

Radiosurgery to the Spinal Dorsal Root Ganglion Induces Fibrosis and Inhibits Satellite Glial Cell Activation While Preserving Axonal Neurotransmission

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Abstract

Objectives: Stereotactic radiosurgery (SRS) is commonly used to create lesions of the Gasserian ganglion (GG) to treat trigeminal neuralgia (TGN). The lumbar dorsal root ganglion (DRG) contains the sensory neurons responsible for pain sensitivity and the genesis and perpetuation of peripheral neuropathic pain. Therefore, radiosurgery to the DRG might improve chronic peripheral pain. This study evaluated the clinical and histological effects of high dose radiosurgery to the DRG in a small animal model.

Methods: Eight Sprague Dawley rats underwent either 40 or 80 Gy single fraction SRS to the left L5 and L6 DRG using the Leksell Gamma Knife Icon. Animals were sacrificed 3 months after treatment, and the lumbar spines were harvested. Common histological techniques were used to assess fibrosis and inflammation. DRGs were stained for Glial Fibrillar Acidic Protein (GFAP), Neu-N, substance P and internexin as a measure of peripheral glial activation, neurogenesis, and pain specific neurotransmission, respectively. The Von Frey Test was used to assess the integrity of the spinothalamic tract.

Results: No motor or sensory deficits were observed in any animal. Fibrosis, edema, and vascular sclerosis were present on the treated, but not the control side and were more pronounced at 80Gy. SRS reduced the expression of GFAP without affecting the expression of Neu-N, substance P or internexin. The Von Frey sensory perception test did not show any differences between the control side for either radiosurgical dose.

Conclusions: Both 40 Gy and 80 Gy SRS doses were well tolerated and provoked no deficits or altered the function of the spinothalamic axons. SRS reduced the activation of satellite glial cells, a primary mechanism for DRG mediated pain, and it elicited similar changes to the ones described on the Gasserian ganglion after SRS for TGN, implying that this treatment might be effective in the treatment of radiculopathic pain.

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Abstract

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