



Cervical Radicular Pain

11

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Case Description

A 35-year-old woman walks into your clinic complaining of neck and right arm pain since a recent fall on ice from a standing position. Besides pain, the patient also complains of weakness with using a screwdriver in her right hand. This is important to her job description involving furniture restoration. Since the fall, she reports difficulty sleeping due to neck stiffness. Pain between the shoulder blades has become commonplace. She has trialed conservative management with nonsteroidal anti-inflammatories and acetaminophen. She has undergone 4 weeks of physical therapy exercises as prescribed with minimal improvement. She reported temporary improvement with heating pad therapy.

What Is Your Preliminary Diagnosis?

The diagnosis begins with the history and physical exam. Clinical features should guide the exam. The acute onset following an antecedent event leads me down the path of a herniated nucleus pulposus versus spondylosis which is often more indolent. However, most cases have no readily identifiable precipitant. The first aim is

to find evidence of weakness and sensory disturbance in myotomal and dermatomal patterns as well as to catch any signs of myelopathy from cord compression. Assess passive and active range of motion if any shoulder weakness or wasting is apparent. Spurling's maneuver (neck compression) is performed by extending and rotating the neck to the side of pain with a downward pressure [2]. This test is positive if limb pain or paresthesias are reproduced. Neck pain alone is nonspecific and constitutes a negative test. The Spurling's test is highly specific but sensitivity is low to moderate. Another test, with low to moderate sensitivity and moderate to high specificity is the shoulder abduction relief test based on a 2006 systematic review [3].

How Is Diagnosis Confirmed?

Cervical radiculopathy is a clinical diagnosis and made on the basis of history and physical findings. Neuroimaging and electrodiagnostic testing are indicated for most patients if myotomal weakness or myelopathy, increased risk of or suspicion for an atypical underlying nondegenerative cause (i.e., neoplastic, infectious, or inflammatory), or when symptoms persist beyond 4–6 weeks of conservative therapy. In the proper setting of radiculopathy symptoms, imaging studies of the cervical spine can confirm the diagnosis. MRI is currently the study of choice for

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initial neuroimaging evaluation of the cervical spine, unless contraindicated. CT myelography is the superior study for diagnosing foraminal compression for its distinction of osteophyte from soft tissue material [4]. Plain radiographs are rarely diagnostic because soft tissue is not well visualized. Radiculopathy is nondiagnostic, but usually confirmed by electromyography. This study usually consists of nerve conduction studies (NCS) and a needle EMG of the upper arm and neck [5].

What Is the Pathophysiology of This Condition?

A radiculopathy is a pathologic process affecting the nerve root. The causes of radiculopathy can be divided into nondegenerative and compressive etiologies. The two main causes of compressive radiculopathy are cervical spondylosis and disk herniation. Compressive radiculopathy is by far the most common pathophysiology, but nondegenerative disorders should always be considered.

Cervical spondylosis is a general term for non-specific, degenerative changes of the spine. Degenerative changes occur in the vertebral disks, the zygapophysial (facet) and uncovertebral joints, and the vertebral bodies. Bone formation occurs in these areas as osteophytes [5]. Spondylosis is theorized to be from increased stress from the aging process leading to osseous and ligamentous hypertrophy and osteophyte formation. Disk herniation is another common cause of compressive radiculopathy as prolapsed material presses on a nerve root. This root compression with radicular symptoms is most likely to occur if herniation occurs laterally. In a large epidemiological survey of patients with cervical radiculopathy, disk protrusion was found to be the case in 21.9% of patients [6]. Nondegenerative radiculopathy can be from causes including infectious processes (i.e., herpes zoster and Lyme disease), nerve root infarction, root avulsion, infiltration by tumor, granulomatous tissue infiltration, and demyelination. Deficits associated with nondegenerative radiculopathy often spans multiple myotomes and dermatomes.

This is more complete than a typical compressive radiculopathy due to the more diffuse ventral and dorsal affect [5].

How Is This Problem Managed?

