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Case Report

Catheter Ablation of Idiopathic Ventricular Arrhythmias Originating from the Para-Hisian area – QRS Morphology Change and Late Effect of the Ablation: Case Series

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Abstract

Introduction: Radiofrequency catheter ablation of idiopathic ventricular arrhythmias originating in the para-Hisian region could be challenging because of a potential risk of iatrogenic atrioventricular block. Uncommonly, shift of the exit site during the ablation can be observed. Consequently, different approaches of radiofrequency catheter ablation of para-Hisian ventricular foci can be needed.

Case series presentation: Three patients (2 males) underwent electroanatomical mapping and catheter ablation for idiopathic premature ventricular contractions originating near the His bundle. Patients underwent 24-h ECG Holter monitoring during follow-up. All patients had premature ventricular contractions with left bundle branch block morphology and inferior or horizontal axis. However, change of QRS morphology during ablation was observed, due to a change in the exit site. In two patients there was reduction of the arrhythmia burden after initially unsuccessful procedure. Mapping and ablation in the aortic root were needed in one patient. There were no complications.

Discussion: Radiofrequency catheter ablation of para-Hisian ventricular arrhythmias is feasible and safe when performed cautiously. A change in the premature ventricular contractions' morphology and exit site during ablation may ensue; therefore, extensive mapping on both sides of the interventricular septum as well as in the aortic root may be warranted.

Keywords

catheter ablation, bundle of His, para-Hisian, premature ventricular contractions

INTRODUCTION

Idiopathic ventricular arrhythmias (VAs) commonly present as symptomatic and drug-resistant ventricular ectopy or tachycardia and may cause a reduction of the left ventricular function.[1] A few studies have demonstrated idiopathic VAs arising near the His bundle, which represented 3–9% of all idiopathic Vas.[2-5] Ablation in this highly complex region could be challenging due to the potential risk of damage to the conduction system of the heart.[6] The aim of this study was to show the relatively uncommon phenomenon of shift of the exit site and corresponding change of the QRS morphology during catheter ablation (CA), different CA approaches and short- and long-term results of radiofrequency (RF) CA of para-Hisian VAs.

MATERIALS AND METHODS

Three patients (2 males), aged 50 to 78 years, underwent CA for idiopathic para-HisianVAs between March 2017 and November 2018. After obtaining written informed consent, an electrophysiological study was performed with an 8-pole diagnostic catheter placed in the coronary sinus for positional reference and an open-irrigated ablation catheter (CoolFlex, Abbott), placed in the right ventricle (RV) via long steerable introducer (Agilis, Abbott). Electroanatomic activation mapping (EnSite Precision, Abbott) was performed in all cases to identify the earliest site of ventricular activation during the premature ventricular contractions (PVCs) as previously described.[7,8] All patients had a post-procedural surface ECG and 24-h Holter ECG monitoring during follow-up.

RESULTS

Patient 1 is a 78-year-old man with ischemic heart disease, arterial hypertension, diabetes mellitus, sigmoid resection for cancer and anemia. He was admitted for symptomatic frequent monomorphic PVCs (PVCs burden – 21% on 24-h Holter ECG recording) with left bundle branch block (LBBB) morphology, horizontal axis and precordial transition at leads V_{3-4} (**Fig. 1A**). Echocardiography demonstrated normal left ventricular function. The earliest ventricular activation was identified at the septal RV wall near the tricuspid annulus just beneath the His bundle (**Fig. 1B**). After application of RF energy in this area, slightly different morphology of the PVCs (**Fig. 1C**) appeared. On the second activation map the earliest activation was identified closer to His bundle and tricuspid annulus (**Fig. 1D**). The PVCs suddenly disappeared when RF energy was delivered in close proximity to the His bundle, with His bundle potential recorded on the proximal dipole of the ablation catheter. The RF energy application was terminated when junctional ectopic beats signalling impending risk of atrioventricular (AV) block were observed. Unfortunately, the PVCs reappeared soon after RF application was halted. The procedure was stopped due to high risk of iatrogenic AV block. On the follow-up 24-h Holter ECG ventricular bigeminy and trigeminy (PVCs burden – 36%) with the same morphology was registered. On a second ablation attempt, decrease of the ectopic activity was achieved without AV conduction disturbances. Holter ECG on the first and the twentieth month after the second procedure revealed substantial reduction of the PVCs burden down to 4%.

