Cardiac Imaging in Electrophysiology — Routine or Science Fiction?

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Recent progresses in imaging and computer technologies stimulated an impressive development in many medical fields. Among them, electrophysiology (EP) is currently one of the fastest developing fields, a significant number of new techniques and tools being launched every year in the market of EP products. New methodologies have been developed to record intracardiac electrophysiology signals and to treat cardiac arrhythmia, well-known examples being represented by 3D applications of intracardiac navigation for diagnosis and treatment of rhythm or conduction disturbances.

Taking into consideration the 3D nature of different techniques for intracardiac navigation, a strong interlink has been developed throughout the years between electrophysiology and cardiac imaging. Complex procedures like CARTO or EnSite navigation are actually based on an association between 3D cardiac imaging and EP, relying on 3D imagistic representations of EP recordings. When available, intracardiac echocardiographic guidance is also used for assisting complicated CARTO ablation procedures.

For sure, due to the extreme complex spatial 3D representations associated with modern complex EP techniques, they could appear nowadays as "science fiction" for those not familiarized with the complexity of these interventions, and "science fiction" EP technology requires "science fiction" imaging techniques.

However, the connection between cardiac imaging and electrophysiology is not that recent and not always that complex. Standard echocardiographic techniques, such as routine bidimensional echocardiographic assessment, can provide reliable information, useful for electrophysiologists in the current practice and especially in the follow-up of patients with implantable devices. The role of echocardiographic assessment in following the patients treated with resynchronization therapy is well known. In this application, the echocardiographic determination of hemodynamic parameters, such as stroke volume or velocity time integral at the level of left ventricular outflow tract, are frequently used for adjusting the pacing intervals, method known as CRT echo-based optimization [1]. This method implies the adjustment of pacing parameters in different settings and the determination of stroke volume and velocity time integral (LVOT VTI) for each pacing configuration, followed by the selection of the pacing configuration that provided the highest stroke volume, highest LVOT VTI or the smallest degree of mitral regurgitation.

In the current days, the assessment of ventricular dyssynchrony in paced ventricles relies more on the use of complex echocardiographic techniques, like strain imaging, Tissue Doppler or 3D computerized representations of graphical displays of contraction amplitudes in all the 17 ventricular segments [2]. The charts obtained are generally used to monitor the response to resynchronization therapy and to adjust the pacing parameters until the contraction curves show a higher degree of synchronicity.

An article published in this issue describes the role of echocardiography in assessing the effect of different right ventricular pacing sites on left ventricular contraction synchronism and function in patients with implanted pacemakers, comparing two of the most commonly used right ventricular pacing sites: septal and apical [3].

Similarly to other studies demonstrating that apical pacing induces left ventricular dyssynchrony, which could be associated with a decrease in left ventricular ejection fraction [4], the authors conclude that septal stimulation is associated with superior results regarding intraventricular dyssynchrony. In randomized trials it has also been proved that septal stimulation is associated with superior clinical and functional outcomes, reflected by a significantly higher ejection fraction in patients with septal stimulation as compared with those with RV apical leads [5]. As also underlined by other studies, a major application of this observation could be the fact that haemodynamic echo-based parameters would be used to monitor the evolution of left ventricular function after right ventricular pacing, which could predict the response to CRT in case of device upgrade from single or dual-chamber pacing to biventricular pacing [6]. In the assessment of the effect of pacing site on ventricular synchronism and function, the authors of the current study used routine echocardiographic techniques, generally available in all the laboratories and easy to perform.

In this study the echocardiography examination was used to assess the left ventricular dyssynchrony based on parameters easily determined by M-mode echocardiography, like interventricular mechanical delay, septal to posterior wall motion delay or electro-systolic delay, showing that in the absence of more sophisticated imaging techniques, standard imaging technology can be used to assist the electrophysiologist in choosing the proper treatment and select the best pacing site of the right ventricle.

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While the cost-efficiency of "science fiction" EP-related modern imaging techniques remains to be established, this study demonstrates that "oldies but goldies" cardiac imaging techniques, like standard echocardiography, could still play a role in certain applications of modern electrophysiology.

References

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