Abstracts

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Abstracts printed below are shown in their originally submitted form.

1st Place

Cytochrome P450 2D6 Genotype Test: A New Tool for the Pain Physician

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Background: Over the last decade there has been an increase in the prescription use of opioids for chronic non-cancer pain management. Manchikanti et al has shown that over the last 10 years there has been an increase of 149% in retail sales of opioids from 1997 to 2007 (1).This dramatic rise in the prescription use of opioids is riddled with potential abuse, diversion and addiction issues. The pain physician must weigh the risks versus benefits of pain management with chronic opioid therapy. This "balancing act" of providing pain relief with opioid analgesia while minimizing the overuse or abuse of opioid medications is a very difficult task and can be even more challenging to the non-pain specialist. In a recent comprehensive review article, Christo et al reported that drug abuse in patients who were prescribed opioid medications for chronic pain range from 18% to 41% (2). In context of such circumstances, the availability of tools to help the physician monitor for the patient's responsible medication use is vital. A review article by Manchikanti et al. describes 12 different tools to monitor opioid adherence, but indicates that there is no one single test/questionnaire that has been uniformly accepted nor can be applied to all aspects of pain management (3).

The urine drug test (UDT) is a commonly used test that is considered by pain specialists as the "gold standard" for monitoring patient adherence to opioid treatment. This instrument is easy to use, inexpensive and allows for the presence or absence of certain drugs to be evaluated with good specificity and sensitivity (4). The UDT is a powerful tool available to the pain physician but it does have its limitations. Nafzinger and Bertino describe such limitations which include variable test results that are influenced by variability in pharmacokinetics, pharmacodynamics (pharmacologic effects), pharmacogenetics (the effect of genetics and the environment on pharmacokinetics and pharmacodynamics), and issues relating to the collection, handling, and assay methodologies for urine (5).Above all, the education and training of how to properly interpret the results is probably the major limitation of the UDT. In a review article by Christo et al, he reports that medical students and residents receive poor training and that practitioners are unfamiliar with the applications and implications of UDTs (6).This is an important factor to consider as UDTs continue to be a growing integral part of patient care and management. When examining the results of a UDT, the inexperienced physician may not understand or properly interpret the results, especially the reported levels of prodrug drug and metabolites. An understanding of the pharmacokinetics, the pharmacodynamics and the pharmacogenetics of the drugs

in question is instrumental in the physician's ability to interpret UDT results correctly.

As you will see in the presented case report our patient's UDT was inconsistent with her prescribed medication. We were able to decipher her clinical symptoms of poor pain relief coupled with her UDT to order further testing to explore possible inherent metabolic enzyme defects. We performed the Cytochrome P450 assay to explore metabolic effects, such as metabolic impairments resulting from polymorphisms, in great detail to explain the inconsistency in her UDT. We present this unique case report to educate and inform our colleagues of new testing to resolve/explain possible inconsistencies related to UDTs when warranted.

Objective: We present this case report to educate and inform the pain community of the ability to add yet another crucial tool in the management of patients who are prescribed narcotic medications. As with any diagnostic exam or clinical evaluation the "overall picture" must be taken into account as any single exam or test is insufficient to correct the problem at hand. Therefore, it is imperative that physicians have a strong foundation in interpreting UDTs and their associated limitations. The Cytochrome P450 2D6 Genotype test will be of little importance and the patient may be mismanaged without a clear understanding of the basic principles of pharmacology. It is our belief that the Cytochrome P450 2D6 Genotype test offered by Quest Diagnostics will aid in clarifying any ambiguity of an "inconsistent" UDT associated with a prodrug and its metabolites. This test will help the physician adequately treat and manage chronic pain patients that are either displaying "inconsistent" UDTs or that are claiming no relief from a CYP2D6 influenced medication.

Methods: Our patient is a 35-year-old woman with a past medical history significant for chronic back pain, multiple sclerosis, urinary incontinence and depression who was referred to the Stony Brook University Medical Center for Pain Management by another pain physician after being prescribed hydrocodone/acetaminophen 10/325 for her intractable low back pain. The patient had undergone thoraco-lumbar fusion for scoliosis as a teenager and subsequently received three caudal epidural steroid injections and sacroiliac joint injections by her previous physician with no relief and continued to use up to 8 hydrocodone 10/325 per day with little pain relief. Upon her referral, a 10-drug screening UDT was performed and Quest Diagnostics confirmed the results as "inconsistent." The inactive prodrug, Hydrocodone, was detected in her urine, but its active metabolite, hydromorphone, was not. The patient assured The Pain Management Team that she consistently took her opioid medication daily as prescribed. A repeat UDT with Quest Diagnostics confirmation was obtained, and the results were "consistent" but with aberrations; the produrg, hydrocodone, was at acceptable levels, however the active metabolite, hydromorphone, was present well below anticipated levels consistent with her norco regimen. In light of her unusual UDTs results and the overall clinical picture, the pain team was suspicious that there may be an issue with the enzymes that metabolize hydrocodone. Therefore a new Cytochrome P450 (CYP) CYP2D6 / CYP2C19 Genotype test was performed with the patient's consent. The results revealed that she is an intermediate metabolizer because she contains one non-functional allele and one poor functioning allele resulting in decreased metabolic activity of substrates of the CYP2D6 enzyme. She was recommended to avoid hydrocodone and oxycodone. She was prescribed hydromorphone 2 mg every 3 to 4 hours which improved her pain relief dramatically.

Conclusions: Just as absorption and distribution vary from individual to individual, so does metabolism. It is known that key enzymes for the metabolism of many opioids can exhibit genetic variations from one patient to another. Cytochrome P450 enzymes are essential to oxidative drug metabolism and eliminate about 50% of commonly used medications (7).In our presented case report Hydrocodone is metabolized by more than one CYP substrate (CYP2D6 & CYP3A) which is often the case; however, the CYP2D6 enzyme, which may have the largest impact on medications, is responsible for the metabolism of approximately 25% of drugs including antidepressants, antipsychotics, antiemetics, cardiovascular drugs, dextromethorphan, tamoxifen, and pain medications: codeine, hydrocodone, oxycodone, tramadol and R-methadone. The CYP2D6 enzyme is encoded by a highly polymorphic gene located on chromosome 22 with greater than 60 alleles which can result in a broad range of genotypes that present with four different phenotype categories: 1. Extensive metabolizers, 2. Intermediate metabolizers, 3. Poor metabolizers, and 4. Ultra rapid metabolizers (8). The clinical implications of such variations, as in the case of genetic polymorphisms, will lead to irregular UDT results which may be misinterpreted by the physician as a "positive", "inconsistent" or "negative" test. For example, cytochrome P450 enzymes or phase I CYPs such as CYP2D6, CYP2C9 or CYP2C19 will affect the conversion of an inactive prodrug to its active form or metabolite. In certain patient populations of poor or intermediate drug metabolizers, and in the presented case, the inactive prodrug is

not metabolized well to its active metabolite which will result in no and/or low active metabolites of the drug in the UDT, as seen in the presented patient's UDTs. Consequently, the patient may require a higher dosing regimen than normal of the parent drug for clinically relevant analgesia therapy i.e. an increase the inactive prodrug hyrdocodone and its active metabolite hydromorphone; however, this carries risks in its own right. By having the availability of the Cytochrome P450 (CYP) CYP2D6 / CYP2C19 Genotype test by Quest Diagnostics the Pain Team was able to properly target her P450 enzymes using medication, hydromorphone, which adequately addressed the patient's chronic pain. The report by Quest diagnostics details the break down and effect that a CYP2D6 intermediate metabolizer has on various opioids and their metabolites. The report even goes as far as suggesting alternative opioid medications that may be considered because they do not involve the CYP2D6 enzyme. Not only does this specific enzymatic test provide crucial information for the pharmacokinetics of a specific patient it is also able to confirm that no such abuse or diversion was taking place, providing peace of mind to an always present concern. While this test has its uses and place within pain management it should not be a substitute for any other questionnaire or test required by standard of care, but should be seen as a useful adjunct when appropriate. Like all tests it is limited by what it does, as in the Cytochrome P450 (CYP) CYP2D6 / CYP2C19 Genotype test by Quest Diagnostics this blood test only examines the CYP2D6 & CYP2C19 enzymes and as seen in Table 1 there are many others that may play an important role in pain medication therapy. Therefore we reiterate that proper training and knowledge are an important factor in the decision process for ordering and interpreting this new P450 enzymatic blood test.

Disclosure: Department of Anesthesiology, Stony Brook University

References

1. Manchikanti L, Fellows B, Ailinani H, Pampati V. Therapeutic use, abuse, and nonmedical use of opioids: A ten year perspective. Pain Physician 2010; 13:401-435.
2. Christo PJ, Manchikanti L, Ruan X, Hansen H, Solanki DR, Jordan AE, Colson J. Urine drug testing in chronic pain. Pain Physician 2011; 14:123-144.
3. Solanki DR, Koyyalagunta D, Shah RV, Silverman SM, Manchikanti L. Monitoring opioid adherence in chronic pain patients: Assessment of risk of substance abuse. Pain Physician 2011; 14:E119-E131.
4. Manchikanti L, Malla Y, Wargo B, Cash K, Pampati V, Damron K, McManus C, Brandon D. Protocol for accuracy of point of care (POC) or in-office urine drug testing (immunoassay) in chronic pain patients: A prospective analysis of immunoassay and liquid chromatography tandem mass spectometry (LC/MS/MS). Pain Physician 2010; 13:E1-E22.
5. Nafziger AN, Bertino JS. Utility and application of urine drug testing in chronic pain management with opioids. Clin J Pain 2009; 25:73-79.
6. C hristo PJ, Manchikanti L, Ruan X, Hansen H, Solanki DR, Jordan AE, Colson J. Urine drug testing in chronic pain. Pain Physician 2011; 14:123-144.
7. Wilkinson GR. Drug metabolism and variability among patients in drug response. N Engl J Med. 2005;352:2211–2221.
8. Foster, A., Mobley, E. and Wang, Z. (2007), Complicated Pain Management in a CYP450 2D6 Poor Metabolizer. Pain Practice, 7: 352–356. doi: 10.1111/j.1533-2500.2007.

2nd Place

Outpatient Percutaneous Thoracic Endoscopic Discectomy (PETD) For Herniated Thoracic Disc with Thecal Sac Adhesions: Case Report and Review of Literature

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Background: Surgical treatment of thoracic disc disease remains a challenge. Because outcomes from thoracic laminectomy have been poor, modern posterolateral and lateral approaches have evolved to replace this older procedure. However, all approaches have a relatively high morbidity. Additionally, with thecal sac adhesions, any procedure carries with it the risk of thecal sac injury and potential or actual dural tears. Most

surgical options require hospitalization and require extensive post operative rehabilitation.

Objective: To demonstrate the basis for considering a framework of how to treat challenging thoracic disc herniations.

Case Report: A 31-year-old white female developed right sided thoracic pain following a ski accident. MRI of the thoracic spine revealed a small superiorly extruded component of disc material at T10-11, extending to mid T10 vertebral body. At T11-12, a left sided disc bulge was present with a small central superiorly extruded component. At T12-L1, a right sided disc extrusion was present with adhesions to the thecal sac and with mild flattening of the spinal cord. Initial surgical opinion was an anterior thoracic discectomy and fusion with thoracotomy. The patient was hesitant to undergo the extensive surgery. Subsequently, she underwent a series of conservative measures including two rounds of physical therapy, epidural steroid injections, thoracic medial branch blocks and radiofrequency ablation of the thoracic medial branches, all with limited success. A thoracic discogram was performed which revealed concordant discograms at T12-L1 and T11-12. Various surgical options were discussed, and the patient chose to have a Percutaneous Endoscopic Thoracic Discectomy (PETD). Preoperative planning included planning options to minimize thecal sac injury, and careful review of MRI and CT discogram. Endoscopic discectomy was carried out with a Storz endoscope system using a posterolateral approach on the right side at T12-L1. An 18 G 10 inch needle was advanced into the posterolateral margin of the disc, indigo carmine contrast was injected into the disc. A guidewire was inserted through the needle, the needle was removed and a stab incision was made into the back. Over the guidewire, a blunt dilator was advanced under fluoroscopic control into the posterior lateral margin of the disc and over the dilator a 9 mm sheath was then advanced. Next, through the sheath a working endoscope was inserted under fluoroscopic and video guidance. A surgical decompression was carried out using microforceps and bipolar radiofrequency probe for thermal ablation of the annulus. Good visualization of the exiting nerve root was obtained. This was seen to be pulsating and without any evidence of dural tears.

Discussion: Several anatomic features increase complexities in management of thoracic disc herniations. The thoracic spine is normally kyphotic and the spinal cord runs close to the posterior elements of the vertebral bodies. Tethering of the spinal roots by dentate ligaments limits mobility of the spinal cord to drift away from anterior impingement. The spinal cord diameter to canal diameter ratio is higher in the thoracic area compared to the lumbar and cervical areas, leaving less room for the spinal cord in case of stenosis. The thoracic spinal cord is vulnerable to ischemic injury due to poor blood supply ("watershed zone"). In contrast to cervical and lumbar disc herniations, thoracic disc herniations are more frequently centrally located, and calcify more frequently. They may be adherent to and even erode over the dural sac over a period of time, as was present in our case. Posterior and posterolateral approaches allow indirect decompression of the spinal cord, unless the disc herniation is posterolateral, and thereby carry the risk of inadvertent spinal cord injury. Anterior approaches (conventional thoracotomy, mini thoracotomy and thoracoscopy) allow excellent visualization and direct decompression of the spinal cord; however, pulmonary compromise is frequent. All open approaches include the need for hospitalization, possibility of peri-operative complications (bleeding) and insertion of a chest tube or drains. Conventional posterior or posterolateral approaches in our case would have needed retraction of the dura and possible complications to get access to the herniated disc. Considering these factors and the need for the patient to return to an active lifestyle, as well as to offer a minimally invasive option, we decided to perform a PETD. Several critical planning steps were necessary to have an optimal outcome. A thoracic discogram was absolutely essential for us to plan the level of surgery. Next, preoperative planning included review of the MRI as well as the CT discogram to plan the access point. We were able to identify a window between 5 and 9 cm from midline as the ideal window to get access to the disc. Review of the MRI also revealed a segmental blood vessel at the intended area of access on the right side. Therefore, initial access with the guide wire was performed very carefully. Next, considering the adhesions with the dura, we felt it would be more prudent to achieve an "inside out" decompression instead of a direct access to the disc that would potentially compromise the thecal sac. Decompression was carried out with an endoscopic approach, with the availability of an Elmann RF probe and a laser probe, and the bleeding was minimal. The entire operation was performed in an outpatient setting, with no drains or chest tubes inserted. No retraction of the spinal cord was necessary.

