Use of the LocaLisa mapping system during ablation procedures in patients with atrioventricular nodal reentrant tachycardia

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Abstract

Introduction: LocaLisa is a novel system for anatomical mapping. It enables an assessment of the three-dimensional position of electrodes within cardiac chambers without fluoroscopy. With this technique it may be possible to reduce radiation exposure during catheter-based ablation procedures.

Aim: To evaluate the efficacy and safety of ablation procedures performed using the LocaLisa mapping system in patients with atrioventricular nodal reentrant tachycardia (AVNRT).

Methodology: This study evaluated the course of the first 26 ablations performed using the LocaLisa system (studied group). The control group involved 30 consecutive patients with AVNRT treated with the conventional ablation technique that was routinely used prior to the introduction of the novel system into clinical practice.

Results: In the studied group procedural duration was 72.4±24.9 minutes, in the control group 80.1±18.2 minutes (NS). However, radiation exposure was significantly lower in the examined group - 74.4±109.2 mGy compared to 184.8±59.9 mGy in the control group ($p < 0.05$). All procedures were successful. No complications related to the ablation were observed.

Conclusions: Employment of the LocaLisa mapping system enables the reduction of fluoroscopic exposure without any decrease of efficacy or elevation of risk of any complications during AVNRT ablations.

Key words: LocaLisa, ablation, atrioventricular nodular tachycardia

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Atrioventricular nodal reenrant tachycardia (AVNRT), as a result of functional dissociation of the atrioventricular junction, is one of the most common forms of rhythm disturbances with electrocardiographical features of tachycardia with narrow QRS complexes [1]. Nowadays, both pathomechanisms and methods of treatment including an invasive approach are well established and relevant papers have also been published in the Polish medical literature [2, 3]. However, continuous technological progress enables the introduction of new electrophysiological systems into clinical practice, allowing a broader spectrum of therapeutic interventions to be performed or for them to be made easier. Nowadays, besides the CARTO system (Biosens Webster) used in many Polish electrophysiological centres, the new LocaLisa three-dimensional anatomical mapping system is also used (Medtronic). The latter was introduced into clinical practice at the end of the 90's [4]. Its use enables the assessment of three-dimensional localisation of the electrodes within the cardiac chambers without fluoroscopy. Moreover, an obvious advantage of the LocaLisa system is the possibility to use standard electrophysiological electrodes, making this system cost effective.

The purpose of the study was to assess the efficiency and safety of ablation procedures performed

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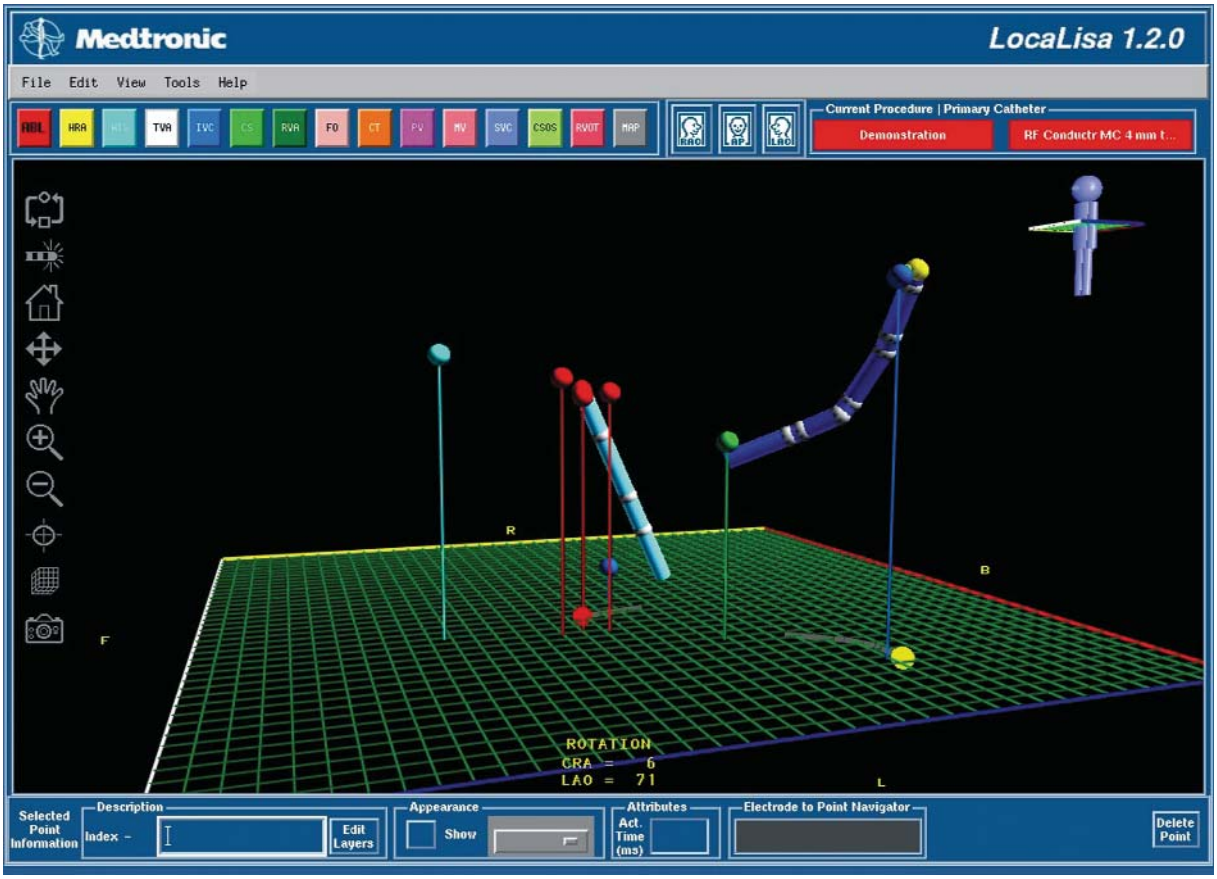

