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Don't move during ablation of atrial fibrillation! ☆

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ABSTRACT

Background: Restless patient is recalcitrant during ablation of atrial fibrillation (AF). We aimed to assess the association between patient movements during AF ablation and its outcome.
Methods: We examined the body movement during AF ablation in 78 patients with the use of a novel portable respiratory monitor, the SD-101, which also has the ability to quantify the frequency of body movements.
Results: The body movement index, defined as the number of the units of time with body movement events divided by the recording time (11.4 ± 6.5 events/h), was significantly correlated with the ablation time defined as the time from the first point of the ablation to the end of the procedure (1.2 ± 0.3 h) (r = 0.35; p = 0.0014) and a total radiofrequency energy applied (56.6 ± 17.7 kW) (r = 0.36; p = 0.0015). A multiple linear regression analysis showed that non-paroxysmal AF (β = 0.25; p = 0.036) and the body movement index (β = 0.36; p = 0.0019) were independent determinants of the ablation time. The body movement index was similar in patients with and without recurrence of AF.
Conclusions: Keeping patients motionless may be important to reduce the procedural duration of AF ablation.

1. Introduction

During catheter ablation of atrial fibrillation (AF) with consciousness sedation, though a sufficient amount of sedatives or analgesics is given, patients often move their body unconsciously on the procedure table because of pain caused by the radiofrequency applications to the left atrium (LA) [1]. This annoys the operators, and sometimes even interrupts the procedure. However, this issue has not been discussed because it is difficult to know precisely how often and how seriously the patients move during the ablation. The SD-101 sleep recorder is a newly developed portable respiratory recorder [2], which can also assess the body movements of the examinee quantitatively with pressure sensors embedded in its sheet-shaped body. With the use of the SD-101, in this study we sought to answer the question, “Does the patient movement observed during AF ablation matter?”

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2. Methods

2.1. Patients

This study was conducted by the Cardiovascular Center of Nagoya Daini Red Cross Hospital from May 2011 to April 2012. The study protocol was approved by the research committee of the institution. Patients were considered eligible for inclusion if they were scheduled to undergo radiofrequency catheter ablation of drug refractory AF for the first time. Patients were excluded from the study if they were scheduled in advance to undergo any additional procedure other than pulmonary vein (PV) isolation and cavotricuspid isthmus ablation. All the participants underwent transthoracic and transesophageal echocardiography prior to the ablation. The eligible patients were enrolled after giving informed consent.

2.2. Cather ablation

All antiarrhythmic drugs (AADs) were discontinued 5 half-lives before the ablation procedure. The details of the double Lasso catheter-guided extensive encircling PV isolation performed in the present study have been described elsewhere [3]. In brief, two 7-French decapolar circumferential catheters (Lasso, Biosense Webster, Diamond Bar, CA, USA) were placed within the ipsilateral superior and inferior PVs. After constructing 3-dimensional electroanatomical maps using a non-fluoroscopic navigation system (CARTO3, Biosense Webster), circumferential ablation lines were created around the left- and right-sided ipsilateral PVs using a 3.5-mm irrigated tip catheter (ThermoCool, Biosense Webster). Radiofrequency energy was delivered with a maximum power of 35 W for 20 s at each site. The endpoint of the PV isolation was either the elimination or dissociation of the PV potentials recorded from the circular catheters placed within the PVs and exit block from the PVs. Transthoracic cardioversion was applied to restore sinus rhythm in the patients with persistent or longstanding persistent AF. Finally, the cavotricuspid isthmus was ablated with the use of a non-irrigated ablation catheter with an 8-mm tip (Fantasista, Japan Lifeline, Tokyo, Japan).

Radiofrequency energy was delivered with a target temperature of 55 °C and power limit of 50 W.

The ablation procedures were carried out by four different operators.

2.3. Quantification of the body movement

The SD101® (Kenzmedico, Saitama, Japan) is a newly developed portable respiratory monitor with a sheet-like shape (Fig. 1) [2]. Unlike conventional portable monitors, the device does not have any cords, tubes or belts, and therefore never restrains the examinee. All that the examinee needs to do is turn the device on and lie on it. The device recognizes the patterns of thoracic ventilatory efforts using 162 coin-shaped pressure sensors embedded in it, and creates respiratory waveforms. In addition, the device also can quantitatively assess the body movements of the examinee. Specifically, since the sensors can detect the pressure load in an all or none fashion, when the patients move any part of their body, the distribution of the sensors detecting the pressure load changes from that before the movement. When (the number of sensors that newly detect the pressure load and that no longer detect any pressure load after the change in the body position)/(the number of the sensors that detect the pressure load before the change in the body position) is more than 0.6, it is recognized as a body movement (Fig. 2). With the use of this criterion, the body movement events are checked automatically every 0.1 s. When the events are identified one or more times within a time window of 25.6 s, this unit of time is recorded as having a body movement event (Fig. 3).

We put the SD-101 on an X-ray table in the cath lab (Fig. 1), and then the patients lied on it. The recording with the device was started when the radiofrequency energy was initially applied and the recording was stopped when the procedure was completed. All data recorded by the device were analyzed automatically with the use of the SD ANALYZER software (Kenzmedico) and were reviewed by experienced technicians. We defined the number of the units of time with body movements divided by the total recording time as the body movement index, and used it for the analyses. We excluded any recorded events of body movements resulting from electrical cardioversion from the analyses in patients with persistent or longstanding persistent AF (non-paroxysmal AF). Also, the time required for the cardioversion was subtracted from both the ablation time and recording time.