Conclusions: All these thoughtful steps thus led to an excellent outcome, and provide the basis for consid-

ering a framework of how to treat challenging thoracic disc herniations in a minimally invasive outpatient technique, without the need for hospitalization or bleeding complications and without retraction of the spinal cord even in the presence of significant adhesions to the dural sac.

References

1. Choi KY et al. Percutaneous Endoscopic Thoracic Discectomy: Transforaminal approach. Minim Invas Neurosurg 2010; 53; 25-28.
2. Deviren V, Kuelling FA, Poulter G, Pekmezci M. Minimal invasive anterolateral transthoracic transpleural approach. J Spinal Disord Tech 2011; 24(5): E40-48.
3. Mulier S, Dubois V. Thoracic disc herniations: transthoracic, lateral or posterolateral approaches? A review. Surg Neurol 1998; 49: 606-608.
4. Chi JH, Dhall SS, Kanter AS, et al. The mini-open transpedicular thoracic discectomy: surgical technique and assessment. Neurosurg Focus 2008; 25: 1-5.
5. Anand N, Regan JJ. Video assisted thoracoscopic surgery for the thoracic disc disease: classification and outcome study of 100 consequtive cases with a 2 year minimum follow-up period. Spine 2002; 27: 871-879.
6. McAfee PC, Regan JR, Zdeblink T, et al. The incidence of complications in endoscopic anterior thoracolumbar spinal reconstructive surgery: a prospective multicenter study comprising the first 100 consecutive cases. Spine 1995; 20: 1624- 1632.

3rd Place

Percutaneous Arthrodesis of the Lumbar Facet Joint with Use of Bone Cement in the Cadaveric Veal Spine

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Background: Facet joint pathology is one of the leading causes of chronic low back pain (1-3). Lumbar facet instability can be a source of low back pain and facet effusions have been used as radiological correlate to diagnose abnormal lumbar facet motion and increased lumbar facet joint space in degenerative spondylolisthesis (4-7). Current conservative treatment modalities for symptomatic segmental instability consist of early stage symptomatic analgesic therapy with facet joint injections, aspirations, and radiofrequency ablation. Recalcitrant facet pain can be treated with surgical instrumentation involving stabilization, or arthroplasty; however, these techniques are not the standard of care (8). Here, we are introducing the idea of a new, minimally invasive treatment modality for facet instability. In our animal cadaveric study, we achieved a percutaneous arthrodesis of the facet joints with the use of bone cement in veal cadaver spine.

Objective: To explore the possibility of a new, minimally invasive technique to address lumbar facet instability, by filling the facet joint with bone cement.

Methods: Intact veal cadaver spine with no visible signs of facet capsular tears or facet joint fractures was used. Individual joint mobility was assessed with manual distraction commensurate with the joint lines. Joints were identified as non distractible (<0.5 mm–group 1) and moderately distractible (0.5 to 1 mm–group 2). Five joints were chosen from each group. An 18-gauge needle was placed into the zygapophyseal joint and position was confirmed under fluoroscopy. 0.5 mL of contrast outlined the facet joint and confirmed articular space cannulation. Medical bone cement was mixed and prepared using 20 grams powder (polymethylmethacrylate 69%, benzoyl peroxide 0.6%, barium sulfate 30%) and 9.2 g of solvent (methylmethacrylate 98%, N:N dimethyl-ptoluidine 2%, hydroquinone 20 ppm). The ingredients were mixed manually for one minute using standard mixing protocol. Thereafter, 1 to 2 mL of the radiopaque bone cement mixture was injected with the use of a compatible bone cement injector system. The injection was stopped when a firm endpoint was reached. Successful filling of the zygapophyseal joint was again confirmed using fluoroscopic guidance. The cement was allowed to harden for 10 minutes. Manual traction of the joint was then applied to confirm joint arthrodesis. This methodology was reproduced on several different occasions.

For final anatomical confirmation, the soft tissue (including capsule and cartilage) was debulked from the spine segments by boiling the samples followed by manual soft tissue removal. Bone and bone cement were the remaining structural elements; this heat treatment allowed unobstructed observation of the intra-articular bone cement and facets.

Results: Cannulation and injection of all facets were achieved using a slow injection technique; however, the amount of cement injected was dependent on the group type. Group 1 joints accepted less than 0.3 mL of volume with no change in manual distractibility after 10 minutes of cement hardening. Group 2 joints filled with approximately 1 mL of cement before a firm endpoint was reached; bulging of the joint capsule was concomitantly observed. Fluoroscopy confirmed equal and complete filling of these joints. After hardening of the cement, three-dimensional mobility of the spinal segments was significantly restricted compared to pre-injection mobility. After removal of all soft tissue from the heat treated spinal segments, an exact model of the joint spaces was formed by the bone cement, confirming articular surfacing and capsular filling. Arthrodesis was only successful in all moderately distractible joints.

Discussion: Low back pain due to facet instability is a relatively common condition and can have different etiologies. The three most common factors are isthmic fractures, degenerative facets, and post-operative peri-instrumentation having prevalences that approximate 7%, 8%, and 13% (4, 9). Physical therapy, oral medications, and local injections are the most frequently prescribed treatment modalities. Surgery is considered when conservative treatment fails, yet there is no consensus on when to proceed and which type of surgery should be performed for this condition (8).

Here, we present a new approach for performing a percutaneous arthrodesis of the facet joint in an animal cadaveric model. The role of this treatment is not known in humans and the reproducibility and safety in living subjects is not yet established. Therefore, human subject consideration warrants further research and investigation. We are not promoting a new minimally invasive technique as a replacement for surgery but rather suggesting that this technically feasible form of stabilization may be used in a select cohort with mild facet instability refractory to conservative management. As this is obviously an early stage animal cadaveric study without biomechanical measurements, there are many questions that arise from our animal setup.

Conclusion: There is evidence supporting a biomechanical correlation with pain eliciting properties between facet instability and degenerative spondylolisthesis. However, the standard of care for this condition remains elusive. We present a technically feasible, percutaneous semi-mobile arthrodesis of the facet joint in an animal cadaveric model that may guide future interventional pain management of unstable degenerative facet arthropathy.

Disclosure: Bone cement donated by Cook Medical.

References

1. Chaput C, Padon D, Rush J et al. The significance of increased fluid signal on magnetic resonance imaging in lumbar facets in relationship to degenerative spondylolisthesis. Spine 2007:17:1883–1887.
2. Merskey H, Bogduk N. Classification of Chronic Pain: Descriptions of Chronic Pain Syndromes and Definitions of Pain Terms. 2nd ed. Seattle: IASP Press; 1994.
3. S ehgal N, Shah RV, McKenzie-Brown A, et al. Diagnostic utility of facet (zygapophyseal) joint injections in chronic spinal pain: a systematic review of evidence. Pain Physician. 2005:8:211–224.
4. Berven S, Tay BB, Colman W, Hu SS. The lumbar zygapophyseal (facet) joints: a role in the pathogenesis of spinal pain syndromes and degenerative spondylolisthesis. Semin Neurol. 2002:22(2):187-96.
5. Oishi Y, Murase M, Hayashi Y, Ogawa T, Hamawaki J. Smaller facet effusion in association with restabilization at the time of operation in Japanese patients with lumbar degenerative spondylolisthesis. J Neurosurg Spine. 2010:12(1):88-95.
6. Caterini R, Mancini F, Bisicchia S, Maglione P, Farsetti P. The correlation between exaggerated fluid in lumbar facet joints and degenerative spondylolisthesis: prospective study of 52 patients. J Orthop Traumatol. 2011:12(2):87-91. doi: 10.1007/s10195-011-0141-3. Epub 2011 May 20.
7. Lattig F, Fekete TF, Grob D, Kleinstück FS, Jeszenszky D, Mannion AF. Lumbar facet joint effusion in MRI: a sign of instability in degenerative spondylolisthesis? Eur Spine J. 2012:21(2):276-81. Epub 2011 Sep 20.
8. Umeta RS, Avanzi O. Techniques of lumbar-sacral spine fusion in spondylosis: systematic literature review and meta-analysis of randomized clinical trials. Spine J. 2011:11(7):668-76. Epub 2011 Jun 8.
9. Nizard, R. S., M. Wybier, and J. D. Laredo. "Radiologic Assessment of Lumbar Intervertebral Instability and Degenerative Spondylolisthesis." Radiologic Clinics of North America. 2001:39:55-71.

Digital Subtraction Angiography Does Not Reliably Prevent Paraplegia Associated with Lumbar Transforaminal Epidural Steroid Injection

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Background: Digital subtraction angiography (DSA) has been touted as a radiologic adjunct that might minimize complications from interventional neuraxial procedures where it is imperative to identify vascular compromise during the injection. Transforaminal epidural steroid injections (TFESI) are commonly performed interventions for treating acute and chronic spine pain with radiculopathy.

Objective: We present a case of instantaneous paraplegia following lumbar TFESI wherein a local anesthetic test dose, as well as DSA was used as adjuncts to fluoroscopy. Methods Case report and literature review.

Results: An 80 year-old male with severe lumbar spinal stenosis and chronic L5 radiculopathic pain was evaluated at a University Pain Management Center, seeking symptomatic pain relief. Two prior lumbar interlaminar epidural steroid injections (LESI) provided only a transient pain relief, and decision was made to perform right-sided L5-S1 TFESI. A 5 inch, 22-gauge Quincke type spinal needle with a curved tip was used. Foraminal placement of the needle tip was confirmed with AP, oblique, and lateral views on fluoroscopy. Aspiration did not reveal any blood or cerebrospinal fluid. Digital subtraction angiography was performed twice, to confirm the absence of intravascular contrast spread. Subsequently, a 0.5 mL of 1% lidocaine test dose was performed without any changes in neurological status. Next, a mixture of 1 mL of 1% lidocaine with 80 mg triamcinolone acetonide was injected. Immediately following the completion of the injection, the patient reported extreme bilateral lower extremity pain. He became diaphoretic, and reported marked weakness in his bilateral lower extremities and numbness up to his lower abdomen. The patient was transferred to the Emergency Department for evaluation. An MRI of the lumbar and thoracic spines was completed 5 hours post injection showing a small high T2 signal focus in the thoracic spinal cord at the T7-8 level. The patient was admitted to the critical care unit for neurological observation and treatment with intravenous methylprednisolone. Follow-up MRI revealed a hyper-intense T2 and STIR signal in the central portion of the spinal cord beginning at the level of the T6 superior endplate and extending caudally to the T9-10 level with accompanying development of mild spinal cord expansion. The patient was diagnosed with paraplegia from acute spinal cord infarction. At discharge to an acute inpatient rehabilitation program, the patient had persistent bilateral lower extremity paralysis, and incontinence of bowel and bladder.

Conclusions: In the present patient, digital subtraction angiography performed twice and an anesthetic test dose did not prevent a catastrophic spinal cord infarction and resulting paraplegia. DSA use is clearly not foolproof and even in well-trained hands, may not be sufficient to identify potentially life-or-limb threatening consequences of lumbar TFESI.

Disclosure: This case report has been accepted by Pain Physician Journal and is pending future publication.

References

1. Jasper JF. Role of digital subtraction fluoroscopic imaging in detecting intravascular injections. Pain Physician 2003;6:369-372.
2. Rathmell JP, Aprill C, Bogduk N. Cervical transforaminal injection of steroids. Anesthesiology 2004;100:1595-1600.
3. Botwin KP, Gruber RD, Bouchlas CG, Torres-Ramos FM, Freeman TL, Slaten WK. Complications of fluoroscopically guided transforaminal lumbar epidural injections. Arch Phys Med Rehabil 2000;81:1045-1050.
4. Kennedy DJ, Dreyfuss P, Aprill CN, Bogduk N. Paraplegia following image-guided transforaminal lumbar spine epidural steroid injection: two case reports. Pain Med 2009;10:1389-1394.
5. Smuck M, Yu AJ, Tang CT, Zemper E. Influence of needle type on the incidence of intravascular injection during transforaminal epidural injections: a comparison of short-bevel and long-bevel needles. Spine J 2010;10:367-371.

6. Smuck M, Maxwell MD, Kennedy D, Rittenberg JD, Lansberg MG, Plastaras CT. Utility of the anesthetic test dose to avoid catastrophic injury during cervical transforaminal epidural injections. Spine J 2010;10:857-864.
7. Houten JK, Errico TJ. Paraplegia after lumbosacral nerve root block: report of three cases. Spine J 2002;2:70-75.
8. McLean JP, Sigler JD, Plastaras CT, Garvan CW, Rittenberg JD. The rate of detection of intravascular injection in cervical transforaminal epidural steroid injections with and without digital subtraction angiography. Pm R 2009;1:636-642.

Position-Adaptive Spinal Cord Stimulation (SCS) for Chronic Pain: Results of the RestoreSensor Study

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Background and Objective: Variation in intensity of neurostimulation with body position is a problem for some patients with SCS systems. The purpose of the study was to assess safety and efficacy of the RestoreSensor™ neurostimulator (Medtronic, Inc., Minneapolis, MN) which included an optional position-adaptive stimulation feature.

