF) thermocoagulation, pulsed RF, cryoneuromodulation, and, more recently, SPG stimulation devices.[3,5]

Cryoneuromodulation offers the advantage of inducing temporary axonal disruption via Wallerian degeneration while preserving the epineurium and perineurium, thus avoiding permanent injury and the risk of neuroma formation.[6,7] Minimally invasive transnasal access may represent a well-tolerated alternative to infrazygomatic and computed tomography (CT)-guided approaches and may be suitable for outpatient management.

Sphenopalatine ganglion access approaches

Several anatomical approaches can be used to access the SPG, depending on the procedure's objective, the operator's expertise, and the availability of imaging guidance. The three most commonly described approaches are the transnasal, transoral, and infrazygomatic routes.

Transnasal approach

The transnasal route is commonly used and is generally considered minimally invasive. A cotton-tipped applicator or a nasopharyngeal swab soaked in local anesthetic is inserted through the nostril along the superior border of the middle turbinate until contacting the mucosa overlying the SPG. This method allows both diagnostic blocks and therapeutic procedures. When combined with fluoroscopic guidance, it enables precise advancement of instruments, such as cryoprobes, into the pterygopalatine fossa for neuromodulation procedures.

Transoral approach

The transoral approach involves advancing a dental needle through the greater palatine foramen, located in the posterior hard palate, medial to the gingival margin of the third molar. This route provides direct access to the pterygopalatine fossa but requires greater technical skill and carries increased risk of vascular injury due to proximity to the descending palatine vessels.

Infrazygomatic lateral approach (ultrasound- or CT-guided)

The lateral infrazygomatic approach accesses the SPG through the infratemporal fossa using ultrasound or computed tomography guidance. This approach allows precise needle placement within the pterygopalatine fossa for neuroablative or neuromodulatory procedures such as RF thermocoagulation. However, it is more technically demanding, requires advanced imaging, and is generally less comfortable for the patient.

Transnasal cryoneuromodulation technique

Cryoneuromodulation via the transnasal approach is performed under continuous fluoroscopy to ensure accurate localization of the SPG. A transparent silicone guide is inserted along the superior border of the middle turbinate to reach the mucosa overlying the ganglion. A cryoprobe is then advanced into the pterygopalatine fossa.

Low temperature (−78°C) is applied to temporarily interrupt sensory function through the formation of intracellular and extracellular ice crystals, leading to reversible axonal disruption without permanent neural injury. This mechanism allows gradual nerve regeneration while minimizing the risk of post-procedural neuroma.

This technique has the advantages of being minimally invasive, well-tolerated, and feasible as an outpatient procedure without the need for sedation or lateral decubitus positioning.

Case Report

A 41-year-old male presented with left-sided chronic facial pain consistent with Sluder's neuralgia. His medical history included anxiety-depressive syndrome, arterial hypertension, and prior surgical turbinate reduction.

Symptoms and clinical features

The patient reported a 15-year history of unilateral burning-stabbing pain starting in the medial periorbital region and radiating to the nasal ala, supraorbital, frontal, and occasionally occipital areas. The pain was accompanied by photophobia, phonophobia, lacrimation, rhinorrhea, and tactile hyperalgesia. Pain intensity was rated as 10 on the Numerical Rating Scale (NRS) during exacerbations and 3 during pain-free periods, with a sensation of facial heaviness.

Imaging

Facial CT (1 February 2021) showed mild mucosal thickening of ethmoidal cells and left frontal sinus, right concha bullosa, inferior turbinate hypertrophy, and left convex septal deviation.

Diagnostic intervention

A diagnostic transnasal SPG block using a 2% lidocaine-soaked swab resulted in immediate and complete pain relief (NRS 0), confirming SPG involvement.

Therapeutic intervention: cryoneuromodulation

Fifteen days after the diagnostic SPG block, the patient reported a marked clinical improvement. Pain intensity had decreased from NRS 10 to NRS 4, accompanied by residual paresthesia and a dull, pressure-like discomfort in the previously affected regions, with no further pulsating pain flares. This pattern of improvement confirmed the involvement of the SPG as the primary pain generator and supported the indication for a more durable therapeutic option. Therefore, after obtaining written informed consent, fluoroscopy-guided transnasal cryoneuromodulation was planned and performed.

The patient was positioned supine on a radiotransparent operating table with the head immobilized and the cervical spine in a neutral position. The upper limbs rested alongside the body to ensure procedural stability.

The C-arm fluoroscope was initially positioned in an anteroposterior projection over the patient's head to identify the anatomical landmarks of the pterygopalatine fossa and confirm the correct trajectory toward the SPG.

A nasopharyngeal swab soaked in contrast medium was gently introduced transnasally and positioned between the middle and inferior turbinates, enhancing fluoroscopic visualization of the target area. Following topical anesthesia with lidocaine spray, a transparent cylindrical silicone guiding sheath was inserted into the nostril on the symptomatic side. The sheath was advanced along the superior border of the middle turbinate until it made contact with the mucosa overlying the SPG within the pterygopalatine fossa.

