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Degenerative Cervical Myelopathy: A Literature Review

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Abstract

Introduction: *Degenerative cervical myelopathy (DCM) is the most common cause of spinal cord dysfunction in adults, characterized by progressive cervical spinal canal narrowing and subsequent neurological decline. Early clinical manifestations such as gait instability, sleep disturbances, and impaired coordination are frequently subtle and misattributed to normal aging, often leading to delayed diagnosis. Despite occasional periods of clinical stability, most patients experience ongoing neurological deterioration, particularly in the presence of risk factors. Without timely intervention, DCM may result in significant motor impairment or permanent disability. This review aims to provide an overview of the pathophysiology, diagnostic challenges, and current management strategies for DCM, emphasizing the importance of early recognition and intervention to optimize patient outcomes.*

Methods: *A comprehensive narrative review of the literature was conducted to explore the epidemiology, pathophysiology, clinical presentation, diagnostic approaches, and management strategies of degenerative cervical myelopathy (DCM).*

Results: *A practical guide to equip health care providers with essential knowledge of DCM, aiming to enhance clinical practice, examination performance, and diagnostic interpretation. It also addresses the importance of interdisciplinary collaboration and outlines effective referral strategies for optimal patient care."*

Conclusion: *This review emphasizes the importance of clinical evaluation, advanced imaging, and tailored treatment strategies particularly surgical decompression for severe cases.*

Keywords: *Degenerative , cervical , spinal cord , myelopathy , spondylosis*

INTRODUCTION:

Degenerative cervical myelopathy (DCM) is a progressive disorder resulting from narrowing of the cervical spinal canal , marked by a stepwise decline in neurological function interspersed with temporary periods of clinical stability affecting quality of life. Early symptoms are often subtle such as increased falls, sleep disturbances, and impaired coordination during daily tasks as driving and are frequently misattributed to normal aging, contributing to diagnostic delays.[1, 2] Despite periods of stabilization, the majority of patients (57% to 95%) eventually experience neurological deterioration, while sustained remission is uncommon.[3] Factors associated with a higher risk of progression include prolonged duration of symptoms, underlying congenital cervical stenosis, presence of T2-weighted hyperintensities on MRI, ossification of the posterior longitudinal ligament (OPLL), and poor baseline neurological status.[4-6] Without timely and appropriate intervention, DCM can lead to profound motor deficits, including severe weakness or paralysis.[4]

This article focuses on providing essential insights into diagnosing and managing degenerative cervical myelopathy (DCM), emphasizing the importance of understanding its pathophysiology and recognizing it early to ensure timely and effective treatment.

Epidemiology and Global Burden of Degenerative Cervical Myelopathy (DCM):

- **Incidence and Prevalence**

With increasing global life expectancy and aging populations, the prevalence of degenerative cervical myelopathy (DCM) is projected to rise. Although DCM is recognized as a leading cause of non-traumatic paraparesis and tetraparesis in adults, comprehensive epidemiological data remain sparse.[7] Early estimates suggested a prevalence of 3.5 per 1,000 individuals.[8] A more recent pooled analysis of three international studies involving 1,202 asymptomatic adults aged 45 to 66 years reported a DCM prevalence of 2.3%, though the evidence quality was deemed low. [9] This gap in reliable global data underscores the need for further population-based studies.

- **Age and Sex Distribution**

Age is a significant determinant in the development of DCM, reflecting the progressive nature of cervical spine degeneration. Degenerative disc changes become increasingly common with age, affecting over 85% of individuals by their sixth decade.[10] Epidemiological trends indicate that DCM most frequently affects individuals between the ages of 45 and 64, with peak prevalence between 50 and 54 years.[11] Furthermore, the condition exhibits a clear sex disparity, with males being disproportionately affected; male-to-female prevalence ratios as high as 2.7:1 have been reported.[12]

- **Risk Factors**

The etiology of DCM is multifactorial, encompassing demographic, anatomical, metabolic, and traumatic contributors. Advancing age, male sex, and lower socioeconomic status are well-established risk factors.[13] Congenital narrowing of the cervical spinal canal (anteroposterior canal diameter <10 mm) and structural deformities of the atlas or axis can predispose individuals to earlier cord compression. Metabolic disorders, including obesity, diabetes mellitus, and dyslipidemia, may promote pathological ossification and impair spinal cord perfusion.[14, 15] Traumatic injuries can lead to osteophytic or heterotopic bone formation, aggravating spinal cord compression.[16] Additionally, though less extensively studied, conditions such as rheumatoid arthritis , gout, pseudogout, have been implicated as potential contributors.[17-19]

Pathophysiology and Mechanisms of Degenerative Cervical Myelopathy:

