Kardiologia Polska
2012; 70, 2: 194–195
ISSN 0022–9032

Use of non-contact mapping to localise distant from endocardium origin of atrial tachycardia

Wykorzystanie systemu elektro-anatomicznego z elektrodą typu Array w celu mapowania nietypowej lokalizacji ogniskowego częstoskurczu przedsionkowego

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Abstract

A 65 year-old woman developed tachycardia and hypotension during haemodialysis. The non-contact mapping system was used to localise the origin of focal atrial tachycardia, and showed a remote from the endocardium focus. We discuss techniques that are helpful in identifying the origin, the area of preferential conduction, and the endocardial breakthrough of tachycardia.

Key words: atrial tachycardia, non-contact mapping

Kardiol Pol 2012; 70, 2: 194–195

CASE REPORT

The patient was a 65 year-old woman with a medical history significant for hypertension, diabetes mellitus, and end-stage renal disease on haemodialysis who developed palpitations and hypotension during dialysis. A 12-lead electrocardiogram showed a narrow-complex, long RP tachycardia. Given the symptoms and hypotension during the tachycardia, she was offered ablative therapy.

During isoproterenol infusion of 2 μg/min, burst pacing from the coronary sinus initiated a tachycardia with a cycle length of 232 ms. The atrial activation was concentric and VA time was 200 ms. Right ventricular pacing showed dissociation of the tachycardia from the ventricle, consistent with the diagnosis of atrial tachycardia (AT) [1]. The Ensite Array balloon catheter (St. Jude Medical, St. Paul, MN, USA) was advanced to the right atrium (RA). Heparin infusion was started to maintain the activated clotting time > 300 s. The RA anatomy was reconstructed and non-contact activation mapping performed. The potential origin was identified in the superior anterior aspect of the RA (Fig. 1) consistent with focal AT. The ablation catheter was positioned in the area of interest, but no early electrograms were recorded there. Analysis of the tracking virtual electrogram revealed multiple plateau potentials before the actual 'QS' complex configuration was seen. This suggested a remote from the endocardium origin of the tachycardia (Fig. 1). Subsequent mapping of the right atrial appendage revealed the earliest local activation — 38 ms from the surface P wave. Single radiofrequency (RF) current application was done in this area, with successful termination of the AT.

DISCUSSION

Atrial tachycardia is sometimes difficult to eliminate by RF ablation, usually because of incorrect mapping and identification of the point of the earliest activation for focal AT, or inaccurate mapping of the critical conducting pathway for reentrant AT [1].

The EnSite System helps gather the information and translates the real-time electrical information into a 3D graphical map [2]. The system allows the use of either the EnSite Array balloon catheter or EnSite NavX navigation and visualisation technology. The more commonly used contact mapping may be poorly tolerated in some patients with unstable, multiple, complex, or not easily reproducible arrhythmias. The procedural and fluoroscopy time may be therefore increased, and the success rate decreased, due to limited recordings with conventional catheter techniques. High-resolution non-contact mapping has been developed to overcome the difficulties encountered in such patients [2–4]. Briefly, the EnSite

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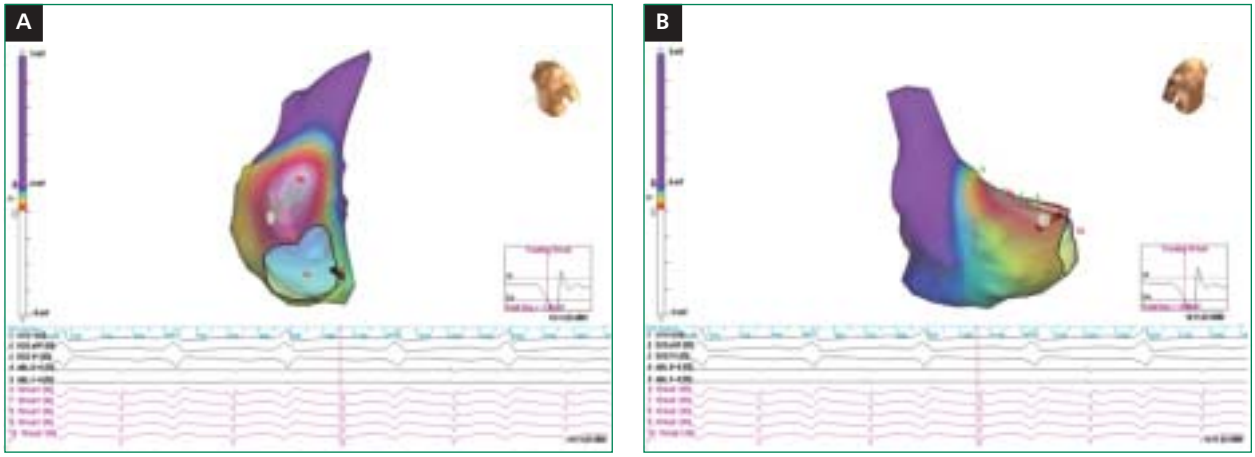

