Diagnostic and therapeutic spinal interventions

Facet joint interventions

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Summary

Axial spine pain is a common condition that is due to facet joint disease in some patients. Local anesthetic blocks of the medial branches of the dorsal rami of the spinal nerves that innervate facet joints are used to identify painful facet joints. Subsequent radiofrequency neurotomy of the medial branches serving symptomatic facet joints may provide prolonged albeit impermanent pain relief. The diagnostic blocks and radiofrequency treatments are best validated in the cervical spine. Neurologists should be aware that patients with axial spine pain who are referred to a pain clinic or pain management facility are likely to be considered for diagnostic and therapeutic interventions directed at facet joints and their sensory nerve supply.

Pain of spinal origin is common and can manifest as axial pain originating from the spinal articulations (facet joints or intervertebral disks) or radicular pain due to a compressed or irritated spinal nerve. Neurologists are frequently asked to diagnose and treat patients with such pain. With the development of advanced spinal imaging that can allow for precise needle placement, spine interventions for diagnostic or therapeutic purposes or both have become commonplace. This series of 3 articles addresses the most common minimally invasive spine interventions—medial branch blocks and radiofrequency (RF) facet neurotomy, selective spinal nerve blocks and epidural corticosteroid injections, and diskography. Medial branch blocks, selective spinal nerve blocks, and diskography are purely diagnostic procedures. RF neurotomy and epidural steroid injections have therapeutic intent. While

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some neurologists perform facet interventions and epidural injections, more often they refer patients to interventionalists (typically anesthesiologists, physiatrists, or radiologists) who work in specialized pain centers. This article covers indications for medial branch blocks and RF facet neurotomy, how the interventions are performed and interpreted, and risks and benefits.

Indications, contraindications, and patient and segment selection for medial branch blocks and RF neurotomy

The facet or zygapophyseal joints are a considerable source of axial spine pain.^{1,2} Lumbar region facet-mediated pain is rare in young adults (about 15% of chronic back pain) but increases in prevalence up to age 70 and accounts overall for about 30% of patients with chronic low back pain.³ Cervical facet joints are responsible for 25%–65% of nontraumatic and 50%–60% of trauma-induced cases of chronic neck pain.⁴ The medial branches of the dorsal rami of the spinal nerves innervate the facet joints. Medial branch blocks are indicated in patients with chronic (>6 months) axial spine pain that is inadequately explained and poorly controlled. If diagnostic blocks of the nerves that supply specific facet joints relieve the patient's pain, RF lesioning of the same nerves can be offered to provide prolonged benefit. Contraindications to the performance of medial branch blocks or subsequent RF neurotomy include systemic infection, local infection at the procedure site, substantial bleeding diathesis, and pregnancy.

The facet joints targeted for medial branch blocks are chosen based on a combination of clinical and prevalence data. Physical and neurologic examination does not identify symptomatic facet joints. Structural findings of facet joint arthrosis on plain radiographs, CT, or MRI are not predictive of facet joint origin pain.⁵ MRI T2 hyperintensity or increased uptake on SPECT or SPECT/CT are purported to identify painful joints, but these findings have not been confirmed. Facet joint localization can be facilitated by comparing the patient's pain to facet joint pain referral maps.^{1,2,4} Prevalence data are also used.² Upper cervical pain with headache is most likely attributable to the C2-3 facet. Lower cervical pain is more likely to be C5-6 than C6-7 in origin. Lumbar pain is overwhelmingly due to the L4-5 or L5-S1 facet joints.

How the interventions are performed and interpreted

Medial branch blocks Each facet joint is innervated by 2 vertically adjacent spinal medial branches; the only exception is the C2-3 facet, innervated solely by the superficial medial branch of the C3 dorsal ramus known as the third occipital nerve.^{1,2} The medial branches can be targeted with image guidance because anatomic studies have shown consistent relationships between the medial branches and bony landmarks visible on fluoroscopy. Under fluoroscopic x-ray guidance, with sterile technique and without sedation, 25-gauge spinal needles are sequentially placed at the predicted position of medial branches of the dorsal rami of the spinal nerves which innervate the targeted facet joints. Injection of a small amount of contrast material (0.3 mL) excludes vascular uptake. A small volume of local anesthetic (0.5 mL) is then instilled. Because of frequent false-positive responses, the diagnostic criterion best supported by the literature is that of dual, comparative medial branch blocks in which the targeted medial branches are blocked on separate occasions using local anesthetics with different durations of action (e.g., lidocaine and bupivacaine). For a positive medial branch block, the patient must have substantial (80%–100%) pain relief for an appropriate duration with each

Figure The use of electrodes to coagulate a medial branch of a cervical dorsal ramus

(A) Cross-section through the C5 vertebra. An oblique pass is used to reach the nerve over the anterolateral aspect of the articular pillar. A parasagittal pass is used to reach the nerve over the lateral aspect of the pillar. With each pass, lesions are placed at, above, and below the cephalocaudal center of the pillar (B). From Lord SM, Barnsley L, Wallis BJ, et al. Percutaneous radiofrequency neurotomy for chronic cervical zygapophyseal joint pain. *N Engl J Med* 1996;335:1721-1726. Copyright © Massachusetts Medical Society. Reprinted with permission from Massachusetts Medical Society.

anesthetic agent. Such a concordant response should provide a specificity of 88%.² Many patients only receive a single local anesthetic injection directed at each suspect facet joint's medial branches. Because single injections have a false-positive rate of 27%–34%, the specificity of single blocks is much reduced.^{2,6}

