Physiological vs. non-physiological heart pacing as assessed by Ultra-high-frequency ECG

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Background: Permanent cardiac pacing is the only available treatment for patients with symptomatic bradyarrhythmias. Although it is safe and effective in preserving heart frequency, it leads to a decline in the left ventricular ejection fraction and possible development of heart failure in some patients. The leading cause of these consequences is the dyssynchrony related to the myocardial pacing of the right ventricle.
Method: New pacing techniques, named His-Purkinje physiological pacing, were introduced and entered into clinical practice in recent years. They are His bundle pacing (HBp), left bundle branch pacing (LBBp), and left ventricular myocardial septal pacing (LVSP). Several ventricular capture types are possible in all of them, thanks to the lead placement into the location where both conductive tissue and myocytes are present. It can result in selective capture of the conductive tissue or nonselective capture of the conductive tissue with concomitant activation of the surrounding myocardium. The effect of these pacing modalities on the ventricular synchrony and pattern of depolarization was not known. We used UHF-ECG to compare the selective and nonselective HB pacing in bradycardia patients.
Results: We showed the nonselective HB pacing produces the same pattern of UHF-ECG ventricular depolarization as selective HB pacing. Next, we showed the nonselective His bundle pacing in the area below the tricuspid valve has the best interventricular synchrony from all other RV pacing locations with myocardial capture. We also compared UHF-ECG-derived parameters of ventricular depolarization during HBp, LBBp, and LVSP. We showed that both pacing types from the left septal area are less physiological than nsHBp.
Conclusion: UHF-ECG is an effective tool that can be used in clinical practice to assess the electrical dyssynchrony caused by cardiac pacing. Furthermore, its real-time implementation allows recognizing between physiological vs. non-physiological pacing during an implant procedure.