

# Personalized Dosimetry Based Peptide Receptor Radionuclide Therapy for Neuroendocrine Tumors with $^{90}\text{Y}$ -DOTATOC

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**Background:** Peptide Receptor Radionuclide Therapy (PRRT) with  $^{90}\text{Y}$ -DOTATOC is typically administered with a fixed-dosage approach. However, personalized dosimetry can guide the amount of administered activity to maximize tumor dose while not exceeding toxic levels to the kidneys. The goal of this study is to evaluate the feasibility and impact of dosimetry-based adaptive approach in determination of the administered activity of  $^{90}\text{Y}$ -DOTATOC.

**Methods:** Patients with non-resectable or metastatic neuroendocrine tumors are enrolled in a prospective clinical trial with PRRT.  $^{90}\text{Y}$ -DOTATOC is produced in a synthesis unit (ModularLab PharmTracer, Eckert & Zeigler, Berlin, Germany) using GMP grade DOTATOC and  $^{90}\text{Y}$ -Chloride utilizing a GMP-certified cassette. Patients are treated with 3 cycles separated by 6 weeks. Adult subjects receive 4.44 GBq and pediatric patients receive 1.85 GBq/m<sup>2</sup> for the 1st cycle. Renal and blood dosimetry obtained from the 1st and 2nd cycles determine the administered activity for subsequent cycles. PET-CT is used to quantify the initial renal uptake of  $^{90}\text{Y}$ -DOTATOC. This is immediately followed by bremsstrahlung SPECT-CT, repeated at 24, 48 and 72 hours, to measure the renal residence time of  $^{90}\text{Y}$ -DOTATOC. Administered activities of  $^{90}\text{Y}$ -DOTATOC are deescalated up to 50% or escalated up to 25% constrained by a cumulative kidney threshold dose of 23 Gy and blood dose of 2 Gy.

**Results:** 18 patients were treated with at least one cycle of  $^{90}\text{Y}$ -DOTATOC. The kidney dose ranged from 0.6 to 2.7 mGy/MBq; blood dose was between 0.04 to 0.24 mGy/MBq. The administered activity was changed by more than 10% from baseline in 17 adult patients for the 2nd and/or 3rd cycle, with the activity ranging between 2.3 - 5.6 GBq. The administered activity was reduced in 6 and increased in 20 administrations.

**Conclusion:** A hybrid dosimetric approach using PET-CT and bremsstrahlung SPECT-CT allows for individualized adaptive dosage administrations for PRRT with  $^{90}\text{Y}$ -DOTATOC.