Interventional Headache Medicine: New Sub-speciality

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I have no relevant financial relationships with industry to disclose
Neurologists and Pain Physicians should not work in "silos" to fight headaches

Welcome 2020 and a New Journal: Annals of Headache Medicine

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According to the Center for Disease Control and Prevention and National Center for Health Statistics:
www.cdc.gov/nchs/data/series/sr_10/sr10_260.pdf:

- 14% of adults suffer from migraine or severe headache
- 14% of adults suffer from neck pain
- 5% of adults suffer from face pain

Up to 20% of patients don’t respond to or cannot tolerate medications. Therefore, multimodal interdisciplinary approach is paramount for pain relief and to improve function.
Center for Disease Control and Prevention (CDC)  
National Health Interview Survey, 2012

Migraine headaches alone affect nearly 15% of the United States population

Migraine headaches affect 24.4% of females between ages 30-39 years.

2016 Global Burden of Disease report: migraine is the leading cause of years lived with disability among ages 15 and 49 years old

The WHO headache report: up to 4% of the world’s population experience chronic migraine.

>50% of all patients with migraine report severe impairment.

20% do NOT respond to or tolerate meds
Interventional Amenable Headaches

- Chronic/Refractory Migraine
- Cervicogenic Headache
- Cluster Headache & TACs
- SIH and PDPH
- Cranial Neuralgias and Occipital Neuralgia
Peripheral Nerve Blocks and Trigger Point Injections in Headache Management – A Systematic Review and Suggestions for Future Research

Avi Ashkenazi, MD; Andrew Blumenfeld, MD; Uri Napchan, MD; Samer Narouze, MD, MSc; Brian Grosberg, MD; Robert Nett, MD; Traci DePalma, MD; Barbara Rosenthal, MD; Stewart Tepper, MD; Richard B. Lipton, MD, on behalf of the Interventional Procedures Special Interest Section of the American Headache Society

Patterns of Use of Peripheral Nerve Blocks and Trigger Point Injections Among Headache Practitioners in the USA: Results of the American Headache Society Interventional Procedure Survey (AHS-IPS)

Andrew Blumenfeld, MD; Avi Ashkenazi, MD; Brian Grosberg, MD; Uri Napchan, MD; Samer Narouze, MD; MSc, Bob Nett, MD; Traci DePalma, MD; Barbara Rosenthal, MD; Stewart Tepper, MD; Richard B. Lipton, MD
Occipital Nerve Blockade – An Evidence-Based Clinical Practice Guideline from the American Interventional Headache Society

Efficacy in different primary headache disorders
Frequency of injections
What to inject?
Difference between different techniques?
C2 DRG: Grand Station for Cervicogenic headaches
Suboccipital Block 1 (SOB-1) and Suboccipital Block 2 (SOB-2)
Samer Narouze, MD, PhD
Western Reserve Hospital, Northeast Ohio Medical School

Summary

SOB-1; injection superficial to the IOM, into the fascial plane between the SSC and IOM. This block will target the greater occipital nerve (GON) and more medially, the terminal branches of the third occipital nerve (TON).

SOB-2; injection into the fascial plane deep to the IOM. This block will target the C2 DRG, C2 nerve root, and the AAJ capsule. The injectate may spread into the anterior epidural space as well.

SOB-1 Injection Superficial to the Inferior Oblique Capitis Muscle

SOB-2 Injection Deep to the Inferior Oblique Capitis Muscle

SOB-2 Spread to C2 DRG, AAJ capsule, epidural

SSC (Rt) & IOM (Lt) Contrast Spread

17th Annual Pain Medicine Meeting
November 15-17, 2018 | San Antonio, Texas | AASFPALL18

@NarouzeMD
NEW SUBOCcipital PLANE BLOCKS (SOB)
Samer Narouze, MD, PhD

SOB-1: G.O.N. + DISTAL T.O.N. BLOCK
SOB-2: SPREAD TO C2 DRG+AAJ CAPSULE+EPIDURAL
C 2 DRG

Atlanto-occipital joint
Lateral Atlanto-axial joint
Vertebral artery
C2 dorsal root ganglion
Occipital Nerve Neurolysis

• Permanent neuroablative approaches:
  – Surgery (decompression or neurolysis)

• Neuromodulation approaches
  – Cryoneurolysis
  – Pulsed Radiofrequency Ablation (RFA)

• Improvement is seen in only 1/3 of patients
• Recurrence because of nerve regeneration

Differential Diagnosis of Cervicogenic Headache

- Atlanto-occipital joint
- Atlanto-axial joints
- C2-3 zygapophysial joint
- Upper cervical spinal nerves and roots
- C2-3 intervertebral disc
- Upper posterior neck and paravertebral muscles, trapezius, sternocleidomastoid
- Posterior cranial fossa dura
- Vertebral Artery
Trigeminal-Cervical Complex

Narouze S. Cervicogenic Headache, ASA 2006
Noxious stimulation of GON induces increased central excitability of supratentorial afferents.