Degenerative cervical myelopathy (DCM), a term formally introduced in 2015, more precisely characterizes age associated degenerative disorders of the cervical spine, such as cervical spondylotic myelopathy (CSM) and ossification of the posterior longitudinal ligament (OPLL).[20]This classification better captures both the pathological and demographic aspects of the condition. DCM is a multifactorial disease primarily resulting from age related degenerative changes, including disc herniation, spondylosis, and spinal canal narrowing, which lead to spinal cord compression. Contributing factors include osteophyte formation, ligamentum flavum hypertrophy, and disc protrusion.[20]

Although the exact pathophysiological mechanisms are not fully elucidated, spinal cord injury is believed to arise from a combination of direct mechanical compression and impaired vascular supply. This compression disrupts neural transmission between the brain and body, resulting in progressive neurological decline.[21] Mechanical forces cause direct injury to neural tissue, including axonal disruption, demyelination, and neuronal loss, while increased intramedullary pressure reduces perfusion and oxygenation, potentially leading to ischemia and hypoxia.[21]

Pathological changes in DCM are not restricted to the site of compression; they also extend to neighboring spinal cord regions via proximal and distal segments in a phenomena described as Wallerian degeneration.[20] The spinal cord undergoes various reactive processes, such as gliosis, proliferation of astrocytes and fibroblasts, and scar formation. While these responses initially help contain injury, prolonged gliosis and fibrosis may further inhibit axonal repair and exacerbate compression.[21] Histopathological findings include interstitial and mitochondrial edema, vacuolar degeneration, and evidence of innate immune activation, such as elevated levels of proinflammatory cytokines and macrophages.[22, 23]

Clinical Presentation of Degenerative Cervical Myelopathy (DCM):

An accurate diagnosis of Degenerative Cervical Myelopathy (DCM) begins with a detailed clinical history and a comprehensive neurological examination. Due to the often subtle and non-specific nature of DCM symptoms, there is a significant risk of under diagnosis or misdiagnosis if these initial assessments are not meticulously conducted.[24] Diagnosing degenerative cervical myelopathy (DCM) can be challenging due to the variability in symptoms, which depend on the degree of spinal cord compression and the specific cervical levels affected.[25] Early symptoms often include neck pain, upper extremity pain, numbness, and muscle weakness.[26-28] These can contribute to difficulties with fine motor tasks, such as buttoning shirts or using keys. As the condition progresses, symptoms can extend to the lower extremities, leading to gait instability, which is often wide-based and ataxic.[29] Additionally, patients may experience bowel and bladder dysfunction, such as urinary incontinence and constipation.[30]

As the disease advances, more severe neurological impairments may emerge, including significant sensory loss, muscle atrophy, and decreased reflexes. In later stages, autonomic dysfunction can occur, and patients may experience profound disability, including paralysis or quadriplegia. The hallmark features of DCM include sensory disturbances and weakness in both upper and lower limbs, coordination issues, and gait abnormalities.[29]

Imaging Modalities in the Diagnosis of Degenerative Cervical Myelopathy (DCM)

Imaging is essential in the diagnosis, evaluation, and management planning of degenerative cervical myelopathy (DCM). Among available techniques, conventional Magnetic Resonance Imaging (MRI) is considered the gold standard due to its superior ability to visualize spinal cord structures, intervertebral discs, and soft tissue abnormalities.[31] MRI effectively identifies key pathological features such as spinal cord compression, disc herniation, ligamentous hypertrophy, and foraminal stenosis. Additionally, MRI can reveal intramedullary signal changes particularly on T2-weighted sequences which may be associated with disease severity and prognostic outcomes. However, conventional MRI has limitations in assessing microstructural changes and correlating imaging findings with clinical severity.[32] Advanced techniques like diffusion-weighted imaging (DWI) and diffusion tensor imaging (DTI) further enhance diagnostic accuracy by detecting microstructural spinal cord alterations and aiding in predicting functional recovery. These advanced techniques aim to improve diagnostic accuracy and objectivity.[33]

Computed tomography (CT) complements MRI by providing detailed visualization of bony anatomy, including osteophyte formation and foraminal narrowing. It is particularly valuable in detecting ossification of the posterior longitudinal ligament (OPLL), which can significantly influence the choice of surgical approach. In cases where MRI is contraindicated, CT myelography serves as an alternative for visualizing the spinal cord and cerebrospinal fluid spaces, although it lacks the soft tissue resolution of MRI.[34, 35]

Additional diagnostic tools include dynamic imaging techniques, such as flexion-extension radiographs and dynamic MRI, which help assess cervical instability or motion-dependent pathologies like spondylolisthesis.[36] Moreover, neurophysiological studies, including somatosensory evoked potentials (SSEPs) and electromyography (EMG), are used in conjunction with imaging to evaluate neural function.[37] These modalities contribute valuable information about the physiological integrity of the spinal cord and peripheral nerves, improving diagnostic accuracy and guiding surgical planning.[38]

