



CHAPTER SEVENTEEN

PAIN MANAGEMENT IN THE HEAD AND NECK PATIENT

|| Peter S. Staats
|| Nilesh Patel

INTRODUCTION

Pain is the leading cause of health care visits and disability in the United States, costing the American people more than cancer and heart disease combined. Pain can adversely affect quality of life, and wound healing and can take on a life of its own after the pain-generating cause has been resolved. It is important, therefore, to have a rationale framework for approaching the treatment of pain.

What Is Pain?

The International Association for the Study of Pain defines pain as “an unpleasant sensory and emotional experience associated with either actual or potential tissue damage.”

Acute pain is a normal and generally self-limited response to injury, including tissue degeneration, which can be considered an aging injury. Pain is defined as “chronic” when it has persisted for at least 3 months. Because of its emotional component, pain is often associated with psychological comorbidities, including depression. Chronic pain serves no useful function and leads to great disability. It is important to search for the underlying biologic aspects of pain and treat them whenever possible.

Types of pain

Somatic pain involves activation of peripheral receptors and somatic sensory efferent nerves without damage to the peripheral nerves.

Visceral pain, a poorly localized type of somatic pain, results from activation of visceral nociceptors and efferent nerves and is frequently described as deep, aching, and cramping. Although visceral pain may seem less relevant than somatic pain when assessing head and neck pain, it is important to remember that patients can experience a referred pain to the jaw or shoulder from angina or other visceral pain sources.

Myofascial pain affects skeletal muscles and can be referred or local. The presence of a trigger point in a taut band of muscle—an area where local stimulation causes referred pain—is indicative of myofascial pain, as are restricted range of motion and a local twitch response to stimulation. Trigger points develop in taut bands of muscle.

Neuropathic pain results from direct injury to the central or peripheral nervous system and is characterized by a burning sensation. It is found in postherpetic neuralgia, chronic regional pain syndrome, reflex sympathetic dystrophy, nerve injury, diabetic neuropathy, and chemical neuropathy. Neuropathic pain is further divided into the categories of sympathetically maintained pain and sympathetically independent pain. The diagnosis can be difficult to distinguish and depends on the response of pharmacologic blockade of the sympathetic nervous system. If a patient has profound relief of pain after a sympathetic blockade, the pain syndrome is said to be sympathetically mediated. If there is no relief with an appropriately performed sympathetic block of the affected area, the pain is said to be sympathetically independent.

Measurement of Pain

Unfortunately, we do not have a tool that objectively determines whether a patient has significant pain. Instead, we must rely on a number of pain scales that patients can use to describe their pain. We cannot use an x-ray or a laboratory test to determine whether someone hurts. Pain is what the patient says it is, and it is defined by the patient.⁵⁷ Asking our patients how much they hurt serves several functions. First, it defines the severity of the pain in that patient. Second, it allows us to track the success of therapy.

Numeric pain scales range from 0 to 10. Patients are asked to rate the pain, using 0 to indicate no pain and 10 for the worst pain they can imagine (Figure 17-1). Visual analog pain scales accomplish the same

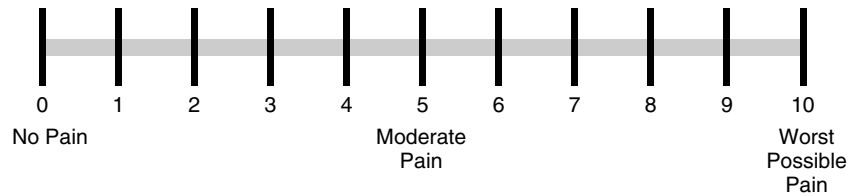


Figure 17-1. Brief pain inventory. From the Pain Research Group, Department of Neurology, University of Wisconsin—Madison.

thing with a 10 cm or 100 cm line. The far left registers “no to minimal pain,” and the far right correlates with very intense pain (Figure 17-2). Other tools include a verbal descriptor, a brief pain inventory, and the CRIES assessment (for children).

Treatment of Pain

The first step in the treatment of all pain is to diagnose and treat (if possible) the root problem. All pain

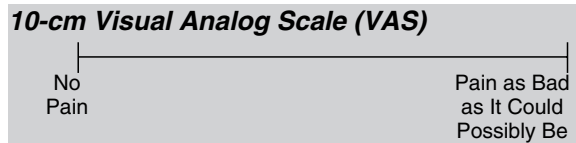


Figure 17-2. Visual analog scale. From the Agency for Healthcare Research and Quality: Acute pain management: operative or medical procedure and trauma, *Clinical Practice Guideline No. 1*. AHCPR Publication, No. 92-0032; Rockville, MD, 116–117, 1992.

treatment begins with conservative therapies (e.g., medical management and physical management) and proceeds if these therapies fail or are associated with intolerable adverse effects to neural blockade (visceral, sympathetic, sensory, spinal), the use of implantable technologies (implanted pumps or spinal cord stimulators), and neurodestructive techniques. Because pain has an emotional component, pain treatment may also involve psychological interventions.

Medical Therapies

Nonsteroidal agents. Nonsteroidal antiinflammatory drugs (NSAIDs) are used to treat mild pain associated with inflammation (Table 17-1). When added to an opioid regimen, they often permit reduction in the opioid dose. NSAIDs alter the inflammatory process by blocking expression of the cyclooxygenase (COX) enzymes that mediate production of the prostaglandins, especially PGE2, that sensitize pain afferents.

TABLE 17-1				
MEDICATIONS USED IN PAIN				
Class	Route	Usual Indication	Concerns	Comments
Nonsteroidal agents	• Oral • Intravenous	• Inflammatory pain	• Gastrointestinal bleeding • Platelet dysfunction • Renal dysfunction	COX-2 inhibitors appear to have a lower adverse-effect profile
Antiepileptics (neuronal stabilizing agents)	• Oral	• Neuropathic pain	• Tegretol is associated with aplastic anemia	
TCAs	• Oral	• Neuropathic pain • Depression	• Causes sedation due to anticholinergic effects	Use cautiously in patients with glaucoma, conduction abnormalities, or prostatic hypertrophy
Local anesthetics	• Oral • Local injection	• Neuropathic pain • Myofascial pain		
Botulinum toxins	• Injection	• Muscle spasm • Headache		
Opioids	• Oral • Intravenous • Intramuscular • Intrathecal • Intraventricular	• All types	• Addiction • Diversion	

Some NSAIDs (e.g., aspirin) indiscriminately block two cyclooxygenase enzymes, COX 1, which has a protective gastrointestinal role, and COX 2, which is implicated in inflammation. This distinction is not as clear-cut as was first thought, but the new “coxibs” designed to selectively block COX 2 have improved the safety profile of this class of medication.

Anticonvulsant (antiepileptic, membrane-stabilizing, or neuromodulating) agents. The “classic” antiepileptic, carbamazepine, has been widely used in the treatment of neuropathic pain associated with shooting or lancinating

pain and is the initial choice for many patients with trigeminal neuralgia (Table 17-2). Anticonvulsant drugs, especially gabapentin, have recently become a mainstay in the treatment of all types of neuropathic pain. The agents that fall in this class have multiple mechanisms of action and should be tried consecutively.

Tricyclic antidepressants. Tricyclic antidepressants (TCAs) also have multiple mechanisms of action and are used to treat neuropathic pain. In general, tricyclics work by decreasing the emotional depression that amplifies pain. They also decrease the reuptake

TABLE 17-2

ANTICONVULSANT AGENTS					
	GABA	Glutamate & Excitatory Amino Acids (EAA)	Channels	Ectopic Impulses	Miscellaneous
I. Gabapentin	Augments transmission Increases rate of synthesis	Inhibits release	Blocks Na ⁺ and Ca ⁺⁺		Stimulates 5HT release Inhibits branch chain AA transferase
Topiramate	Enhances at GABA-a receptor	Antagonizes AMPA & kainate receptors	Blocks Na ⁺	Suppresses	Carbonic anhydrase inhibition
Lamotrigine	Decreases	Decreases release of glutamate and aspartate	Blocks voltage dependent Ca ⁺	Suppresses	Suppresses acetylcholine
Carbamazepine		Decreases transmission	Slows recovery of voltage activated Na ⁺ Modulates L-type Ca ⁺⁺	Reduces	TCA effects Antagonizes adenosine receptors
II. Phenytoin	Enhances activity		Inhibition of Na ⁺ and Ca ⁺		May inhibit somatostatin release
Zonisamide			Blocks Na ⁺ & T-type Ca ⁺⁺		Facilitates dopaminergic & serotonergic neurotransmission
Valproate	Decreases degradation, increases synthesis	Reduces cerebral EAAs			Structurally unrelated to any other anticonvulsant
Clonazepam	Increases potentiation of transmission				Structurally related to benzodiazepines May have antianxiety & antispasmodic effects

of the inhibitory neurotransmitters, norepinephrine and serotonin.

