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Abstract

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Cost-Effectiveness of Prophylactic Vertebroplasty for Patients with Spine Metastases at High-Risk for Vertebral Compression Fracture After Stereotactic Radiotherapy

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Abstract

Objectives:

Vertebral compression fracture (VCF) is a significant complication of spinal stereotactic body radiotherapy (SBRT), impacting both patient quality of life and healthcare costs. These costs include pain management, emergency department (ED) visits, hospital admissions, and even major surgeries such as laminectomy and instrumented fusion for spinal cord compression. In this study, we examined the financial implications of VCF and explore the potential benefits of considering prophylactic vertebroplasty for high-risk patients, as identified by our nomogram. Costs were calculated based on CPT codes.

Methods:

This retrospective cohort study was conducted at a single institution, gathering demographic and treatment data from patients who underwent spinal SBRT between 2013 and 2020. According to our VCF nomogram, patients were divided into high-, intermediate-, and low-risk categories. We evaluated the events related to VCF ED visits, hospitalization, and surgical intervention. We excluded uncontrolled back pain requiring pain medication to avoid the confounding factor of patients who had already been on pain medications for other indications before SBRT.

Results:

This study included 173 patients, of whom 30 (17%) developed vertebral compression fractures (VCFs) at a median of 4.4 months following SBRT. The following factors were significantly associated with an increased 1-year VCF risk: primary tumors originating from non-small cell lung cancer (NSCLC), breast, or ano-colorectal cancer (27% vs. 12%, $p < 0.001$), chronic steroid use (38% vs. 13%, $p = 0.01$), a SINS score > 7 (32% vs. 4%, $p < 0.001$), Bilsky grade 1 (28% vs. 11%, $p = 0.001$), and endplate (EP) disruption (31% vs. 5%, $p < 0.001$). Univariate analysis identified chronic steroid use (HR 2.87, $p = 0.02$), elevated SINS score (HR 1.62, $p < 0.001$), Bilsky grade 1 (HR 3.19, $p = 0.002$), EP disruption (HR 6.02, $p < 0.001$), adverse pathology (HR 3.31, $p = 0.001$), and circumferential treatment (HR 2.26, $p = 0.03$) as significant predictors of VCF. On multivariate analysis, chronic steroid use (HR 2.91, $p = 0.04$), higher SINS score (HR 1.31, $p = 0.005$), EP disruption (HR 3.42, $p = 0.016$), and adverse pathology (HR 2.81, $p = 0.007$) remained significant independent predictors of VCF risk. Each of these factors was assigned one point, resulting in stratification into three risk groups: low-risk (0-1 points, 105 patients), intermediate-risk (2 points, 47 patients), and high-risk (3-4 points, 21 patients). VCF rates were 62% for high-risk, 30% for intermediate-risk, and 3% for low-risk groups. The estimated VCF-related healthcare costs for the 30 patients with VCFs ranged from \$915,500 to \$1,710,500. In the HR group, the cost was between \$442,500 and \$897,500, or \$21,071 to \$42,738 per patient. In the IR group, the cost was between \$293,000 and \$373,000, or \$6,234 to \$7,936 per patient. In the LR group, the cost was between \$180,000 and \$440,000, or \$1,714 to \$4,190 per patient. Prophylactic vertebroplasty for the HR group, aimed at preventing the 13 VCF events, was estimated to cost between \$10,000 and \$15,000 per patient, with a total cost ranging from \$210,000 to \$315,000.

Conclusion(s):

Based on the findings that HR patients with VCFs experience significant healthcare costs and complications, prophylactic vertebroplasty could be a cost-effective intervention. By preventing severe VCF-related events in high-risk patients, it has the potential to reduce the financial burden and improve patient outcomes.