Electrodiagnosis in Cancer Rehabilitation

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KEYWORDS

• Electrodiagnosis • Radiculopathy • Plexopathy • Neuropathy
• Paraneoplastic syndrome • Cancer rehabiliation

KEY POINTS

- The patient with cancer is prone to peripheral nervous system injury at multiple anatomic levels.
- A wide variety of nerve injuries can be caused by cancer and its treatments, either by direct effects from tumors, cancer treatment effects, paraneoplastic effects, or indirect effects associated with cancer symptoms.
- Electrodiagnostic studies are an invaluable tool in the evaluation of neuromuscular disorders in the cancer patient population.

INTRODUCTION

Neuromuscular complications related to cancer are common. Cancer can directly affect the peripheral nervous system at any level via numerous mechanisms, including direct nerve compression or infiltration, hematogenous or lymphatic spread, meningeal dissemination, or perineural spread. Paraneoplastic syndromes often manifest with neuromuscular dysfunction, as can cancer-associated medical complications, such as infections, weight loss, or malnutrition. Acquired neuropathies can result from effects of cancer treatment itself, be it surgery, chemotherapy, radiation therapy, hematopoietic stem cell transplantation, or immunologic therapy. Patients may also have pre-existing neurologic conditions, such as diabetic or hereditary neuropathies, that can be exacerbated by cancer or its related treatments. Often, a combination of processes can be present.

Electrodiagnostic studies, including nerve conduction studies (NCS) and needle electromyography (EMG), are invaluable tools for assessing neuromuscular function

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in patients with cancer. Electrodiagnosis can confirm a suspected neuropathic or myopathic process as well as rule out other possibilities. It can detect subclinical neuropathies, which can inform clinical decision making regarding use of neurotoxic chemotherapeutic agents. They can help with localizing lesions and determining pathophysiology, chronicity, and severity, which in turn can aid the cancer physiatrist in determining prognosis for recovery and the utility of future rehabilitation interventions. Finally, the information obtained with electrodiagnostic testing can help guide the oncology team with regards to surgery, chemotherapy, or radiation therapy planning.

Electrodiagnosis should be thought of as an extension of the history and physical examination, with the expected clinical and NCS/EMG findings dependent on the location, distribution, and pathophysiology of the neurologic lesion. Any and all levels of the peripheral nervous system can be affected by cancer and its treatments, including spinal roots, brachial or lumbosacral plexus, peripheral axons and/or myelin sheaths, the neuromuscular junction, and muscle fibers. Because of the variety of mechanisms of injury and wide scope of clinical presentation, the true incidence and prevalence of neuromuscular disorders in patients with cancer are unknown. However, it is estimated that approximately one-third of adult patients with chronic cancer pain, across all tumor types and stages, are thought to have cancer-related neuropathic pain.[1]

RADICULOPATHY

After disc disease and spinal stenosis, tumors involving the spine and spinal cord are the most common causes of radiculopathy.[2] All tumor types can metastasize to the spine, although the most common primary malignancies that do so include breast, lung, prostate, colon, thyroid, and kidney. Common primary malignant spinal tumors include multiple myeloma, plasmacytoma, and Ewing and osteogenic sarcoma. Single- or multilevel radiculopathies due to malignancy can result from primary or epidural metastatic tumor extension into the neural foramina. Leptomeningeal disease is due to metastatic involvement of the leptomeninges from infiltrating cancer cells, and involvement of the cauda equina can be thought of as a lumbosacral polyradiculopathy. The most common primary cancers associated with leptomeningeal disease are breast, lung, gastric, melanoma, lymphomas, and leukemias.[3] Of the leukemias, leptomeningeal disease is most commonly seen in acute lymphocytic leukemia.[4,5]

Patients can present with an asymmetric array of symptoms resulting from radicular or polyradicular involvement, including focal and radicular pain, areflexia, paresthesias, and lower motor neuron weakness. In leptomeningeal disease, there may be associated findings of nuchal rigidity as well as upper motor neuron signs, especially if there is concomitant brain involvement. Cranial nerves can be involved as well, with the oculomotor, facial, and auditory nerves most commonly affected.

In radiculopathies, sensory responses should be normal on NCS, because the location of involvement is proximal to the dorsal root ganglion, thereby making the segment of sensory nerve fibers tested metabolically and histologically intact. Motor responses within the affected myotomes may be normal or reduced in amplitude, depending on severity. Needle EMG is the most sensitive electrodiagnostic test for evaluation of a radiculopathy. One should record neuropathic abnormalities in at least 2 muscles innervated by different peripheral nerves but sharing the same root innervation, including increased insertional activity, fibrillation potentials, reduced recruitment, and large, polyphasic motor unit potentials (MUPs). Because paraspinal muscles are innervated by the dorsal primary rami, branching directly off of the nerve root, abnormal neuropathic EMG findings noted in the paraspinals further support the