Patient 2 is a 50-year-old female with symptomatic monomorphic PVCs (PVCs burden – 30%) with LBBB morphology, inferior axis and precordial transition at lead V4 **(Fig. 2A)**. Earliest ventricular activation was identified in the His bundle area **(Fig. 2B)**, where small far-field His bundle potential was recorded. RF ablation in this region abolished clinical PVCs, but slow ventricular tachycardia with slightly different morphology **(Fig. 2C)** appeared. Ac-

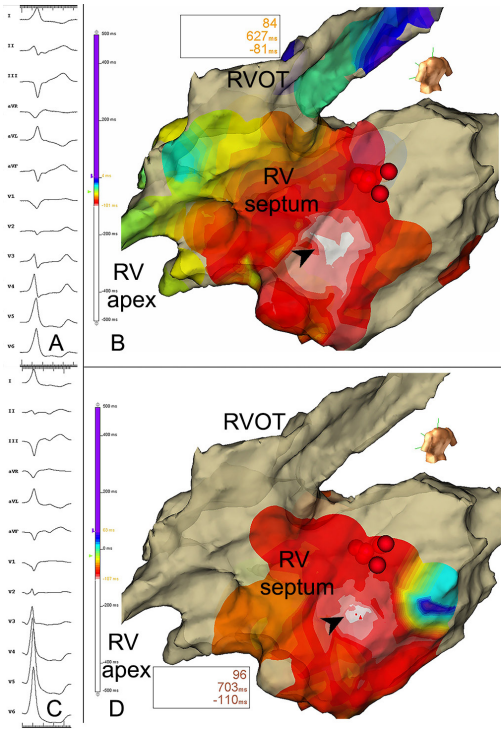

Figure 1. Patient 1. Standard 12-lead surface ECG (75 mm/s) of PVCs before (A) and after a few RF applications (C) and corresponding electroanatomic activation maps in right posterior oblique view respectively before (B) and after change in the exit site (D). The exit site on panel D had moved mainly posteriorly, which is reflected in an earlier precordial transition and almost no change of the frontal axis. The black arrowhead points to the earliest ventricular activation. The His bundle is marked with red spheres. RVOT: right ventricular outflow tract, RV: right ventricle.

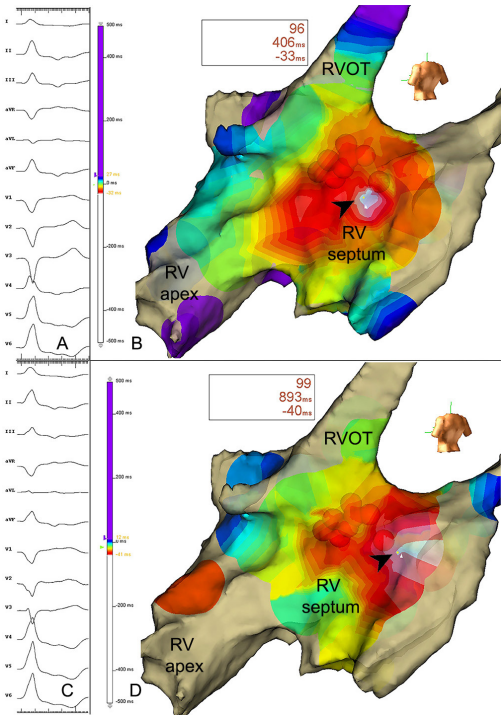

Figure 2. Patient 2. Note again the subtle change of the precordial transition after the ablation. Abbreviations are as in **Fig. 1**.

tivation mapping recorded earliest activation directly on the proximal His bindle **(Fig. 2D)** with large-amplitude retrograde His bundle potential. Few minutes later the tachycardia stopped without any intervention and did not reappear. During the first month of follow-up, the patient was asymptomatic without PVCs.

