Paced QRS morphology for confirming septal pacemaker lead implantation: correction of a misconception

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This editorial refers to ‘Radiological and electrocardiographic characterization of right ventricular outflow tract pacing’ by J.C. Balt et al., on page 1739

In keeping with Hippocrates’ oath of ‘primum non nocere’, physicians involved in pacing have been exploring alternatives to the right ventricular apex, because this site adversely affects ventricular pump function and increases events such as heart failure and atrial fibrillation. A description of the ideal pacing site may include the following characteristics: (i) it results in a physiological electrical and mechanical activation of the heart, (ii) it provides adequate electrical parameters (sensing, thresholds) to ensure proper device function, (iii) it is associated with a low risk of complications (lead dislodgment, perforation, etc.), and (iv) it is technically easy to target using standard tools and imaging techniques. The existence of such a pacing site is probably wishful thinking. His bundle pacing is conceptually attractive, but technical challenges and high capture thresholds have limited its use. Cardiac resynchronization therapy or left univentricular pacing is a promising option, but there are few data up to now regarding their use outside the setting of heart failure.

Right ventricular septal pacing, either from the mid-septum or from the right ventricular outflow tract (RVOT) septum, has been studied since a number of years. The rationale for pacing from this site is that it may provide more physiological activation of the ventricles, either by directly capturing conduction tissue (which may be unlikely due to anatomical considerations and high thresholds) or by decreasing total left ventricular activation duration. There is unequivocal evidence that septal or RVOT sites are superior to the right ventricular apex in terms of physiological pacing, and ongoing randomized studies will hopefully provide clarification.1 Electrical parameters and complication rates with septal pacing have been shown to be comparable to pacing from the apex.2 An unsolved issue is which technique should be used for placing the ventricular lead. Deflectable catheter-delivered systems1 and specially shaped styleslets3 have been proposed to facilitate selective site pacing. More importantly, there is currently no reliable way for the operator to know that the lead has effectively been delivered to the intended target site. Fluoroscopy is the universally used imaging technique that provides real-time information on the lead position during implantation. The problem is that the interventricular septum is imprecisely defined by fluoroscopy. Physicians rely upon oblique views (especially the left anterior oblique view), but this does not guarantee inadvertent positioning of the lead in an anterior position.4 This is due to the complex shape of the right ventricle that ‘wraps’ itself partly around the left ventricle. In order to confirm the septal position of the lead, the morphology of the paced QRS complexes with negativity in lead I has been advocated as a marker,5,6 despite the fact that this criterion has never been properly validated.

Balt et al.7 analysed the pattern of the paced QRS complexes in 143 patients with a pacing lead implanted in RVOT. The authors found that no single electrocardiographic (ECG) criterion (including a Qr or QS pattern in lead I) could accurately differentiate RVOT pacing sites (septal, anterior, or free wall), due to overlap between groups. The disagreement with the previous data3 that indicated a 50% sensitivity and a 100% specificity of a negative or isoelectric QRS complex in lead I may be partly explained by the lack of validation of the lead position by methods other than fluoroscopy or chest X-rays in these studies. Echocardiography would have been a simple method to confirm the lead position, and this is feasible in most patients.4

Perhaps, the most convincing evidence that refutes the claim that QRS morphology can confirm RVOT septal pacing comes from electroanatomical mapping studies that evaluated ECG criteria for localizing RVOT tachycardia. Dixit et al.8 studied 14 patients using a detailed RVOT CARTO mapping. The authors found that a negative QRS complex in lead I was observed when pacing from the RVOT anterior free wall or the RVOT anterior septum, whereas it was positive or isoelectric when pacing from...
other RVOT septal sites. In another report in 52 patients studied using NavX, Zhang et al.\textsuperscript{9} also reported that a QS complex in lead I indicated an anterior site. We reported similar findings regarding pacing of the mid-septum using NavX to validate the pacing site, namely that a negative QRS complex in lead I tended to be more frequent when pacing from the anterior wall than from the interventricular septum.\textsuperscript{10} The reason for these findings is that the anterior wall may in fact be located more leftwards than the septum, due to the orientation of the heart and the shape of the right ventricle described earlier.

How important is it to truly target the (RVOT) septum rather than the anterior wall? There is little reason to believe that pacing the anterior wall is more physiological than pacing the apex. Also, as the RVOT free wall is relatively thin, there may be risk of perforation and tamponade (which is absent when pacing from the septum). In the report by Balt et al.,\textsuperscript{7} only one-third of the patients actually had their lead placed at the RVOT septum despite the use of oblique fluoroscopic views at implantation, although the implanting physicians were not specifically required to target the septum.

In conclusion, the report by Balt et al.\textsuperscript{7} is in line with studies that have used the electroanatomical mapping of RVOT septal pacing and helps correcting the misconception that the paced ECG pattern may be used to confirm septal lead placement. Other techniques, such as reliable fluoroscopic landmarks, need to be defined to assist the implanting physician in effectively attaining the target site.

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References
1. Kaye G, Stambler BS, Yee R. Search for the optimal right ventricular pacing site: design and implementation of three randomized multicenter clinical trials. Pacing Clin Electrophysiol 2009;\textsuperscript{32}426–33.