Comparison of prevalence and mechanism between Right ventricular apical pacing and Non-right ventricular apical pacing induced tricuspid regurgitation: Insight from 3D echocardiography

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Introduction: Permanent pacemaker (PPM) implantation has been increasing in recent years due to the increased life expectancy of the population and better detection of arrhythmia by advanced monitoring. Tricuspid regurgitation (TR) is a known complication from PPM implantation and the prevalence is up to 39%.\(^1\)\(^2\) One of the proposed mechanisms of PPM induced TR is due to endocardial lead interference with the tricuspid valve (TV).\(^4\) Conventional 2-dimensional echocardiography (2DE) has limitations in identifying the relationship between lead and the TV leaflets and thus cannot accurately evaluate the mechanism of lead-induced TR.\(^4\) The advent of 3-dimensional echocardiography (3DE) enables detailed enface visualization of the TV and studies have confirmed that this imaging modality can delineate the lead route and position at the TV in relation to lead-induced TR.\(^2\)\(^5\)\(^6\) Endocardial lead for PPM is usually placed at the right ventricular apex (RVA) and Non-RVA (including RV septal or RV outflow tract). Studies have suggested that Non-RVA pacing is more physiological than RVA pacing, although data are conflicting.\(^7\)\(^8\)\(^9\) Nonetheless, the degree of lead-induced TR and the lead position at the TV between RVA and Non-RVA pacing received less attention. The present study aimed to compare the prevalence of TR and the lead-leaflet relation using 3DE in patients with RVA and Non-RVA pacing.

Methods: Conventional echocardiography performed in 458 patients after pacemaker implantation. In addition, 284 patients with pre-pacemaker implantation echocardiography available were included to evaluate the development of significant TR prospectively.

Result: RVA pacing patients had a higher frequency of significant TR (degree>=2) compared to Non-RVA pacing (63% vs. 42%, p-value <0.01). For RVA pacing, the lead was more likely to be positioned at the anterior, posterior and septal compared to Non-RVA pacing (51% vs 33%, p-value <0.01). Importantly, leads were more likely to be positioned in the central portion with Non-RVA pacing compared to RVA pacing (30% vs. 13%, p-value <0.01). Among 284 patients with pre- & post-implantation Echocardiography, RVA pacing is associated with the development of significant TR compared to Non-RVA pacing (59% vs 41%, P=0.012). Further, the conditions of male patients were better than female patients (p<0.05).

Conclusion: The study demonstrates that RVA pacing is more likely to develop significant TR compared to Non-RVA pacing. Significantly, this study is the first to demonstrate that lead impingement is one of the possible mechanisms that could explain the higher frequency of TR in RVA pacing compared to Non-RVA pacing by 3DE.