Bartsch and Goadsby. Brain 2002;125, 1496-1509
Increased cervical nociception after stimulation of the dura.

Bartsch and Goadsby. Brain 2003;126, 1801-1813
Modulation of occipital input can alter brain processing of primary headaches.

Bartsch and Goadsby. Brain 2002; 125, 1496-1509
Cervicogenic Headache

- R/O myofascial pain
  - Pain with head nodding
    - Atlanto-occipital joint pain
      - Optimize conservative therapy
      - Atlanto-occipital joint injection rarely needed
  - Pain with upper C-spine movements
  - R/O lower cervical facet syndrome

- Pain with rotation of C1 over C2
  - Atlanto-axial (C1-2) joint pain
    - Atlanto-axial joint injection
    - Atlanto-axial joint RFA
  - Third occipital headache
    - Third occipital nerve block

- Pain over C3 joint whiplash injury
  - Third occipital headache
    - Third occipital nerve RFA

Narouze. Interventional Headache Management Book (Springer 2014)
Facet Medical Branch Nerve block/RFA
ACCIDENTAL VASCULAR PUNCTURE AND ABERRANT SPREAD DURING
CERVICAL MEDIAL BRANCH BLOCKS

Daniel Adams1, Sameh Hakim2, Roderick Finlayson3, Stephania Paredes4, Dmitri Souza1, Nick Knezevic4,
Patrick Connell9, Imanuel Lerman5, Alex Feoktistov6, Lynn Kohan7, Antoun Nader8, Samer Narouze1,9

1Western Reserve Hospital, Center for Pain Medicine, 2Ain Shams University, 3McGill University, 4Advocate Illinois Masonic Medical Center, 5University of California, San Diego,
6Diamond Headache Clinic, 7University of Virginia, 8Feinberg School of Medicine, 9Ohio University Heritage College of Medicine

Objective
Assess the success of the CMBB using ultrasound-guided technique in comparison to the gold standard techniques, CT scan or fluoroscopy (FL).

Background
Cervical Medial Branch Block (CMBB) is a treatment for chronic neck pain that is typically guided by fluoroscopy or CT scan. Ultrasound-guided CMBB is an emerging modality that shows advantages compared to the current standard approach.

Methods
This systematic review and meta-analysis was performed following the Preferred Reporting Items for Systematic Review and Meta-analyses (PRISMA) recommendation data. Studies were included if outcomes analyzed change in success rate, pain level change, performance time, or adverse effects (Fig. 1).

Results
• Individual analysis showed a benefit with the US technique, with fewer cases of vascular puncture due to early identification of vessels with the sonoanatomy and, therefore, prevention of the puncture. In our meta-analysis, pooling of both studies favored US over fluoroscopy (overall OR = 0.09, 95% CI = 0.01 to 0.75, z = 2.23, P = 0.03).
• No statistically significant difference was seen between other outcomes including intraarticular spread, while intra-foraminal and other aberrant spread were estimated to show no significant difference.

No statistically significant difference was seen in success of the block between US and FL.

Conclusion
Ultrasound-guided nerve block shows no differences in success rate compared to standard techniques, yet reduces cost, performance time, number of injections, local anesthetic volume, radiation dose, and the risk of intravascular injections.

Contact
dadams@westernreservehospital.org
Cervical Facet Sono-Anatomy, Sono-Pathology and Interventions

Cervical Level-Lateral Decubitus

Cervical Medial Branches: Long Axis

Cervical Medial Branches Block: Short Axis

Cervical Facet Intra-articular Injection

Cervical spine Sono-pathology
US-guided Cervical Facet Nerve Block: Systematic Review and Meta-analysis

New Targets in Headache Management
Targeting CGRP In Migraine

CGRP Antagonists – Gepants

CGRP Monoclonal Antibodies – CGRP mAb

CGRP and Related Receptor Family

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<th>Calcitonin</th>
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CL = Calcitonin receptor-Like Receptor  
RAMP = Receptor Activity Modifying Protein  
CT = Calcitonin Receptor  
RCP = Receptor Component Protein
Gepants