RF neurotomy Properly performed dual comparative blocks can confirm or refute a diagnosis of facet-mediated pain. If the diagnosis of facet joint pain is confirmed, the medial branches innervating the implicated facet joints can be thermocoagulated using RF energy (RF neurotomy or rhizotomy). In this procedure, performed with minimal or no sedation, a RF electrode (16–22 gauge; larger electrodes produce larger thermal lesions) is directed under fluoroscopy via a posterolateral approach to the location of each targeted medial branch (figure). Meticulous electrode placement is essential to successful medial branch nerve lesioning. In the cervical spine, the medial branch is targeted as it passes over the lateral aspect of the articular pillar. In the lumbar region, the medial branch is targeted at the junction of the superior articular process and transverse process. The electrodes are heated to 80–85°C for 90 seconds. Because 1 facet joint is innervated by 2 medial branch nerves, RF neurotomy is appropriately performed at 2 levels on 1 side. The procedure may be performed on both sides for bilateral pain or more than 1 spinal level on the same side. Depending on the duration of benefit, RF neurotomy can be repeated. The authors stress the need to carefully select patients and identify symptomatic facet joints using dual comparative diagnostic medial branch blocks. There is no place for performing multisegment, bilateral procedures simply to “cover all possibilities.”^{1,2}

Intra-articular corticosteroid injections Separately, or coupled with a medial branch block, patients may receive intra-articular facet joint injections of a steroid in hopes of providing prolonged pain relief by an anti-inflammatory effect. There is, however, no high-quality literature support for therapeutic benefit from such injections.

Risks and benefits

Serious side effects are very rare and occur in a fraction of 1% of interventions. Patients undergoing RF neurotomy may experience local numbness, dysesthesias, or transient increase in

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pain. Temporary neuritis may occur (2%).² Third occipital neurotomy patients often experience cutaneous numbness and mild ataxia due to this nerve's role in cervical proprioception.² Allergic reactions are extremely rare but can occur with local anesthetics, corticosteroids, or contrast media. If corticosteroids are injected, systemic side effects can occur. Pretreatment imaging and fluoroscopy during the procedure expose the patient to radiation. Complications common to any needle procedure can occur and include infection, dural puncture, spinal nerve or cord injury, and vascular injury. Spine interventions have a higher risk when performed in the cervical or thoracic more than the lumbar spine. The medial branches can regenerate with return of pain.

Benefits include discovery of the patient's pain mechanism, improvement in their chronic pain, improvement in physical functioning, return to work, and decreased use of other health care. In the cervical spine, RF neurotomy may be especially helpful for pain following whiplash-type injury.⁷ If obtained, pain relief may not be complete or permanent. Additional improvement often follows repeat intervention, but benefit may wane over time. In addition to the facet joints, the medial branches supply some paraspinal muscles (chiefly the multifidus), soft tissues, and at some spinal levels, paraspinal skin. As RF neurotomy is designed to interrupt sensory signals, not treat or modify a disease process, the ultimate pathologic cause of the patient's pain is not known or directly treated.

What is the evidence that medial branch interventions are beneficial? A Cochrane systematic review concluded that there is "limited evidence that RF denervation offers short-term relief for chronic neck pain of zygapophyseal joint origin and for chronic cervicobrachial pain" and "conflicting evidence on the short-term effect of RF lesioning on pain and disability in chronic low-back pain of zygapophyseal joint origin."⁸ Chou et al.⁹ in an evidence-based American Pain Society Clinical Practice Guideline found "insufficient evidence to adequately evaluate benefits of" therapeutic medial branch blocks and RF denervation for low back pain.

A challenge to such reviews is that they evaluate and include studies based on research methodology, not whether the procedures were performed with evidence-based patient selection and procedural technique. Studies performed without rigorous patient selection, or without procedural technique based on proven anatomic principles, will not achieve good outcomes and will obscure the benefit that can be achieved with proper technique. In contrast to these reviews, high-quality studies using meticulous technique report that the majority of patients experienced 80%–100% pain relief for months to a year or more following RF neurotomy for chronic neck pain.^{7,10,11} With optimal technique, 66% of cervical RF patients achieved complete pain relief, restoration of activities of daily living, return to work, and no need for other health care for neck pain for a median duration of 17–20 months.¹¹ Prolonged relief could be restored by repeat neurotomy.^{7,10,11} In a study of low back pain patients using dual comparative medial branch blocks and correct RF technique, 60% of patients achieved at least 90% pain relief at 1 year follow-up; 87% of patients obtained at least 60% pain relief after 1 year.¹² In another rigorous study of lumbar RF neurotomy, the majority of patients had complete relief of low back pain, restoration of function, return to work, and no other health care needed for back pain for a median duration of 15 months from the first procedure and 13 months for repeat treatment.¹³ Outcomes are better, and the evidence is stronger, in the cervical spine than in the lumbar spine. This in part reflects the lower prevalence of facet-mediated pain in the lumbar region and hence greater challenges in patient selection. There is

little evidence to support facet interventions in the thoracic spine. When appropriately evaluated, only a minority of patients with axial spine pain will be candidates for RF neurotomy.

The discrepancy between the less favorable results in metadata and guidelines analyses and the excellent results reported in series using optimal diagnostic and RF technique implies considerable provider variability. Skilled interventionalists who select patients using established criteria will have much better outcomes than less skilled providers who are willing to use these procedures on anyone with neck or low back pain. With proper technique, these interventions are beneficial. However, the paucity of data regarding provider skill levels and outcomes makes it difficult to select interventionalists for referral.

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