Figure 1. Non-contact mapping using the EnSite Array Balloon Catheter; **A.** Left anterior oblique cranial view; **B.** Right anterior oblique cranial view. Isopotential map shows the activation wavefront of the tachycardia, white indicating the earliest activation and purple the latest. The origin (red point) of the focal tachycardia was localised initially at the superior anterior aspect of the right atrium, but analysis of the virtual electrograms at this level revealed multiple plateaus before the 'QS', corresponding to the preferential conduction pathway. Application of radiofrequency energy inside the right atrial appendage (white point) resulted in termination of the tachycardia during ablation; TA — tricuspid annulus

Array multi-electrode diagnostic catheter rapidly collects real-time cardiac electrical information, translating it into a 3D isopotential map [4, 5]. With 64 electrodes, this catheter collects more than 3,000 points of electrical data in a single heartbeat that are translated simultaneously in virtual electrograms. A high-pass filter has to be set up in such a way as to preserve the components of slow conduction on the isopotential map, although occasionally it should be decreased to allow identification of slow activation wavefronts. The different aspects of the non-contact unipolar electrograms encountered during AT have been identified and described previously [5]. The three important aspects of the non-contact unipolar electrograms that should be recognised during AT are those related to the origin of the AT, the preferential conduction, and the breakthrough point of the AT.

The origin of an AT is defined as the earliest site showing a single spot of isopotential map and a 'QS' pattern of non-contact unipolar electrogram. The breakout point of AT is the earliest site showing an 'rS' pattern with sudden increase of peak negative potential of non-contact unipolar electrogram. The preferential conduction pathway is represented by the initial direction of depolarisation away from an origin and is revealed as multicomponents of electrogram deflections. Catheter ablation of the origin or the proximal portion of the preferential conduction pathway results in effective elimination of the focal AT [5].

In our case, the focus of the AT was rapidly localised with the EnSite Array, but it did not in fact represent the origin of the tachycardia. Careful analysis of the tracking virtual electrograms showing multiple plateaus corresponding to the preferential conduction pathway suggested a different possible origin of the tachycardia: epicardial, right appendageal, left atrial, or simply that the origin of the tachycardia was beyond the effective mapping range of the balloon. This last possibility was quickly eliminated given that the earliest activation was seen well within the body of the balloon. Given concentric activation of the tachycardia, the left atrial origin was less likely. The location of the earliest activation with non-contact mapping in the superior aspect of the anterior wall of the RA suggested possible appendageal origin of the tachycardia, and this indeed turned out to be the case.

The EnSite Array catheter not only allowed for rapid identification of the area of interest, it also provided additional information about the origin of the tachycardia. It remains a very useful tool in decreasing procedural, ablation, and fluoroscopy time. It is however critical to understand the morphology of virtual electrograms for successful mapping and ablation of the tachycardia.

Conflict of interest: *Adam S. Budzikowski reported being a member of Speakers Bureau of Zoll and receiving speaker honoraria from Boston Scientific, St. Jude Medical; John Kassotis reported being a member of Speakers Bureau of Medtronic and receiving followship support from Medtronic, Boston Scientific, St. Jude Medical.*

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