Figure 1. 2hr pain freedom rate based on published gepant related clinical trials.
Yuan H, Chen AY, Silberstein SD. CGRP Therapeutics For The Treatment Of Migraine – A Narrative Review. Ann Head Med 2020; 01:03.
Trigeminal nerve signals to the meningeal blood vessels by secreting neuropeptides, including CGRP, which signals through its corresponding receptor. 1,2
Frequent activation of the trigeminal system contributes to the development and maintenance of sensitization at the PNS and CNS.\textsuperscript{1,2}

**CENTRAL NERVOUS SYSTEM (CNS)**

**PERIPHERAL NERVOUS SYSTEM (PNS)**

**TRIGEMINAL GANGLION (TG)**

**TRIGEMINAL NUCLEUS CAUDALIS (TNC)**
ONS

• Occipital neuralgia

• **Primary headache disorders:**
  Migraine
  Cluster headache
  Hemicrania continua

• **Secondary headache disorders:**
  Cervicogenic headache
  C2-mediated headaches
  post-surgical headaches
Multicenter, randomized, blinded, controlled feasibility study with a follow up of 3 months.

“As a feasibility study, especially in a patient population that has been the focus of very few randomized controlled trials, no primary endpoint was prespecified”

A responder was defined as a subject who achieved a 50% or greater reduction in number of headache days/month or a three-point or greater reduction in average overall pain intensity.

Three-month responder rates were 39% for AS, 6% for PS and 0% for MM.

Lead migration occurred in 12 of 51 (24%) subjects

Infections developed in 14%
The percentages of patients who achieved a 30% and 50% reduction in headache days and/or pain intensity were 59.5% and 47.8%, respectively (not statistically significant).

Headache days were significantly reduced by 6.7 (±8.4) days in the ITT population (p < 0.001) and by 7.7 (±8.7) days in the ICM population (p < 0.001).

MIDAS and Zung PAD scores were significantly reduced for both populations.
Analysis of Adverse Events in the Management of Chronic Migraine by Peripheral Nerve Stimulation

Ashwini Sharan, MD*; Billy Huh, MD, PhD†; Samer Narouze, MD, PhD‡; Terrence Trentman, MD§; Alon Mogilner, MD, PhD§; Julien Vaisman, MD**; Joe Ordia, MD††; Timothy Deer, MD††; Lalit Venkatesan, PhD‡‡; Konstantin Slavin, MD§§

PNS IMPLANT-RELATED ADDITIONAL SURGERIES

- NPPIP > 10 Surgeries (n = 36)
- NPPIP = 6 to 10 Surgeries (n = 49)
- NPPIP = 0 to 5 Surgeries (n = 72)

STIMULATION-RELATED AEs

- NPPIP > 10 Surgeries (n = 36)
- NPPIP = 6 to 10 Surgeries (n = 49)
- NPPIP = 0 to 5 Surgeries (n = 72)

BIOLOGICAL AEs

- NPPIP > 10 Surgeries (n = 36)
- NPPIP = 6 to 10 Surgeries (n = 49)
- NPPIP = 0 to 5 Surgeries (n = 72)

HARDWARE-RELATED AEs

- NPPIP > 10 Surgeries (n = 36)
- NPPIP = 6 to 10 Surgeries (n = 49)
- NPPIP = 0 to 5 Surgeries (n = 72)
Analysis of Adverse Events in the Management of Chronic Migraine by Peripheral Nerve Stimulation

![Bar chart showing adverse event incidence rates for different conditions and patient groups.](http://onlinelibrary.wiley.com/doi/10.1111/ner.12243/full#ner12243-fig-0003)
Where to place the lead??
Occipital ridge vs C1/2
The need for New Targets

• Burden of chronic headaches

• ONS: RCT are equivocal!!

Sanders M, Zuurmond W. J Neurosurg 1997; 87:876-880
Headache and the SPG

JC DEVOGHEL.

Cluster headache and sphenopalatine block.

SPG activation provokes cluster-like attacks

METHODS:

double-blind randomized cross-over study, seven CH patients implanted with an SPG neurostimulator were randomly allocated to receive HF or LF stimulation for 3 min on 2 separate days.

DISCUSSION:

LF SPG stimulation may induce cluster-like attacks with autonomic features, which can subsequently be treated by HF SPG stimulation.

