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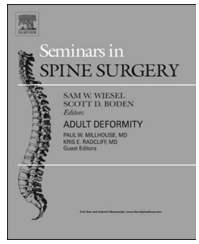

Epidemiology and pathophysiology of cervical disc herniation

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ABSTRACT

The objective of this article is to review the epidemiology and pathophysiology of cervical disc herniation (CDH). A literature search was performed using PubMed as well as other online data sources (e.g., Science Direct). Reviews, case reports, and both prospective and retrospective studies were searched and have been referenced. The data regarding epidemiology of CDH is not as extensive as that of lumbar disc herniation, however, CDH tends to be the most common among those with degenerative disc disease more than 40 years of age. Presenting symptoms include radiculopathy associated most commonly with the cervical (C) 6–7 level. The pathophysiology of symptomatic CDH may be understood by appreciating both the mechanical and chemical changes that occur within the intervertebral disc as one ages. Finally, more studies should be conducted to better understand the outcome and prognosis of this diverse patient population.

1. Introduction

The cervical spinal cord may be considered the most important segment of the spinal cord, surpassing the thoracic and lumbar spinal segments. From driving the respiratory musculature to supplying key components of the autonomic nervous system, it is an essential portion of the spinal cord that is susceptible to life-altering injuries. Among the most common disorders and processes that can affect the cervical spine are disc disorders including the herniated nucleus pulposus (HNP) and degenerative disc disease (DDD).

A cervical disc herniation (CDH) may occur suddenly from trauma, but most often it occurs over time from chemical and mechanical degenerative changes. The focus of this article is to outline the epidemiological trends and the pathophysiologic mechanisms that are responsible for symptoms and clinical presentation of cervical disc herniation. While this review is thorough and current, readers should be reminded that the data regarding cervical disc herniation is still growing and lags behind the wealth of data regarding lumbar disc herniation.

2. Epidemiology

The literature regarding the epidemiology of cervical disc herniation (CDH) is limited by the nature of this dynamic entity. It is difficult to precisely diagnose CDH in a well-defined population given the extensive differential diagnosis and variability in symptom presentation. Furthermore, finding patient populations who do not undergo any treatment to allow an extended period of observation in this diverse population who often undergo multiple treatments is challenging. Literature is therefore primarily focused on discussion of specific issues and well-defined populations among those with CDH (e.g., trauma, occupation based, and degenerative disc). Descriptions of the epidemiology of CDH

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can be gathered from a few large series, such as the highly cited study from the group in Rochester which included 561 patients with cervical radiculopathy and did not attempt to distinguish those with CDH.[1] Wong et al.[2] sought to be more specifically characterize the course and prognostic factors in patients with radiculopathy associated with cervical disc herniation.

Regarding age, the Rochester study reported that the mean age of men with cervical radiculopathy was 47.6 and for women was 48.2.[1] Of the 332 males and 229 females, aged 13–91 years, studied in that report, 21.9% had a confirmed disc protrusion. Other studies suggest that the types of cervical disc herniation presentations tend to be age specific and related to various habits or occupations such as those requiring heavy lifting or activities involving repeated axial loading. The reported male-to-female incidence varies from 1:1 to 1.4:1.[3]

Cervical disc herniation incidence as a function of race or geographical distribution has been less well characterized. Correlations between these factors and CDH may be important for patients with degenerative disc if there is a genetic predisposition to early disc degeneration or inflammatory patterns by race as will be mentioned in subsequent sections.

The most common level for symptomatic herniation in the cervical spine occurs at the cervical (C) 6–7 disc which results in compression of the C7 root. Common symptoms involve posterior upper arm pain, triceps weaknss, wrist drop, and paresthesias in the fingertips of the middle fingers.[4] The second-most common roots affected are the C6 and C8 roots from disease at the (C) 5–6 disc and C7–thoracic (T) 1 disc, respectively.

