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Theme: Physics **Abstract No:. PTCOG-AO2025-ABS-0106**

Abstract Title: Evaluation of target dose robustness in carbon ion therapy treatment planning for refractory ventricular tachycardia

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Background / Aims:

- The potential utility of carbon-ion radiotherapy (CIRT) for refractory ventricular tachycardia has been reported in both clinical case studies and preclinical research[1,2,3].
- In this study, we evaluated the dosimetric robustness of treatment planning against cardiac motion in carbon ion radiotherapy (CIRT) for ventricular tachycardia and investigated appropriate margin settings and motion management strategies.

Subjects and Methods:

- Single field carbon ion beam were generated using ECG-gated contrast-enhanced CT images at end-diastole and end-systole in 15 patients, with virtual targets delineated in the apical (Target 1) and septal regions (Target 2).
- Four planning strategies were employed
    1. Conventional planning with isotropic margins of 1, 2, 3, and 5 mm around the target (ITVxmm).
    2. Robust optimization using both cardiac phases (2-phase Robust).
    3. Robust optimization incorporating setup uncertainties of 1, 2, 3, and 5 mm in all directions (Robustxmm).
    4. A reference plan without any motion or setup countermeasures (Plan_w/o).

    In total, ten treatment plans were created for each case.
- The calculated biological effective weighted dose distributions were subsequently recomputed on the opposite phase CT to evaluate changes in target coverage

Result & Discussion:

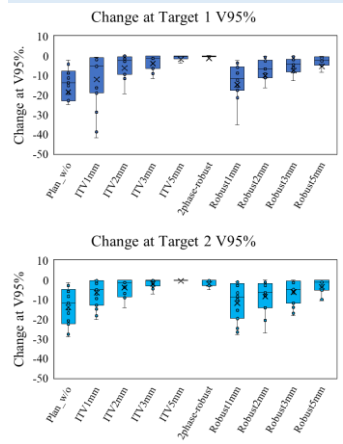

Figure 1 Variation in Target D95

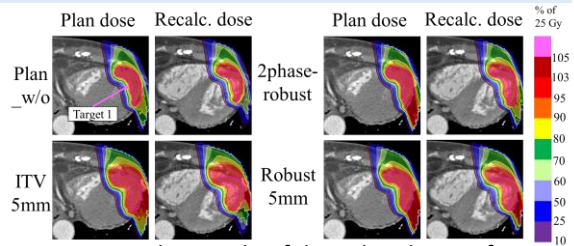

Figure 2 Typical example of dose distribution for Target 1

To limit changes in V95% to approximately 5%, treatment planning with ITV5mm, 2-phase robust, or Robust5mm was required. Assuming large positional errors led to increased OSR doses, indicating the need to balance dose delivery between the target and OARs. Considerable variation was observed in the changes in the dose coverage.

Conclusion:

- In CIRT, cardiac-induced motion of approximately 5 mm should be taken into account. Since the extent of motion varied considerably between individuals, patient-specific verification is likely necessary.

Reference:1) Amino M. et al., A.N.E.2024 , 2) Amino M. et al., Cardiovasc. Res. 2006
3) Amino M. et al., Am J Physiol Heart Circ Physiol. 2010