

## The Prognostic Significance of Lymph Node Ratio in Carcinoid Tumors

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**Background:** Neuroendocrine tumors are an increasingly prevalent tumor occurring in roughly 5 per 100,000 persons. Carcinoid tumors, a subset of NET, are slow growing and frequently occur in the gastrointestinal tract. Several studies have highlighted the prognostic significance of nodal metastases in carcinoid tumors. Currently, The American Joint Committee on Cancer (AJCC) only uses the presence (N1) or absence (N0) of regional node metastases as a prognostic indicator in carcinoid tumors., however some research suggests that lymph node ratio may be a superior way to evaluate nodal involvement in cancer. <sup>1-5</sup> However, no research to our knowledge has evaluated lymph node ratio in carcinoid tumors. The aim of this study was to evaluate whether lymph node ratio (LNR) is a better predictor of survival than N1 of 10-year survival in carcinoid tumors.

**Methods:** 11,189 individuals with carcinoid tumors who were recorded in the Surveillance, Epidemiology, and End Results (SEER) database between 1988-2010 were evaluated. Carcinoid tumors were classified according to ICD-O-3 histology codes. The Kaplan-Meier estimator was used to evaluate overall survival. Receiver operator curves (ROC) and the area under the ROC curve (AUC) were used to evaluate the ability of nodal involvement or lymph node ratio to predict ten-year survival. All analyses were preformed using STATA and SAS v9.3.

**Results:** ROC curve analysis indicated that LNR and node positivity were both predictive of ten-year survival, AUC .734,  $p < .0001$ , AUC 0.7048,  $p < .0001$ . LNR was 88% specific and 50% sensitive in predicting ten-year survival. N1 was 88% specific and 49% sensitive in predicting ten-year survival. Both LNR and N1 were the most (100%) specific in predicting 10-year survival for patients with carcinoid tumors located outside of the fore, mid, or hindgut region with a 61% (N1) and 70% (LNR) sensitivity. LNR and N1 were most (86%) sensitive in predicting ten-year survival in patients with carcinoid tumors of the foregut with a 53% (N1 and LNR) specificity.

**Conclusion:** We believe that LNR is an important independent predictor of survival for individuals with carcinoid tumors. However, LNR only provides a modest benefit when compared with the binary predictor of whether or not there are positive regional nodes.