Symptomatic herniation causes sensory changes and pain in the arm in a dermatomal distribution and weakness in a myotomal distribution.[5] The pattern of symptoms is diverse but usually involves radicular pain, neck pain, and paresthesias, with gradual development and progression of weakness.[2] Often, in nontraumatic situations, patients will report awaking with new onset symptoms.[4] With trauma, patient with CDH may develop central cord syndromes or Brown Sequard syndrome. Of the two, the later has the best prognosis but is less commonly seen.

As mentioned, the differential diagnosis is extensive, and diseases with poor outcomes such as tumor should not be low in the differential given the correct population. It is important to obtain imaging to rule out other causes of cervical radiculopathy, especially in those not responding to initial conservative therapy. Perhaps the most common differential would be spondylosis, but each patient history and physical should evaluate whether other diagnoses could explain the patient's symptoms. The extensive differential includes but is not limited to peripheral compressive neuropathy, spinal trauma, spondylolisthesis, root avulsion, radiation injury, infiltrative, infectious, parainfections, and metabolic conditions, muscular pathology, brachial plexus pathology, rotator cuff disease, arthritis, or complex regional pain syndromes among other diseases.

Predictive factors for developing a symptomatic CDH include physical exertion or trauma and simultaneous symptomatic lumbar radiculopathy.[1] Rarely does a cervical disc herniation occur suddenly. Typically the disc herniates over time after degenerative changes have altered the biomechanics of the disc. An epidemiologic study of patients participating in various sports including weight lifting suggested there were associations between both lumbar and cervical disc herniation and participation in sport. They studied 65 patients with cervical disc herniation and matched them by sex, source of care, and decade of age to a control patient. They found that most recreational sports including baseball, softball, golf, swimming, and racquet sports were not associated with increased risk of herniation. Interestingly they did see a weak positive association between bowling and lifting free weights and both lumbar and cervical disc herniation.[6]

Other associations with CDH related to DDD have been shown in patients who underwent prior spine surgery. DDD may be more common at levels adjacent to the surgical level with the incidence of adjacent segment disease estimated at 2.9% per level per year following a single level anterior cervical decompression and fusion (ACDF) in one study.[7] Advancing age and nicotine intake may correlate with radiological findings of DDD as well. This corroborates findings of other studies, which have shown that cigarettes and nicotine use are implicated in impeding bone metabolism.[8,9]

Outcomes for CDH tend to be favorable, however, when traumatic injury causes central cord syndrome as a result of preexisting CDH, the recovery is typically incomplete.[4] Meaningful recovery from atraumatic symptomatic disc herniation tends to occur within the first 4–6 months after onset of symptoms.[2] Complete recovery may take up to 2 years regardless of whether patients undergo some form of treatment or are observed for signs of spontaneous regression.[10] Metrics used to measure associated disability for CDH such as return to work are highly variable and may be impacted by seemingly unrelated factors such as a patient's insurance plan. According to one prospective study, those seeking treatment under workman's compensation (WC) programs missed an average of 37.1 days of work compared to an average of 5.1 days missed by patients who made claims through private disability insurance companies also known as personal injury (PI) insurance.[11]

3. Pathophysiology

A herniated disc in the cervical spine can cause a wide array of symptom presentations that may be understood by knowing the basics of cervical spine anatomy and the relationships of the mechanical and chemical environment in this region known as biomechanics or mechanobiology.[9,12] The most significant anatomic structures which are relevant include the vertebral body, pedicle, the cervical nerve root, the posterior longitudinal ligament, and the intervertebral disc (IVD) itself. The basic components included the nucleus pulposus (NP), the lamellar annulus fibrosis (AF) and the cartilaginous endplates which form a basis for anchoring the disc to the vertebral body. The gelatinous nucleus is the core of the iVD and acts as a shock absorber aided by a hydrated extracellular matrix rich in hydrophilic proteoglycans. The NP is surrounded by the concentric lamellae of the fibrous AF which has a more organized structure of collagen and proteoglycans.