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**PRECISION RADIOABLATION FOR REFRACTORY VENTRICULAR TACHYCARDIA:
REDEFINING NONINVASIVE CARDIAC THERAPY**

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Stereotactic Arrhythmia Radioablation (STAR) is rapidly becoming the primary treatment non-invasive therapeutic option for management of refractory ventricular tachycardia (VT); it's a life threatening arrhythmia which is related to increased morbidity and risk of sudden cardiac death. Though all advancements in traditional therapeutical methods available including antiarrhythmic drugs, implantable cardioverter defibrillators (ICDs), and catheter ablation many patients continue to experience repeated arrhythmic episodes, indicating an unmet regular clinical need (van der Ree et al., 2020). STAR represents a turning point by extending the usage of stereotactic body radiotherapy (SBRT) apart from being the primary treatment method for cancer to accurately target arrhythmogenic myocardial substrates non-invasively.

This literature analysis explores the success rate, safety, mechanistic basis, and technical considerations of STAR, with particular emphasis on motion management, optimization of dosages, and existing research gaps. The method involves the usage of higher dosage of ionizing radiation most commonly 25 Gy at once to arrhythmogenic myocardial regions identified through electrocardiographic imaging (ECGI), electroanatomical mapping, and advanced imaging modalities; such as cardiac magnetic resonance imaging and computed tomography (MasoudKabir et al., 2023). Treatment is delivered using linear accelerator based systems, using advanced motion compensation strategies, including respiratory gating and real time tracking, to address the challenges posed by continuous cardiac and respiratory motion.

Recent findings show a significant clinical success rate, with reductions in VT burden of approximately 75–90%, and up to 90–99% in highly selected patient populations (Miszczyk et al., 2025). These improvements are accompanied by lowering the number of ICD interventions, with a concomitant improvement in quality of life and a fast onset of actions occurring within days to weeks. Notably, improving mechanistic insights challenge the traditional view of radiation induced fibrosis as the primary mode of action. Instead, STAR appears to induce early electrophysiological remodeling, characterized by upregulation of connexin-43 and increased number of voltage gated sodium channels, resulting in improved conduction velocity and disruption of re-entry circuits (Guarracini et al., 2023). This suggests that STAR functions not merely as an ablative modality, but as a form of targeted electrophysiological reprogramming.

STAR has shown a favorable short-term safety profile, with a low rate of significant toxicity and mainly mild adverse reactions. There are uncertainties about potential for delayed side effects due to radiation damage, particularly radiation induced heart problems. Target accuracy in delineation and having an effective management of dynamic cardiac and respiratory motion remains critical. Real time visualization and precision targeting, potentially enhancing therapeutic outcomes are promising advancements of emerging technologies such as MRI guided radiotherapy.

Despite these promising results, the existing research still remains limited to small samples, differences in study design, and a lack of uniform treatment protocols for treatment administration. Moreover criteria for patient selection, dose fractionation strategies, biological mechanisms behind therapeutic effects have not been fully elaborated.

In conclusion, STAR is an innovative technique that can have a revolutionary impact on the fields of cardiology and radiation therapy, presenting a promising treatment alternative as a non-invasive option for patients with no other therapies that could produce positive results. Future researchers need to address issues such as long term patient outcomes through large scale studies, clinical efficacy to confirm the technique's status as a proven treatment method.