Because they have anticholinergic effects, tricyclic antidepressants must be used with caution in the elderly or in patients with comorbid disease. Care should be exercised in determining dosages for patients with cardiac conduction abnormalities, narrow-angle glaucoma, or prostatic hypertrophy.

Local anesthetics. Local anesthetics such as lidocaine have central effects but also decrease the spontaneous activity of peripheral pain generators. When applied topically or with injection, they block the transmission of ectopic impulses associated with pain. Local anesthetic injections are also used systemically to treat neuropathic pain and must be used cautiously in patients with comorbid cardiac disease.

Opioids. Patients with pain rarely become addicted to appropriately prescribed opioids, and these drugs have demonstrated efficacy in nociceptive and neuropathic pain. When possible, opioids should be administered on a time-contingent instead of a pain-contingent basis. A regimen of opioids given with nonsteroidal agents remains the mainstay of acute pain management.

Physicians and patients alike are concerned about addiction. This term is frequently confused with both physical dependence and tolerance. Addiction is an abnormal behavior pattern of drug abuse. It involves taking medications for reasons other than pain relief. Physical dependence is a normal physiologic response to chronic medical therapy and causes patients who stop receiving the drug to experience withdrawal. Tolerance necessitates taking an increasing dose to achieve the same effect.

Physical medicine and rehabilitation. Stretching techniques, including traction, massage, strengthening exercises, posture adjustment, and application of heat and cold may help correct underlying pain-generating conditions.

Neuromodulating Therapies

Neural blockade. Nerve blocks are useful for diagnosis and therapy. A diagnostic nerve block involves injecting a local anesthetic around a nerve proximal to a presumed pain-generating lesion to see whether this relieves pain. Many variables must be taken into account when interpreting the results of nerve blocks. False positives, when the pain generator is not distal to the site anesthetized, can be due to placebo response, can be the effect of systemically administered analgesics, or can be the inadvertent spread of the injected local anesthetic agents.⁶⁸ False negatives occur when the site is inadequately anesthetized or when there are multiple pain

generators. Other nonspecific effects may result from improper needle placement or an unaccounted for effect of saline during a placebo test. It is, thus, inappropriate to decide that a patient's pain is psychogenic just because he or she responded to a placebo injection.

To reduce the subjective nature of the interpretation of nerve blocks, some clinicians inject a series of active agents and compare the results. This is known as the "comparative blocks" strategy. Investigation of the sensitivity and specificity of this regimen (lignocaine, bupivacaine, and saline randomly administered in masked fashion on separate occasions) compared with placebo-controlled blocks for cervical zygapophyseal joint pain (from whiplash injury) found that the comparative blocks have a specificity of 88% (causing few false-positive diagnoses) but their sensitivity is only 54%, which leads to many false-negative diagnoses.⁴⁷

When neural blockade is used for therapy, clinicians inject local anesthetics plus steroids around the target nerves. One of the most common nerve blocks involves injecting a steroid into the epidural space. Cervical epidural blocks have been used for more than 20 years to treat chronic, benign head and neck pain.¹⁴ Such injections are often used to treat disk herniation with nerve root injury and, when specifically directed to the transforaminal space, are thought to decrease inflammation around nerves.

Specific Nerve Blocks⁶⁰

Trigeminal (gasserian) ganglion block: The trigeminal nerve, located in Meckel's cave, is the largest cranial nerve and provides sensation to the oral mucosa, cranial fossa, tooth pulp, gingiva, and periodontal membrane. The trigeminal ganglion block is generally reserved for cases of pain arising from a surgical procedure or when more conservative treatment fails to mitigate the pain of trigeminal neuralgia, cluster headaches, cancer pain, or pain associated with multiple sclerosis. The three percutaneous lesioning techniques, each with advantages and disadvantages, involve injection of a neurolytic solution under fluoroscopic guidance, use of an electrode for radiofrequency lesioning, or balloon compression. These blocks are associated with serious complications and must be accomplished with extreme care and attention to proper technique.

Maxillary division nerve block: The purely sensory maxillary nerve is the second division of the trigeminal nerve. Maxillary nerve blocks provide regional anesthesia for the upper jaw and are used to prevent intraoperative and postoperative pain and to treat chronic pain arising from maxillary tumors. Blockade is achieved by injection of a neurolytic solution or applying radiofrequency to induce a lesioning. Possible complications include temporary blindness, intravascular injection, and hematoma formation.

Mandibular division nerve block: The mandibular nerve, which has a sensory and motor function, is the third division of the trigeminal ganglion. Blocking of this nerve is useful in treating pain arising from treatment of a fractured mandible and from cancer of the tongue, lower jaw, or mouth floor. Using the same block technique as for the maxillary nerve results in a high degree of success with few complications.

Glossopharyngeal nerve block: This mixed motor-sensory nerve affects the stylopharyngeus muscle, the posterior third of the tongue, the palatine tonsil, and mucous membranes. A branch of this nerve transmits information that helps control blood pressure, pulse, and respiration. The proximity of the carotid artery dictates extreme care during this block to avoid profound toxicity from a misplaced injection. Indications for this block include surgery, diagnosis, conscious intubation, cancer pain, and glossopharyngeal neuralgia. These nerve blocks can be performed daily, if necessary, with reduced doses of methylprednisolone. A glossopharyngeal nerve block often severely compromises swallowing and may cause a hematoma and inadvertent dysphonia from paralysis of the ipsilateral vocal cord. Some patients develop postprocedural pain (anesthesia dolorosa) that can exceed the original pain.

Sphenopalatine ganglion block: The sphenopalatine ganglion comprises the largest neural center outside the cranial cavity and has a mixed sensory, motor, and autonomic function. Indications for this block include facial pain, cluster headaches, and migraine. After proper needle positioning, injection of a local anesthetic agent achieves a diagnostic block, and radiofrequency lesioning produces neurolysis. In some patients, stimulation-induced bradycardia may require administration of atropine to complete the procedure. Lesioning can cause transient numbness in the palate, maxilla, or posterior pharynx.

Stellate ganglion block: The stellate ganglion block is used for sympathetic denervation of the head and neck. The stellate ganglion is formed by the fusion of the inferior cervical ganglion to the first thoracic ganglion and generally extends from in front of the neck of the first rib to the space between C7 and T1. The stellate ganglion is blocked to manage pain from Raynaud's disease, arterial embolism (arm), intraarterial injection of drugs, Ménière's disease (controversial), postherpetic neuralgia in the area managed by the ganglion, complex regional pain syndrome, Sudeck's disease, and facial reflex sympathetic dystrophy. The block also provides useful diagnostic information for the management of upper extremity vascular surgery patients. Simultaneous bilateral blocks are only used as emergency treatment for a pulmonary embolism. The stellate ganglion block can

be achieved with a paratracheal or anterior approach using a chemical agent or radiofrequency for neurolysis. The main complications associated with this block are pneumothorax and inadvertent intraspinal or intravascular injection. Neurolysis can also lead to Horner's syndrome. Chemical blockade can lead to hoarseness, shortness of breath, or a sensation of an obstacle in the throat.

Botulinum toxin injections. Intramuscular injection of the tiny doses of the neurotoxin botulinum toxin A is a successful short-term therapy for neurologic disorders that cause uncontrollable muscle spasm and contraction. The neurotoxin works by blocking the presynaptic release of acetylcholine. Botulinum toxin was first used therapeutically to treat strabismus and is now used to treat torticollis spasmodicus, oromandibular dystonia, blepharospasm, spasmodic dysphonia, hemifacial spasm, and infantile cerebral palsy. The efficacy of botulinum injections extends from approximately 6 weeks to several months, until neurons regenerate. Botulinum, thus, must be used long-term for chronic conditions, yet, its long-term effects are unknown.

Neurodestructive techniques. Specific techniques used to destroy nerves in the head and neck include chemical, thermal, and compression methods. Chemical neurodestruction can be accomplished with phenol or alcohol. Thermal destruction is achieved with either cold or heat. Radiofrequency lesioning to achieve facet rhizolysis is often used to treat patients whose pain is exacerbated with extension and whose imaging studies reveal facet arthropathy. Neurodestructive procedures in the spine are generally delayed until more conservative measures have failed.