Methods: Patients in the prospective, open-label study were randomized to receive either position-adaptive stimulation or manual programming adjustment for 6 weeks prior to crossover to the opposite treatment arm for 6 additional weeks. Cross-tabulation of two separate 5-point Likert scales was used to assess improvements in pain relief and convenience with position-adaptive stimulation compared with manual programming adjustment alone. Uncomfortable sensations from stimulation during both study arms and all adverse events were assessed.

Results: In an intent-to-treat analysis, 86.5% of the 74 patients achieved the primary objective of improved pain relief with no loss of convenience or improved convenience with no loss of pain relief when using automatic position-adaptive stimulation. The primary efficacy results were significantly greater than the predefined minimum success rate of 25%, $p<0.001$. The adverse event profile did not differ between study arms. The incidence of device-related serious adverse events was 3.9%.

Conclusions: This study demonstrated that automatic position-adaptive stimulation is safe and effective in providing benefits in terms of patient-reported improved pain relief and convenience compared with manual programming adjustment alone.

Disclosures

David M. Schultz, MD:
- Paid consultant for Medtronic
- Principal investigator for Medtronic, Advanced Neuromodulation Systems, Pfizer, Lilly
- Owner of MAPS Applied Research Center
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Lynn Webster, MD:
- American Academy of Pain Medicine
- American Board of Pain Medicine
- Boston Scientific
- Medtronic
- Nevro Corporation

Peter Kosek, MD:
Did not consult, had no honoraria, had no stock in Medtronic, and did not receive material support from Medtronic. Served as an investigator for the RestoreSensor study.

Mark Sun, PhD:
Medtronic employee

Ye Tan, MS:
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References

1. Olin JC, Kidd DH, North RB. Postural changes in spinal cord stimulation perceptual thresholds. Neuromodulation 1998; 1:171-175.
2. Abejon D, Feler CA. Is impedance a parameter to be taken into account in spinal cord stimulation? Pain Physician 2007; 10:533-540.

Prevalence of Polypharmacy in Chronic Pain Patients

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Background: Chronic pain patients are often a complicated and challenging population. Many of these patients have underlying psychological problems, destructive social habits, and take medications and supplements not prescribed by their respective pain specialist.

Objective: This study used a large cohort of chronic pain patients in order to test the hypothesis that these patients are taking herbal supplements, over the counter medications, and/or psychiatric medications not prescribed by their pain physician.

Methods: After LSUHSC IRB approval (#7839), a survey was developed to evaluate polypharmacy practices. The survey measured age, diagnosis, history in a Pain Clinic and polypharmacy use. Herbal supplements, psychiatric related medications, over the counter agents, and complete list of prescribed medications were evaluated.

Results: 212 patients were surveyed from June-August 2011. Patients were seen in an urban Pain Clinic by a board certified pain specialist. Patients indicated neck 73%, back 93%, shoulder 38%, and knee pain 21% of the time. Age averaged 40.8 years. 9% reported they were taking psychiatric medications, 4.7% herbal supplements, and 22.6% over the counter agents. 89% who visited a psychiatrist reported discussing the prescribed medications with their pain physician and 53% of these patients stated their entire medication regimen had been reported and reviewed by their pain physician. Overall, 39.2% reported discussing all of their medications. Only 27.8% of patients reported all medications had been presented and reviewed. The most commonly listed over the counter medications included melatonin, fish oil, glucosamine, diphenhydramine products, aspirin, Tylenol PM, Advil, Aleve, Motrin, Goodies Powder, Excedrin, and Zantac. A number of patients were taking potentially dangerous combinations of prescribed and over the counter medications. For example, one patient took 10 aspirin per day and another patient took 5-6 25 mg. diphenhydramines with their prescribed medications.

Conclusion: Multiple medications prescribed by different physicians is a critical issue. In some cases, certain combinations of medications can have adverse affects. The results of the present survey suggest a significant number of patients are taking psychiatric medications and over the counter agents. The pain physician should survey and scrutinize all medications each patient takes to improve dosing regimens and prevent potentially fatal drug combinations.

References:

1. Smith H, et al. Implications of opioid analgesia for medically complicated patients. Drugs Aging. 2010 May;27(5):417-33.
2. Fanciullo GJ, et al. Best practices to reduce the risk of drug-drug interactions. Am J Manag Care. 2011 Sep;17 Suppl 11:S299-304.

A Novel Lumbar Facet Medial Joint Injection and Sural Block Combination in Low Back Pain And Sciatica

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Background: Facet medial joint injection and sural block combination has not been described previously for lumbar radiculopathy in patients with a mild neurological deficit.

Objective: In this study, we want to investigate the clinical effectiveness combination of medial joint injection and sural block in 386 patients with lumbar pathology (disc herniation, foraminal stenosis and spondylolisthesis).

Methods: Between May 2007 to and May 2011, 386 patients with radiculopathy was evaluated for foraminal stenosis, disc hernia and spondylolisthesis. Clinical criteria and pain map were used in selecting the levels to be blocked. Based on the clinical and imaging findings, surgery was justifiable in all cases. Pain commonly radiated in to the buttock and/or down to the thigh, extending to the foot usually. Single level block was used in 214 patients and double level block was used in 172 patients, sural block was used in all the patients. Neural theraphy was added in 84 patients at the same time. If the patient passed more than two operation disc or fusion and had got any enstrumantation system that it's create a problem for blocked were excluded this study. Fluoroscopically (4 or 8 magnified) guided system used for facet medial joint injection. Patient was informed before the facet medial joint injection and any level of pain it's not resolved, operation will be thought for this level. All the patients were monitorized while during the procedure. We prefers to use 2-3 cc of % 5 bupivacaine and 1.5cc or 2 cc of 80 mg Depomedrol and 0.09 Nacl solution.14 gauge, 1,5 inch spinal needels, two 10 cc syringe were used for lomber injection and 0.5cc depomedrol, 0.5 cc syringe was used for sural block at foot. All the patients take the analgesic and antienflamatuary drug and carbamazepin 200 mg /daily after the procedure. Under the floroscopy Y (joint nerve bifurcation demonstrated) shape was found and choosen for a target point in the middle of the pedicular area. Sural blocked performed in all the patients. If it's necessary, one or two times sural block were added. After the injection theraphy, disc resorption percent was evaluated with MRI in 1 years later.

Results: They returned the daily activites 10 days, returned the their job 20-25 days later. The final outcome after facet medial joint injection and sural block was excellent in 264 (68%), and good in 115 (29%), Fair 7 (3%). Disc resorption volume rate was changed 20% to 80%.

Conclusions: A novel combination of facet medial joint injection and sural block was found very effective to reduce the pain and disc volume. Pain map and injection theraphy should be very important aspect of the non operative treatment with lumbar pathology. injection combination helps to reduce the pain and resoption of the disc volume visibly.

References:

1.Jarett D.cain et al, Revisional peripheral nerve surgery,Clin podiatr med surg 26(2009) 11-22 Autio RA et all,Determinants of spontaneus resorption of intervertebral disc herniation spine (phila pa1976) 2006 May 15;31(11)1247-52 .

Spinal Cord Stimulation for the Treatment of Intractable Chronic Functional Abdominal Pain/Irritable Bowel Syndrome

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Background: With Irritable Bowel Syndrome (IBS) affecting 3 – 20% of the U. S. population and an estimated yearly cost of over $20 billion dollars to the U.S. economy, directly and indirectly through lost productivity, their treatment is an important area for research.1-2 Another even less understood gastroenterologic disorder is Functional Abdominal Pain Syndrome (FAPS) which is less common (estimated incidence of 0.5% to 2% in North America) and is characterized by pain that is constantly or near-constantly present and can be unrelated to food intake or defecation.3 Until recently the only available treatment options for either disorder were pharmacologic, diet alteration, and psychological in nature. These treatments have variable efficacy and often leave many sufferers with minimal to moderate symptomatic relief. We are reporting the successful use of dorsal column stimulation (SCS) to treat a patient with mixed features of Chronic Functional Abdominal Pain Syndrome and Irritable Bowel Syndrome that was refractory to standard conservative therapies.

Results: An otherwise active and healthy 52 year-old male patient suffering from a sudden onset of debilitating abdominal pain that began in November of 2009 was referred to our pain clinic in October of 2011.

He reported that initially the pain presented only at night, would wake him from his sleep between 1 and 3 A.M., and would last until he had a series of small bowel movements (typically 5-6, of variable volume and consistency) that would start between 6 and 9 A.M. and continue for approximately 2-3 hours. Over time, however, he noted that the pain became more constant; with exacerbations noted after eating meals or drinking liquids during the day and that the nighttime onset of his pain began to start as early as 9 P.M. He also noted that the worst pain was primarily located in his left hypochondriac and left lumbar divisions but that during the last 2 years he had developed additional diffuse pain of a lower intensity involving the rest of the abdomen as well. As a result of his nighttime symptoms his sleep steadily worsened until he was averaging approximately 3 hours of interrupted sleep per night. With the addition of the potent hypnotics eszopiclone and zolpidem he was able to obtain roughly 4 hours of uninterrupted sleep per night before being woken by pain. The Irritable Bowel Syndrome Quality of Life questionnaire (IBS-QOL) was utilized to obtain a baseline evaluation of the impact that this abdominal pain had on his quality of life. Prior to any interventions he reported a score of 64 (0-100 where 100 is the highest quality of life).4

His description of the pain was comprised of distinctly different components such as "bloating," "cramping," "sharp," "dull," and "radiating to the low back". An extensive work-up by two different gastroenterology groups over the course of two years involving multiple radiologic, serologic, endoscopic, and physical studies yielded no definitive etiologies other than a Helicobacter Pylori infection which was identified early and resolved after a single course of treatment. He was treated with multiple medications including: dicyclomine, hyoscyamine, bismuth subsalicylate, amylase/protease/lipase, omeprazole, metronidazole, tetracycline, desipramine, and ranitidine. He was also directed to try multiple diet modifications in an attempt to ameliorate his suffering. No treatment or lifestyle modification produced any significant or lasting benefit.

He was referred to our pain clinic by his primary care manager for "Chronic abdominal pain since November 2009… symptoms have been gradually getting worse…." At his first appointment he stated that he had been diagnosed by the gastroenterologists with "Functional Abdominal Pain." A careful review of the notes from his extensive gastroenterologic workup only referred to the following diagnoses: LLQ pain, LUQ pain, and abdominal pain. At this appointment his physical exam was entirely unremarkable: he had a well-muscled mesomorphic body and appeared more like a man in his early 40s than 50s and no amount of percussion or deep palpation reproduced or exacerbated his abdominal pain. Given his physical exam and reported history, his pain appeared to have characteristics that might be visceral in nature so the decision was made to attempt a series of splanchnic plexus blocks (consisting of 15ml of 0.5% ropivicaine with 1:200,000 epinephrine injected at the anterolateral aspect of each side of the inferior third of T12 vertebral body) to further define, and possibly treat, his abdominal pain. Over the course of a month the patient received three splanchnic plexus blocks with surprisingly powerful results: he obtained 100% resolution of his abdominal pain after each block with the severe left hypochondriac/lumbar pain returning after 3 days and the remainder of his diffuse abdominal pain returning several weeks later. The primary author conducted a review of the existing literature for abdominal pain treated with dorsal column stimulation, also referred to as spinal cord stimulation (SCS), techniques and found its utilization for visceral abdominal pain in patients with a history of chronic pancreatitis of various etiologies.5-8 Days later he attended the North American Neuromodulation Society (NANS) annual meeting in December, 2011 where multiple abstracts involving gastrointestinal neuromodulation therapies were presented. Upon his return to the pain clinic he made a presentation to the group proposing a percutaneous SCS trial for this patient. Given the patient's excellent response to the splanchnic plexus blocks, and the existing literature supporting SCS for visceral pain, the group agreed and the decision was made to schedule the patient for a dorsal column stimulation trial.

The patient returned in February and a trial lead (1X8 Compact® 3874-60, Medtronic Inc., Minneapolis, MN, USA) was placed percutaneously and advanced midline to the superior endplate of T5. Intraoperative testing was performed (External Trialing Neurostimulator® Model 37022, Medtronic Inc., Minneapolis, MN, USA) with lead position adjustment until the patient reported parasthesia coverage over his left-sided pain. This was noted midline at the T6 inferior endplate in an AP view on fluoroscopy. The following contacts and stimulation parameters were used: 0 + - + + 0 0 0 (contacts are listed from distal/cephalad to proximal/caudad), Amplitude 4.7V, Pulse Width 240 microseconds, Frequency 35 Hz. Three days later the patient returned

and he reported that he had received 100% relief of his abdominal pain, his bowel movements were more "consistent" and had decreased to 1 – 2 per day, he had been able to sleep through the nights without hypnotics, and his "stomach seemed to be more active with the stim 'on' enabling [him] to eat meals more comfortably." He also noted that following periods of stimulation lasting minutes to hours he continued to experience sustained improvement in his pain and bowel function for a period of time even after cessation of stimulation. Two weeks later an implantable pulse generator (IPG) (RestoreSensor Neurostimulator® Model 37714, Medtronic Inc., Minneapolis, MN, USA) with two percutaneously placed leads (1X8 Compact® Model 3778-60, Medtronic Inc., Minneapolis, MN, USA) were implanted in this patient. The two leads were advanced to the superior endplate of T7 (in an AP view on fluoroscopy) with one lead directly midline to the bony anatomy and the second just left paramedian to the first (fig. 1). Intraoperative testing yielded the best parasthesia coverage of his painful areas utilizing the following contacts and stimulation parameters: the left paramedian lead 0 0 0 + - - + 0, the midline lead 0 0 0 0 + + 0 0 Amplitude 4.1V, Pulse Width 450 microseconds, Frequency 55 Hz. Now, 1 month after implantation, he continues to report dramatic improvement in his comfort: 100% pain relief and improvement in bowel function with no further need for hypnotics to obtain an optimal quantity and quality of sleep. This was further correlated with his IBS-QOL score which increased dramatically to 97. He reports that within the exercise limitations we have placed on him to prevent post-operative lead migration he is able to perform yard work, bicycle, and swim as he did previous to the onset of his abdominal pain and dysfunction.

