Taming the headache tiger using Sphenopalatine Ganglion Blockade

Embolization of intracranial aneurysms
As physician co-leaders of Palmetto Health’s neuroscience service, we share a vision to provide the most advanced neurology and neurological surgery treatments available to the residents of South Carolina. We are excited to share this edition of our neuroscience journal featuring articles about new treatment options for headache sufferers, intracranial aneurysm embolization techniques, and the opening of Palmetto Health’s neuroscience intensive care unit.

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Meet our newest physicians
The sphenopalatine ganglion (SPG) is a collection of neurons that is closely associated with the trigeminal nerve, which is the main nerve involved in various headache disorders. SPG is a small triangular or heart-shaped structure, which is located superior to the pterygopalatine fossa (sphenopalatine foramen), inferior to the sphenoid sinus and maxillary nerve, and posterior to the middle turbinate in the nasal cavity. It is covered by 1-1.5 mm thick mucous membrane (figure 1). The SPG, which is the largest extracranial ganglion with multiple connections to trigeminal, facial, parasympathetic and sympathetic systems, consists of somatosensory, sympathetic, and parasympathetic fibers. The SPG has connections to the brainstem (where cluster and migraine attacks are thought to be generated) and to the meninges by the trigeminal nerve. Sterile neurogenic inflammation and opening of the blood vessels around the meninges can activate pain receptors that send pain impulses through the trigeminal nerve and eventually to the sensory area of the brain and are perceived as head pain. Specifically, in migraine and cluster headache (CH), nerves carrying these pain signals pass through the SPG, with some making connections to the autonomic nerves. In the SPG, autonomic nerves supply the lacrimal glands and the inner lining of the nose and sinuses. This also explains why in CH, and sometimes in migraine, we see autonomic features including tearing of the eyes and nasal congestion or discharge. This is called trigeminal autonomic reflex.

Since the SPG has a major role in cranial parasympathetic outflow, it has been hypothesized that modulating the activity of this ganglion may be effective in the treatment of headaches associated with prominent cranial autonomic symptoms. Based on this notion, SPG blockade was most commonly used for patients with CH in the past. The efficacy of SPG blockade for CH has been shown in a number of studies. In those studies, SPG blockade was performed by delivering a local anesthetic to the ganglion intranasally using various techniques (e.g. spraying, dropping, or local application via a long cotton swab). SPG modulation using other techniques, such as electrical stimulation, chemical neurolysis, laser, microvascular decompression and surgical or radiofrequency ablation, also has been performed for a variety of head pain conditions. However, these interventions may be associated with significant adverse effects.

More recently, several new devices (SphenoCath®, Allevio®, and Tx360®) have been developed which facilitate a more accurate and effective delivery of the local anesthetics to the SPG. Among these three devices, Tx360 is the only device that has demonstrated efficacy in a randomized, double-
Neurology-Headache Clinic, Dr. Androulakis offers Tx360 SPG blocks to patients who meet the specific criteria for this treatment. Tx360 also is an alternative migraine prophylaxis for those with chronic migraine but who could not tolerate or are unresponsive to Botox.

In a recent resting state functional MRI connectivity study, our group demonstrated that repetitive SPG block treatment in chronic migraine may improve connectivity in the executive network (including insular, thalamus, prefrontal and other regions), salience and default mode network. This increase in functional connectivity may represent a repair mechanism after effective treatment and a reorganization of the brain network in resting state, which helps to promote re-establishment of the baseline homeostasis of brain networks involved in pain processing.

Use of SPG block has been recommended by American Headache Society (AHS) as part of comprehensive headache management plan. At USC Department of Neurology-Headache Clinic, Dr. Androulakis offers Tx360 SPG blocks to patients who meet the specific criteria for this treatment. Tx360 also is an alternative migraine prophylaxis for those with chronic migraine but who could not tolerate or are unresponsive to Botox.

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Embolization of intracranial aneurysms

Case Study 1
A 70-year-old female presented with a headache and dizziness to an outside ER. She was transferred to Palmetto Health Richland where a CT Angiogram of the brain and neck was performed revealing a 2.4 x 2.2 cm. giant right cavernous internal carotid aneurysm (Figure 1a and b). Subsequent angiogram confirmed the aneurysm size and location and also demonstrated an extremely wide aneurysm neck encompassing approximately 270 degree surface area of the parent artery (Figure 2a and b). The aneurysm was treated using two telescoping Pipeline™ embolization devices, 4.75 x 30 mm., and 5.0 x 20 mm., (Covidien/Medtronic, Inc. Minneapolis, MN) followed by angioplasty using a 5 x 20 mm. HyperGlide™ balloon (Covidien/Medtronic, Inc. Minneapolis, MN). (Figure 3a, b and c) The patient was discharged four days post treatment without neurological deficit. Follow up angiography at six months demonstrated no residual aneurysm (Figures 4a and b).