Efferent parasympathetic outflow from the SPG may initiate autonomic symptoms and activate trigeminovascular sensory afferents, which may initiate the onset of pain associated with CH.
Sphenopalatine ganglion neurostimulation


SPG Permanent Implant
Stimulation of the sphenopalatine ganglion (SPG) for cluster headache treatment. Pathway CH-1: A randomized, sham-controlled study

Jean Schoenen¹, Rigmor Højland Jensen², Michel Lantéri-Minet³, Miguel JA Láinez⁴, Charly Gaul⁵, Amy M Goodman⁶, Anthony Caparso⁶ and Arne May⁷

Neurostimulation in cluster headache: A review of current progress

Jeppe L Pedersen, Mads Barloese and Rigmor H Jensen
PATHWAY CH-1: RESPONDER ANALYSIS

Safety Analysis

- 32 enrolled / underwent implantation procedure
- 4 safety analysis only
  - 1 failure to implant
  - 2 explanted (lead migration)
  - 1 skipped experimental period (pregnant)

Efficacy Analysis

- 28 completed experimental period
- 68% Responders
- 32% Non-Responders
  - 25% Acute Responders
  - 7% Acute & Frequency Responders
  - 36% Frequency Responders
Cranial Para-sympathetic Innervations: SPG
Lesser Petrosal Nerve & Otic ganglion Block/RFA

Lesser Petrosal Nerve Block/RFA

Too Early to Celebrate!!
Non-invasive Devices

Transcutaneous Supraorbital Neurostimulator (tSNS)

Non-invasive Vagal Neurostimulator (nVNS)

Transcranial Magnetic Stimulation


Vagus nerve stimulation for primary headache disorders: An anatomical review to explain a clinical phenomenon

Dylan Jozef Hendrik Augustinus Henssen¹,² ***, Berend Derks¹, Mats van Doorn¹, Niels Verhooft¹, Anne-Marie Van Cappellen van Walsum¹, Peter Staats³ and Kris Vissers⁴

A systematic literature review of VNS in primary headache

12 clinical trials were included, total of 866 patients

Article highlights

- nVNS is a moderately effective, safe and well-tolerated therapy for migraine and cluster headache.
- In animals, connections between the trigeminal and vagus systems were found at the level of the brainstem. These connections could contribute to the neural underpinnings of nVNS in primary headache disorders.
- The existence of a trigeminovagal complex remains elusive in humans.
Vagus Nerve Stimulation

Increased release of inhibitory neurotransmitters in CNS
Inhibition of over expression of Glutamate

EVENT study 2014
Vagal nerve stimulation (VNS)

DOI 10.1007/s10072-009-0073-3

ORAL COMMUNICATION

Vagus nerve stimulation in drug-resistant daily chronic migraine with depression: preliminary data

Alberto Proietti Cecchini · Eliana Mea · Vincenzo Tullo · Marcella Curone · Angelo Franzini · Giovanni Broggi · Mario Savino · Gennaro Bussone · Massimo Leone
Transcutaneous Supraorbital Nerve Stimulator - Cefaly

- Should be used for 20 minutes, daily
- 54% of satisfied patients
- Reduced migraine days and medication use (p<0.05)
  - 67 patients only
  - -2.06 headaches/month (p<0.023)
- Low SE profile:
  - Paresthesias - 2%
  - Fatigue - 0.9%
Single-pulse Transcranial Magnetic stimulation

TMS inhibits cortical spreading depression

Inhibits nociceptive thalamocortical projection neurons
Mapping migraine to a common brain network

Matthew J. Burke,1,2,3 Juho Jouts,1,4,5 Alexander L. Cohen,1,6 Louis Soussand,1
Danielle Cooke,1 Rami Burstein1 and Michael D. Fox1,8,9

Figure 4 Visual cortex V3/V4 analyses and network connectivity. (A) From left to right: Region of 100% connectivity overlap in the left.

Figure 6 Simulation of electric fields using an oval TMS coil placed on the back of the head for the treatment of migraine. Simulation was based on estimating eNeura sTMS coil geometry and positioning used for the FDA-approved treatment of
Trigeminal Ganglion Procedures
PNS
Trigeminal Neuropathic Pain
Headache Board Review Courses

Cleveland October 9-11 2020

American Board of Headache Medicine

(May 17th 2020)

AIHS Cadaver Workshop-Board Review
Chicago May 16-17 2020

AIHS Boot Camp-Board Review
Observing Live Head & Neck Procedures
Akron, OH, October 9th 2020
Thank you
@NarouzeMD
SOB-1
Injection *Superficial* to the Inferior Oblique Capitis Muscle
SOB-2
Injection Deep to the Inferior Oblique Capitis Muscle
SOB-1 and SOB-2
IOM Contrast Spread

SSC^(Rt) & IOM^(Lt) Contrast Spread
SOB-2

Spread to C2 DRG, AAJ capsule, epidural