Conclusions: This patient had mixed features of both IBS and FAPS making differentiation difficult (and perhaps irrelevant). Nonetheless, he responded very well to splanchnic plexus blocks with follow-on improvement in both pain and bowel function with dorsal column stimulation. Celiac plexus blocks and splanchnic plexus blocks have both been described for the diagnosis and treatment of visceral abdominal pain. In our clinic we chose splanchnic plexus blocks for diagnostic purposes due to our comfort with their relative safety and reproducibility in our hands. While we performed a series of three sympathetic blocks on this patient prior to a SCS trial we are now considering performing only one or two if a patient experiences dense, but short-lived, relief of their pain. As there are multiple structures at risk during such sympathetic blocks at the thoracic levels, and there is a low likelihood of additional blocks providing further therapeutic or diagnostic benefit, it appears that the risk to benefit ratio may favor proceeding to a SCS trial sooner if the results are unequivocal. Neuromodulation may be an inadequately explored option for the treatment of intractable severe IBS or FAPS symptoms refractory to conventional therapies. Given the impact on quality of life, as well as the direct and indirect costs associated with the sequelae of poorly controlled IBS and FAPS, neuromodulation should be considered as a treatment modality for those patients whose quality of life is significantly impacted, and who respond poorly to other more conservative therapies.

Disclosure: The views expressed in this article are those of the author(s) and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense or the United States Government.I am a military service member. This work was prepared as part of my official duties. Title 17 U.S.C. 105 provides that 'Copyright protection under this title is not available for any work of the United States Government.' Title 17 U.S.C. 101 defines a United States Government work as a work prepared by a military service member or employee of the United States Government as part of that person's official duties.

References

1. Longstreth GF, Thompson WG, Chey WD, Houghton LA, Mearin F, Spiller RC. Functional Bowel Disorders Gastroenterology 2006; 130: 1480-1491.
2. Saito YA, Schoenfeld P, Locke R. The Epidemiology of Irritable Bowel Syndrome in North America a Systematic Review. Am J Gastroentrol 2002;97: 1910-1915.
3. Clouse RE, Mayer EA, Aziz Q, Drossman DA, Dumitrascu DL, Mönnikes H, Naliboff BD. Functional Abdominal Pain Syndrome. Gastroenterology 2006; 130: 1492–1497.
4. Patrick DL, Drossman DA, Frederick IO. A Quality-of-Life Measure for Persons with Irritable Bowel Syndrome (IBS-QOL): User's Manual and Scoring Diskette for United States Version. Washington, DC: University of Washington; 1997
5. Kapural L, Rakic M. Spinal Cord Stimulation for Chronic Visceral Pain Secondary to Chronic Non-Alcoholic Pancreatitis. J Clin Gastroenteral 2008; 42(6): 750-751
6. Kapural L, Nagem H, Tlucek H, Sessler DI. Spinal Cord Stimulation for Chronic Visceral Abdominal Pain. Pain Medicine 2010; 11: 347-355.
7. Kapural L, Deer T, Yakovlev A, Bensitel T, Hayek S, Pyles S, Khan Y, Kapural A, Cooper D, Stearns L, Zovkic P. Technical Aspects of Spinal Cord Stimulation for Managing Chronic Visceral Abdominal Pain: The Results from the National Survey. Pain Medicine 2010; 11: 685-691.
8. Kim JK, Hong SH, Kim MH, Lee JK.Spinal Cord Stimulation for Intractable Visceral Pain due to Chronic Pancreatitis. J Korean Neurosurg Soc. 2009; 46(2): 165–167.

Bilateral Transversus Abdominis Plane (TAP) Blocks for Post-Operative Pain Control in a Patient Undergoing a Major Abdominal Surgery

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Background: Transversus abdominis plane (TAP) blocks and TAP catheters have been used to provide prolonged postoperative analgesia after laparotomy. After the initial description of the technique by Rafi 1 multiple studies have highlighted the value of the TAP block. The technique involves injection of local anesthetic solution into a plane between internal oblique (IO) and TA (Transversus Abdominis) muscles. In this plane lie the thoracolumbar nerves originating from T6 to L1 spinal roots, which supply sensation to the anterolateral abdominal wall. These multiple mixed segmental nerves branch and communicate as they run through the lateral abdominal wall between IO and TA muscles, within the TA fascial plane.2 We present a case that was successfully managed by bilateral TAP blocks for post-operative pain control following a total abdominal hysterectomy.

Objective: Examining the efficacy of the TAP block in controling post-operative pain.

Methods: This is a case report Results A 75 year old woman with hypertension and severe dementia (Alzheimer) presented with vaginal bleeding. She was found to have uterine cancer and a decision was made to perform total abdominal hysterectomy (TAH). Discussing the plan for postoperative pain management for this patient, we considered placing a thoracic epidural catheter but patient's blood pressure was low, which made this option unacceptable. The patient was sensitive to IV opioids possibly because of her dementia. We decided with the patient's family to perform bilateral TAP blocks with bilateral catheters instead. The block was performed under ultrasound guidance, Ropivacaine 0.5 % was used as the local anesthetic, and 15 mL were injected on each side followed by placement of a catheter for continuous postoperative pain control. Pain was well controlled post-operatively, and her pain scores were 2-4/10 in the first 2 days after surgery. TAP catheters were removed on POD#2 after patient resumed oral intake and was started on oral acetaminophen.

Conclusions: TAP catheters are effective in managing post-operative pain for patients undergoing abdominal surgeries. They may be a good alternative to epidural analgesia when epidurals cannot be performed or are contraindicated.

References

1 Rafi AN. Abdominal field block: a new approach via the lumbar triangle. Anaesthesia 2001; 56: 1024–6

2 Rozen WM, Tran TMN, Ashton MW, Barrington MJ, Ivanusic JJ, Taylor GI. Refining the course of the thoracolumbar nerves. A new understanding of the innervations of the anterior abdominal wall. Clin Anat 2008; 21: 325–33.

Increasing the NaCl Concentration of the Preinjected Solution Enhances Lesion Size

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Background: Percutaneous radiofrequency (RF) is used to treat facet joint mediated pain. Because pain reduction requires the ablation of small nerves, manipulating RF delivery to augment lesion size has been investigated. Manipulating the duration of RF application, electrode temperature, and tip size are known to alter lesion size, and recently it was demonstrated that pre-injecting 0.9% NaCl increases lesion size [1]. It is unknown if other concentrations of NaCl would increase the size of lesions produced with interventional pain RF equipment.

Objective: The purpose of the study was to exam-

ine the effects of increasing NaCl concentration on monopolar RF lesions.

Methods: Monopolar RF with temperature control at 80° C for 90 seconds was performed with ex vivo chicken samples. Eleven groups, each with 10 samples, were used. Seven groups were used to investigate the preinjection (0.74 mL) of different NaCl concentrations (0.7%, 0.9%, 3%, 8%, 13%, 18%, or 23.4%). 1% lidocaine in 0.7% NaCl, and two nonionic fluids (water and D5W) were also investigated. The final group received no fluid preinjection. The horizontal diameter (Dh), vertical diameter (Dv), maximal effective radius (Mer) and distal radius (T) of the lesion from the tip of the electrode were each measured in millimeters. The shape (Dh/Dv) and overall surface area (pi/4*[Dh*Dv]) were calculated. Impedance and power values were measured. Alpha was 0.05 for all statistical comparisons.

Results: When compared to no fluid injection, preinjection of D5W, but not water, increased the mean area of lesion by 57% (p=0.012; Fig. 1). This increase was primarily confined to the Dh parameter, which was increased by 47% (p<0.001; Fig. 2). Water also increased mean Dh over no fluid by 35% (p=0.012), and both D5W and water significantly increased mean Mer, but not T, by 57% (p=0.002) and 50% (p=0.020), respectively.

The addition of NaCl to preinjected fluid alters mean lesion attributes beyond that observed with nonionic fluids. 0.7% NaCl increased the mean area of lesion over that seen with preinjected water by 29% (p=0.012), and this increase enlarged as NaCl concentrations were elevated. Preinjection of 23.4% NaCl produced a 154% (p<0.001) increase over water in mean area lesioned and this area was larger than that produced by any other concentration examined (p=0.002 – p<0.001) except 18%. Similar increases in Dh and Dv were observed with higher concentrations of pre-injected NaCl, with less profound increases noted in Mer and T. Strikingly, mean T was extended by a full 1.9 mm over the mean T produced by water (0.45mm; 95% CI = 0.19-0.71).

Increasing the NaCl concentration to 0.7% and above resulted in a significant reduction in the impedance and an increase in the power (watts) output (Fig. 3)

Conclusions: Preinjected fluid increases RF lesion size, and increasing NaCl concentration significantly augments this effect. In part, NaCl may produce larger lesions as a result of reduced impedance and increased power. Preinjected fluid strategies with increasing NaCl concentrations should be considered when enhanced lesions are desired and warranted.

References

1. Provenzano DA, Lassila HC, Somers D: The effect of fluid injection on lesion size during radiofrequency treatment. Reg Anesth Pain Med 2010; 35: 338-42.

Conversion of Chronic Pain Patients from High Dose Full-Opiate Agonists to Sublingual Buprenorphine

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Background: Sublingual buprenorphine (buprenorphine SL) is a preparation that has been used to treat opiate dependence. In addition, the Drug Enforcement Administration (DEA) has acknowledged the legality of an off-label to use treat pain with the sublingual buprenorphine preparation. Buprenorphine SL is unique among the opiate class of analgesics; this compound has a high affinity for the μ-receptor, yet only partially activates it. Thus, buprenorphine SL can provide analgesia while minimize opiate side effects. Many patients on high doses of opiate medication develop opiate-induced hyperalgesia (OIH) (1).

Objective: To determine the effectiveness of converting patients from high doses of full agonist opiate medication to sublingual buprenorphine, as well as to identify patient groups that are most likely to benefit from this therapy.

Methods: Retrospective data from clinical records was taken on 35 de-identified chronic pain patients (22 male and 13 female, age 24-66) who had previously treated with high-dose opiate-agonist drugs and were converted to buprenorphine SL in tablet form during the study. High dose opiates were defined as over 200 mg morphine equivalent per day. Data collected from patient profiles included age, sex, diagnosis, medication history, pre-induction opioid intake, and pre-induction

Clinical Opiate Withdrawal Score (COWS). Numerical pain levels and Quality of Life scores were recorded before and after conversion to buprenorphine SL. Results After initiation of buprenorphine SL therapy for more than two months, the mean pain scores on a scale from 0-10 decreased by 3.7 points ($p<0.001$). Patient Quality of Life (QOL scale) was not significantly affected by buprenorphine SL therapy ($p=0.087$

Conclusions: Patients continuing buprenorphine SL therapy for more than 60 days reported significant decreases in pain (3.7 points).

References

1. Angst M, Clark J. Opiod-induced hyperalgesia: A qualitative systematic review. Anesthesiology 2006; 104:570-587.

Variable Presentation of Ligamentum Flavum Stimulation Following Cylindrical Spinal Cord Stimulation Lead Implant

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Background: Spinal cord stimulation (SCS) has become an important therapy for patients suffering from chronic neuropathic pain of the trunk and limbs. However, Spinal cord stimulation is sometimes limited by the uncomfortable side effects experienced by the patient as the amplitude of stimulation is increased. These side effects include dorsal root stimulation and ligamentum flavum stimulation due to recruitment of small fibers in ligamentum flavum, which may occur when electrodes are inserted percutaneously and their contacts are exposed circumferentially. This may further necessitate placement of plate electrodes with insulated dorsal surfaces.

Objective: We report a series of 6 patients with ligamentum flavum stimulation who presented at variable time periods following percutaneous cylindrical spinal cord stimulation lead implant

Methods: First case presented with painful ligamentum flavum stimulation during trial , second and third patients presented 2 months post implant, fourth patient presented 4 months post implant, fifth patient presented 1.5 years post implant and sixth patient presented 3 years and 2 months post implant.

Re**sults:** In all of the above cases except one, repeated attempts to obtain adequate paresthesia coverage without painful sensation in the midline back was unsuccessful. In four of these patients paddle lead placement resolved the issue. In one of the cases who presented 2 months post implant, ligamentous stimulation resolved with reprogramming during 1 year follow up. One of the patients is awaiting paddle lead placement.

Conclusions Ligamentum Flavum stimulation as a complication of percutaneously placed cylindrical SCS leads was first described in 1997. This may occur secondary to circumferential stimulation as opposed to unidirectional stimulation with paddle leads. Circumferential stimulation may lead to recruitment of small fibers in ligamentum flavum as the amplitude of stimulation is increased. There is a paucity of literature regarding the variable time periods when ligamentum flavum stimulation may present itself. We hypothesize that this may be due to changes in the distance between the cylindrical lead with reference to dura and ligamnetum flavum. This may happen secondary to delayed scar formation, epidural fat or some unknown causes.

References

1. North RB, Lanning A, Hessels R, Cutchis PN. Spinal cord stimulation with percutaneous and plate electrodes: side effects and quantitative comparisons. Neurosurg Focus. 1997;2(1):1-5.

Use of Transversus Abdominus Plane (TAP) Blocks in Pediatric Patients Anterior Cutaneous Nerve Entrapment Syndrome

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Background: Anterior cutaneous nerve entrapment syndrome (ACNES) is a common source of chronic abdominal wall pain that is often overlooked in patients. Described as a sharp, localized pain, ACNES is caused by the entrapment of a branch of the lower thoracic (T7-T12) intercostal nerves in the abdominal wall muscle. Failure to make an accurate diagnosis may be, in part, due to clinicians' unawareness and can result in unnecessary examinations and invasive treatments. In fact, a study by Thompson and colleagues [1] estimated an average of $6727 spent on diagnostic testing and hospital charges before patients were ultimately diagnosed with "abdominal wall syndrome". With a simple Carnett's test, the majority of patients with chronic abdominal wall pain can be identified without risk of missing intra-abdominal pathology [2]. Briefly, it involves palpating the area of greatest tenderness on the patient. If the pain increases or stays the same severity, then the source of pain likely originates from the abdominal wall itself. Treatment is also simple and effective; a properly administered injection of local anesthetic can completely relieve the pain of ACNES.