Case Study 2
A 68-year-old female with a three-year history of headaches. Outside MRI (Figure 1a) and CT angiogram of the brain (Figure 1b) performed at Palmetto Health Richland demonstrate a 10 mm. parapontal segment left internal carotid artery aneurysm (Figure 1). Catheter angiogram and 3D reconstructed images (Figure 2a and b) confirm the aneurysm size and location as well as a relatively wide aneurysm neck at 6.5 mm. The aneurysm was subsequently treated using a single 4.0 x 18 mm. Pipeline™ embolization device without complication (Figure 3). Post procedure Dyna CT images demonstrate excellent wall apposition of the device (Figure 4a and b). The patient was discharged the following day without complication. Six month follow up catheter angiogram (Figure 5a) and Dyna CT images (Figure 5b) demonstrate and no residual aneurysm.
Over the past 20 years, the treatment of intracranial aneurysms has dramatically evolved. For decades prior and still today, microsurgical aneurysm clipping provides an effective treatment method with an excellent success rate in preventing re-bleeding. However, in some patients with severe bleeding, serious co-morbid medical conditions or aneurysms with difficult surgical access, the risk of surgical treatment is significant. As a result, less invasive, endovascular treatment methods have been introduced and continue to improve. In 1995, the Guglielmi Detachable Coil (GDC) was approved by the FDA for the treatment of surgically high-risk intracranial aneurysms. Since that time “coiling” of intracranial aneurysms has become a widely adopted treatment alternative to open surgical clipping. By 2006 more than 150,000 patients had been coiled. Despite advances in coil technology (including stretch resistance, biodegradable coated coils and coils with complex three-dimensional and variable shapes), as well as advanced endovascular techniques (such as stent-assisted and balloon-assisted coiling), coil embolization often is challenged with an inability to completely and permanently occlude all aneurysms, especially aneurysms that are large and wide-necked. As a result, newer devices, called “flow diverters” have emerged as a promising technique for endovascular vessel reconstruction and aneurysm therapy. Flow diverters are flexible, self-expanding, braided stents with significantly expanded metal surface area and decreased porosity relative to traditional stents. These devices redirect flow away from the aneurysm, promote stasis and delayed thrombosis within the aneurysm and reconstruct the parent artery. In contrast to coil embolization and microsurgical approaches, the aneurysm is not immediately occluded, but rather the flow diverter reduces flow into the aneurysm promoting thrombosis and eventual endothelialization. Aneurysm occlusion is subsequently achieved over time while preserving flow in the parent artery and adjacent branch (Figures 1 and 2). Two flow diverting devices currently are being used internationally, the Pipeline™ Embolization Device (Figures 1 and 2) and the Silk stent (BALT Extrusion, Montmorency, France). New flow-diverting devices such as Surpass (Stryker Neurovascular, Fremont, CA) and FRED (Microvention, Tustin, CA) currently are being evaluated in clinical trials. The Pipeline™ Embolization Device is a flow-diverting stent composed of 48 braided cobalt chromium and platinum tungsten strands resulting in a 30–35 percent metal surface area coverage when fully deployed. The device was FDA approved in April 2011 following completion of The Pipeline for Uncoilable or Failed Aneurysms study (PUFs). The PUFs trial included 108 patients with large and giant wide-necked (mean 18.2 mm) internal carotid aneurysms. Following Pipeline™ embolization, complete aneurysm occlusion was noted in 73.6 percent of patients at six months, with a relatively low rate of major complications (5.6 percent). A five year aneurysm occlusion rate of 95.2 percent was later reported with no delayed safety events and no delayed recanalization after occlusion by flow diversion. Since PUFs, multiple case studies and post market registries also have been reported (>1000 patients), which include patients with a wide variety of aneurysm locations and anatomical configurations. The results of these studies also have been excellent, with high occlusion and low complication rates.

Dual anti-platelet therapy is necessary prior to Pipeline™ deployment in order to minimize thromboembolic complications. This requirement limits the use of Pipeline™ for ruptured aneurysms. In addition, it is well documented that some patients fail to adequately respond to clopidogrel or aspirin. As a result, platelet inhibition is carefully monitored in the peri- and post-procedural period for all patients treated with Pipeline™. Treated patients are followed up with catheter angiography at six and 12 months post procedure. Typically, clopidogrel therapy is continued for six months with aspirin continued indefinitely.

Discussion

In November 2015, Palmetto Health opened its neuroscience intensive care unit, the first of its kind in the Midlands. This subspecialized unit is an 8-bed ICU dedicated to taking care of patients with neurological disorders. The ICU is staffed with neurosurgeons, neurologists and neurointensivists 24/7, concentrating on taking care of patients with neurological disorders. Furthermore, the ICU is staffed with advanced practice providers, nurses, pharmacists and team members dedicated to taking care of neurological patients. In this unit ischemic and hemorrhagic stroke patients as well as patients with brain tumors and other neurological disorders have a dedicated unit concentrating on their coordinated care. The unit is another example of the continued dedication of Palmetto Health to be the leader in neuroscience in the state of South Carolina. Plans are underway for expansion of the neuroscience ICU to 16 beds later this year.
Contact us for more information or to refer a patient

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