Patient 3 is a 78-year-old male with arterial hypertension admitted for asymptomatic monomorphic PVCs (PVCs burden – 21%) with LBBB morphology, inferior axis and precordial transition at lead V3 **(Fig. 3A)**. Echocardiography demonstrated structurally normal heart with reduced left ventricular function. Earliest ventricular activation was visualized at mid-septal RV near the His bundle **(Fig. 3B)**. After the initial ablation, a slight change in the PVCs morphology **(Fig. 3C)** was observed. New earliest site was identified more anteriorly and basally to tricuspid annulus, closer to His bundle **(Fig. 3D)**. RF application at this site again changed the morphology of the PVCs **(Fig. 3E)**. The new activation map demonstrated earliest site directly on the His bindle **(Fig. 3F)**. RF application in this area seemed to bear unacceptably high risk of AV block, so the ablation approach was changed. Aortic root was mapped retrogradely. The local PVCs activation time within the right coronary and non-coronary sinus of Valsalva preceded the QRS onset by 38 msec. Furthermore, in the non-coronary sinus small-amplitude His bundle potential was recorded and PVCs disappeared when RF delivery was performed at that site **(Fig. 3F)**. When junctional ectopic beats were observed the RF energy application was halted and soon after that the PVCs reappeared. The procedure was stopped due to high risk of iatrogenic AV block. A 24-h Holter ECG monitoring immediately following the procedure showed sudden disappearance of the PVCs three hours after the procedure till the end of the recording. One month post ablation there were only 373 (0.004%) PVCs for 24 hours.

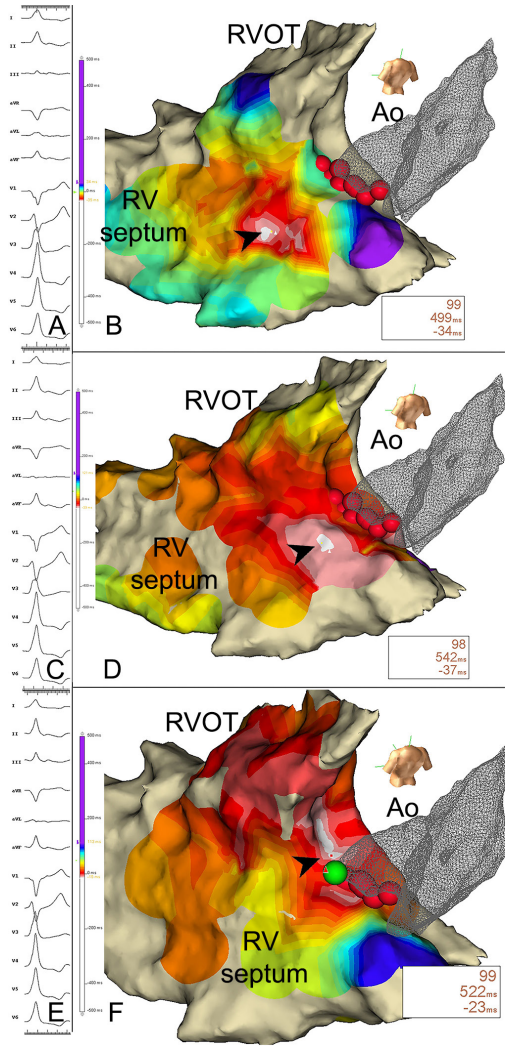

Figure 3. Patient 3. The exit site moved mainly upwards (panels D and F) and this resulted in a change of the frontal axis to more inferiorly directed (panels C and E). Panel F shows the final electroanatomic activation map during the ablation, with part of the red spheres hidden to visualize the earliest site coincident with the His bundle. The aorta (Ao) is shown as a grey mesh-like structure. The green sphere marks successful ablation site within the right coronary sinus overlying the His bundle. Other abbreviations are as in **Fig. 1**.