Recommendations for diagnosis and treatment of cervical radiculopathy from degenerative disorders have been described by the North American Spine Society (NASS) Clinical Guidelines, 2010. It is recommended that diagnosis be considered in patients with arm pain, neck pain, scapular or periscapular pain, paresthesias, numbness and sensory changes, and weakness or abnormal deep tendon reflexes in the arm. This grade B recommendation was based off of the findings presented by Henderson et al. following a retrospective observational study reporting results in the treatment of 736 patients with cervical radiculopathy. Of these patients, the reported symptoms were as follows: arm pain (99.4%), neck pain (79.7%), scapular pain (52.5%), anterior chest pain (17.8%), and headache (9.7%). Dermatomal arm pain alone is not specific in identifying the pathologic level in patients with cervical radiculopathy. For this reason, CT, CT myelography (CTM), or MRI is suggested prior to any surgical decompression. This suggestion is of course after a failed course of conservative therapy in most cases. Modic et al. conducted a prospective study comparing the accuracy of MRI, CTM, and myelography in the evaluation of cervical radiculopathy. This study included 52 patients who underwent MRI, myelography, and CTM; 28 went on to surgery. Findings confirmed in surgery identified diagnostic accuracy rates of 74% for MRI, 85% for CTM, and 67% for myelography. The author concluded that MR with CTM used jointly was a viable alternative to myelography with 90% of patients having diagnostic agreement with surgical findings [7]. CT alone is recommended by work group consensus if MRI is contraindicated. Evidence is insufficient to make a recommendation for or against the use of EMG for patients in whom the diagnosis of cervical radiculopathy is unclear after clinical exam and MRI [8].

Selective nerve root block with specific dosing and technique protocols may be considered in the evaluation of patients with cervical radiculopathy and compressive lesions identified at multiple levels on MRI or CT myelography to discern the symptomatic level(s). Selective nerve root block may also be considered to confirm a symptomatic level in patients with discordant clinical symptoms and MRI or CTM findings [9, 10]. There are no studies to adequately address the role of physical therapy, exercise, chiropractic manipulation, or massage therapy in the management of cervical radiculopathy from degenerative disorders. The aforementioned treatment modalities should be considered carefully given case reports of adverse outcomes including radiculopathy, myelopathy, disk herniation, and vertebral artery compression with manipulative therapy. Transforaminal epidural steroid injections using fluoroscopic or CT guidance may be considered when developing a medical/interventional treatment plan for patients with cervical radiculopathy from degenerative disorders. There are many studies reporting up to 65% of patients reporting good or excellent results with regard to pain relief and many opting out of surgery. For instance, Lin et al. described a retrospective case series of 70 patients considered potential surgical candidates for cervical radiculopathy, underwent cervical transforaminal epidural steroid injections, of which the 65% with good or excellent results was abstracted [11]. Ancillary treatments such as bracing, traction, electrical stimulation, acupuncture, and transcutaneous electrical stimulation have been associated with improvements in uncontrolled case series. These modalities may be considered recognizing that no improvement relative to natural history of cervical radiculopathy has been demonstrated. Overall, surgical intervention is suggested for the rapid relief of symptoms of cervical radiculopathy from degenerative disorders when compared to medical/interventional treatment.

There is good evidence for cervical epidural steroid injections for radiculitis secondary to disk herniation with local anesthetics and steroids. Manchikanti et al., in a large randomized trial with 120 participants receiving cervical interlaminar epidural steroid injections under fluoroscopy

with long-term follow-up yielded positive results. Outcome measures showed significant improvement in pain relief and functional status >50% at 3, 6, and 12 months out [12].

What Is the Prognosis of This Condition?

The North American Spine Society work group found no validated outcome measures to be utilized in prognostication of the subset of patients with cervical radiculopathy from degenerative disorders. The Neck Disability Index (NDI), SF-36, SF-12, and VAS are recommended outcome measures for assessing treatment of cervical radiculopathy from degenerative disorders, with a grade A recommendation [11].

The majority of radiculopathies arise from nerve root compression; the two predominant mechanisms are cervical spondylosis and disk herniation. Although data are limited, some, if not most, patients with compressive cervical radiculopathy improve without specific treatment [13–15]. Evidence that improvement is not treatment specific comes from a population-based study of 561 patients with cervical radiculopathy from Rochester, Minnesota. This was not a natural history study, since most patients received some treatment and 26 percent had surgery for cervical radiculopathy. Nevertheless, at last follow-up, 90 percent of patients were asymptomatic or only mildly incapacitated.

What Is the Long-Term Outcome: Complete Cure, Recurrent or Chronic Persistent Problem?

Symptoms of cervical radiculopathy recur in up to one-third of patients after initial improvement [14]. Conservative management should be reemployed when symptoms recur, unless a significant motor deficit or myelopathy is present. Abstracted from the 2013 ASIPP guidelines, most evidence indicates that between 50 and 75% of people who have neck pain initially also report pain 1 to 5 years later [16].

Discussion

Prevalence

One of the largest epidemiological studies of cervical radiculopathy was a retrospective population-based review of 561 patients (332 men and 229 women) with cervical radiculopathy seen from 1976 to 1990 in Rochester, Minnesota [14]. All patients with complaints of neck pain were screened, and clinical criteria using symptoms, signs, and diagnostic testing were used to retrospectively make the diagnosis of definite, probable, or possible cervical radiculopathy. A total of 561 cases (332 men and 229 women) with cervical radiculopathy were identified.

