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Vertebral Compression Fracture Post Spine Stereotactic Body Radiotherapy: The Role of Vertebral Endplate

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Abstract
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Abstract

Objectives:

Background: Maintaining hydrostatic pressure -via Pascal's Principle- between vertebral bodies is essential to decrease the chance of vertebral compression fracture (VCF). Vertebral endplates (EP) play an essential role in this matter through maintaining the mechanical environment as well as the proper nutrition of avascular discs. The purpose of this study is to establish the correlation of VCF with disrupted EP by tumor involvement.

Methods:

A retrospective analysis of de novo spine metastases treated with stereotactic body radiotherapy (SBRT) between 2013-2019. Patients (pts) with previous surgical intervention were excluded. VCF defined as new or progression of existing loss of vertebral body height. The vertebral EP region defined in relation to the vertebral body as superior EP vs inferior EP. Kaplan-Meier curves used to analyze the variables. A multivariate proportional hazard model used to assess the risk of all covariates.

Results:

111 pts were treated with SBRT with a median dose of 27Gy (10-35Gy). Median follow-up was 18 months (1.2-107). The median age was 60 years (24-87) and 59 were males (53%) and 52 were females (47%). The median body mass index (BMI) was 27 kg/m2 (16-47). Almost 9 pts diagnosed with osteoporosis prior radiation. Twelve pts received prolonged steroids. Twenty pts received bisphosphonate and 8 pts received denosumab. The median PTV was 50cc (8-465) and median Conformity Index was 1.05 (0.42-1.4). Almost 75% of pts received >95% of the dose covering 100% of the PTV. The most common histopathologies were renal cell carcinoma (25%), lung (13%) and breast (11%). Most of the pts (77%) had SINS score of 7 or less. 48 pts (43%) had either superior or inferior EP disruption secondary to the tumor at the time of radiation. Twenty pts (18%) had both superiorly and inferiorly disrupted EP. Around 20 pts (18%) developed VCF. The median time to VCF was 5.2 months (1.1-57.4). The one-year cumulative incidence of VCF was 18%. The 1-year cumulative incidence of VCF with either superiorly and/or inferiorly disrupted EP was 29% vs 6%, p value < 0.001. The 1-year cumulative incidence of VCF with both superiorly and inferiorly disrupted EP was 57% vs 7% (p value < 0.001). The median time to VCF was earlier in pts with both disrupted EP (2.4 months vs 5.7 months, p value < 0.05). Other risk factors like SINS score of >7 and local recurrence (LR) associated with higher risk of VCF. On multivariate analysis, LR (HR 8.2 [CI 2.4-28, p- value < 0.001]), tumor disrupting the EP (HR 4.5 [CI 1.3-16, p-value< 0.018]) and SINS score of seven and above (HR 1.7 [CI 1.3-2.25, p-value < 0.001]) correlated with the VCF risk.

Conclusion(s):

In this retrospective analysis, tumor disrupting the EP, disease recurrence and high SINS score increased the

risk of VCF. Cement augmentation either prophylactically or immediately following SBRT is currently being studied in a prospective trial within our institution.