Electroneuronal stimulation. In 1967, Shealy and colleagues⁶⁴ responded to the introduction of Melzack and Wall's gate control theory of pain⁵⁴ and the availability of cardiac pacemaker technology by introducing spinal cord stimulation (SCS) for the management of chronic intractable pain. Since then, the use of electrical stimulation to mask pain has been applied to ever-increasing applications with more sophisticated techniques, including the use of multi-channel systems with electrodes that can be placed percutaneously. Stimulating peripheral nerves by placing a subcutaneous electrode transversely across the base of the occipital nerve trunk at C1, for example, has been used to treat intractable occipital neuralgia with good-to-excellent results.⁷³ Subcutaneous implantation of electrodes has been used to stimulate greater and lesser occipital nerves, supraorbital nerves, and trigeminal nerves.

To receive SCS, a patient's pain must have an objective basis for pain and must have failed to respond to alternative therapies. Additional criteria include psychiatric clearance and no unresolved drug addiction issues. SCS candidates undergo a 3- to 5-day trial before implantation to determine whether SCS will be successful (pain relief >50%) and identify the optimal frequency and duration of stimulation. If the trial is successful, an impulse-generating device is implanted subcutaneously and connected to the electrodes. The parameters are adjusted with radiofrequency telemetry.

Intrathecal/intraventricular infusion. Intrathecal infusion requires implanting a pump and catheter designed to deliver medication directly to the spine. This technique is rarely used for patients with head and neck pain. Appellgren and colleagues,³ however, reported using intracisternal infusions of local anesthetics with dramatic reduction in head and neck pain. Catheters are placed at either C7 or T1 and threaded cephalad. Occasionally, patients with severe head pain due to cancer are treated with intraventricular morphine.⁴⁹ This approach allows clinicians to minimize the total dose delivered to control pain and, thus, reduce adverse effects.

Treatment of Acute (Postoperative) Pain

We rely on narcotics and nonsteroidal agents to treat acute pain, especially postoperative pain. Patient-controlled analgesia, a drug delivery technique that, as its name indicates, allows the patient to control some aspects of the dosing and frequency of drug delivery, is especially appropriate for use with opioids so long as safeguards are in place to prevent the patient's visitors from administering the drugs. Indeed, many of the short-acting medications that are used for chronic pain are also appropriately applied to acute pain in the postoperative setting.

HEADACHE PAIN

Etiology

Trigemincervical complex pathophysiologies are considered the main source of headaches. Secondary causes include an identifiable pathology, infection, medication side effect, space-occupying lesions, spinal pathology, or inflammation. Headaches can be nociceptive, neurogenic, or neurohumoral. The pain of headaches results from vasodilation or muscle spasm and can be self-perpetuating. In more than 90% of patients, the primary type of head pain is migraine, cluster, or tension-type/daily headache.

Migraine Prevalence

Migraines may affect 30 million Americans.⁴ The prevalence of migraine in the United States is highest among white women at 20.4%, followed by 16.2% for black women, 9.2% for Asian American women, 8.6% for white men, 7.2% for black men, and 4.2% for Asian American men.⁷⁰

Pathogenesis

Although the exact cause of migraine is uncertain, the results of experimental studies and the success of some migraine-specific therapies have helped define the pathology as a cervical-trigeminal-vascular disorder. Sensitization and activation of the trigeminal ganglia nerves release the calcitonin gene-related peptide and cause inflammation in the nerves serving meningeal blood vessels.

In a 1993 study on the pathogenesis of migraine, Kaube et al.⁴² found that stimulating the sagittal sinus (a trigeminally innervated structure) in cats increased cervical cord activity, including expression of c-fos immunoreactivity. This allowed visualization of the neurons that likely play a role in a vascular headache such as migraine. A few years later, Goadsby and Hoskin³³ stimulated the sinuses of monkeys and mapped the resulting evoked expression of c-fos in laminae of the trigeminal nucleus and C1 dorsal horn. Because they found that the amount evoked at the C2 level was closer to the control, they concluded that C1 trigeminovascular afferents may have a specialized role in mediating the pain of migraine.

In addition, serotonin levels are higher centrally and lower peripherally during migraines. In 1993, Marcus⁵¹ reviewed reports on the role of serotonin in migraine and concluded that changes in serotonin levels may precede the cerebral vascular dilation and muscular changes noted in both migraine and tension-type headache. Further implicating serotonin, triptans designed to activate two receptors in the 5-HT1 serotonin family, the 5-HT1B receptors that constrict meningeal vessels (reversing migraine-associated vasodilation) and the 5-HT1D receptors that may block the secretion of the trigeminal neuropeptides which may play a role in the neurogenic inflammatory response, can relieve migraine pain.³⁶

Spreading oligemia has been observed in studies of cerebral blood flow during the aura phase of migraine. The time course and relationship of the changes in cerebral blood flow and the symptomatology of the migraine are as follows. As the aura phase gives way to the headache, cerebral blood flow diminishes. Depressed cortical spreading may induce neurogenic inflammation and vasodilation. This inflammation, in

turn, irritates the perivascular trigeminal sensory fiber, increasing capillary permeability, vasodilation, and hypothalamic and cervical cord activation. After approximately 1 hour of headache pain, the brain becomes hyperperfused with blood. This continues for less than 2 hours beyond cessation of pain, when blood flow returns to normal.

Another hypothesis is that a “hyperexcitable” brain may be predisposed to cause an imbalance between neuronal inhibition and excitation and that this imbalance has an important role in migraine pathophysiology.⁴⁵

As we learn more about the pathogenesis of migraine, we will be able to improve its management.

Symptoms/Diagnosis

Migraines may proceed through four phases: (1) a prodromal phase characterized by depression, irritability, and anorexia; (2) an aura phase that occurs in approximately 15% of cases, is transient and reversible, and may involve visual, somatosensory, or motor or language deficit of neurologic origin (generally, hypersensitivity to normally non-noxious stimuli, such as light or noise); (3) the headache phase marked by unilateral throbbing pain of moderate-to-severe intensity that lasts 4 to 72 hours, sometimes accompanied by nausea; and (4) a resolution phase, marked by fatigue. Migraine is never a daily occurrence, but it is a recurring syndrome.

Like all painful conditions, migraine is underdiagnosed. A pilot study indicates that as many as 96% of patients with migraine (according to the International Headache Society criteria) also have nasal symptoms and, thus, mistakenly believe they are experiencing sinus headaches.⁴¹

Several migraine triggers can cause pain within 12 hours of exposure, including alcohol and foods that trigger tyramine (cheese, fermented food), aspartame (diet soft drinks), monosodium glutamate (used as a flavor enhancer), phenylethylamine (chocolate), and, possibly, sinus inflammation. Additional triggers are changes in hormone levels, sleep patterns, and stress. Even a minor degree of trauma, such as whiplash,⁷⁷ concussion with subsequent normal neurologic examination,⁵⁰ or trauma causing only a brief loss of consciousness,⁷⁴ can trigger migraines.

Treatment

Migraine is an undertreated and inadequately treated syndrome because patients generally rely on over-the-counter medication, and physicians have little to guide them in prescribing for this condition.¹⁸

Migraine treatment can be prophylactic (including avoiding triggers), abortive (using specific or nonspe-

cific analgesics), or acute. Treatment choices include the administration of prescription or over-the-counter pharmaceuticals, physical therapy, alternative therapies, or interventional therapies (neural blockade or modulation: trigeminal blockade, C1-3 blockade, botulinum toxin A injections).

Prophylaxis. Patients who experience frequent migraines or are unable to relieve their severe migraine pain may benefit from prophylaxis.⁴⁵ The first step, eliminating or reducing exposure to triggers, can lead to a 50% improvement in 50% of intractable migraines. After that, first-line pharmacologic prophylactic treatment includes the administration of β -blockers, calcium blockers, antidepressants, or NSAIDs. The efficacy of these drugs for migraine prophylaxis was discovered by chance; their mechanism of action for this indication remains unknown.⁴⁵

The prophylactic β -blockers include propranolol (adverse effects: hypotension, bradycardia, depression, sedation), timolol, nadolol, metoprolol, and atenolol (data suggest care in prescribing these drugs to patients with chronic heart failure or asthma). Common adverse effects of β -blockers include fatigue, depression, exacerbation of Raynaud’s phenomenon, sleep disturbance, and diarrhea.