The following observations were reported in an epidemiological review [14]:

- The mean age at diagnosis was 47.9 years (range 13–91 years).
- Average annual incidence rates per 100,000 people for men and women were 107.3 and 63.5, respectively; the male to female ratio was 1.7:1.
- Age-specific incidence rates per 100,000 people were highest for the 50–54 year age group, 245.1 in males and 164.5 in females, and declined steeply after the age of 60 years.
- Lower cervical roots, particularly C7, are more frequently affected by compression than higher cervical roots. In a series of cases that came to surgery, the following observations were made [15]:
 - C7 was the most frequently affected nerve root, accounting for approximately 70 percent of patients with cervical radiculopathy.
 - C6 root involvement was found in approximately 20%.
 - Involvement of the C5, C8, and T1 levels together accounted for the remaining 10 percent.

Differential Diagnosis

As mentioned, cervical radiculopathy is a clinical, and to some extent subjective, diagnosis made on the basis of history and clinical findings. Typical findings of solitary root lesions may include pain, numbness, weakness, reflex changes, as well as overlapping dermatomes. Neuroimaging and electrodiagnostic studies are indicated for most especially in the setting of significant neurologic deficit, suspicion for an atypical underlying (non-degenerative) cause, or when persistent symptoms do not resolve with 4–6 weeks of conservative therapy. The differential should include entrapment neuropathy, zygapophyseal (facet) joint pain, brachial plexus syndromes, nondegenerative etiologies (neoplastic, infectious, or inflammatory), myalgia, nerve root infarction, root avulsion, demyelination, and traumatic causes to name a few other possible etiologies.

Predictive Value of Different Clinical Features (Both on History and Physical Exam) and Lab Testing/Imaging

- MRI is currently the study of choice in most patients for the initial neuroimaging evaluation of the cervical spine. CT myelography is superior to MRI in the distinction of osteophyte from soft tissue and remains superior to MRI.
- The diagnosis of radiculopathy is usually confirmed by needle electromyography, frequently involving a myotomal pattern of denervation. Nerve conduction studies alone are not sensitive for radiculopathy and should be done beyond 3 weeks of symptoms to improve sensitivity.
- Due to a high prevalence of asymptomatic degenerative changes in the cervical spine, an imaging evaluation revealing evidence of degenerative changes or disk herniation can only support the diagnosis of cervical radiculopathy and cannot by itself establish a diagnosis [17].

Strength of Evidence for Different Treatment Modalities

In summary, the evidence for cervical epidural injections is good for radiculitis secondary to disk herniation with local anesthetics and steroids, fair with local anesthetic only; whereas it is fair for local anesthetics with or without steroids for axial or discogenic pain, pain of central spinal stenosis, and pain of post-surgery syndrome [12].

Future Directions or Clinical Trials in Progress

Future clinical trials are needed to describe improved and effective nonsurgical means of treating radicular pain. While serious complications of cervical interlaminar epidural procedures are rare, future research should be directed at improved complication rates. A cervical spinal cord injection of corticosteroids is a devastating complication, and multiple cases of intramedullary injection have been described after interlaminar approach [12].

Conclusion/Summary

Cervical radiculopathy is a term applied when a nerve root is inflamed, irritated, and has produced a clinically significant motor or sensory neurologic deficit in that nerves distribution. The most common cause for this includes disk protrusion and cervical spondylosis. The common view is that this compressive force on the affected nerve is what leads to common symptoms being numbness, paresthesia, weakness, and hyporeflexia by blocking conduction and causing ischemia. There is another theory that inflammatory markers are irritants of the spinal nerves leading to pain. History and physical exam are critical to the diagnosis although dermatomal patterns are often overlapping. Many specialized tests exist including the Spurling's compression test, Lhermitte's

sign, neck distraction test, shoulder abduction test, Adson's test, and Hoffmann's sign [17]. Imaging is the most useful in diagnosis, and MRI is the society-supported gold standard. The prevalence of abnormalities on MRI in asymptomatic individuals is of concern, however [18]. Multimodal conservative therapy is always the first recommendation. Interventional pain management has been described with substantial differences in technique and outcomes. Thus, characteristics applicable to each technique including interlaminar and transforaminal approaches are considered as separate entities. Response has also been found quite variable to epidural injections depending on pathologic condition (i.e., disk herniation, radiculitis, discogenic pain without herniation, spinal stenosis, and post-surgery syndrome) [1]. One must be attentive to the severity of complications when considering invasive techniques [19]. Surgery is typically indicated when all of the following criteria are met: MRI or CT myelography indicating compressive etiology, pain persistence after 6–12 weeks of conservative treatment; a progressive motor deficit; or cervical spinal cord compression on imaging and/or clinically significant myelopathy. There is no good consensus on proper timing of surgery, however [12, 20].