2.4. Sedation and analgesia

The patients were sedated while monitoring the non-invasive blood pressure and oxygen saturation without intubation during the ablation procedure. A total of 30 mg of pentazocine was given in 2 separate injections at the beginning of the ablation procedure and just before mapping the LA. Thiamylal was then administered as an intravenous bolus of 1.25 mg/kg every 10 min during the radiofrequency applications to the atria. When the patients complained of chest pain or moved their body due to the pain, an additional infusion of thiamylal was administered. The patients were given 2 L/min of oxygen through a nasal canula throughout the procedure.

2.5. Follow-up

Previously ineffective AADs were restarted the day after the ablation. The patients were discharged from the hospital 2 days after the ablation and were scheduled to be followed up at the outpatient clinic 3, 6, 9, and finally 12 months after the procedure to check for any AF recurrences defined in the current guidelines [1]. Twelve lead electrocardiograms were obtained at all clinical visits, and 24-hour Holter monitoring was performed at 3-month intervals during the follow-up period. The oral AADs were encouraged to be discontinued in patients who remained free of AF for 3 consecutive months.

2.6. Endpoints

The endpoints of this study were (1) an association of the body movement index with ablation time defined as the time from the initial application of the radiofrequency energy to the completion of the ablation procedure and a total amount of radiofrequency energy applied to complete PV isolation and cavotricuspid isthmus block, and (2) a relationship between the body movement index and the occurrence of an AF recurrence.

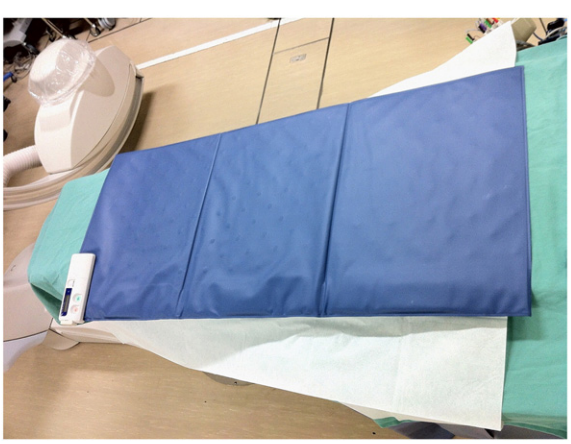

Fig. 1. SD-101 sleep recorder; a sheet shaped portable respiratory monitor which has 162 pressure sensors in its body to detect events of disordered breathing and changes in body position.

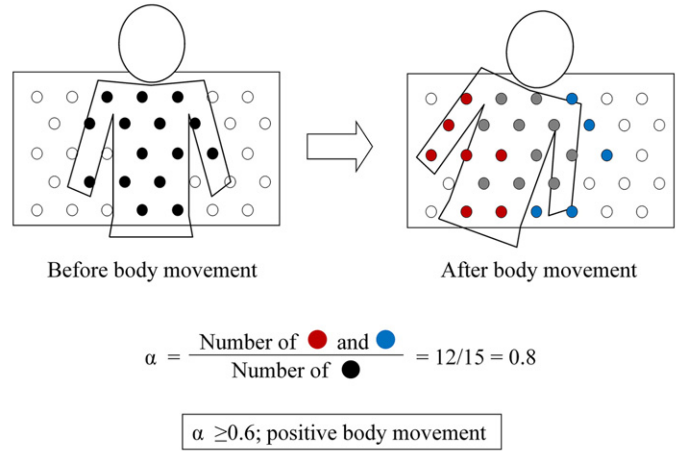

Fig. 2. Schema of the distribution maps of the pressure load. The black circles indicate the sensors detecting the pressure load before any change in body position. The red and blue circles show the sensors that newly detect the load and the ones that no longer detect the load after the body movement, respectively. The gray circles indicate the sensors that continue to detect the load even after the body movement.

2.7. Statistical analysis

The continuous variables were summarized as the means ± SD or medians with interquartile ranges, and categorical variables as proportions. A Pearson's correlation analysis was used to access the correlations between the body movement index and ablation time or total radiofrequency energy. Multivariate linear regression analyses were performed to determine the independent determinants of the ablation time and the total radiofrequency energy using the body movement index and other potential clinical parameters as independent variables. The body movement index was compared between the patients with and without AF recurrences by means of an unpaired *t*-test. The statistical analyses were performed using JMP software version 8.0 (SAS Institute, Cary, NC, USA). For all analyses, a P value of <0.05 was considered statistically significant.

3. Results

3.1. Patients

We included 83 patients. However, 5 patients were not analyzed because an unplanned superior vena cava isolation and LA linear ablation were performed in addition to the PV isolation and cavotricuspid isthmus ablation in 3 and 2 patients, respectively. Therefore, we analyzed 78 patients. The mean age of the patients was 63 ± 10 years old, and two-thirds of them were men and had paroxysmal AF (Table 1).

3.2. Association of the body movement index with ablation time and total radiofrequency energy

The body movement index (11.4 ± 6.5 events/h, Fig. 4) was significantly correlated with the ablation time (1.2 ± 0.3 h) ($r = 0.35$; $p = 0.0014$, Fig. 5) and total radiofrequency energy (56.6 ± 17.7 kW) ($r = 0.36$; $p = 0.0015$, Fig. 6). A multiple linear regression analysis including the age, male gender, body mass index, non-paroxysmal AF, LA diameter and body movement index as independent variables showed that non-paroxysmal AF ($\beta = 0.25$; $p = 0.036$) and the body movement index ($\beta = 0.36$; $p = 0.0019$) were independent determinants of the ablation time (Table 2). Another multiple model including the same parameters as explanatory variables also revealed the body movement index as the only independent determinant of the total radiofrequency energy ($\beta = 0.37$; $p = 0.002$) (Table 3).