Prophylactic calcium-channel blockers include verapamil (adverse effects: hypotension, fatigue, constipation), diltiazem, nimodipine, and nifedipine (adverse effects: flushing, edema). Use of calcium-channel blockers should be avoided in patients with cardiac rhythm disorders or chronic heart failure.

Tricyclic antidepressants (TCAs), such as amitriptyline, nortriptyline, and doxepin, may be effective but their use can be limited by their adverse effect profiles.⁵⁹ Amitriptyline is one of the most anticholinergic TCAs (adverse effects dry mouth, constipation, blurred vision, and urinary retention) and nortriptyline the least. Amitriptyline also has a strong sedative effect but is least likely to cause an autonomic effect leading to orthostatic hypotension, whereas nortriptyline is most likely to. TCAs are contraindicated in patients with prolonged conduction times and should be used with caution in patients with cardiac disease.

The NSAIDs used as migraine prophylactic and abortive treatment are aspirin, naproxen, flurbiprofen, ketoprofen, and fenoprofen. As with all NSAIDs, adverse effects include analgesic nephropathy and gastrointestinal upset and bleeding.

Because these prophylactic drugs are not effective in a significant number of migraineurs, investigators continue to test the efficacy of additional pain treatments, including anticonvulsants, in preventing migraine.⁹ When used to prevent and treat migraine

and chronic daily headache, anticonvulsants, which are γ -aminobutyric acid agonists, are better considered “neuromodulating agents” or “neuronal stabilizing agents.”⁴⁴ The use of these agents is based on the hyperexcitable brain theory of migraine pathogenesis. To date, only sodium valproate has gained approval by the U.S. Food and Drug Administration for this indication, but baclofen, gabapentin, and topiramate are under investigation and may prove to be especially useful for patients with comorbidities.^{1,16,25}

A 2002 literature review concurred that divalproex sodium (valproate semi-sodium) is an efficacious migraine prophylactic. This agent dilutes cerebral arteries, but its adverse effect profile includes hepatic dysfunction thrombocytopenia, gastrointestinal upset, hair loss, and weight gain.⁴⁵ The same review noted that lamotrigine may have a role in preventing migraine-associated aura, topiramate shows promise (and additional trials are underway), and only insufficient evidence points to a role for gabapentin, magnesium, lisinopril, botulinum toxin A, tiagabine, levetiracetam, zonisamide, or petasites.⁴⁵

Abortive therapy. The choice of abortive therapy for migraine should be based on the characteristics of the pain (severity, frequency, and associated symptoms) and on the characteristics of the patient (therapeutic history, comorbidities, etc.). Most abortive therapy is pharmaceutical, but this approach can be augmented or replaced by complementary/alternative therapies or interventional treatment.

Other nonspecific medical therapies used for abortive treatment include opioids, phenothiazines, NSAIDs, intranasal lidocaine, and steroids.¹⁸

Vasoconstrictors such as dihydroergotamine mesylate and other ergotamine derivatives and the triptans (selective serotonin 5-HT_{1B/1D} agonists) are the mainstay of abortive migraine therapy. These pharmaceuticals should be used with caution in patients with coronary artery disease, primary vascular disease, and hypertension. In fact, triptans are contraindicated in patients with ischemic heart disease or symptoms consistent with ischemic heart disease; coronary artery vasospasm, including Prinzmetal’s variant angina; and any other significant cardiovascular disease, including uncontrolled hypertension.

Choosing the best of the seven triptans at the best oral dose for any given patient will be difficult because the differences are small but probably clinically relevant for individual patients. One review, using the guidelines of evidence-based medicine, found that 59% of patients taking 100 mg of sumatriptan had a 2-hour improvement from moderate/severe to mild/no pain, 29% were pain free in 2 hours, and in 20% this was sustained, in 67% these results were consistent.

At least one adverse event was experienced by 13% of patients. Findings were similar but not identical (some triptans offered lower efficacy but better tolerability, for example) for sumatriptan 25 mg; rizatriptan 10 and 5 mg; eletriptan 80, 40, and 20 mg; almotriptan 12.5 mg; naratriptan 2.5 mg; and zolmitriptan 2.5 and 5 mg. The investigators noted that data suggest frovatriptan may offer substantially lower efficacy and concluded that rizatriptan 10 mg, eletriptan 80 mg, and almotriptan 12.5 mg are most likely to be consistently efficacious.²⁴

Another study notes that 25% to 45% of patients suffer headache recurrence on triptans, but that almotriptan 12.5 mg is associated with a recurrence rate of just 18% to 27% while offering similar efficacy to the other triptans, 75% consistency, and tolerability similar to placebo.¹⁷ Headache recurrence is, in fact, a major reason that patients become dissatisfied with triptans. One study of this phenomenon found that headache recurrence is lowest among triptans with the longest half-lives and greatest 5-HT_{1B} receptor potency.³² Tizanidine has been successfully used as an adjunct to a long-acting NSAID to treat rebound headache accompanying the discontinuation of overused acute migraine therapies.¹⁶

Additional analgesics used to abort migraines include rectal indomethacin; Excedrin (combination of acetaminophen, aspirin, and caffeine),⁴⁶ naratriptan, or zolmitriptan, each of which can cause flushing, nausea, esophageal spasm, or angina. The goal of these drugs is to inhibit the trigeminocervical complex and, thus, interfere with the migraine pain referral pathway. Investigators have even used intranasal capsaicin to treat migraine.²⁹

Highlighting the need to find the right drug for the right patient, a study of 347 patients with migraine who self-identified as nonresponders to sumatriptan found that 36% obtained pain relief at 2 hours with a second dose of sumatriptan when the drug was masked. The group of actual nonresponders was then randomly assigned to receive 2.5 mg naratriptan vs placebo, which led to pain relief at 2 hours for 25% and at 4 hours for 42%. The placebo relieved pain in 10% at 2 hours and 20% at 4 hours.⁶⁹

Acute therapy. When migraine is especially severe or refractory, its victims may appear in emergency rooms. Treatment options will be dictated by which pharmaceuticals the patient has recently consumed and by the associated symptoms.³⁴

For acute migraine therapy, 80% efficacy can be gained with 12.5 to 37.5 mg of intravenous chlorpromazine or 10 mg of intravenous prochlorperazine.¹⁵ However, one study showed that 16 of 28 patients treated with prochlorperazine needed rescue medica-

tion after 1 hour,³⁹ which is associated with a risk of hypotension, sedation, and dystonia. Other agents that are commonly administered but are only 50% to 65% effective are metoclopramide, lidocaine, transnasal butorphanol, propofol, sumatriptan (chest pressure and a sensation of heaviness are common adverse effects, and headache recurrence is as high as 40%), and intravenous valproic acid. Using dihydroergotamine or ergotamine for migraine abortive therapy is associated with a minor risk of angina, cramps, nausea, and vomiting.

Interventional therapy. Botulinum toxin type A inhibits acetylcholine release at nerve terminals and may also block parasympathetic nervous system action. In a double-blind, controlled trial of the safety and efficacy of botulinum toxin A as a migraine prophylactic, 123 patients who suffered 2 to 8 migraines per month were randomly assigned to receive injections of either 25 or 75 U botulinum A.⁶⁵ The injections occurred during a single visit and were made into various pericranial muscles. Participants kept migraine diaries for 1 month before and 3 months after the injections. In each botulinum group, the neurotoxin reduced the frequency and severity of migraines, use of migraine medication, and migraine-induced vomiting. The 75-U group, however, had a higher rate of adverse events than did the control group. Specific features of the headache (frequency, severity, etc.) may influence response.¹⁰

A literature review that classified this trial as negative for the 75-U group and positive for the 25-U group, the other controlled study as “partly positive,” and the four open studies as negative, however, concluded that until further studies are conducted, there is insufficient evidence to recommend botulinum toxin A treatment for migraine.²² This conclusion is echoed by other investigators who note the trials reported few significant adverse events, but more research is needed to determine the mechanism of action of botulinum toxin A in migraines as well as the optimal treatment schedule and injection sites for specific headaches.¹⁶

Another interventional approach is to treat moderate to severe migraines by removing the corrugator supercilii muscles, transecting the zygomaticotemporal branch of the trigeminal nerve, and repositioning the soft tissue in the temple. In a prospective study, investigators injected 25 U botulinum toxin A into each corrugator supercilii muscle of 24 female and 5 male patients. Of the 24 patients with a positive response, 22 went on to the surgical treatment. Of these, during a follow-up of 222 to 494 days, headaches were eliminated in 10 patients and considerably improved in intensity and frequency in 11. The remaining patient experi-

enced no change. These investigators concluded that the surgical approach was a success and that the botulinum injection was a reliable predictor of that success.³⁵

