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64Cu-DOTATATE PET/MRI for Radiosurgery Planning in Head and Neck Paragangliomas

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Takahiro Sanada [1], Harshal Shah [2], Sanjeev Srinivasan [3], John Starner [4], Emel Calugaru [5], Jessica Jung [6], Michael Schulder [7], Anuj Goenka [8]

1. Neurosurgical Oncology, Northwell Health, Manhasset, USA 2. Neurological Surgery, Donald and Barbara Zucker School of Medicine at Hofstra/Northwell, New York, USA 3. Neurosurgery, Northwell Health, Lake Success, USA 4. Radiation Oncology, Northwell Health, New Hyde park, USA 5. Radiation Medicine, Northwell Health, Lake Success, USA 6. Medical Physics, NYU Langone, New York, USA 7. Neurosurgery, Zucker School of Medicine at Hofstra/Northwell, New York City, USA 8. Radiation Medicine, Northwell Health, New York, USA

Corresponding author: Takahiro Sanada, tsanada@northwell.edu

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Abstract

Objectives: Paragangliomas are rare neuroendocrine tumors occurring near vital neurovascular structures of the head and neck. Stereotactic radiosurgery (SRS) provides a safe and effective treatment option, but accurate tumor delineation is critical to ensure tumor control and minimize radiation exposure to surrounding tissue. The radiotracer ^{64}Cu-DOTATATE positron emission tomography (PET) has demonstrated high sensitivity for detecting paragangliomas. This study aimed to evaluate the impact of integrating ^{64}Cu-DOTATATE PET with magnetic resonance imaging (MRI) on radiotherapy target contouring and treatment planning for patients undergoing SRS.

Methods: A retrospective chart review was conducted for patients with non-metastatic head and neck paragangliomas treated over a 20-month period with SRS planned using ^{64}Cu-DOTATATE PET/MRI fusion imaging. Demographic, clinical, radiographic, and treatment data were collected at baseline and follow-up. Tumor volumes based on MRI alone were compared with those derived from PET/MRI fusion using the Wilcoxon signed-rank test, with statistical significance defined as $p < 0.05$.

Results: Seven patients met inclusion criteria. Presenting symptoms included hearing loss in 3 (42.9%) and tinnitus in 2 (28.6%) patients. Cranial nerve palsies were observed in 5 patients (71.4%), including CN XII (n = 2), CN X (n = 2), and CN VII (n = 1). Patients were administered a mean dose of 4.22 mCi of radiotracer prior to PET imaging. SRS was delivered using Gamma Knife (n = 5) or LINAC (n = 2). Post-treatment complications included cerebrospinal fluid otorrhea (28.6%) and throat dryness (14.3%). At a mean follow-up of 13 ± 2 months (n = 5), all patients demonstrated stable or improved disease. Mean tumor volume delineated on MRI alone was 8.5 ± 2.7 cm^3, increasing to 10.7 ± 3.4 cm^3 after PET/MRI fusion ($p = 0.016$). SUVmax ranged from 72.0 to 206.2, with a mean of 126.9.

Conclusion(s): ^{64}Cu-DOTATATE PET/MRI fusion improved visualization and volumetric definition of head and neck paragangliomas, resulting in larger target contours for radiotherapy planning. These findings suggest enhanced tumor delineation may optimize radiation coverage while maintaining safety. Further prospective studies are warranted to confirm its clinical utility and long-term impact on tumor control and patient outcomes.