Biomarkers and Genetic Testing:

Research is ongoing into the use of biomarkers and genetic sequencing to better understand disease progression and personalize management strategies.[32]

Assessment of DCM Severity

The Modified Japanese Orthopaedic Association (mJOA) scale is a widely recognized and validated tool used to evaluate the severity of degenerative cervical myelopathy (DCM) and to monitor disease progression and treatment outcomes. [39] This scoring system assesses key neurological domains, including motor function in the upper and lower limbs, sensory function, and sphincter control, offering a comprehensive evaluation of functional impairment.[39]The mJOA scale ranges from 0 to 18, with higher scores indicating better neurological function and lower levels of disability. Its utility in both clinical and research settings has been well-established. This scale not only facilitates standardized assessment across different patient populations and treatment strategies but also assists clinicians in stratifying disease severity, guiding treatment decisions, and predicting patient outcomes.[39]

Management Strategies for Degenerative Cervical Myelopathy (DCM)

Degenerative Cervical Myelopathy (DCM) is a progressive spinal cord disorder that often requires an individualized and multidisciplinary treatment approach. The choice of management ranging from surgical intervention to conservative and pharmacological therapies is guided by symptom severity and the extent of spinal cord compression.

Treatment Guidelines for Degenerative Cervical Myelopathy

In 2017, Fehlings et al. published comprehensive clinical practice guidelines for the management of degenerative cervical myelopathy (DCM). These guidelines serve as a crucial framework for clinicians, offering evidence-based recommendations tailored to disease severity and neurological status.[40]

For patients with mild DCM (defined by a modified Japanese Orthopaedic Association (mJOA) score of 15–17) and no significant neurological impairment, a nonoperative approach is advised. This includes patient education, activity modification, physical therapy, and analgesic or NSAID therapy for symptom control. Ongoing clinical monitoring is essential to detect progression and reassess treatment needs.[40]

Conversely, surgical intervention is recommended for patients with moderate (mJOA 12–14) and severe DCM (mJOA <12) due to the higher risk of neurological deterioration and functional decline.[40]

The guidelines discourage prophylactic surgery in asymptomatic individuals (non myelopathic) who exhibit cervical spinal cord compression on imaging without signs of radiculopathy. These individuals should instead receive counseling regarding the risk of disease progression and be educated on the early signs of myelopathy, with regular follow-up evaluations.[40]

However, for non myelopathic patients who demonstrate clinical radiculopathy, with or without supportive electrophysiological evidence, there is a heightened risk of developing myelopathy. In such cases, shared decision-making is emphasized, with patients being offered either surgical treatment or conservative management, such as a supervised rehabilitation program and close clinical observation.[40]

Conservative Management

For patients with mild or stable DCM, conservative treatments such as physical therapy, cervical traction, and neck immobilization may offer symptom relief. [41]

Pharmacological Approaches

Pharmacological treatments remain limited

with several agents demonstrating efficacy in preclinical studies but lacking substantial human data. Compounds such as riluzole and cerebrolysin are under investigation; however, their therapeutic effectiveness in clinical settings remains.[42]

In summary, while surgical intervention is the cornerstone of DCM management, conservative and alternative therapies may benefit selective patient populations. Nonetheless, the current absence of robust pharmacological options underscores the necessity for further research to refine and expand treatment modalities.

Surgical Management:

Surgical intervention remains the mainstay treatment for moderate to severe DCM. Common procedures include anterior cervical discectomy and fusion, corpectomy, and posterior techniques such as laminoplasty and laminectomy with fusion.[41] Evidence suggests that both anterior and posterior approaches significantly improve clinical outcomes, with anterior procedures potentially offering greater gains in patient-reported functional scores.[43, 44] Laminoplasty, including both open-door and double-door variants, is also effective and yields comparable functional benefits .[45]

Conclusion:

Degenerative Cervical Myelopathy (DCM) is a progressive neurological disorder requiring early diagnosis and appropriate intervention to prevent long-term disability. This review emphasizes the importance of clinical evaluation, advanced imaging, and tailored treatment strategies particularly surgical decompression for severe cases.

A multidisciplinary approach and continued research are essential to improve outcomes, refine therapies, and explore novel treatments. Enhancing patient education and awareness is also crucial for early recognition and management of the condition.

Conflicts of interest

The authors report no conflict of interest.

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Ethics Information

This is a review of the literature, ethical approval is not required.

Abbreviations

CSM Cervical spondylotic myelopathy
CT Computed tomography
DCM Degenerative cervical myelopathy
DTI Diffusion tensor imaging
DWI Diffusion-weighted imaging
EMG Electromyography
mJOA Modified Japanese Orthopedic Association
MRI Magnetic resonance imaging
OPLL Ossified posterior longitudinal ligament
SSEPs Somatosensory evoked potential

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