Psychological aspects. As noted above, all pain has an emotional component, and migraine is sometimes treated with psychological interventions such as biofeedback or cognitive therapy. The placebo response also has an emotional component and, if we can expect a portion of study subjects to have an active response to a placebo, it is equally reasonable to expect a portion of study subjects to fail to respond to an active drug simply because they know they are taking part in a placebo-controlled trial. In other words, if some patients optimistically but mistakenly believe they are receiving the active drug and have a positive response to a placebo, other patients may pessimistically but mistakenly believe they are receiving a placebo and block their body’s ability to have a response to the active drug. Investigators are beginning to examine this aspect of the placebo response. One such study compared the effectiveness of an active drug for migraine in trials that had a placebo control with those that did not and found a significantly lower response to the active drug in the placebo-controlled trials (61% vs 71%).²⁰ Findings such as these should lead investigators both to consider ways to enhance the action of migraine therapies and to develop new psychological approaches to treatment.²¹

Cluster Headache Prevalence

Unlike migraine, cluster-type headache is uncommon, occurring in only 1 in 1000 individuals. Also unlike migraine, this headache occurs six times more often in males than females. Cycles of cluster headaches can last 1 to 4 months, and remissions range from 6 to 24 months.

Symptoms

The symptoms of cluster headache are excruciating unilateral pain involving the eye/temple/upper jaw. Attacks of pain are 15 minutes to 2 hours in duration and may occur 1 to 4 times/day. Additional symptoms include pacing the floor, lacrimation, ptosis, nasal stuffiness, and rhinorrhea.

Treatment

Prophylaxis. Verapamil (240-480 mg) is the drug of choice to prevent cluster headaches and may be combined with prednisone or 1 mg qhs Wigraine. Additional pharmaceuticals include lithium (300 mg/day divided), methysergide (2-8 mg/day). Episodic cluster headache

is commonly treated with prednisone (40 mg qd tapered down every week by 10 mg).

Acute therapy. When patients with cluster headache come to the emergency room, appropriate acute therapy includes administration of oxygen 8 to 10 L/min for 10 minutes, ergotamine, DHE-45, triptans, lidocaine, or a sphenopalatine block.

Interventional therapy. In a study of the efficacy of radiofrequency lesioning of the sphenopalatine ganglion to treat and prevent cluster headache in patients refractory to pharmaceuticals, 34 of 56 patients with episodic and 3 of 10 patients with chronic cluster headache achieved complete pain relief. The remaining patients gained no relief. Eight patients had temporary postoperative epistaxis, and 11 experienced a cheek hematoma. In four patients, the maxillary nerve was partially lesioned. Hypesthesia of the palate, which occurred in nine patients, resolved within 3 months. The investigators concluded that this approach is reasonable in this population of patients.⁶²

Intractable chronic cluster headaches can resolve with blockade of the trigeminal ganglion³⁷ or the sphenopalatine ganglion. One follow-up study found sphenopalatine ganglion neurolysis to be 60% effective in 56 patients with episodic cluster headache and 30% in 10 with chronic cluster headache.⁶²

Chronic Tension-type/daily Headache Prevalence

Chronic tension-type/daily headache is a relatively common condition, occurring in approximately 3% to 5% of the U.S. population and in women more often than men.

Pathophysiology

The pathophysiology of this headache type is unknown, but overactive pericranial muscles may play a role. Because chronic daily headache can be transformed migraine, new-onset daily headache, or tension-type headache,³⁰ achieving an exact diagnosis can be difficult.¹³

Symptoms

These headaches occur more than 15 days a month and consist of a constant band-like pain that feels like mild to moderate pressure, tightness, or dull ache. The pain is bilateral and contained in the forehead.

Treatment

Some patients benefit from psychological techniques, including strengthening exercises, self-hypnosis, cognitive therapy, and biofeedback to relax muscles.⁵⁵ Most patients can achieve adequate relief from ten-

sion-type headache with over-the-counter analgesics, such as NSAIDs. Things become more complicated for headaches that are a daily occurrence.

Prophylactic drugs for chronic daily headache include antidepressants (amitriptyline, doxepin, fluoxetine), neuromodulating agents (divalproex), β -blockers (propranolol, nadolol, etc.), calcium-channel blockers (verapamil), and miscellaneous agents, such as methysergide.

Acute treatment relies on pharmaceutical regimens that may include tizanidine (for chronic cases or prophylaxis) or depend on augmenting standard analgesics with sedating antihistamines, antiemetics, butalbital, or opiates. Muscle relaxants may be useful for acute cases.

Regular analgesic use has been implicated as a cause of chronic headache because approximately 2% of those with daily headache use analgesics on a routine basis. In these patients, analgesic withdrawal can lead to improvement in symptoms. One study designed to shed light on this possibility examined headache history in 110 patients using daily analgesics for rheumatoid arthritis, seronegative arthritis, or miscellaneous rheumatology-related disorders and concluded that regular analgesic use in patients with a history of migraine will likely lead to chronic daily headache.⁶

The results of botulinum toxin A injections are mixed. For example, in four patients, tension-type refractory headaches improved in terms of severity, frequency, and subsequent medical interventions for control of headaches with injection of 20 U botulinum toxin A in symptomatic areas.⁷⁶ In a double-blind, randomized controlled trial involving 21 patients with acute tension headaches who received 10 pericranial injections of 20 U botulinum toxin A or saline placebo, however, no significant differences were found at 4, 6, and 12 weeks in visual analog scale pain scores, frequency and duration of attacks, analgesic use, pressure pain threshold, total tenderness score, or quality of life. These investigators concluded that peripheral mechanisms play only a minor role in the pathogenesis of tension-type headache.⁶¹ Another double-blind, randomized controlled trial involving the injection of 100 U botulinum toxin A or 2 cc saline into temporal or cervical muscles found a 25% to greater than 50% improvement in the number of headache-free days, headache severity score, and quality of life at 3 months' follow-up in 13 treatment patients vs only 2 control subjects.⁶⁷

Paroxysmal Hemicrania Prevalence

Hemicrania is rare and occurs more often in women than in men.

Symptoms

As its name indicates, this is a unilateral headache. It causes excruciating pain in the ocular and frontotemporal area for 10 to 30 minutes, 10 to 30 times/day, and is provoked by certain neck movements and pressure in the upper back. Each occurrence can last up to 20 hours. Because additional symptoms include nasal congestion, conjunctival injection, lacrimation, and rhinorrhea, hemicrania is often misdiagnosed as sinus headache.

Treatment

Both hemicrania continua and chronic paroxysmal hemicrania respond to 150 to 200 mg divided doses of indomethacin. In fact, this response confirms the diagnosis: a patient may have all the symptoms of hemicrania but respond only to triptans and pizotifen, which usually work for cluster headache.²⁸

Cervicogenic Headache

Prevalence

Cervicogenic headaches are common. One such headache, occipital neuralgia, results from injury to the occipital nerve caused by stress, trauma, or repetitive muscular contraction. Pain arising from the C2-C3 facet joints also generally radiates to the occiput and can be reproduced with ipsilateral rotation and extension of the cervical spine. Facet joint syndrome is difficult to diagnose because it arises from the same types of degenerative changes that show up in x-rays of asymptomatic joints. The patient's response to a nerve block helps in the diagnosis of cervical facet joint syndrome. Facet joint syndrome can be differentiated by the response to radiographically guided injections of local anesthetics into the zygapophyseal joints or around the dorsal medial branches of the posterior primary rami.

Symptoms

In 1990, Sjaastad⁶⁶ described cervicogenic headache as a variant of migraine that originates in the back of the head and spreads to the front. Pain is unilateral, of moderate severity, and, because it is triggered by neck movement, can be precipitated mechanically. He noted that occipital nerve blocks effectively stop the pain. Edmeads¹⁹ had previously associated this phenomenon with photophobia, phonophobia, nausea, and dizziness. Cervicogenic headaches are difficult to distinguish clinically from migraine and tension-type headache.

Treatment

Treatment ranges from conservative therapy, such as massage and rest, to interventional therapy, including nerve blocks and steroid injections.

