

## Linac-Based STereotactic Arrhythmia Radioablation (STAR) for Atrial Fibrillation: Preliminary Evaluations

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### Abstract

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## Abstract

**Objective:** Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia, occurring in 1-2% of the general population. Current European guidelines recommend catheter ablation of AF in symptomatic patients, refractory to antiarrhythmic therapy. Pulmonary veins (PVs) isolation remains the cornerstone of any ablation procedure. Recently, stereotactic arrhythmia radioablation (STAR) was used to treat, safely and effectively, ventricular arrhythmias. Based on the latter background, the aim of this exploratory prospective phase II study (NCT04575662) will be to investigate the feasibility of Linac-based STAR for the treatment of paroxysmal AF in elderly patients.

**Methods:** The inclusion criteria are age > 70 years, symptomatic AF, antiarrhythmic drugs intolerance or non-response to antiarrhythmic drugs. A sample size of 20 patients is planned to complete trial. All patients undergo to treatment simulation 4D CT with 1 mm slice thickness. The target volume is identified in the area around PVs and named as clinical target volume (CTV). Main Organs at Risks (OaRs) are esophagus and main bronchus. Internal target volume (ITV) and OaRs planning risk volume (PRV) are created to compensate heart and respiratory movement. Considering OaRs constraints and target motion, the planning target volume (PTV) is defined adding 0-3 mm to the ITV in all directions, excluding the overlap area with OaRs PRV, where PTV is cropped. STAR treatment is performed in order to obtain PVs electrical isolation with FFF-VMAT technique in free-breathing for a dose of 25Gy (single fraction) prescribed to the PTV. A "cold boost" is realized to the interface between PTV-OaRs PRV at 15 Gy to ensure the tolerability of esophagus (D max in 1 fraction 15.4 Gy). Image guided Radiotherapy and Surface guided RT were used during treatment for monitoring inter-intra fraction motion.

**Results:** From May to September 2021, 4 patients were enrolled and planned in the trial and 3 underwent to STAR treatment. The median CTV, ITV and PTV volumes were, respectively, 13 cc, 22 cc and 40 cc. A median of isotropic margin of 3mm was applied between ITV-PTV. To obtain a PRV for esophagus a median of anisotropic margin was applied (4 mm in all directions excluding latero-lateral projection where 1 cm was used to compensate also the esophageal dislocation due to peristalsis movements); for main bronchus, a median of 4 mm isotropic margin was used. The prescription dose was 25Gy/1fx at isodose of 80%, with D98% of 20 Gy and D2% 33 Gy. The treatment was delivered using 10X-FFF VMAT 3 coplanar arcs. The maximum dose to the esophagus, left and right bronchus PRV were, respectively, 14.4, 15.4 and 7.2 Gy. The mean dose to heart minus PTV was 6 Gy. All patients completed the planned STAR in 3 minutes. After a median follow-up of 3 months, No acute side effects were reported and absence of AF. No antiarrhythmic drugs were used.

**Conclusion:** STAR is an advanced form of radiation therapy tailored to treat heart arrhythmia. This is the first worldwide experience in Linac-based STAR for AF, which reported for the first 3 patients the safety of the procedure in elderly patients. Surely the role in AF treatment in terms of efficacy will be evaluated.