Figure 1. LocaLisa screen during AVNRT ablation (LAO view). Diagnostic electrode in the coronary sinus (right side) and ablation electrode are seen. Points indicate bundle of His (in blue), delivery site (in red), coronary sinus ostium (in green) and inferior *vena cava* at the bottom (in navy blue)

using the LocaLisa mapping system in comparison to the conventional technique in patients with atrioventricular nodal reentrant tachycardia (AVNRT).

Methods

This study evaluated the course of the first 26 ablations performed using the LocaLisa system (studied group). The control group involved 30 consecutive patients with AVNRT treated with the conventional ablation method that was used prior to the introduction of this novel system into clinical practice. In all patients ablation of the slow conduction pathway was performed.

Procedures in the control group were carried out using the anatomical technique according to methodology described earlier [3]. Based on the fluoroscopic images in the reference views (RAO 30-45, LAO 30-45) the ablation electrode was placed in the target area (half way between the electrode recording His bundle electrogram and coronary sinus ostium) to search for an appropriate signal (balanced level of A and V potentials in bipolar acquisition and dominance of V signal in unipolar acquisition in A:V ratio 1:2) from the ablation electrode. Besides the ablation electrode, at least two diagnostic electrodes, including one for His bundle recording, were always used. During application fluoroscopy was used (to facilitate sudden termination of application in case of ablation catheter dislocation) and intracardiac records were analysed (indication for termination was the presence of features of impaired antegrade and retrograde conduction via the atrioventricular junction, e.g. during junctional rhythm and fast atrioventricular rhythm). The following application parameters were used: 55°C, 40 W and application time not exceeding 1 minute.

In the studied group, an additional mapping electrode was used. This electrode, a reference one (because of its stability), was always placed in the coronary sinus. Using an ablation electrode (as mapping electrode for the LocaLisa system), the reference point of the electrical cardiac map was established. The latter was usually close to the inferior edge of the atrium near