An open study with masked outcome assessment sought to determine the efficacy of manipulation therapy and exercise alone and in combination compared with controls by randomly assigning 200 patients into four groups. By 1-year follow-up, manipulative therapy and exercise therapy alone reduced the frequency and intensity of headaches and neck pain compared with control subjects. Although the combined therapy showed no significant benefit over either single therapy, 10% more of the patients in this group improved. The patients maintained the positive effects.⁴⁰

A double-blind, randomized controlled trial examined the effects of injecting 100 U botulinum toxin A in five cervical trigger points (14 patients) vs injecting 1 mL of saline placebo (12 patients). At 2- and 4-week follow-ups, the treatment group showed a significant improvement in pain and range of motion compared with their preinjection levels, whereas the placebo group demonstrated no significant changes.²⁶

A case report describes excellent but temporary results in a patient with refractory retroorbital headaches using three consecutive C2 ganglion blocks with 0.5 mL of local anesthetic administered under fluoroscopy. After the clinicians subsequently performed percutaneous radiofrequency ganglionectomy with multiple C2 lesions at 60°C for 90 seconds, the patient remained pain free throughout 4 years of follow-up.⁵

To determine the efficacy of treating intractable occipital neuralgia using percutaneous peripheral nerve electrostimulation, 13 patients had an electrode implanted transversely at the C1 level across the base of the occipital nerve trunk. With 18- to 72-month follow-ups, 12 patients reported greater than 50% pain control and required little or no medication. In the remaining patient, the symptoms resolved and the electrode was removed. The investigators concluded that electrostimulation in such cases is a reasonable therapy.⁷³

Trigeminal Neuralgia

Prevalence

Trigeminal neuralgia is found more often in women than in men and generally in people over the age of 50 years.

Symptoms

Trigeminal neuralgia causes a sudden, severe pain that feels like an electric shock or stab. The pain generally affects only one side of the jaw or cheek and can last only 20 to 30 seconds or occur in rapid sequence. This pain may continue off and on for a day or several months and then might disappear only to recur months or even years later. The pain may be triggered by trivial, everyday stimuli, such as brushing teeth or touching the face.

Diagnosis

Magnetic resonance imaging (MRI) of the ganglion can be used to diagnose this condition.

Treatment

Pharmaceuticals used to treat this condition include Tegretol (carbamazepine), Dilantin (phenytoin), baclofen, clonazepam, gabapentin, and valproic acid alone or in combination.

If pain is refractory, a single percutaneous stereotactic radiofrequency rhizotomy can be effective. Barring that, patients undergo a surgical intervention.

NECK PAIN**Etiology**

Biomechanical disorders are the most common cause of neck pain and can be caused by the degeneration that accompanies aging (degenerative arthritis), inflammatory diseases (rheumatoid arthritis), or trauma. This pain can also provide early warning of spinal cord compression (an emergency situation), a primary or secondary tumor, or (rarely) infection.

Additional and sometimes multiple therapies may become necessary to treat chronic or radicular neck pain.¹² As always with painful conditions, treatment begins with diagnosis and the most conservative appropriate therapies and proceeds, when indicated, to interventional therapies. Other treatments include psychological techniques (cognitive therapy), manipulative techniques, pharmaceuticals, acupuncture, massage, cervical epidural blocks (C2 ganglion, trigeminal ganglion, sphenopalatine), neuroablation (botulinum injections, radiofrequency), neuromodulation (greater occipital nerve stimulation, supraorbital nerve stimulation, gasserian ganglion stimulation), intrathecal infusion, and surgical techniques (fusion, discectomy). In cases of systemic illnesses or spinal compression, pain and the underlying cause must be treated aggressively to prevent development of complications.

Degenerative Disk Disease

Degenerative arthritis can reduce surface cartilage in the cervical spine and/or produce bone spurs that can entangle a nerve or put pressure on a nerve root. Degenerative disk disease occurs because aging disks lose their flexibility, and the results are locally painful tears in the annulus fibrosis or herniated disks that press on nerve roots. Depending on their manifestation, degree, and location, degenerative arthritis and degenerative disk disease can be benign or can cause radiculopathy, pain that is referred to the shoulder and arm on the affected side(s) and produces a tingling sensation in fingers, hand(s), or arm(s). In severe cases, called myelopathy, degenerative disk

disease can cause spinal stenosis that is sometimes manifested as weakness or difficulty with walking or coordination.

Treatment

Asymptomatic patients with degeneration should not undergo prophylactic treatment, and medical management should be tried first in patients with radiculopathy or mild myelopathy.

Many patients with radiculopathy or pronounced myelopathy, however, will have a positive outcome after a surgical intervention, even in those with severe myelopathy,²³ but especially those whose symptoms are recalcitrant through 6 weeks of management or are progressive. Cervical foraminotomy/discectomy increases space where the nerve root exits the spinal canal by removing part of the joint that covers the nerve root and a portion of the disk, if necessary. Anterior cervical discectomy, in which a surgeon gains access to the cervical spine through the front of the neck, is used when it is necessary to remove one or more intervertebral disks or bone spurs that are causing nerve damage. Some surgeons fill the resulting intervertebral space with a bone graft. In the presence of axial neck pain or any segmental kyphosis, fusion is also performed. In patients with posterolateral or lateral soft disk herniations, with focal osteophyte infringement, or in large patients with short necks and caudal lesions, a posterior laminoforaminotomy is often performed.^{2,72}

Chronic Neck Pain

Some patients experience chronic neck pain without radiculopathy or myelopathy. Treatment can range from conservative to interventional, as seen in the following examples.

Treatment

Conservative treatment can include acupuncture and massage. In one prospective, randomized, controlled trial comparing these therapies after five treatments over 3 weeks, 56 patients received acupuncture, 60 massage, and 61 sham laser acupuncture. Compared with the massage group but not the sham group, motion-related pain significantly improved in the acupuncture group, which also had best results for all secondary outcomes. These investigators believed their results point to the short-term efficacy of acupuncture and called for studies of its long-term efficacy.³⁸

A panel charged with developing evidence-based clinical practice guidelines for rehabilitation methods for neck pain identified therapeutic exercises as the only intervention offering clinically important benefits and noted that evidence is lacking for the efficacy

of thermotherapy, therapeutic ultrasound, massage, and electrical stimulation.⁵⁸

Investigators have also sought to determine the efficacy of injecting botulinum toxin A into chronically painful neck muscles. One study compared the efficacy of a single injection of high-dose botulinum toxin A vs a saline injection and found that each group of patients improved significantly in terms of pain, disability, and tolerance to trigger point pressure. The incidence of adverse events with the botulinum injections was “large,” and the investigators concluded that this was not an effective single therapy.⁷⁵

Anterior cervical discectomy and fusion may also be performed to treat chronic neck pain without radiculopathy or myelopathy. One 53-month follow-up study involved 38 patients who had painful disk(s) proven by diskography. After the procedure, patients reported a significant decrease in pain and significant increase in function, and 30 patients were satisfied with their outcomes.⁵⁶

Another study to assess the clinical outcome for anterior cervical discectomy and fusion patients at an average follow-up of 4.4 years found that 82% of the 87 patients were satisfied with their outcome, and 93% reported improvement in pain.³¹

Atlantoaxial Subluxation and Basilar Invagination

Rheumatoid arthritis can cause serious problems in the relationship between C1 (the atlas vertebrae) and C2 (the axis vertebrae), including instability or a partial dislocation (atlantoaxial subluxation). When subluxation exceeds 9 mm, cord compression is likely. Rheumatoid arthritis can also cause deterioration of the joints between the base of the skull and C1-C2 to such an extent that the odontoid migrates upward and places pressure on the brain stem (basilar invagination). This can cause sudden death and may present as an untoward amount of flexion, posterior skull pain, tingling, and numbness in the fourth and fifth finger, in the medial forearm, or with neck movement.

Treatment

The KIM-STIM, an electrical stimulator that is molded to the patient's ear, fitted with multiple electrodes, and managed by the patient, is being used to treat pain associated with atlantoaxial subluxation syndrome as well as head, neck, and shoulder pain.⁴³

Posterior fusion of C1-C2 is indicated for atlantoaxial subluxation when patients have neurologic abnormality, intractable pain, or vertebral artery or cord compression demonstrated on MRI. The recommended treatment for basilar invagination is neurosurgery when MRI confirms cord compression. Otherwise, patients may benefit from conservative pharmaceutical and stretching approaches (neck traction).⁷⁸

Spinal Stenosis

Degeneration can also lead to two types of narrowing or stenosis in the cervical spine: (1) cervical spondylolysis, which occurs when the pars articulares is damaged and cannot continue to separate vertebrae, which may cause neck pain as well as arm weakness; and (2) the narrowing of the spinal canal and foramina, which occurs when the facets become inflamed from undue pressure and results in compression of the spinal cord, neuropathic symptoms, and neuropathic pain.