While ACNES has been implicated as a source of abdominal pain in up to 30% of adult cases [2], information about children is lacking. The incidence of ACNES in the pediatric population is unknown though it appears to be substantial. Chronic pain can have significant emotional and social impact on children and their families. Suffering from pain daily can limit a child's ability to attend school, socialize with peers, and participate in physical activity. In addition, the physical and psychological sequelae associated with chronic pain may impact overall health, predisposing a child for the development of adult chronic pain [3][4]. Objective The purposes of this case series are to describe the clinical manifestations, sequelae, and outcome of three cases of ACNES in adolescent patients, to prompt better recognition of the condition, and to identify effective treatment options.

Methods: Three case reports are presented of adolescents evaluated for severe, debilitating abdominal pain at a tertiary care, pediatric chronic pain clinic within a large, urban hospital.

Result: Case 1: 15 yo male presented with a >3 month history of severe right lower quadrant pain. Prior to consultation, he was evaluated by a Gastroenterologist and a Pediatric Surgeon. The pain was debilitating resulting in decreased function and poor school attendance (missed 3 months of school). He had multiple ED visits and required inpatient admission for pain control. He had an extensive work up for abdominal pain including CT scan, endoscopy/colonoscopy, ultrasounds, gastric mucosa scan, MRI, and upper GI series, all of which were unremarkable. Treatments included an oral opioid and an antidepressant transitioned to an anticonvulsant with minimal reported effect. He underwent right transversus abdominis plane (TAP) block for potential ACNES with a 3 mL mixture containing 1 mL of 40 mg/mL triamcinolone and 2 mL 1% plain lidocaine injected under ultrasound guidance into the junction between the internal oblique and transverse abdominus muscles. Post-procedure he reported an immediate decrease in abdominal pain and reported complete resolution of abdominal pain later the same day. He had a recurrence of severe RLQ pain approximately one year later following strenuous exercise. He underwent repeat TAP block with a 5 mL solution containing 4 mL of 10 mg of regular triamcinolone and 1 mL of 1% of plain lidocaine that was injected under ultrasound guidance into the appropriate junction. Post-procedure he reported an immediate decrease in pain.

Case 2: 15 yo female presented with >1 year history of severe right upper quadrant abdominal pain. Prior to consultation, she was evaluated by multiple Gastroenterologists and a Gynecologist. She had multiple ED visits and required inpatient admission for pain control during which she underwent appendectomy. The pain continued and was debilitating resulting in decreased

function and poor school attendance (missed 3 months of school). She had an extensive work up including endoscopy/colonscopy, ultrasound, MRI, and upper GI series, all of which were unremarkable. Treatments included an oral opioid, an antidepressant, and a benzodiazepine with minimal reported effect and NSAIDs with reported moderate effect. She underwent right TAP block for potential ACNES with a 3 mL solution containing 2 mL of 10 mg of Kenalog and 1 mL of 1% plain lidocaine was injected under ultrasound guidance into the appropriate junction. Post-procedure she reported a minimal decrease in abdominal pain. Upon follow up three weeks later, she reported improved function but no improvement in pain control. She underwent a repeat TAP block two months later with a solution of 1 mL of 40 mg/mL of triamcinolone acetate and 1 mL of 1% lidocaine injected under ultrasound guidance into the plane between the transversus abdominis and the internal oblique. Upon follow up one month after, she reported moderately improved pain control and improved function.

Case 3: 16 yo male presented with a 3 month history of severe left upper quadrant abdominal pain. Prior to consultation, he was evaluated by a Gastroenterologist and an Allergist. The pain was debilitating resulting in decreased function and poor school attendance (missed 2 months of school). He presented to the ED for pain control. He had an extensive work up including endoscopies, upper GI series, and a gastric emptying scan. He was shown to have esophagitis. Treatments included an oral opioid and antidepressants with minimal reported effect. He underwent left TAP block for potential ACNES with a solution containing 2 mL of 10 mg/mL, Kenalog and 4 mL of 1% lidocaine. Post-procedure he reported an immediate decrease in pain. Upon follow up 4 days later, he continued to report improved pain control and improved function.

Conclusions: Pain originating from the abdominal wall is often overlooked in children with reports of chronic abdominal pain. Rather than being considered as an initial diagnosis, anterior cutaneous nerve entrapment syndrome is treated as a diagnosis of exclusion after other treatment options have been exhausted. A diagnosis of ACNES should be considered in cases of severe, localized abdominal pain that is accentuated by physical activity and remains at exactly the same spot, never migrating or changing with positioning.

The three case reports highlight the potential impact undiagnosed ACNES may have on children, including prolonged and debilitating pain, unnecessary examinations, invasive treatments, as well as disruption to daily function and school attendance. Of note, each patient in the case series also reported anxiety and/or negative effect on mood due to prolonged pain. As a result, they were given a psychiatric diagnosis and prescribed a course of antidepressants.

Though diagnosis can be difficult, a positive result on Carnett's test and the precise localization of the pain are regarded as diagnostic criteria for ACNES. Substantial pain relief after an accurately placed anterior cutaneous nerve block is considered confirmatory for ACNES. It is a relatively quick procedure that can provide dramatic results, as was seen in the patients in our case series. Prompt identification and treatment of ACNES can have implications for the future as persistent abdominal pain in childhood is significantly associated with decreased quality of life and an increased risk of psychiatric disorder in adulthood [3].

References

1. Thompson C, Goodman R, Rowe WA. Abdominal wall syndrome: a costly diagnosis of exclusion. Gastroenterology 2001;120:A637.
2. Lindsetmo R, Stulberg J. Chronic abdominal wall pain, a diagnostic challenge for the surgeon. Am J Surg 2009;198:129-134.
3. Campo, JV, Di Lorenzo C, Bridge J, Chiappetta L, et al. Adult outcomes of recurrent abdominal pain: do they just grow out of it? Pediatrics 2001;108:E1
4. Walker LS, Garber J, Van Slyke DA, Greene JW. Long-term health outcomes in patients with recurrent abdominal pain. J Ped Psych 1195;20:233-45
5. B onica JJ, Johansen K, Loeser JD. Abdominal pain caused by other diseases. In: Bonica JJ, editor. The management of pain. 2nd ed Vol 2. Philadelphia: Lea & Febiger; 1990. p 1254-82.

Cost-Effectiveness of Spinal Cord Stimulation (SCS) for the Treatment of Chronic Neuropathic Pain

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Background: Technological advances in SCS have accelerated rapidly over the last decade. These advances have led to markedly increased utilization of SCS. While published analyses of clinical outcomes have been steadily increasing as well, the availability of published cost-effectiveness analyses remains relatively scarce. For SCS to remain a viable therapeutic option in the healthcare paradigm of the 21st century and the rapidly changing reimbursement landscape, there is a tremendous need to establish a body of evidence on not just the therapy's therapeutic effectiveness, but its cost-effectiveness as well.

Objective: The study included a review of clinical outcomes and the associated costs for SCS patients treated with the Boston Scientific Precision® SCS system at the MPMC clinic. Methods Data collected included patient-reported pain rating on a visual analog scale (VAS) and direct costs, before and after the SCS implant procedure, over a median duration of 14.3 months and 16.8 months pre- and post-procedure, respectively. Cost-effectiveness was assessed by estimating effectiveness in terms of VAS pain reduction. In our study, the incremental cost-effectiveness ratio (ICER) represents the additional cost incurred by the payer to obtain a reduction of 1 point in the VAS score with intervention (SCS) compared to SMC.

Results: A total of 46 patients were included in the study (51% Female) with a mean age of 55.3±10.6 years. The median pain reduction in VAS pain score from pre- to post-procedure was 3.0 points. This improvement in pain score is both clinical significant and highly statistically significant (P<0.0001). The median direct costs prior to permanent implant procedure were $3,438/year, compared to $2,012/year post-permanent implant procedure, adjusted for the duration of follow-up. This annual cost reduction of approximately 42% is highly statistically significant (P = 0.0007). With a mean per-patient SCS cost of $31,530, the ICER of SCS was $11,250 compared to SMC.

Discussion: With recent healthcare reform and a rapidly changing reimbursement landscape, health economic research in the U.S. is quickly becoming standard practice in the U.S. medical decision-making arena, as has been the case for a number of decades in Europe. This transition will likely be particularly challenging for the field of Neuromodulation, where practitioners and researchers alike must face highly subjective health outcomes and interventional procedures that do not easily lend themselves to traditional comparative assessment and research methods. Consequently, there is an urgent need for an established body of evidence demonstrating the cost-effectiveness of neurostimulation therapies for the treatment of pain.

Conclusion: Our retrospective cost-effectiveness analysis suggests that SCS provides both clinically significant and cost-effective reduction in pain, and when compared to standard medical management over the patient's lifetime. Further prospective and longer-term studies including direct and non-direct cost are required to validate our results.

Disclosure: The abstracted was submitted to AAPM 2012, but was not able to present due to time issue.

References

1. Kumar, K., Malik, S., and Demeria, D. (2002). "Treatment of chronic pain with spinal cord stimulation versus alternative therapies: cost-effectiveness analysis". Neurosurgery, 51(1), 106–115.

Accuracy of Needle Placement with Blind Plantar Fascia Injections

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Background: Plantar fasciitis (PF) is a common cause of heel pain in adults. Corticosteroid injections are frequently used as a treatment for PF. Patients experience a variable response to corticosteroid injections when done by a palpation-guided technique. Some studies have demonstrated that ultrasound-guided corticosteroid injections reduce the number of recurrences at one year. A needle placed away from the plantar fascia may be the reason palpation guided injections are not as effective as sonographically guided injections.

Objective: To evaluate the accuracy rate for palpation-guided PF injections by sports medicine fellows using the medial approach.

M**ethods:** This is a prospective observational study. Sports medicine fellows inserted a needle into a patient's foot using a medial plantar fascia injection approach. A diagnostic ultrasound probe was then placed on the foot to determine where the needle was placed. The images were reviewed by an independent physician to determine whether the needle placement was accurate.

Results: Four fellows performed a total of 23 plantar fascia injections. 39% of the needle placements were deemed accurate. 35% were placed directly in the PF. 22% were greater than 1 cm from the calcaneous, while 13% were > 3 mm away from the PF.

Conclusions: Palpation guided (blind) PF injections from the medial approach are inaccurate. Ultrasound guidance provides accurate placement of the needle for PF injections. This may be a reason for variable responses to blind PF injections. Further studies are needed to determine if the accuracy of needle placement affects patient outcomes.

References

1. Riddle DL, Schappert SM. Volume of ambulatory care visitis and patterns of care for patients diagnosed with plantar fasciitis: a national study of medical doctors. Foot Ankle Int. 2004; 25:303-310.
2. Porter MD, Scadbolt B. Intralesional corticosteroid injection versus extracorpeal shock wave therapy for plantar fasciopathy. Clinical Journal of Sports Medicine. 2005; 15:119-309.
3. Young CC, Rutherford DS, Niedfeldt MW. Treatment of plantar fasciitis. American Family Physician. 2001; 63(3): 467-473. 4. May TJ, Judy TA, Conti M, Cowan JE. Current treatment of plantar fasciitis. Current Sports medicine Reports. 2002; 1:278-284.

Ultrasound-Guided Paramedian Epidural Access: Evaluation of a Real Time In-Plane Transverse View Technique

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Background: Epidural anesthesia or analgesia has become very popular for management of post-operative pain following several varieties of surgeries. Success of the technique depends on the accuracy of locating the required anatomical space. Currently physicians mostly rely on identifying anatomical landmarks. Anatomical landmarks are difficult to palpate in the obese and those with edema in the back, and do not take into account anatomical variations or abnormalities.1 Ultrasound is an evolving technique used to identify the epidural space. To our knowledge we are the first to describe a novel in-plane transverse technique to identify the epidural space.

Objective: Evaluation of a novel technique for placement of epidural catheters by using paramedian access with real time in-plane transverse view.

Methods: Case presentation: Our first patient was a 38 years old woman with a BMI of 27 and Familial Adenomatous Polyposis (FAP), rectosigmoid carcinoma status post low anterior resection with anastomosis, appendectomy as well as adjuvant chemotherapy and radiation. The patient had been un-

dergoing routine surveillance for her FAP with upper and lower endoscopies. She underwent colonoscopy and upper endoscopy and was noted to have multiple polyps within the duodenum. The patient was allergic to meperidine and morphine. The patient presented for a pancreas-preserving duodenectomy. The epidural was placed for this patient in the sitting position. Our second patient was a 56 years old man with a BMI of 26 and benign prostatic hyperplasia. Patient presented for open prostatectomy. Patient had no other comorbidities and no known allergies. The epidural catheter was placed for this patient in the lateral position.

Technique: We used ultrasound guidance to place a paramedian epidural catheter using a real time transverse view in-plane approach. The transverse view of the T9-10 interspace was obtained using a curvilinear low frequency (2-5 MHz) ultrasound probe. The skin was infiltrated at the right lateral end of the probe about 4 cm lateral to the midline. The Touhy needle was introduced in-plane with the ultrasound probe and advanced with some medial angulation. Once engagement with the ligamentum flavum was felt, an Episure AutoDetect Syringe*(Indigo ORB, INC., Irvine, CA, USA) filled with 4 ml of normal saline was attached to the Touhy needle. The needle was then gradually advanced until forward movement of the plunger with expulsion of the saline indicated entry into the epidural space. An epidural catheter was then placed through the needle (4 cm beyond the needle skin mark). Both patients were started on an epidural infusion of bupivacaine 0.1% with fentanyl 2 mcg/ml. The only difference in performing this technique between both patients was that it was performed in the first patient in the sitting position while performed on the second patient in the lateral position. The epidural infusion provided adequate analgesia for both patients and the catheter was removed from the first patient on post-operative day 3 and from the second patient on post-operative day 1.

