Right ventricular angiography in permanent pacemaker implantation and in management of cardiac perforations

Impact of the research

The research on RVMS pacing holds significant relevance and potential contributions to cardiac pacing and patient care. Establishing RVMS pacing as a viable alternative to traditional RVA pacing offers a more physiological approach to ventricular activation and reduces complications such as RV perforations. RVMS pacing has important implications for improving patient outcomes by reducing the incidence of pacing-induced cardiomyopathy and heart failure.

Achieving accurate and reproducible placement of the mid-septal lead is crucial to predict the optimal physiological response to RVMS pacing. Traditional imaging methods, such as fluoroscopy and echocardiography, have limitations in precisely localizing the RVMS. This thesis shows that contrast angiography provides a high-resolution roadmap for lead manipulation. Moreover, it offers immediate availability and can be performed in any catheterization laboratory. Other advantages of using contrast angiography while performing RVMS pacing include accurate lead positioning, reduced reliance on fluoroscopy and ECG vectors, and enhanced localization of septal leads, particularly in patients with complex congenital heart disease or distorted anatomy. Furthermore, developing specialized tools, such as pre-shaped sheaths and stylets, can enhance the accuracy and consistency of mid-septal lead implantation, benefiting the patients and implanting physicians alike.

The research also highlights the role of contrast angiography in guiding RVMS lead placement. It offers a practical and readily available method for precise localization of mid-septal lead position. It is vital in patients with abnormal and distorted right ventricular anatomy and with complex congenital heart disease. Using contrast angiography, we have demonstrated that it is possible to successfully perform mid-septal pacing in various operated and unoperated congenital heart diseases. We have shown favorable outcomes with angiography-guided mid-septal pacing in patients with congenital heart diseases. Therefore, contrast angiography should be encouraged, especially in challenging anatomical situations, to overcome the limitations of traditional imaging techniques.

The research results are relevant to various target groups within the medical community. Pacemaker implantations performed by electrophysiologists with intimate knowledge of the anatomy, physiology, and outcomes of non-physiological RV pacing would perform conduction system pacing. However, a vast majority of pacemaker implantations worldwide are performed by non-electrophysiologists. Physicians who perform pacemaker implantations can benefit from the findings of this thesis for incorporating RVMS pacing into their practice. Training programs for electrophysiology fellows and cardiology residents can integrate the technique described in the research to broaden the number of implanters proficient in RVMS pacing. Additionally, patients undergoing permanent pacemaker implantation, especially those with complex congenital heart

disease or anatomical distortions, stand to gain from the improved outcomes associated with RVMS pacing. Training more physicians in RVMS pacing could reduce the incidence of pacing-induced cardiomyopathy and heart failure, ultimately benefiting the patients receiving pacemakers.

Future efforts should focus on advancing and implementing the present research findings. These include developing specialized tools, such as pre-shaped sheaths and stylets, through collaboration with physicians, engineers, and industry. At present, there are no specific tools for RVMS lead implantation. Recent studies have reported the repurposed use of 3-dimensional sheaths used for conduction system pacing for accurate placement of leads in the RVMS (1–3). Specialized tools would facilitate consistent and precise lead delivery to the RVMS, improving the reliability and ease of mid-septal lead implantation.

Further studies are needed comparing accurate RVMS pacing using specific tools with RVA pacing in patients requiring a high percentage of RV pacing (>40%). These studies should incorporate image-guided lead implantation with RV contrast injection and anatomical verification using computed tomography (CT). Long-term multi-center randomized clinical trials are also necessary to evaluate the impact of RVMS pacing on physiologically derived endpoints (e.g., ejection fraction and synchronicity indices) and hard clinical endpoints (e.g., exercise capacity, left ventricular function, heart failure, and quality of life).

References

1. Yamagata K, Ishibashi K, Wakamiya A, Shimamoto K, Ueda N, Kamakura T, et al. Comparison Between Septal Pacing With the Catheter Delivery System and Apical Pacing With the Stylet Delivery System for Ventricular Lead Placement: A Randomized Controlled Trial. Circ Arrhythm Electrophysiol. 2021;14(11):e010362.
2. Morita J, Kondo Y, Morita Y, Kitai T, Fujita T. Impact of optimal septal pacing with a novel catheter delivery system. Heart Rhythm O2. 2022;3(4):393–5.
3. Morita Y, Morita J, Kondo Y, Kitai T, Fujita T, Tanabe K. Septal pacing using an inner guiding catheter without an outer sheath: A case series. Heart Case Reports. 2022;8(3):214–6.