Treatment

Spinal stenosis is treated by decompressing the spinal cord, the nerve roots, or both, and replacing a section of the vertebra and adjacent intervertebral disks with a bone graft or metal plate (cervical corpectomy). When patients have four or more levels of stenosis, the preferred method is laminoplasty.⁷²

A review was conducted of the outcome of anterior cervical corpectomy, reconstruction with allograft fibula, and placement of an anterior plate in 261 patients with spinal stenosis due to spondylosis (197 patients), postlaminectomy kyphosis (27 patients), acute fracture (25 patients), or ossification of the posterior longitudinal ligament (12 patients). Nearly half of the procedures involved two disk levels and one vertebral body; 96 involved two levels, 31 three levels, and 1 four levels. The mean follow-up was 25.7 months. The fusion was successful in 226 patients, 33 developed an asymptomatic stable or fibrous union, and 2 developed unstable pseudoarthrosis requiring reoperation. Two patients had transient unilateral upper extremity weakness, 35 developed transient dysphagia, 7 permanent dysphagia, 35 transient hoarseness, and 2 permanent hoarseness. The hardware failed in 14 patients. These investigators concluded that this procedure is effective and improves symptoms in nearly all patients.⁵²

Trauma

Trauma or an accident can injure the neck through hyperextension (whiplash) or can produce fractures, dislocations, disk herniations, or an injured spinal cord (producing paralysis in extreme cases).

Treatment of Whiplash

Whiplash often leads to chronic pain in the cervical zygapophyseal joints.⁸ Treatment ranges from conservative measures to neuroablation.

Bogduk et al.¹¹ have published widely on this condition and maintain that the evidence for efficacy of conservative measures is poor. Another group reviewed the literature to determine the efficacy of various exercise methods and concluded that moderate

evidence supports early treatment with mobilizing exercise to treat acute whiplash, but no evidence supports the effectiveness of group exercise, "neck schools," or single sessions of extension-retraction exercises.⁶³

Clinicians have also investigated the merits of injecting various agents. One double-blind study, for example, compared the efficacy of an intraarticular injection of 0.5% bupivacaine (n = 20) or 5.7 mg of betamethasone (n = 21). The end point was time needed to return to 50% of preinjection pain. In each group, fewer than 50% of patients had pain relief from more than a week and fewer than 20 had relief for a month, indicating that the corticosteroid injection was not effective.⁷ Another randomized, controlled trial compared five trigger-point injections of botulinum toxin A in 14 patients and with saline in 12 and found that range of neck motion and subjective pain improved significantly in the treatment group compared with control subjects but the treatment only led to a trend toward improved functioning.²⁷

To help establish the efficacy of percutaneous radiofrequency neurotomy for the treatment of cervical zygapophyseal joint pain, Lord et al.⁴⁸ conducted a randomized, double-blind trial, comparing percutaneous radiofrequency neurotomy involving multiple lesions using an 80°C electrode in 12 patients with a sham identical control treatment in 12 similar patients. The pain generator had been confirmed by double-blind, placebo-controlled nerve blocks using a local anesthetic. The active treatment group had a median time until pain returned to 50% of pretreatment level of 263 days vs 8 days in the control group. One control patient and 7 treatment patients were pain free at 27 weeks. These investigators concluded that multiple radiofrequency lesioning of target nerves is efficacious.

The same group reported on the use of radiofrequency neurotomy in 28 patients in whom diagnostic blocks confirmed cervical zygapophyseal pain. An initial procedure led to complete pain relief in 71% of patients. Those who failed the initial procedure did not benefit from a repeat procedure, but pain return after a beneficial initial procedure was successfully treated with a repeat neurotomy.⁵³

REFERENCES

1. Agostoni A, Frigerio, Santoro P: Antiepileptic drugs in the treatment of chronic headaches, *Neurol Sci* 24(Suppl 2): S128-S131, 2003.
2. Albert TJ, Murrell SE: Surgical management of cervical radiculopathy, *J Am Acad Orthop Surg* 7:368-376, 1999.
3. Appellgren L and others: Continuous intracisternal and high cervical intrathecal bupivacaine analgesia in refractory head and neck pain, *Anesthesiology* 84:256-272, 1996.
4. Aukerman G, Knutson D, Miser WF: Management of the acute migraine headache, *Am Fam Physician* 66:2123-2130, 2002.
5. Awan S and others: Retro-orbital headaches relieved by C2-ganglion radiofrequency thermal ablation. Abstract presented to the International Spine Injection Society Meeting, 2002.
6. Bahra A and others: Does chronic daily headache arise de novo in association with regular use of analgesics? *Headache* 43:179-190, 2003.
7. Barnsley L and others: Lack of effect of intraarticular corticosteroids for chronic pain in the cervical zygapophyseal joints, *N Engl J Med* 330:1047-1050, 1994.
8. Barnsley L and others: The prevalence of chronic cervical zygapophysial joint pain after whiplash, *Spine* 20:20-25, 1995.
9. Bigal ME, Krymchantowski AV, Rapoport AM: New developments in migraine prophylaxis, *Expert Opin Pharmacother* 4:433-443, 2003.
10. Binder WJ and others: Botulinum toxin type A (BOTOX) for treatment of migraine, *Dis Mon* 48:323-335, 2002.
11. Bogduk N, Lord SM: Cervical spine disorders, *Curr Opin Rheumatol* 10:110-115, 1998.
12. Borenstein DG: Management of neck pain: a primary care approach, *Hosp Pract (Off Ed)* 33:147-154, 160, 1998.
13. Bussone G: Chronic migraine and chronic tension-type headache: different aspects of the chronic daily headache spectrum. Clinical and pathogenetic considerations, *Neurol Sci* 24(Suppl 2):S90-S93, 2003.
14. Catchlove RF, Braha R: The use of cervical epidural nerve blocks in the management of chronic head and neck pain, *Can Anaesth Soc J* 31:188-191, 1984.
15. Coppola M, Yealy DM, Leibold RA: Randomized, placebo-controlled evaluation of prochlorperazine versus metoclopramide for emergency department treatment of migraine headache, *Ann Emerg Med* 26:541-546, 1995.
16. Corbo J: The role of anticonvulsants in preventive migraine therapy, *Curr Pain Headache Rep* 7:63-66, 2003.
17. Dahlof CG and others: How does almotriptan compare with other triptans? A review of data from placebo-controlled clinical trials, *Headache* 42:99-113, 2002.
18. Diamond S, Wenzel R: Practical approaches to migraine management, *CNS Drugs* 16:385-403, 2002.
19. Edmeads J: The cervical spine and headache. *Neurology* 38:1874-1878, 1988.
20. Eikermann A, Diener H: Effect of active treatment is lower when using placebo control in clinical trials on acute therapy of migraine, *Cephalalgia* 23:344-347, 2003.
21. Evans RW: The non-nocebo response: can migraine medication efficacy be enhanced? *Headache* 43:693, 2003.
22. Evers S: Is there a role for botulinum toxin in the treatment of migraine? *Curr Pain Headache Rep* 7:229-234, 2003.
23. Falope ZF and others: Cervical myelopathy and rheumatoid arthritis: a retrospective analysis of management, *Clin Rehabil* 16:625-629, 2002.
24. Ferrari MD and others: Triptans (serotonin, 5-HT_{1B/1D} agonists) in migraine: detailed results and methods of a meta-analysis of 53 trials, *Cephalalgia* 22:633-658, 2002.
25. Freitag F: Preventative treatment for migraine and tension-type headaches: do drugs having effects on muscle spasm and tone have a role? *CNS Drugs* 17:373-381, 2003.
26. Freund BJ, Schwartz M: Treatment of chronic cervical-associated headache with botulinum toxin A: a pilot study, *Headache* 40:231-236, 2000.
27. Freund BJ, Schwartz M: Treatment of whiplash associated neck pain [corrected] with botulinum toxin-A: a pilot study, *J Rheumatol* 27:481-484, 2000.