* EpisureTM AutoDetectTM syringe (Indigo Orb, Inc., Irvine, CA, USA), is a new LOR syringe with an internal compression spring that applies constant pressure on the plunger.

Conclusions: We demonstrated successful use of real-time US guidance in combination with LOR to saline for paramedian epidural access using a transverse in-plane technique. This report represents the beginning of a larger study to explore the utility of this novel technique.

References

1. Broadbent CR, Maxwell WB, Ferrie R, Wilson DJ, Gawne-Cain M, Russell R. Ability of anaesthetists to identify a marked lumbar interspace. Anaesthesia 2000; 55:1122-1126.

Lumbar Spinal Stenosis Treatment with an Interspinous Spacer: Results of a Prospective Randomized Controlled Trial

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Background: Intermittent neurogenic claudication secondary to mild lumbar spinal stenosis (LSS) is treated with conservative measures although long-term success is mediocre.(1) Patients with severe symptoms often require surgical intervention.(2) A significant therapeutic void exists for patients with moderate LSS and increasingly bothersome and recalcitrant symptoms. **Objective:** To evaluate the safety and effectiveness of the Superion Interspinous Spacer (Vertiflex, Inc., San Clemente, CA) in patients with intermittent neurogenic claudication secondary to radiographically confirmed moderate LSS.

Methods: This multicenter, prospective, randomized, controlled, investigational device exemption trial enrolled 198 patients with intermittent neurogenic claudication secondary to moderate LSS and unresponsive to conservative care. Patients were randomly allocated to treatment with the Superion (n=98) or X-STOP (n=100) interspinous spacer. Main outcome measures included Condition-specific Zurich Claudication Questionnaire (ZCQ), back function with Oswestry Disability Index (ODI), and back and leg pain severity with visual analogue scale (VAS) through 1 year post-treatment. Results ZCQ symptom severity and physical function scores improved 29% to 32% in both groups through 1 year (all $p<0.001$). ZCQ patient satisfaction scores at

1 year were 2.0±1.0 with Superion and 1.8±0.8 with X-STOP. Axial pain decreased from 58±26 mm to 27±28 mm at 1 year in the Superion group (p<0.001) and from 56±25 mm to 28±28 mm with X-STOP (p<0.001) (p=0.10 between groups). Extremity pain decreased from 65±24 mm to 25±31 mm at 1 year with Superion (p<0.001) and from 65±25 mm to 26±30 mm with X-STOP (p<0.001) (p=0.92 between groups). Back function similarly improved with Superion (39±12% to 22±17%; p<0.001) vs. X-STOP (40±13% to 24±18%; p<0.001) (p=0.38 between groups) Conclusions Treatment with the Superion Interspinous Spacer results in promising 1-year outcomes in patients with intermittent neurogenic claudication secondary to moderate LSS.

Disclosure: Drs. Miller and Block are independent clinical trials consultants and were remunerated by the sponsor to assist in developing the text of the abstract.

References

1. Deyo RA. Drug therapy for back pain. Which drugs help which patients? Spine (Phila Pa 1976), 21(24), 2840-2849; discussion 2849-2850 (1996).
2. Chen E, Tong KB, Laouri M. Surgical treatment patterns among Medicare beneficiaries newly diagnosed with lumbar spinal stenosis. Spine J, 10(7), 588-594 (2010).

Peripheral Nerve Cuff Placement Using Ultrasound Mapping

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Background: Ultrasound guidance is a newer image modality for interventionalists to perform both spinal injections and peripheral nerve blocks Objective To describe utilizing ultrasound to facilitate neuroelectrode placement via open dissection to wrap around a peripheral nerve using a "nerve cuff electrode" to administer high frequency alternating current.

Methods: After IRB approval- patients were selected to enroll in a first in human feasibility study for high frequency electric nerve block which involves placing a peripheral nerve cuff around the nerve identified as the pain generator- proximal to a Neuroma. This type of stimulation via a peripheral nerve cuff at the stimulation parameters used (10,000 Hz at 1.3 miliamps) has never been done in vivo for pain control. Standard technique involves incision and dissection down to the neuroma, but we utilized an ultrasound preoperatively to "map" the nerve structure. Typically patients who have a neuroelectrode implanted peripherally undergo an open dissection. This can prove to be both time consuming and difficult for the interventionalist to complete. Figure 1 is a picture of such a dissection. We used an ultrasound in the preoperative period to identify the nerve and vascular structure, which in this case were the peroneal and tibial nerves.

Results: The ultrasound allowed us to also gauge the depth and location of the nerves. You can see by figures 2 and 3 that the incisions where much smaller on the patient who had the preoperative ultrasound, the procedure was much less invasive, and the operating room time dropped by close to 50%.

Conclusions: By being able to see both the location and depth of nerve structure the implantation in patients who have had ultrasounds and mapping preoperatively completed with less traumatic dissection. (Figure 4 is a fluoroscopy picture of the leads placed in the patient.) In these cases, patients were implanted with peripheral nerve cuffs to administer high frequency alternating current to create an electric nerve block to block the patients pain state.

Disclosure: Neuros Medical- sponsored research, lead author on the clinical advisory board, shareholder, and stock options

Postdural Puncture Headache or Pituitary Hemorrhage?

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Background: Headache in patients following spinal anesthesia may occur from a variety of reasons. The physician should keep an open mind to explore all possibilities and not rush to judgment that it is necessarily related to the spinal.

Objective: To offer a note of caution to physicians who routinely deal with Post Dural Spinal Headaches after spinal to explore additional causes of headache.

Methods: 26 year old 168cm, 76kg French-speaking parturient admitted to our labor and delivery suite, requested epidural analgesia. History and physical were performed and informed consent was obtained via an interpreter. She was made aware of the risks, benefits and alternatives associated with a combined spinal-epidural (CSE) analgesic including but not limited to the possibility of postdural puncture headache (PDPH). A CSE was inserted using the loss of resistance to air technique. This was achieved via a 17g Tuohy needle through which a 24g Whitacre needle was passed. Clear CSF was obtained and 25mcg of Fentanyl was inserted intrathecally. The catheter was threaded easily, the test dose was negative and 6ml of Ropivacaine 0.2% were injected in divided doses over the next 10minutes. An infusion of the same anesthetic was begun shortly thereafter. The remainder of the labor was uneventful and she delivered a healthy neonate. On post partum day (PPD) #1 the patient complained of a postdural headache which sometimes improved upon reclining. She was given oxycodone 5mg and acetaminophen 250mg for both headache and postpartum analgesia, which did lead to some improvement in the pain. The decision was made to treat the headache conservatively with I.V and oral hydration, oral analgesics, bed rest and Theodur 300mg Po x2 over the next 24 hours. She was discharged home on PPD#2, but returned to the emergency department on PPD#4 with worsening headache, accompanied by neck pain which again unreliably improved upon reclining. Patient denied back pain, fever or any other symptoms suggestive of meningitis or epidural abscess/ hematoma. The anesthesiologist on duty re-evaluated the patient and obtained a more extensive medical history which included frequent headaches in the past, leading to either a CT scan or MRI of the head in her native country in Mali. The results of the study were unknown to the patient. The decision was made to obtain a CT scan of the head before performing an epidural blood patch (EBP). The scan revealed "heterogeneous hyperdensity and apparent enlargement of the pituitary gland (which was) suggestive of intrapituitary hemorrhage, age undetermined." Neurologic examination was non focal and laboratory data failed to reveal any electrolyte abnormalities which would have suggested the diagnosis of pituitary apoplexy. She remained stable and was discharged home on PPD#7 with a headache pain score of 2/10 and was given a follow up appointment with the Endocrine and Neurology clinics

Results: Accidental dural puncture occurs in 0.19-4.4% of those patients who receive epidural anesthesia. If the dura is punctured with an epidural needle, the incidence of PDPH in the obstetric population is 76-85%. The number of theories behind the pathophysiology of PDPH is matched only by the number of suggested therapies to treat it. However, because the differential diagnosis of post partum headache is extensive, ranging from the common tension and migraine headaches to rarer and more serious conditions such as subarachnoid hemorrhage and a report of pituitary apoplexy(1), it is incumbent upon the anesthesiologist to make the correct diagnosis before instituting any of these modalities. In this case the anesthesiologist opted to treat the patient conservatively with hydration, theodur and p.o analgesics before administering an EBP because of the low incidence of PDPH with a 24g Whitacre needle (<1%) and because although postural at times, the description of the headache was not a "classic" PDPH. When the patient was discharged and returned with a worsening headache, the anesthesiologist through a more thorough history was able to elicit information regarding a previous radiological evaluation for headaches in childhood. This resulted in a greater hesitancy to treat with an EBP, at least until a CT scan was performed. The reading suggestive of a

pituitary hemorrhage further clouded the diagnosis of PDPH and calls to question whether the administration of an EBP before the CT scan, would have been identified as somehow contributing to the bleed as in a case where postpartum seizures were attributed to an EBP which then delayed the real diagnosis of eclampsia (2) Conclusions Postdural puncture headache is the third most common cause for litigation in obstetric anesthesia (3) and because of this, as well as the significant discomfort and varying degrees of incapacitation these headaches impart, as anesthesiologists, we are anxious to treat them as soon as possible. However, as effective an EBP is in treating a PDPH (75-80%, it is not without its own complications such as fever, back pain and radiculopathy; one is creating an iatrogenic epidural hematoma. This was a somewhat perplexing case of what was thought to be (and might have been) a PDPH after the insertion of a CSE for labor. As the differential diagnosis of headache in the post partum period is manifold, it is imperative that one obtains a thorough history from a patient who is pressured to have a PDPH, prior to treating invasively with an EBP. This is of even greater importance if there is a focal neurological examination. Furthermore, had an EBP been performed prior too the CT scan, the pituitary abnormality finding would have further confused the picture not only as to the etiology of the headache, but as well as to the part the EBP might have played in the pituitary pathology. Not all headaches after dural puncture are postdural puncture headaches, especially in the obstetric population. A thorough history of prior headaches need to be obtained by clinicians before dural punctures to exclude other causes of headache besides post puncture headaches.

References

1. Lennon M, et al. Pituitary Apoplexy after Spinal Anesthesia. British Journal Of Anesthesia 1998; 81; 616-618.
2. Marfurt D., et al. Recurrent Post –Partum Seizures after Epidural Blood Patch. British Journal of Anesthesia 2003;90: 247-50.
3. Davies J M., et al. Liability Associated with Obstetric Anesthesia. A Closed Claims Analysis. Anesthesiology 2009; 110; 131-9

Possible Complications of Spinal Cord Stimulators: A Literature Review of Reported Cases

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Background: There have been few published reviews on complications of spinal cord stimulators, but none to our knowledge stratify complications into those which the physician should watch out for before the procedure, intraoperative and post operatively. As of 2007, across the United States, one Spinal Cord Stimulator was implanted every twenty minutes on average. Clinicians should be aware of the range of possible complications at every stage of the procedure. This article provides a summary of reported complications published in journals since the first spinal cord stimulator (SCS) was implanted in 1971.

Objective: To identify all possible complications of spinal cord stimulators based on published reports and stratefy them preoperatively, intraoperatively and post operatively,so physicians are alert at every stage of the procedure

Methods: Electronic search on Pub med was performed using key word "spinal cord stimulator' to identify articles published between 1971 and 2011. Our Inclusion criteria were 1, all case reports, case series, cohort, case control and randomized control trials that reported complications with implantation or use of the spinal cord stimulator. Articles dealing with the mechanism of action, design, application, techniques for implantation or other forms of electrical stimulation were excluded from the study.

Our search using our key word " spinal cord stimulator" on MEDLINE revealed 500 articles. Of these we chose 21 articles for review.

Results: Preoperative Intra Operative Post Operative, Epidural Lipomatosis Bleeding, Hematoma, Seroma Pain at incision site, Epidural Hematoma, Cord Compression, Epidural Scarring Inadvertent Dural Puncture, Spinal contusion, Spinal Cord needle Puncture, CSF leakage, Post Dural Puncture headache Infections- Skin Breakdown, Dermatitis, Psoas & Epidural abscess, Meningitis, Paraparesis, Quadriparesis, Quadriplegia, Sixth nerve palsy Hardware Related- Lead

electrode fracture, lead migration, Pulse generator site discomfort, Epidural Scarring around electrode, Allergy to electrode, Battery failure, interference with radiofrequency ablation , Psychiatric- Panic attack, Conversion Disorder Micturition inhibition, Weight loss

Conclusions: Clinicians should be aware of all range of possible complications with the placement of spinal cord stimulators so as to adequately inform patients and watch out for possible pitfalls.

References

1. Devulder J. et al Spinal cord Stimulation in Chronic Pain: Evaluation of Results,Complications and Technical Considerations in Sixty Nine Patients.. Clinical Journal of Pain. 7(1):21-8, 1991 Mar.
2. Mekhail NA, Mathews M, Nageeb F, et al. Retrospective review of 707 cases of spinal cord stimulation: indications and complications. Pain practice. 2011 Mar; 11(2):148-53. 3. Prager,J Estimates of Annual Spinal Cord Stimulator Implant Rises in the United States: Journal of Neuro modulation vol 13 Jan 2010

Paralysis from Lumbar Transforaminal Epidural Steroid Injection. Is "Safe Triangle" Technique Safe? Consider a New "Safe Zone" Approach

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Background: Lumbar transforaminal epidural steroid injections are commonly performed to treat back pain and radicular pain. American Society of Interventional Pain Physicians reported, in an evidence based review, that the recommendation for these injections is strong for managing chronic low back pain and lower extremity pain. In 2004, there were a total of 559,788 transforaminal injections done on Medicare participants alone. This is an increasing trend as only 96,872 of these injections were done in 1998[1].

