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The change of the coronary sinus activation sequence during radiofrequency ablation of cavotricuspid isthmus

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Abstract

Typical atrial flutter (AFL) is one of the most common heart rhythm disorders appearing in clinical practice. According to the current guidelines, the recommended treatment method is percutaneous ablation. This procedure aims to obtain a permanent bidirectional conduction block in the cavotricuspid isthmus (CTI).

This report presents a patient with ongoing typical AFL referred to the radiofrequency (RF) ablation. During the RF applications on CTI, the change of coronary sinus activation sequence and prolongation of tachycardia cycle length was observed. Its occurrence is a rare phenomenon and may suggest a change in the course of the macro-re-entry arrhythmia loop.

Key words: typical atrial flutter, radiofrequency energy, catheter ablation

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Introduction

Typical atrial flutter (AFL) is one of the most common heart rhythm disorders appearing in clinical practice. The prevalence of this arrhythmia increases with age, ranging from 5/100,000 in patients under 50 years old to more than 500/100,000 in patients over 80 years old [1]. Diagnostic criteria for atrial flutter include saw-toothed F waves in the inferior leads of standard 12-leads electrocardiogram (II, III, aVF) and the lack of isoelectric line in limb leads. The frequency of atrial activation is usually above 250 beats per minute (bpm) with typically regular and slower ventricle frequency [2]. The initial efficacy of ablation in cavotricuspid isthmus (CTI) dependent AFL comes up to 95% making this procedure the most effective therapy for maintaining sinus rhythm [3, 4]. Ablation is recommended in symptomatic, recurrent episodes of CTI dependent AFL and should be considered after the first symptomatic episode [5].

Case report

A 74-year-old man with ongoing, symptomatic, typical AFL (Figure 1) was referred to the centre. On admission to the hospital, the patient underwent clinical examination and laboratory checks. After exclusion of thrombi in heart cavities in transoesophageal echocardiography (TEE) patient has been qualified for the radiofrequency (RF) ablation procedure. After the femoral veins puncture under fluoroscopy guidance, decapolar steerable and quadripolar non-steerable catheters were placed in the coronary sinus and the right ventricular apex, respectively. The conducted electrophysiological manoeuvres confirmed

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Figure 1A, B. 12-leads electrocardiogram of clinical arrhythmia obtained at 25 mm/sec paper speed

a counterclockwise typical AFL with a tachycardia cycle length (TCL) of 210 ms. RF applications using non-irrigated 8 mm-tip ablation catheter were performed from the tricuspid valve side towards inferior vena cava (IVC) (with a power limit of 60 W and a target temperature of 60°C, with a 60-seconds time limit for each ablation point). During the ablation, the change of the activation sequence on a 10-pole diagnostic electrode in CS with prolongation of the TCL was observed (Figure 2A). No change of a P wave morphology was detected. Repeated pacing manoeuvres confirmed the CTI-dependence of the ongoing arrhythmia. Subsequent RF applications terminated AFL and allowed to return the sinus rhythm (SR) with a P wave duration of 180 ms and with a PQ interval duration of 240 ms (Figure 2B). Differential atrial pacing manoeuvres have demonstrated a bidirectional conduction block in the CTI including the 20-minute latency. The procedure has been completed with a total procedure time of 40 minutes, fluoroscopy exposure of 153 mGy and sinus rhythm 70 bpm. No complications have been registered during hospitalization after the procedure.

Discussion

The re-entrant circuit in typical atrial flutter runs around the tricuspid annulus and embrace the cavotricuspid isthmus, which is crucial in its pathomechanism. A bidirectional conduction block created during ablation poses highly effective protection against recurrent arrhythmias with relatively low complication risk. In most cases, the direction of the arrhythmia loop is counterclockwise [6], which was also presented in the study patient. In these cases, the activation of the left atrium occurs via connections in the inferior segments of the atrial septum [6] associated with the coronary sinus (Figure 2A). This pathway is being inhibited by RF applications in CTI ranging from the tricuspid valve annulus towards the IVC and the by-stander (left atrium) is then activated through the remaining interatrial connections located in the anterosuperior and posterior part of the atrial septum [6, 7]. These changes in the inter-atrial conduction reveal a change in coronary sinus activation observed on the 10-pole electrode (Figure 2B).

Another interesting and rather surprising occurrence observed during the procedure was, apart from the change in the sequence of coronary sinus activation, a prolongation of TCL. In such a situation, it is recommended to repeat manoeuvres to confirm a CTI-dependent AFL. Not only entrainment mapping can be useful but also placing a hallo catheter into the right atrium or using the three-dimensional electroanatomic mapping system for atrial activation analysis. Among the possible hypotheses explaining the above phenomenon may be an impairment of conduction in the atrial septal area, which is involved in the re-entrant circuit. This may be confirmed by the prolonged P-wave duration (180 ms) of sinus rhythm, which occurrence increases the probability of arrhythmia presence [8]. Another explanation of this phenomenon could be the diversity of the CTI structure. In the proximal segment of IVC, it is composed mainly of fibrous and fatty tissue with minimal muscular fibres content [9], which may contribute to the lower velocity of the arrhythmia wave.

