A Treatment Planning Study for Linac Based Stereotactic Arrhythmia Radioablation (STAR) of Ventricular Tachycardia

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Objectives: The first StTereotactic Arrhythmia Radioablation (STAR) was recently introduced for ventricular tachycardia (VT). With precise high-dose of radiation to a well define target, STAR could become more than an option in the next future. The first STAR treatment in our department was delivered in September 2019, thus in the present analysis different possible treatment delivery for STAR, were compared.

Methods: The anatomy and target volume of the first treated patient were used for this study. A dose of 25 Gy in one fraction was prescribed to the planning target volume (PTV). Linac-based Treatment plans were generated with 6-MV flattening filter free (FFF) beam. First, different plans, in terms of number, lenght arcs and couch rotations, were compared, to chose the best one.
Secondly, from best plan, other 4 treatment plans were generated and optimized to have a prescription isodose line between 63% to 75% (corresponding to dose heterogeneity of 158% and 133%) and with 10FFF . All plans were optimized to be conformal to the PTV and meet dose constraints to the organ at risk. The plans were compared by prescription isodose line, plan conformity index, as well as dose to the healthy heart. To assess the delivery efficiency, planned monitor units (MU) and estimated treatment time were evaluated.

Results: Firstly, Plans #1-4 delivered 25 Gy to the PTV to 75% isodose lines, 6MV FFF approach with several geometry (number of arcs, couch and collimator angle) were generated and compared. The PTV coverage ranged from 96- to 98.5%; with a mean cardiac dose from 4.9 to 5.2Gy. MUs for plans #1-4 ranged from 7300 to 8541 for an estimated beam-delivery-time of 5.5, 5; 6 and 7 minutes, respectively.
Secondly, from Plan#1, other 4 plans with 10FFF approach and plans prescribed to 70, 72 and 63 isodose lines, were optimized. The PTV coverage ranged from 96- to 98.6%; with a mean cardiac dose from 4.9-5.2Gy, and MU from 6269 to 9394. CI ranged from 0.96-0.98. The total beam-delivery-time ranged from 3 to 7 minutes.

Conclusions: Clinically acceptable plans were created with Linac-based stereotactic approach. All plans were considerably more efficient in terms of target coverage, sparing of healthy heart, MU and delivery time. The 10FFF approach was faster but it can not considered for all patients, due to the presence of ICD.