Unlike other approaches to the epidural space like interlaminar or caudal, this technique is uniquely associated with a dreaded complication of permanent paralysis of lower extremities. Since 2002, there have been 9 published reports and one presentation [at an annual meeting] of 19 cases of severe bilateral paralysis and paraplegia due to spinal cord infarction caused by transforaminal epidural steroid injections [2-11].

There is concern amongst several interventional pain physicians that the incidence of this unfortunate complication maybe even higher than reported. Since, the pathologic final diagnosis in all cases is infarction of spinal cord, the implicated blood vessel is, without any doubt, the radicular artery.

This complication appears to be unique to transforaminal approach. This is not reported from interlaminar and caudal epidural techniques. It is thus our opinion that the current approach to TFESI using the "safe triangle" is unsafe and is more likely to damage the radicular artery. We propose a novel approach ("Safe Zone Approach") that carefully avoids damage to the artery of Adamkiewicz, by placing the needle tip in areas ("safe zones") which are away from this vital vessel. Yet, it allows easy access to the epidural space. We strongly urge that the the "safe triangle" approach be abandoned as it has already led to complications which are unacceptable.

Objective: To assess the risk of paralysis from the traditional "Safe Triangle" transforaminal epidural technique and to find alternative safer techniques.

Methods: We analysed the needle position in the lumbar neural foramina based on the images provided and/or the description provided in all the published cases of spinal cord infarctions resulting from transforaminal epidural injections. We checked if the needle tip placement was in the superior, inferior, anterior, posterior, medial or lateral part of the foraminal. We also performed a literature search regarding the position of the radicular artery in the foramen.

A total of 9 publications and one presentation were found reporting a total of 19 cases. Images were provided in only 8 of the cases [2-11] and description was used in 1 case[3]. In one of these 9 cases, we used both the image and description. We attempted to reach out to the authors hoping that we would obtain additional images for better analysis. 9 out of the 10 authors communicated back and informed us that other images were not available. All the authors who responded to us agreed with our assessment of the

needle position in their case reports.The location of the needle in the foramina was determined independently by all the three authors who are all very experienced and performed thousands of these injections. If there was a disagreement, it was resolved by discussion. Superior and inferior needle location was checked in the lateral view. The foramen was measured from the bottom of superior pedicle to the top of inferior pedicle. This zone was divided into superior, mid and inferior portions and the needle position was assessed if it belonged in the superior, mid or inferior zone of the foramen. For the medial and lateral plane, the area of interest was the space between the 6 o'clock position on the interested pedicle and the lateral aspect of the pedicle [9'oclock] on the left pedicle and 3 o'clock on the right pedicle [using both AP views on fluoroscopy and axial views on CT]. This zone was then bisected. Needle positioning medial to the bisecting line was deemed medial and if the needle was lateral to this line, it was determined as lateral positioning. For checking anterior or posterior placement both lateral views on fluoroscopy and axial views on CT were utilized. In the lateral views the foramen is usually reverse teardrop with superior foramen being wider and the inferior foramen being narrower. Depending of whether the needle is in the superior part of inferior part, we divided the width of the foramen into anterior, mid and posterior third of the foramen and then assessed the needle positioning.

Results: In 8 of the nine cases [87.5%] of the patients who has paralysis, the needle was in the superior part of the foramen. In the remaining one case, the needle was in neither superior or inferior but in the mid zone. In all the 8 cases where the needle position could be verified, none had needle placement in the inferior part of the foramen. In 66.6% of the cases where information was available, the needle was in the anterior part and in 33.3% in the posterior part of the foramen. In 50% of the known cases the needle was in the medial part and 50% in lateral part of the foramen.

There is sufficient evidence in the anatomic studies that the radicular arteries are rarely in the inferior part of the foramen. In a cadaveric microsurgical anatomical study, Alleyne et al[12], found that the artery of Adamkiewicz lies in the superior or mid portion of the foramen, closely juxtaposed superiorly and ventrally to the DRG-ventral root complex in a consistent manner. Kroszczynski et al[13], showed in a cadaveric study that 74% of the radicular arteries reside in the upper part of the foramen compared to 23% in the mid -foramen. Only 3% of the radicular arteries lie in the inferior. Rauschning[14] reported that the nerve root complex[root sleeve, ganglion and nerve trunk] invariably lies in the "subpedicular notch" together with the branches of lumbar artery. P. van Roy[15] in a anatomical review stated that the radicular artery follows the cranial aspect of the spinal nerves which reside in the large upper part of the foramen. Radiological evidence also confirms that the radicular arteries reside mostly in the superior part of the foramen. Murthy et al[16] evaluated 113 radiculomedullary arteries in the intervertebral foramen and reported that 88% of them are in the superior third of the neural foramen as opposed to only 9% and 2% in the mid and inferior third respectively. Takase et al[17] traced the artery of Adamkiewicz from the aorta to the anterior spinal artery using computed tomography. In 43 of the 63 patients, they could completely visualise the artery along its course except at the intervertebral foramen because it was too close to the "bone" in the foramina. Personal communication with the author[Dr.Takase] confirmed that this "bone" was infact the medial and inferior part of the pedicle. In other words, 68% of the time, the artery is hugging the pedicle in the superior part of the foramen.

Based on the anatomical and radiological evidence along with clinical evidence that placement of the needle in the superior part of the foramen carries the risk of compromising the radicular artery, we propose avoiding the traditional "safe triangle" technique. This approach involves needle placement in the anterosuperior part for the foramen. In our opinion, the needle should be placed in the "safe zone" which is the posteroinferior part of the foramen. Alternatively, needle positioning can also be considered in the superoposterior or inferoposterior zones.

With our analysis of the available anatomical studies and radiological studies, we have identified a "Inferior Triangle." In the oblique flouroscopic view, its boundaries are as follows. The lateral border of the superior articular process forms one side of the triangle and the transverse process is the base. The hypotenuse is the traversing nerve. This is diametrically opposite of the "Traditional Safe Triangle". We propose to place the needle as inferior and as posterior as possible in the neural foramen which corresponds to the inferomedial part of this Inferior Triangle. The C-ARM should be obliqued ipsilaterally until the facet joint bisects the disc space or vertebral body to obtain a "true" oblique view. The target point is the junction of superior articular process [SAP] and transverse process [TP]. If this landmark is not clearly visualized, alternatively the inferolateral part

of the SAP can be targeted. Targeting either of these points is critical as it will ensure inferior placement of the needle in the foramen. If not, the likelihood of the needle placement in the mid zone of the foramen increases. If an L3 transforaminal epidural is planned, the target point is the junction of the SAP with transverse process [TP] at L4 level and not L3. Place the needle using the "gun barrel" technique to contact the junction of SAP and TP [or the inferolateral part of SAP]. After contacting either one of the above landmarks [this will ensure posterior placement of the needle and also decreases the chances of inadvertently entering the disc], walk off the bone slightly into the foramen. Check the lateral view and advance the needle if necessary until it is in the posterior part of the foramen. Move the C-ARM to visualize the AP view. Make sure that the needle tip is at the lateral aspect of the pedicle. Inject dye under real time flouroscopy [using AP views] and check for any vascular spread and also for medial epidural spread. If the desired medial epidural spread is not achieved, then advance needle slightly and inject again and repeat this process until good medial epidural spread is obtained [make sure that it is not medial to the 6 o'clock of the pedicle to avoid subdural/intrathecal or intradiscal placement]. As soon as initial medial contrast spread is seen [even though lateral spread is noted], cease further needle advancement because staying as lateral as possible in the AP view, will ensure posterior placement of the needle in the foramen. Although in most cases medial contrast spread can be achieved in the posterior part of the foramen, sometimes the needle may have to be advanced to the anterior part of the foramen. If the needle is in the anterior part of the foramen, it is pertinent that it should be in the inferior part. If not, the needle has to be repositioned. After negative aspiration for blood and cerebrospinal fluid and also negative vascular and intrathecal/subdural contrast spread [under real time flouro], inject the medication. Inferior approach [unlike the superior approach] unfortunately increases the likelihood of encountering the disc. These are probably intraannular injections and not intranuclear injections. Staying posteriorly in the foramen will eliminate this risk. At L5 level, true mid oblique position is usually not possible because of the intervening iliac crest. Successful injections can still be done in spite of this limitation replacing the TP with sacral ala. Good epidural contrast spreads were also achieved by placing the needle in the midzone [superoinferior plane] and posteriorly in the foramen. If this approach is contemplated, it is paramount that the needle is absolutely in the posterior part of the foramen.

Conclusions: Based on the evidence presented above, the traditional safe triangle technique is clearly associated with the unquantifiable but definite and unacceptable risk of compromising the major radicular artery resulting in ischemic spinal cord injury leading to the devastating complication of complete permanent paralysis. Presumably safer alternative techniques need to be embraced.When one case of paralysis is too many, we need to do whatever it takes to avoid this catastrophe.

References:

1. Manchikanti L. Medicare in Interventional Pain Management: A Critical Analysis. Pain Physician. 2006;9:171-197.
2. Glaser SE, Shah RV. Root Cause Analysis of Paraplegia Following Transforaminal Epidural Steroid Injections: The'Unsafe' Triangle. Pain Physician 2010;13:237-244.
3. Houten JK, Errico TJ. Paraplegia After Lumbosacral Nerve Root Block: Report of Three Cases. The Spine Journal 2. 2002;70–75.
4. Huntoon MA, Martin DP. Paralysis After Transforaminal Epidural Injection and Previous Spinal Surgery. Pain Regional Anesthesia Medicine. 2004;29(5):494 –495.
5. Glaser SE, Falco F. Paraplegia Following a Thoracolumbar Transforaminal Epidural Steroid Injection. Pain Physician. 2005;8:309-314.
6. Somayaji HS, Saifuddin A, Casey ATH, Briggs TWR. Spinal Cord Infarction Following Therapeutic Computed Tomography-Guided Left L2 Nerve Root Injection. Spine. 2005;30(4):E106 –E108.
7. Quintero N, Laffont I, Bouhmidi L, et al. Transforaminal Epidural Steroid Injection and Paraplegia: Case Report and Bibliographic Review. Annales de réadaptation et de médecine physique. 2006;49:242–247.
8. Kennedy DJ, Dreyfuss P,†Aprill CN, Bogduk N. Paraplegia Following Image-Guided Transforaminal Lumbar Spine Epidural Steroid Injection: Two Case Reports. Pain Medicine. 2009;10(8).
9. Lyders EM, Morris PP. A Case of Spinal Cord Infarction Following Lumbar Transforaminal Epidural Steroid Injection: MR Imaging and Angiographic Findings. AJNR Am J Neuroradiol. 2009;30:1691–1693. 10.Wybier M, Gaudart S, Petrover D, Houdart E, Laredo JD. Paraplegia Complicating Selective Steroid Injections of the Lumbar Spine. Report of Five Cases and Review of the Literature. Eur Radiol. 2010;20:181–189.
11. Murthy NS. Intraforaminal Location of the Great Anterior Radiculomedullary Artery (Artery of Adamkiewicz): A Retrospective Review. Annual Meeting. International Spine Intervention Society. Toronto, Canada 2009 (7/2009)
12. Alleyne CH Jr, Cawley CM, Shengelaia GG, Barrow DL. Microsurgical Anatomy of the Artery of Adamkiewicz and its Segmental Artery. J Neurosurg. 1998;89:791-795.
13. Kroszczynski AC, Kohan K, Kurowski M, Downie SA, Olson TR, Thomas MA. Intraforaminal Location of the Great Radiculomedullary Artery (Artery of Adamkiewicz): A Cadaver Study. Pain Physician. 2010;13:E297.
14. Rauschning W. Normal and Pathological Anatomy of the Nerve Root Canals. Spine. (Phila Pa 1976). 1987;2(10):1008-1019.
15. Van Roy P, Barbaix E, Clarijs JP, Mense S. Der anatomische Hintergrund von Rückenschmerz. Schmerz. 2001;15(6):418-424.
16. Murthy NS, Timothy PM, Behrns CL. Intraforaminal Location of the Great Anterior Radiculomedullary Artery (Artery of Adamkie-

wicz): A Retrospective Review. Pain Medicine. 2010;11:1756–1764.
17. Takase K, Sawamura Y, Igarashi K, Chiba Y, Haga K, Saito H, Takahashi S. Demonstration of the Artery of Adamkiewicz at Multi–Detector Row Helical CT. Radiology. 2002;223(1):39-45.

Spinal Cord Stimulation Efficacy: Review of 5 Years Experience from an Academic Center Database

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Background: Introduction. Spinal cord stimulation (SCS) is an ever growing field that has been widely applied to treat intractable pain entities since 1967. Accepted indications include postlaminectomy pain, CRPS, peripheral neuropathy, and visceral pain. Several authors have reported case series and few randomized trials (Kemler et al 2005; North et al 2008). Robust analysis in large SCS patient registries is very useful.

Objective The purpose of this study is to report the three year experience of an academic pain medicine practice on the use of SCS for chronic nonmalignant pain.

Methods Study design This is a retrospective single center database review of all SCS trials/implants. Over a 5 year period (2006-2011) in a single academic center 275 patients were subjected to a trail of SCS. 189 patients had a satisfactory outcome (>50% improvement in pain and activity) to justify a permanent implant. Results Results. Trial/implant ratio in the general population was 68.4% and disease specific was 71% for FBSS, 64.7% for CRPS, 80% for SFN and 60% for PHN/PN and 80% for visceral pain post differential nerve block. NRS cores decreased from 8.5 to 4.3 at 1 month and 5.2 at 12 months. The number of back surgeries was not correlated with the satisfaction leading to SCS implant (14% of patient on failed trail group and 15% on successful trial group).