A single-use cryoneuromodulation probe (18 G, 120 mm, triangular tip 1.3 mm), connected to the Cryo-S Painless device (Davi medica s.r.l., Rome, Italy), was then advanced through the guiding sheath. Under fluoroscopic guidance, the probe tip was carefully positioned within the pterygopalatine fossa. The C-arm was subsequently rotated into a strict lateral-lateral projection to confirm precise depth and to ensure that the probe had reached the correct anatomical location while avoiding adjacent vascular or bony structures (Figures 1 and 2).

Neurostimulation was performed, eliciting sensations of pain, pressure, heaviness, and burning across the ipsilateral nasal root and ala, zygomatic and infraorbital regions, mastoid area, and occipital region, confirming accurate SPG targeting.

Cryoneuromodulation was then applied at −78°C for a total duration of 4 minutes. At the end of the procedure, the patient reported a pain score of NRS 0.

Follow-up evaluations were performed at 30, 60, 90, and 120 days, during which the patient consistently reported complete and sustained well-being, with NRS 0 at each assessment and no recurrence of autonomic or neuropathic symptoms.

Figure 1. Anteroposterior fluoroscopic view demonstrating contrast spread within the pterygopalatine fossa, confirming accurate localization of the SPG. The radiopaque contrast delineates the target area, allowing precise visualization of the anatomical corridor used for transnasal access and ensuring correct trajectory for cryoprobe placement.

Figure 2. Lateral-lateral fluoroscopic view demonstrating accurate depth and angulation of the cryoprobe in the pterygopalatine fossa. This projection confirms the final positioning of the probe tip in proximity to the SPG, optimizing safety and procedural accuracy during cryoneuromodulation.

Discussion

The SPG plays a central role in the pathophysiology of autonomic cephalalgias and craniofacial pain syndromes due to its parasympathetic, sympathetic, and sensory components. Through its connections with the trigeminal system and its influence on cranial vasodilation, nociception, and autonomic responses, the SPG has become an important therapeutic target in conditions such as cluster headache, migraine with autonomic features, Sluder's neuralgia, and neuropathic facial pain.[2,4]

Over time, several interventional strategies have been developed to modulate SPG activity. RF thermocoagulation has demonstrated the ability to interrupt nociceptive transmission effectively, yet it may result in irreversible nerve injury, neuritis, neuroma formation, or anesthesia dolorosa.[3,8,9] Pulsed RF offers a less destructive alternative but often provides shorter and less consistent analgesia. SPG neurostimulation can achieve long-term improvement in refractory cases, although it requires implanted hardware and carries greater invasiveness and cost.[5]

Cryoneuromodulation has emerged as an intermediate approach combining efficacy with a favorable safety profile. Unlike RF, cryotherapy induces reversible axonal interruption through Wallerian degeneration while preserving the epineurium and perineurium, thereby reducing the risk of neuroma formation and allowing natural neural regeneration.[6,7] Additionally, cryoneuromodulation may offer procedural advantages, including the possibility of outpatient performance without hospitalization while allowing the patient to remain awake and cooperative during the procedure.

From a practical standpoint, the transnasal approach provides a direct anatomical pathway to the SPG and allows the procedure to be performed with the patient in the supine position, which may facilitate procedural stability and airway management. Compared with deeper lateral trajectories, this access route may facilitate probe advancement and fluoroscopic visualization while avoiding deep needle placement. These factors may contribute to improved procedural tolerability and a less invasive procedural profile.

Although the transnasal approach is generally safe and well tolerated, the proximity to the richly vascularized nasal mucosa carries a potential risk of mild epistaxis, typically related to mucosal contact during insertion of the guiding sheath and cryoprobe. Appropriate measures, including the application of soft absorbent nasal packing at the end of the procedure, ensure adequate hemostasis and reduce mucosal irritation. In the present case, nasal packing was applied

routinely, and no bleeding, mucosal injury, or other complications occurred. The patient exhibited excellent tolerability and maintained complete pain remission throughout follow-up.

This report has several limitations that should be acknowledged. First, the single-case design inherently limits the generalizability of the findings. Second, the follow-up duration remains short to intermediate, preventing conclusions about the long-term durability of the therapeutic effect. Finally, outcome assessment relied primarily on pain intensity measured by the NRS, without the use of standardized functional or quality-of-life instruments. Future studies involving larger cohorts, longer follow-up, and multidimensional outcome measures are needed to better define the role of transnasal cryoneuromodulation in Sluder's neuralgia.

Overall, this case supports the role of fluoroscopy-guided transnasal cryoneuromodulation as a safe, effective, and durable therapeutic option for Sluder's neuralgia. The sustained resolution of pain and autonomic symptoms over a 4-month follow-up period highlights the value of this technique within the spectrum of SPG-targeted interventional strategies, particularly when considering efficacy, safety, and feasibility.

Conclusions

Fluoroscopy-guided transnasal cryoneuromodulation of the SPG represents a minimally invasive therapeutic option for Sluder's neuralgia, with the potential to provide meaningful and sustained symptom relief without permanent neural injury. In this case, the procedure was well tolerated and associated with complete resolution of pain and autonomic symptoms throughout follow-up.

These findings support the role of transnasal cryoneuromodulation as a feasible component of SPG-targeted interventional strategies, particularly in patients with refractory craniofacial pain. Further studies involving larger cohorts and longer follow-up are warranted to clarify patient selection, durability of response, and integration with other neuromodulatory approaches.

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Availability of data and materials: the data supporting the findings of this study are available from the corresponding author on reasonable request.