28. Fuad F, Jones NS: Paroxysmal hemicrania and cluster headache: two discrete entities or is there an overlap? *Clin Otolaryngol* 27:472-479, 2002.
29. Fusco BM, Barzoi G, Agro F: Repeated intranasal capsaicin applications to treat chronic migraine, *Br J Anaesth* 90:812, 2003.
30. Galego JC and others: Clinical features of episodic migraine and transformed migraine: a comparative study, *Arq Neuropsiquiatr* 60:912-916, 2002
31. Garvey TA and others: Outcome of anterior cervical discectomy and fusion as perceived by patients treated for dominant axial-mechanical cervical spine pain, *Spine* 27:1887-1895, 2002.
32. Geraud G, Keywood C, Senard JM: Migraine headache recurrence: relationship to clinical, pharmacological, and pharmacokinetic properties of triptans, *Headache* 43:376-388, 2003.
33. Goadsby PJ, Hoskin KL: The distribution of trigeminovascular afferents in the nonhuman primate brain *Macaca nemestrina*: a c-fos immunocytochemical study, *J Anat* 190(pt3):367-375, 1997.
34. Green MW: The emergency management of headaches, *Neurology* 9:93-98, 2003.
35. Guyuron B, Tucker T, Davis J: Surgical treatment of migraine headaches, *Plast Reconstr Surg* 109:2183-2189, 2002.
36. Hamel E: The biology of serotonin receptors: focus on migraine pathophysiology and treatment, *Can J Neurol Sci* 26(Suppl 3):S2-S6, 1999.
37. Hassenbusch SJ and others: Trigeminal cisternal injection of glycerol for treatment of chronic intractable cluster headaches, *Neurosurgery* 29:504-508, 1991.
38. Irnich D and others: Randomised trial of acupuncture compared with conventional massage and "sham" laser acupuncture for treatment of chronic neck pain, *BMJ* 322:1574-1578, 2001.
39. Jones J, Peck S, Chun E: Intramuscular prochlorperazine versus metoclopramide as single agent therapy for the treatment of acute migraine headache, *Am J Emerg Med* 14:262-264, 1996.
40. Jull G and others: A randomized controlled trial of exercise and manipulative therapy for cervicogenic headache, *Spine* 27:1835-1843, 2002.
41. Kaniecki RG: Migraine and tension-type headache: an assessment of challenges in diagnosis. *Neurology* 58(Suppl 6):S10-S14, 2002.
42. Kaube H and others: Expression of c-Fos-like immunoreactivity in the caudal medulla and upper cervical spinal cord following stimulation of the superior sagittal sinus in the cat, *Brain Res* 629:95-102, 1993.
43. Kim KH: Atlanto-axial subluxation syndrome and management of intractable headache, neck pain and shoulder pain with auricular stimulation: a clinical case report, *Acupunct Electrother Res* 26:263-275, 2001.
44. Krusz JC: Prophylaxis for chronic daily headache and chronic migraine with neuronal stabilizing agents, *Curr Pain Headache Rep* 6:480-485, 2002.
45. Krymchantowski AV, Bigal ME, Moreira PF: New and emerging prophylactic agents for migraine, *CNS Drugs* 16:611-634, 2002.
46. Lipton RB, Stewart WF, Ryan RE Jr: Efficacy and safety of acetaminophen, aspirin, and caffeine in alleviating migraine headache pain: three double-blind, randomized, placebo-controlled trials, *Arch Neurol* 55:210-217, 1998.
47. Lord SM, Barnsley L, Bogduk N: The utility of comparative local anesthetic blocks versus placebo-controlled blocks for the diagnosis of cervical zygapophysial joint pain, *Clin J Pain* 11:208-213, 1995.
48. Lord SM and others: Percutaneous radio-frequency neurotomy for chronic cervical zygapophysial-joint pain, *N Engl J Med* 335:1721-1726, 1996.
49. Loriferne JF and others: [Cephalic cancer pain controlled by intraventricular administration of morphine and clonidine], *Ann Fr Anesth Reanim* 14:233-236, 1995.
50. Mandel S: Minor head injury may not be 'minor,' *Postgrad Med* 85:213-217, 1989.
51. Marcus DA: Serotonin and its role in headache pathogenesis, *Clin J Pain* 9:159-176, 1993.
52. Mayr MT and others: Cervical spinal stenosis: outcome after anterior corpectomy, allograft reconstruction, and instrumentation, *J Neurosurg* 96(1 Suppl):10-16, 2002.
53. McDonald GJ, Lord SM, Bogduk N: Long-term follow-up of patients treated with cervical radiofrequency neurotomy for chronic neck pain, *Neurosurgery* 45:61-67, 1999.
54. Melzack R, Wall PO: Pain mechanism: a new theory, *Science* 150:971-978, 1965.
55. Millea PJ, Brodie JJ: Tension-type headache, *Am Fam Physician* 66:797-804, 2002.
56. Palit M and others: Anterior discectomy and fusion for the management of neck pain, *Spine* 24:2224-2228, 1999.
57. Pasero C, McCaffery M: The patient's report of pain: believing vs. accepting. There's a big difference, *Am J Nurs* 101:73-74, 2001.
58. Philadelphia Panel: Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for neck pain, *Phys Ther* 81:1701-1717, 2001.
59. Punay NC, Couch JR: Antidepressants in the treatment of migraine headache, *Curr Pain Headache Rep* 7:51-54, 2003.
60. Raj PP and others: *Radiographic imaging for regional anesthesia and pain management*. New York, Churchill Livingstone, 2002.
61. Rollnik JD and others: Treatment of tension-type headache with botulinum toxin type A: a double-blind, placebo-controlled study, *Headache* 40:300-305, 2000.
62. Sanders M, Zuurmond WW: Efficacy of sphenopalatine ganglion blockade in 66 patients suffering from cluster headache: a 12-to 70-month follow-up evaluation, *J Neurosurg* 87:876-880, 1997.
63. Sarig-Bahat H: Evidence for exercise therapy in mechanical neck disorders, *Man Ther* 8:10-20, 2003.
64. Shealy C, Mortimer J, Reswick J: Electrical inhibition of pain by stimulation of the dorsal columns: a preliminary report, *Anesth Analg* 46:489-491, 1967.
65. Silberstein S and others: Botulinum toxin type A as a migraine preventive treatment. For the BOTOX Migraine Clinical Research Group, *Headache* 40:445-450, 2000.
66. Sjaastad O: The headache challenge in our time: cervicogenic headache, *Funct Neurol* 5:155-158, 1990.
67. Smuts JA, Baker MK, Smuts HM: Prophylactic treatment of chronic tension-type headache using botulinum toxin type A, *Eur J Neurol* 6:99-102, 1999.
68. Staats PS, North RB: *Diagnostic nerve root blocks, facet blocks, and discography: a rational approach*. In Hadley M, editor: *Perspectives in neurological surgery*, vol. 7. St. Louis, Quality Medical Publishing, 1996.
69. Stark S and others: Naratriptan efficacy in migraineurs who respond poorly to oral sumatriptan, *Headache* 40:513-520, 2000.
70. Stewart WF and others: Prevention of migraine headache in the United States: relation to age, income, race, and other sociodemographic factors, *JAMA* 267:64-69, 1992.
71. Taha JM, Tew JM Jr, Buncher CR: A prospective 15-year follow up of 154 consecutive patients with trigeminal neuralgia

- treated by percutaneous stereotactic radiofrequency thermal rhizotomy, *J Neurosurg* 83:989-993,1995.
72. Truumees E, Herkowitz HN: Cervical spondylotic myelopathy and radiculopathy, *Instr Course Lect* 49:339-360, 2000.
 73. Weiner RL, Reed KL: Peripheral neurostimulation for control of intractable occipital neuralgia, *Neuromodulation* 2:217-221, 1999.
 74. Weiss HD, Stern BJ, Goldberg J: Post-traumatic migraine: chronic migraine precipitated by minor head or neck trauma, *Headache* 31:451-456, 1991.
 75. Wheeler AH, Goolkasian P, Gretz SS: Botulinum toxin A for the treatment of chronic neck pain, *Pain* 94:255-260, 2001.
 76. Wheeler AH: Botulinum toxin A: adjunctive therapy for refractory headaches associated with pericranial muscle tension, *Headache* 38:468-471, 1998.
 77. Winston KR: Whiplash and its relationship to migraine, *Headache* 27:452-457, 1987.
 78. Yu KK and others: Nontraumatic atlantoaxial subluxation (Grisel syndrome): a rare complication of otolaryngological procedures, *Laryngoscope* 113:1047-1049, 2003.