DISCUSSION

This case series demonstrated that para-Hisian PVCs could be successfully eliminated by RF ablation without causing any impairment to the AV conduction. Furthermore, change in the PVCs morphology and the exit site during the ablation of para-Hisian ectopic foci was revealed. In all patients, ECG showed LBBB morphology with inferior or horizontal axis, an R-wave in lead I, QS-wave in lead aVR, aVR-aVL polarity reversal and in the first case there was inferior leads discordance (positive/negative), all of which are specific for para-Hisian region.[4,6,9,10] After a few RF applications, slight changes in PVCs morphology and exit site were observed and additional ablation at the new earliest site was needed. Similar findings were reported by other authors.[4,11-13] It may be caused by exit block from the arrhythmia focus, another exit site or a different focus. The myocardial network around the ventricular outflow tracts septum is complex, so a single VA focus with preferential conduction to multiple exit sites may result in different QRS morphologies after ablation.[14] Moreover, mapping and ablation in the right and non-coronary sinus of Valsalva may be needed for para-Hisian PVCs[3,5], as it was shown in the third case where it was necessary to minimize the potential risk of injuring the proximal His bundle. However, acute success could not always be achieved safely, so it seemed better to stop the procedure and wait for a late effect of the ablation. In two of the cases presented, significant reduction of PVCs burden was documented subsequent to initially unsuccessful ablation attempt. In their series Baser et al.[15] showed that in 70% of the patients in whom a procedural failure was suggested, the PVC burden was substantially reduced at the 3-month follow-up. This could be related to the progressive changes seen in the evo-

lution of an RF lesion within two months of the ablation. The lesion shows fibrosis, granulation tissue and chronic inflammatory infiltrates which are typical of healing after any acute injury.[16]

CONCLUSIONS

Radiofrequency catheter ablation of para-Hisian ventricular arrhythmias is feasible and safe when performed cautiously. However, sometimes it is probably better to stop and wait for a late effect of the ablation, instead of putting the patient at risk of potentially severe and irreversible conduction disturbances. Not uncommonly, there is a change in the PVCs morphology and the exit site during the ablation, so an approach with extensive mapping on both sides of the interventricular septum as well as in the aortic root may be warranted.

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Катетерная абляция при идиопатических желудочковых аритмиях, возникающих в парагисиальной области - изменение морфологии QRS и поздний эффект абляции: серия клинических случаев

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Абстракт

Введение: Радиочастотная катетерная абляция желудочковых аритмий, возникающих в парагисиальной области, может быть сложной из-за потенциального риска ятрогенной атриовентрикулярной блокады. Редко наблюдается сдвиг в базовой линии абляции. Впоследствии могут потребоваться различные подходы к радиочастотной катетерной абляции парагисиальных желудочковых очагов.

Представление серии клинических случаев: Трём пациентам (2 мужчин) провели электроанатомическое картирование и катетерную аблацию для идиопатических преждевременных сокращений желудочков, происходящих в пучке Гиса. Пациенты подвергались 24-часовому мониторированию холтеровского ЭКГ во время контроля. У всех пациентов были преждевременные сокращения желудочков с морфологией блока левого бедра и нижней или горизонтальной осью. Однако изменения морфологии QRS наблюдались во время абляции из-за изменения базовой линии. У двух пациентов было снижение аритмии после первоначально неудачной процедуры. Картирование и удаление корня аорты потребовались одному пациенту. Не возникло никаких осложнений.

Обсуждение: Радиочастотная катетерная аблация парагисиальной внутрисосудистой аритмии возможна и безопасна при тщательном выполнении. Могут возникнуть изменения в морфологии преждевременных сокращений желудочков и в начальной точке во время абляции, и может быть оправдано обширное картирование с обеих сторон желудочкового барьера, а также корня аорты.

Ключевые слова

парагисиальный, пучок Гиса, преждевременные сокращения камеры, катетерная абляция