References

1. Boswell MV, Trescot AM, Datta S, et al. American Society of Interventional Pain Physicians. Interventional techniques: evidence-based practice guidelines in the management of chronic spinal pain. *Pain Physician*. 2007;10(1):7–111.
2. Rubinstein SM, Pool JJ, van Tulder MW, Riphagen II, de Vet HC. A systematic review of the diagnostic accuracy of provocative tests of the neck for diagnosing cervical radiculopathy. *Eur Spine J*. 2007;16(3):307. Pub 2006 Sep 30.
3. Bartlett RJ, Hill CR, Gardiner E. A comparison of T2 and gadolinium enhanced MRI with CT pyelography in cervical radiculopathy. *Br J Radiol*. 1998;71(841):11.
4. Bono CM, Ghiselli G. Diagnosis and treatment of cervical radiculopathy from degenerative disorders: USA: North American Spine Society; 2010.

5. Radhakrishnan K, Litchy WJ, O'Fallon WM, Kurland LT. Epidemiology of cervical radiculopathy. A population-based study from Rochester, Minnesota, 1976 through 1990. *Brain*. 1994;117(Pt 2):325.
6. Semmes R, Murphey M. A report of four cases with symptoms simulating coronary disease. *JAMA*. 1943;121:1209.
7. Alrawi MF, Khalil NM, Mitchell P, Hughes SP. The value of neurophysiological and imaging studies in predicting outcome in the surgical treatment of cervical radiculopathy. *Eur Spine J*. 2007;16(4):495–500.
8. Anderberg L, Annertz M, Rydholm U, Brandt L, Saveland H. Selective diagnostic nerve root block for the evaluation of radicular pain in the multilevel degenerated cervical spine. *Eur Spine J*. 2006;15(6):794–801.
9. Modic MT, Masaryk TJ, Mulopulos GP. Cervical radiculopathy: prospective evaluation with surface coil MR imaging, CT with metrizamide, and metrizamide myelography. *Radiology*. 1986;161(3):753–9.
10. Lin EL, Lieu V, Halevi L, Shamie AN, Wang JC. Cervical epidural steroid injections for symptomatic disc herniations. *Agri*. 2012;24:130–4.
11. Lees F, Turner JW. Natural history and prognosis of cervical spondylosis. *Br Med J*. 1963;2(5373):1607.
12. Diwan SA, et al. Effectiveness of cervical epidural injections in the management of chronic neck and upper extremity pain. *Pain Physician*. 2012;15:E405–34.
13. Radhakrishnan K, Litchy WJ, O'Fallon WM, Kurland LT. Epidemiology of cervical radiculopathy. A population-based study from Rochester, MN, 1976 through 1990. *Brain*. 1994;117(Pt 2):325.
14. Kujjper B, Tans JT, Schimsheimer RJ, van der Kallen BF, Beelen A, Nollet F, de Visser M. Degenerative cervical radiculopathy: diagnosis and conservative treatment. A review. *Our J Neurol*. 2009;16(1):15–20.
15. Loss RE, Corbin KB, Maccarty CS, Love JG. Significance of symptoms and signs in localization of involved root in cervical disk protrusion. *Neurology*. 1957;7(10):673.
16. Manchikanti L, et al. An update of comprehensive evidence-based guidelines for interventional techniques in chronic spinal pain. Part I: introduction and general considerations. *Pain Physician*. 2013;16:S1–S48.
17. Bogduk N. Differential diagnosis. In: *Medical management of acute cervical radicular pain: an evidence-based approach*. Newcastle: University of Newcastle, Australia, Newcastle Bone and Joint Institute; 1999. p. 51.
18. Bush K, Hillier S. Outcome of cervical radiculopathy treated with periradicular/epidural corticosteroid injections: a prospective study with independent clinical review. *Eur Spine J*. 1996;5:319.
19. Heckmann JG, Lang CJG, Zöbelien I, et al. Herniated cervical intervertebral discs with radiculopathy: an outcome study of conservatively or surgically treated patients. *J Spinal Disord*. 1999;12:396.
20. Crette S, Fehlings MG. Clinical practice: cervical radiculopathy. *N Engl J Med*. 2005;353:392.