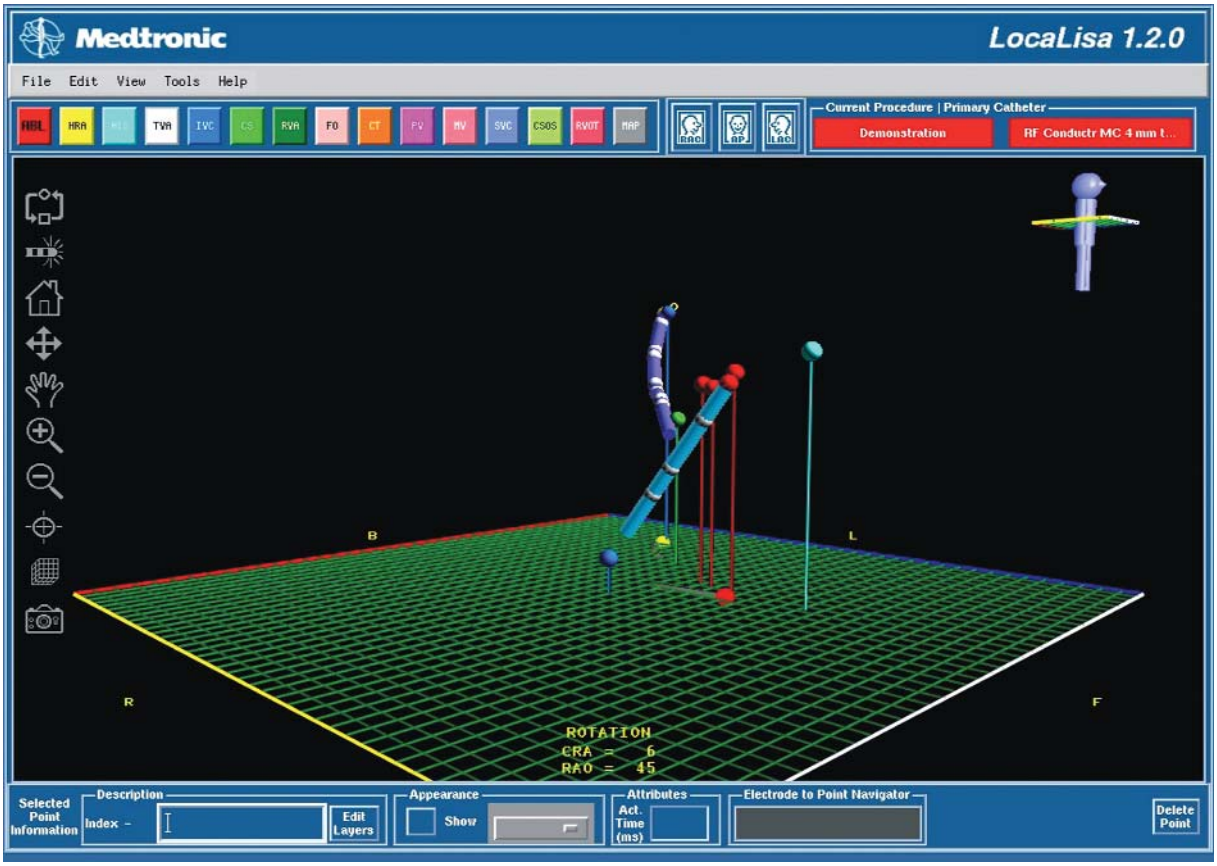

Figure 2. LocaLisa screen during AVNRT ablation (RAO view)

the *vena cava* ostium. Then site of hisogram acquisition as well as coronary sinus ostium were plotted out. As a result, images of the diagnostic electrode placed in the coronary sinus as well as locations of the His bundle, coronary sinus ostia and ablation electrode marked with colour points were displayed on the LocaLisa monitor (Figures 1 and 2). Current application sites and its parameters were similar to the conventional method.

Electrophysiological examination preceding ablation included both programmed and continuous over-drive atrial stimulation. Each time the protocol of arrhythmia induction was evaluated. In case of no possibility to induce tachycardia, the protocol of stimulation was repeated after atropine administration and if necessary followed by isoproterenol injection. If arrhythmia provocation failed, no ablation procedure was performed. Ablation was considered successful if in the following the procedure programmed stimulation including induction protocol and *over-drive* atrial pacing at the rate of arrhythmia, no tachycardia was induced (both in case of ablation and slow pathway modification).

The course of procedures was analysed (time of procedure, radiation exposure, efficacy and potential periprocedural complications).

Results

In the studied group procedural duration time was 72.4±24.9 minutes, in the control group 80.1±18.2 minutes (NS). However, radiation exposure time was significantly shorter in the examined group – 74.4±109.2 mGy compared to 184.8±59.9 mGy in the control group ($p < 0.05$). All procedures were successful. No complications were observed.

