

## **Bone Metastases in Well-to-Moderately Differentiated Neuroendocrine Tumors: A Review of Clinical Characteristics, Hormone Levels, and Survival**

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**Background:** Metastatic neuroendocrine tumors, specifically those with bone metastases, are rare and not yet comprehensively researched. In this study we look at the clinical features associated with bone metastasis in patients with well-to-moderately differentiated neuroendocrine tumors (NETs), specifically primary tumor characteristics, spinal cord compression, pathologic fractures, elevated hormone levels, and survival.

**Methods:** A retrospective study was performed on all patients treated at our hospital for well-to-moderately differentiated NETs diagnosed from 2000 to 2010 who were found to have bone metastases. A control group of patients with metastatic NETs was matched with regards to age, gender, primary site, and date of diagnosis for comparison.

**Results:** 40 patients with well to moderately differentiated NETs were found with bone metastases. Patients with bone metastases had larger primary tumors than matched controls (47.5 mm vs 33 mm diameter,  $p=0.024$ ). Among patients with bone metastases, 8 patients were found with spinal cord compression (20%), 6 patients with pathologic fractures (15%), 18 patients with carcinoid syndrome (45%), and 36 patients with an elevated pancreastatin (90%) on diagnosis. Patients with bone metastases also had shorter survival (52 months) compared to the control group (98 months,  $p=0.024$ ); among only those with bone metastases, patients had a shorter survival if they had non-resectable disease (32 vs 76 months,  $p=0.005$ ). Cord compression, pathologic fracture, carcinoid syndrome, and elevated pancreastatin were not associated with shorter survival among patients with bone metastases.

**Conclusion:** Our study suggests that patients with well to moderately differentiated NETs metastatic to bone have larger tumors, more frequently elevated pancreastatin, and shorter survival than patients without bone metastases.