Conclusions: SCS can provide significant long term relief in various conditions with chronic intractable pain. Stringent patient selection and rigorous assessment of the pain quality affects the efficacy of this treatment.

References

1. Kumar, K., Taylor, R.S., Jacques, L., Eldabe, S., Meglio, M., Molet, J., Thomson, S., O'Callaghan, J., Eisenberg, E., Milbouw, G., Buchser, E., Fortini, G., Richardson, J. & North, R.B. (2008) The effects of spinal cord stimulation in neuropathic pain are sustained: a 24-month follow-up of the prospective randomized controlled multicenter trial of the effectiveness of spinal cord stimulation. Neurosurgery, 63, 762-770; discussion 770.
2. Taylor, R.S., Van Buyten, J.P. & Buchser, E. (2005) Spinal cord stimulation for chronic back and leg pain and failed back surgery syndrome: a systematic review and analysis of prognostic factors. Spine (Phila Pa 1976), 30, 152-160.
3. Williams, K.A., Gonzalez-Fernandez, M., Hamzehzadeh, S., Wilkinson, I., Erdek, M.A., Plunkett, A., Griffith, S., Crooks, M., Larkin, T. & Cohen, S.P. (2011) A multi-center analysis evaluating factors associated with spinal cord stimulation outcome in chronic pain patients. Pain Med, 12, 1142-1153.

Combined Supraorbital (SONS) and Occipital Nerve Stimulation(ONS) in Failed Surgical Treatment of Migraine: Case Report and Review of the Literature

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Background: Epidemiologic studies have shown that an estimated 35 million Americans suffer from migraine headaches. Economic consequences of migraine headache have been estimated to exceed $13 billion per year. Recently, a series of publications have suggested that in certain patients migraine headaches can be surgically treated by decompressing peripheral nerves that acts as migraine triggers. However, such therapies are not always successful, and call into question what options remains for patients failing such surgical therapies.

O**bjective:** We detail a case of a patient who had failed surgical treatment for chronic migraine. Our objective was to see if combined SONS and ONS could result in improvement of the migraines despite neurodestructive techniques applied to the peripheral nerves.

Methods: A 37 year old female patient suffering from migraines since age of 13 received an initial bilateral supraorbital nerve block and then surgical decompression of the proximal supratrochlear nerve. Following this, she also received blocks of the temporal tendon (bilateral). She had then a septal decompression surgery, which also did not relieve the headache. A bilateral decompression of the greater occipital nerves with partial resection of the semispinalis capitus muscle and placement of subcutaneous fat to shield the nerves, endoscopic decompression of the bilateral supratrochlear nerves with fat graft to cushion the nerves, bilateral release of the zygomaticotemporal branch of the trigeminal nerves, septoplasty, bilateral inferior turbinectomy and bilateral middle turbinate outfracture was then carried out to relieve her headaches. 3 months later, she underwent a bilateral supraorbital and supratrochlear neurectomy through a transplapebral approach. Unfortunately, all these 4 separate surgeries did not relieve her migraines. We then decided to proceed with an ONS and SONS trial to see if neuroaugmentation techniques could relieve her migraines. Results The patient had a highly successful trial with bilateral SONS and ONS stimulation. The frontal leads were placed approximately 3 cm above the eyelids in a higher position than normal to cover the pain in her vertex. She reported to have excellent pain relief, but did not feel any paresthesia coverage in her frontal leads. We conjectured that placing the leads in a more conventional position approximately 1.5 cm above the eyebrows would result in better coverage. A permanent implantation was performed with the information from the trial, and led to both better paresthesia coverage and headache relief. She continues to be headache free 5 months after her implant.

Conclusions: Reed et al(3) have demonstrated that combined SONS and ONS stimulation leads to an improvement in outcome in migraine results. A moot issue is related to the success of the SONS and ONS in cases where surgical decompression has already been performed, and if indeed nerves regenerate, whether the regenerated nerves would be amenable to successful neurostimulation paresthesia coverage. What we observed is very interesting in the sense that we achieved resolution of the frontal headaches WITHOUT paresthesia coverage in one of the frontal leads. As expected, output levels needed for relief of headache was higher than seen in normal patients, but successful resolution of migraine symptoms was obtained during the trial period. We hypothesize that the addition of SONS with ONS led to a better outcome to obtain the full therapeutic response, although further studies may be needed to indeed confirm the finding. The permanent implant was then able to replicate and even improve the results during the trial period and has led to a successful outcome at 5 months follow-up. Thus, the case report emphasizes the importance of considering neuro-augmentation modalities versus neuro-destructive modalities, especially in cases of migraines resistant to multiple therapies.

References

1. Guyuron B, Varghai A, Michelow BJ, Thomas T, Davis J. Corrugator supercilii muscle resection and migraine headaches. Plast Reconstr Surg 2000; 106: 429-434; discussion 435-436.
2. Guyuron B, Reed D, Kriegler JS, et al. A placebo controlled surgical trial of the treatment of migraine headaches. Plastic Reconstr Surg 2009; 124: 461-468.
3. Reed KL, Black SB, Banta CJ, Will KR. Combined occipital and supraorbital neurostimulation for the treatment of chronic migraine headaches: initial experience. Cephalalgia 2010; 30(3): 260-271.

Platelet Rich Plasma Therapy (PRP) for Cervical Facet Arthropathy

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Background: Platelet-Rich Plasma (PRP) has been studied and utilized in multiple medical disciplines to assess healing, regeneration of tissues and bones, and to treat intra articular joint pain. Several studies have identified statistically significant improvement in healing and regeneration of tissues and bones in animal models.(1) PRP has also been shown to slow the degenerative changes in plantar fasciitis as well as diminish

chronic inflammatory changes.(2) Compared to corticosteroid injections and hyaluronate, PRP has demonstrated efficacy in pain improvement.(2,3,4)

The potential benefits of PRP are thought to rely on the intrinsic properties and interplay between the concentrated growth factors at the cellular level, such as TGF-β, PDGF, and VEGF to name a few.(1)

PRP is prepared by collecting autologous blood in the immediate pre-procedure period in a sterile manner. The blood is then placed into a single use sterile centrifuge container. The entire process is completed via a closed system. Centrifugation will separate whole blood into three distinct layers: bottom layer of red blood cells (specific gravity of 1.09), the top layer of platelet poor plasma (specific gravity of 1.03) and the middle later of platelet concentrate and white blood cells (specific gravity of 1.06)(1) Blood is drawn into a tube with anticoagulation factor, spun down utilizing a double centrifugation technique, and PRP is isolated after two centrifuge cycles. In office based practice 5-10ml of PRP can be isolated from approx 30-60ml of blood. PRP is defined by the American Red Cross as >200,000 k platelets per µl, which is approximately three to eight times the normal concentration found in whole blood.

Objective: We present this case report to educate and inform the pain community of the possible benefits of PRP therapy for facet joint arthropathy as a possible alternative to currently available treatments.

Methods: Following a successful diagnostic local anesthetic block of medial branch nerves, a series of three patients received intra articular facet joint PRP therapy under fluoroscopic guidance for cervical facet arthropathy. A total of 0.5cc to 1cc of PRP was injected into each targeted facet joint. These patients were evaluated for extent and duration of relief of their axial neck pain. Pain intensity was recorded using the numerical rating scale (NRS) before, immediately post PRP therapy, and four weeks post procedure. Results All three patients reported a short duration of increased pain immediately post PRP therapy, which resolved over 48-72 hours. Patients then reported an improvement in NRS scores of at least 50% during the initial follow-up period (4 weeks) when compared to baseline and two others reported complete resolution of their axial neck pain. Improvement in pain will be assessed on an ongoing basis.

Conclusions: Over 90% of the published literature to date regarding the clinical applications of PRP therapy is within the last 3 years. As PRP treatment becomes more popular, clinical studies evaluating the benefits of PRP have also expanded.

Currently, the most convincing published evidence available regarding PRP therapy exists for treatment of chronic tendonopathy. Mishra et al, a prospective cohort, comparing PRP therapy versus local anesthetic for lateral epicondylitis showed 60% pain score improvement at 8wks, 81% pain score improvement at 6 months and 91% pain score improvement at one year for the PRP group.(5) A prospective randomized double blind study by Peerbooms et al, comparing PRP therapy injection versus corticosteroid injection for lateral epicondylitis showed that at 1 year the PRP group had a 73% success rate versus 49% in the steroid group. (6) Most importantly the PRP group progressively improved while the steroid group regressed.

Spakova et al. provides evidence for intra articular use of PRP therapy. In this prospective cohort study comparing PRP with hyalronate in treatment of knee osteoarthritis, statistically significant improvement in the Western Ontario and McMaster Universities Osteoarthritis Index in patients receiving PRP at 3 and 6 months follow up.(7)

At the Center for Pain Management, 3 patients with cervical facet arthropathy underwent PRP injection after undergoing positive diagnostic medial branch nerve blocks at the affected cervical levels. All 3 of the patients were noted to have a significant improvement at follow-up with no known complications. A current IRB research protocol is being initiated to evaluate PRP therapy versus conventional treatment for facet arthropathy. It is our belief PRP therapy is a successful intervention for cervical facet arthopathy based on current experience as well as available evidence yielding successful results with PRP injection into other synovial joints.

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References

1. Nikolidakis, D. The Biology of Platelet-Rich Plasma and Its Application in Oral Surgery: Literature Review. Tissue Engineering. 14:3 2008.
2. Ertugrul, A. The comparison of the effect of corticosteroid and platelet-rich plasma (PRP) for the treatment of plantar fasciitis. Arch Orthop Trauma Surg. Mach 2012.
3. Lemont, H. Plantar fasciitis: a degenerative process without inflammation. J Am Podiatric Medicine. 93:234-237. 2003.
4. Omer, M. Platelet-Rich Plasma or Hyaluronate in the Management of Osteochondral Lesion of the Talus. Am J of Sports Medicine. 40:2 2012.
5. Mishra A, Pavelko T. Treatment of chronic elbow tendinosis with buffered platelet-rich plasma. Am J Sports Med 2006; 34:1774-1778.

6. Peerbooms JC, Sluimer J, Bruijn DJ, Gosens T. Positive effect of an autologous platelet concentrate in lateral epicondylitis in a double blind randomized controlled trial: Platelet-rich plasma vs corticosteroid injection with a one year follow up. Am J Sports Med 2010; 38: 255-262.

7. Spakova T, et al. Treatment of knee joint osteoarthritis with autologous platlet-rich plasma in comparison with hyaluronic acid. Am J Phys Med Rehabil 2012. Vol 91, No 4; 1-7.

A Prospective Quality Assurance Outcome Study of the Minimally Invasive Lumbar Decompression Procedure

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Background: Chronic low back pain from lumbar spinal stenosis (LSS) is a common cause of pain and impaired mobility. In the Stony Brook University Center for Pain Management, a new quality assurance program (Q/A) was designed and implemented to assess the safety of the "Minimally Invasive Lumbar Decompression" (MILD) procedure and the impact on changes in LSS patient's pain, functional and mood status over time. Here we report the QA safety and outcomes data from 39 MILD patients with 1-6 months follow up.

Objective: To characterize trends over time in pain and functional outcomes in MILD patients and identify risk factors for patients who do not benefit from the procedure.

Methods: Safety and outcomes data from 39 patients undergoing MILD were registered in the Surgical Quality Data Use Group (SQDUG) research database. The IRB-approved SQDUG research database assembles de-identified patient-related data on preoperative medical characteristics, intra-operative course as well as post-operative pain status and functional outcomes information from MILD patients. Major outcomes measures included numerical pain rating scale, symptom severity and physical function by the Zurich Claudication Questionnaire, functional status by Oswestry Disability Index, Pain Interference scores (The National Institutes of Health's (NIH) Patient-Reported Outcomes Measurement Information System (PROMIS) and patient's self-reported low back and lower extremity pain distribution patterns.

Results: The patients were elderly (72.4±10.0) with baseline pain scores of 7.3±1.7 and all had symptomatic neurogenic claudication. From the frequency of the patient's self-reported pain distribution patterns the most common lower extremity dermatomes affected were S1 and S2 followed by L3 and L4. Pain according to the ZCQ symptom severity scale averaged 3.2 (95%CI 3.0, 3.4) and pain interference scores by NIH PROMIS was 63.9 ± 8.1% indicating worse than average impact of pain on daily living compared to the general US population norms. Functional status and symptom severity evaluated by the ODI scores at baseline was 42.9±17.2 (95% Quantiles, 37.3, 48.6) indicating moderate disability in daily living. All patients underwent the MILD procedure without complications. Average NRS pain scores were significantly reduced at 1-month ($p<0.0001$), 3-months ($N=31$, $p<0.0001$) and at 6-months ($N=17$, $p<0.001$) following the procedure when compared to baseline scores (Table 1). At 3 and 6-months the ODI was improved by 25% and 45%, respectively, suggesting that the patients did better over time. The MILD patients drawings onto a physical body of where they 'felt' pain in the low back and/or legs when standing and walking were quantified at each time point and any decrease in 'total tally' over time were assessed. Specifically, this analysis demonstrated that 74% of the MILD patients with 3 months follow up ($N=31$) reported that their pain was less suggesting that the MILD procedure had alleviated lumbar spine nerve root compression thus reducing overall lower extremity neuropathy when standing or walking. In fact, 14 patients (45%) with 3 months follow up reported 'zero' pain. There was also a significant improvement in NIH PROMIS pain interference scores obtained in 24 patients at 1 month ($p=0.0005$) and at 3 months ($p=0.0023$) after the MILD procedure when compared to their baseline scores.

Conclusions: Based on our preliminary findings, we conclude that functional improvements and pain

reduction were demonstrated for the majority of the MILD patients at both 3 & 6 months following the procedure. The patient's self-reported lower extremity pain after the procedure was also improved in the majority of patients. The Pain Interference scale on the NIH PROMIS may be predictive of pain outcomes.

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Encore Presentation This research was also accepted to be presented at IARS in May of 2012