Discussion

LocaLisa anatomical mapping system (Medtronic) enables three-dimensional electrodes localisation and precise imitation of their movement. The rationale for this system function is induction of a high frequency electrical field by 3 pairs of electrodes attached to the patient's skin. Analysis of the changes of its intensity enables the assessment of three-dimensional electrode location. It is important to note that besides disposable skin electrodes, the LocaLisa navigation system does not

require any extra catheters. Standard ablation and mapping catheters after connection to the system are simultaneously used for electrical field generation not interfering with their primary function. This system enables the positioning of up to 10 catheters to be determined, which seems to significantly exceed clinical needs. Digitally depicted electrodes are seen on the screen. Their detailed characteristics including number of rings and distance between them may be saved in the system memory and allows realistic catheter imitation to be produced. This system enables memorisation of three-dimensional points indicating the tip of the mapping electrode position and also a short description of them (for example, electrical activity time, which may allow the choice of delivery site with ideal electrical characteristics). Moreover, it enables permanent localisation of anatomic structures crucial for ablation such as bundle of His, coronary sinus ostia and scars and sites of current application. After acquiring some experience it makes it possible to navigate the ablation catheter within the cardiac chamber essentially without any use of fluoroscopy, although no three-dimensional electro-anatomical cardiac map is reconstructed (in contrast to the Carto system).

We managed to reduce the time of fluoroscopy during ablations of AVNRT in the last two cases to 4 and 6 mGy respectively, which corresponded with an exposure time of 16 and 18 seconds. Using the conventional method, such reduction of fluoroscopy exposure without employment of an anatomical mapping system would not be possible. It must be stressed however that significant reduction in fluoroscopy use was not associated with either lowering of efficacy or increasing the risk of procedures, although only preliminary experience is reported in the study. Reduction of radiation exposure associated with use of the LocaLisa mapping system has also been reported by other authors [5, 6].

Determination of three-dimensional positioning of anatomical or electrical structures with their electrical characteristics is becoming nowadays a rationale for employment of this system during the ablation procedures of a very wide spectrum of rhythm disturbances: from typical forms of atrial flutter, through postoperative arrhythmias and ectopic tachycardias to procedures performed because of ventricular tachycardia with structural myocardial injury or pulmonary vein isolations in patients with atrial fibrillation [7-11]. At the same time, high accuracy in evaluation of electrode localisation also allowed safe use of the LocaLisa mapping system in children [12].

The clear advantage reported by all authors and confirmed also during the first ablation procedures in our centre is the simplicity of use of this system as well as the high fidelity of the reconstruction of the electrodes' movements. Obviously, a novel LocaLisa device cannot replace the systems able to produce a complete electro-anatomical cardiac map and it does not create images of arrhythmia propagation, and thus the ablation procedure of many atypical arrhythmias is in practice difficult to be performed. Depending on the electrophysiologist's experience and imagination, this system extends the possibility and increases the safety of procedures performed as conventional electrophysiological methods of intracardiac signal analysis.

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Zastosowanie systemu LocaLisa w ablacjach u pacjentów z nawrotnym częstoskurczem węzłowym

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Streszczenie

Wstęp: LocaLisa jest nowoczesnym systemem mapowania anatomicznego. Pozwala na ocenę położenia przestrzennego elektrod w sercu bez użycia fluoroskopii. Dzięki temu jej zastosowanie może ograniczyć ekspozycję na promieniowanie rentgenowskie w trakcie zabiegów ablacji.

Cel: Ocena skuteczności i bezpieczeństwa zabiegów ablacji wykonanych przy użyciu systemu LocaLisa u chorych z nawrotnym częstoskurczem węzłowym (AVNRT).

Metodyka: Ocenie poddano przebieg pierwszych 26 zabiegów ablacji wykonanych przy zastosowaniu systemu LocaLisa (grupa badana). Grupę kontrolną stanowiło 30 chorych z AVNRT leczonych ablacją w sposób klasyczny przed rozpoczęciem użytkowania przedmiotowego systemu.

Wyniki: W grupie badanej czas trwania zabiegu wynosił 72,4±24,9 min, w grupie kontrolnej 80,1±18,2 min (NS). Czas ekspozycji na promieniowanie rentgenowskie był natomiast w grupie badanej istotnie krótszy – 74,4±109,2 mGy wobec 184,8±59,9 mGy w grupie kontrolnej ($p<0,05$). Wszystkie zabiegi były skuteczne. Nie obserwowano powikłań u żadnego z pacjentów.

Wnioski: Zastosowanie systemu LocaLisa pozwala na ograniczenie czasu użycia fluoroskopii, nie powodując zmniejszenia skuteczności ani wzrostu ryzyka powikłań podczas zabiegów ablacji AVNRT.

Słowa kluczowe: LocaLisa, ablacja, częstoskurcz węzłowy

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