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ORIGINAL ARTICLE

Relationship between rotors and complex fractionated electrograms in atrial fibrillation using a novel computational analysis

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KEYWORDS
Atrial fibrillation;
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Abstract
Introduction: Rotors and complex fractionated atrial electrograms (CFAEs) have been suggested as possible therapeutic targets in ablation of atrial fibrillation (AF). The aim of this study was to assess the relationship between rotors and CFAEs in patients with AF.
Methods: We studied 18 patients with AF (mean age 69±8 years, 33% female) who underwent rotor ablation and pulmonary vein isolation. Endocardial mapping was performed with a basket catheter to identify the presence, number and location of rotors and CFAEs. The FIRM™ (Abbott) and CARTO™ (Biosense) systems were used with overlapping of frames from continuous 30-s recordings. CFAEs were classified as stable if present in >15 frames, moderately stable if present in 10-15 frames and unstable if present in 5-9 frames.
Results: A total of 44 rotors and 60 CFAEs (39 of them stable) were identified. The mean number of rotors and stable CFAEs per patient was 2.6±1.4 and 2.2±1.5, respectively. In 27 of the 44 identified rotors, CFAEs were found in the same location. Conversely, in 20 of the 39 stable CFAEs identified, a focal rotor was found in the same location. The majority of CFAEs found at the same location as a focal rotor were stable (63% vs. 37%, p=0.001).
Conclusion: Rotors and CFAEs are frequently found in the same location within the atria, particularly when only stable CFAEs are considered. This relationship may have implications in the selection of substrate targets for ablation.

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PALAVRAS-CHAVE
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Eletrogramas potenciais complexos fraccionados;
Eletrogramas potenciais complexos fraccionados estáveis

Relação entre rotores e eletrogramas complexos fracionados na fibrilhação auricular utilizando uma análise computacional inovadora

Resumo
Introdução: Os rotores e potenciais complexos fracionados (CFAE) têm sido apontados como possíveis alvos terapêuticos na ablação de fibrilhação auricular (FA). O objetivo deste estudo foi avaliar a relação entre CFAE e rotores em doentes com FA.
Métodos: Foram estudados 18 doentes com FA (idade média 69 ± 8, 33% mulheres) submetidos a ablação de rotores e isolamento das veias pulmonares. Efetuou-se mapeamento endocárdico com cateter *basket* para identificação da presença, número e localização de rotores e CFAEs. Foram utilizados os sistemas FIRM (Abbott) e CARTO (Biosense) com sobreposição de *frames* obtidos a partir de registos contínuos de 30 segundos. Os CFAEs foram classificados em estáveis se presentes em > 15 frames, moderadamente estáveis se presentes em 10-15 *frames* e pouco estáveis se presentes em 5-9 frames.
Resultados: Foram identificados 44 rotores e 60 CFAEs, dos quais 39 eram CFAE estáveis. O número médio de rotores e CFAE estáveis por doente foi de 2,6 ± 1,4 e 2,2 ± 1,5, respetivamente. Em 27 dos 44 rotores identificados, encontraram-se CFAEs na mesma localização. Por outro lado, em 20 dos 39 CFAE estáveis identificados, foi encontrado um rotor na mesma localização. A maioria dos CFAEs encontrados na mesma localização dos rotores eram CFAE estáveis (63% *versus* 37%, p = 0.001).
Conclusões: Os rotors e CFAEs são frequentemente encontrados na mesma localização a nível auricular, especialmente se apenas se considerarem os CFAEs estáveis. Esta relação poderá vir a ter implicações na seleção do substrato arritmogénico passível de ablação.

Introduction

Pulmonary vein isolation (PVI) is the cornerstone therapy for atrial fibrillation (AF) ablation. However, in patients with non-paroxysmal AF and/or significant left atrial dilatation, results are often suboptimal and the best treatment strategy remains uncertain.[1]

In order to achieve lasting elimination of AF, many centers have suggested additional substrate ablation, particularly additional linear lesions or ablation of complex fractionated atrial electrograms (CFAEs).[2,3] This approach has been questioned in a recent trial,[4] but the failure of CFAE ablation to improve outcomes may in part be due to the shortcomings of current mapping algorithms, including limited temporal and spatial sampling.

Several studies have also reported the presence of focal rotors near or distant from pulmonary vein isolation sites. There is some evidence that ablation of this substrate could likewise increase AF-free survival.[5] Although rotors and CFAEs have been suggested as possible therapeutic targets, their relationship and importance in the maintenance of AF remain to be established. The aim of this study was to assess the relationship between focal rotors and CFAEs in patients with AF, using a new four-dimensional (4D) electroanatomical mapping method to identify stable CFAEs.

Methods

Population

Eighteen consecutive patients undergoing AF ablation using the FIRM (Abbott, Menlo Park, CA) and CARTO (Biosense Webster, Diamond Bar, CA) electroanatomic mapping systems were included (Figure 1). Patients with severe valvular disease, mechanical prostheses or contraindication for anticoagulation were excluded. The study protocol was approved by the Board of Directors of CHLO. Informed consent to participate in the study was obtained from all patients.

Electrophysiology procedure

Before the procedure, patients underwent computed tomographic imaging or transesophageal echocardiography to exclude left atrial thrombus. Conscious sedation was used in all patients. Vascular access was obtained via the femoral veins with two SL1 sheaths (St. Jude Medical, Minneapolis, MN) and a decapolar catheter within the coronary sinus. Transseptal puncture was performed under fluoroscopic guidance and intravenous heparin was infused to maintain activated clotting time >350 s. An anatomical map of the right atrium, left atrium and pulmonary veins was created using the CARTO system (Biosense Webster, Diamond Bar, CA) with a circular mapping catheter (Lasso, Biosense Webster, Diamond Bar, CA). A 64-pole basket catheter (FIRMap® Catheter, Abbott, Menlo Park, CA) was advanced through an 8.5 mm SL1 sheath and deployed first in the right atrium and then in the left atrium.

In patients in sinus rhythm, AF was induced by pacing the atria at a cycle length of 500 ms reduced in 50 ms steps to 300 ms, and then in 10 ms steps.

Computational AF maps were generated using the FIRM system (Abbott, Menlo Park, CA) and electrical