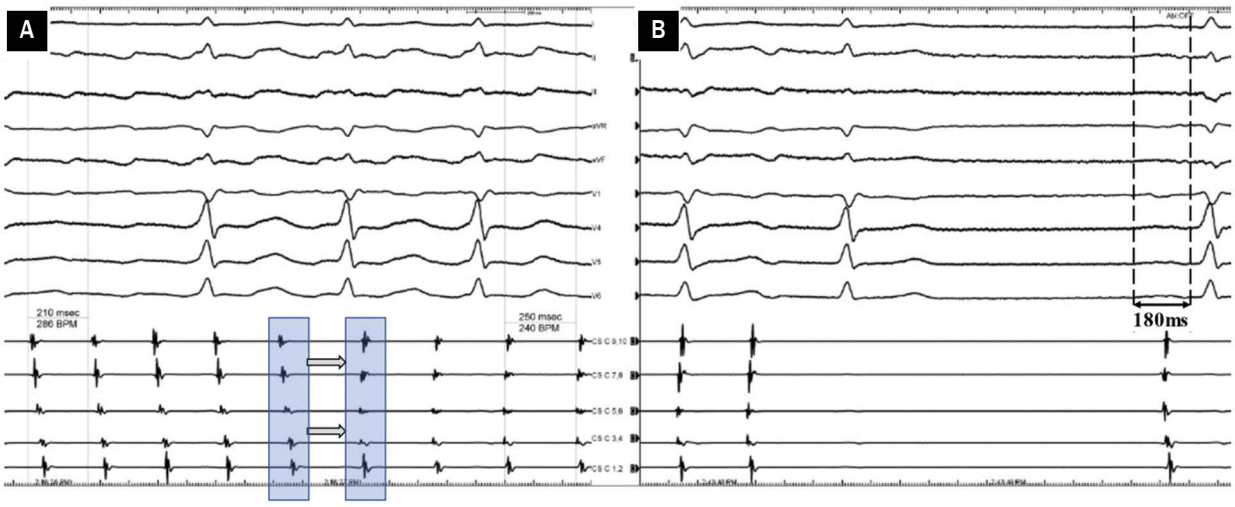

Figure 2. Change in the activation sequence observed on a 10-pole diagnostic electrode placed in the coronary sinus with prolongation of the tachycardia cycle length (TCL) (**A**) and subsequent termination of the arrhythmia and sinus rhythm (SR) recurrence with P wave duration of 180 ms observed during radiofrequency (RF) application on the CTI (**B**). 100 mm/sec sweep speed

Summary

Ablation of the CTI in patients with documented typical AFL is a highly effective and relatively simple procedure characterized by a low risk of periprocedural complications. The described phenomenon observed during RF application on CTI is quite rare. In this case, it has resulted from the interruption of interatrial conduction through the coronary sinus, which is a methodical consequence of this procedure. However, it must be considered that the prolongation of the arrhythmia cycle with activation sequence change in the coronary sinus may suggest a change in the macro-re-entry loop of the arrhythmia. Consequently, performing additional pacing manoeuvres should be considered to confirm the mechanism of the current arrhythmia. The abandonment of the controlled pacing may lead to unnecessary RF applications and increase the risk of complications with no efficacy increase.

Conflict of interest

All authors have no conflicts of interest to report.

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Streszczenie

Typowe trzepotanie przedsionków (AFL) to jedno z najczęstszych zaburzeń rytmu serca spotykane w praktyce klinicznej. Zgodnie z aktualnymi wytycznymi zalecaną metodą leczenia jest ablacja przezskórna. Celem zabiegu jest uzyskanie dwukierunkowego bloku przewodzenia w cieśni trójdzielno-żylnej (CTI).

W niniejszym doniesieniu przedstawiono przypadek pacjenta z typowym AFL poddanego ablacji prądem o częstotliwości radiowej (RF). Podczas aplikacji RF w obrębie CTI obserwowano zmianę sekwencji aktywacji rejestrowanej na elektrodzie umieszczonej w zatoce wieńcowej z wydłużeniem cyklu arytmii. Wystąpienie tego zjawiska jest rzadkie i może sugerować zmianę przebiegu pętli makroreentry arytmii.

Słowa kluczowe: typowe trzepotanie przedsionków, ablacja przezskórna, prąd o częstotliwości radiowej

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