

Case Report

Dissimilar Atrial Rhythms Seen by Transesophageal Echocardiography During an Electrophysiology Study

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ABSTRACT

Dissimilar atrial rhythms describe the coexistence of atrial fibrillation in one atrium and a more regular rhythm in the other. Electrograms are typically used to diagnose this rare entity. The use of transesophageal echocardiography in this context has not been described previously. We present a case of an 88-year-old woman with paroxysmal atrial fibrillation and new-onset, symptomatic atrial flutter who underwent electrophysiology study that confirmed dissimilar atrial rhythms. Transesophageal echocardiography images reveal differential function of the left and right atrial appendages, a novel finding that may be useful in diagnosing this rhythm disorder.

RÉSUMÉ



Des rythmes atriaux dissimilaires montrent la coexistence d'une fibrillation auriculaire dans un atrium et un rythme plus régulier dans l'autre. Les électrogrammes sont généralement utilisés pour détecter cette entité rare. L'utilisation de l'échocardiographie transœsophagienne dans ce contexte n'a pas été décrite auparavant. Nous présentons le cas d'une femme de 88 ans atteinte de fibrillation auriculaire paroxystique et de flutter auriculaire symptomatique d'apparition récente dont l'étude électrophysiologique a permis de confirmer des rythmes atriaux dissimilaires. Les images de l'échocardiographie transœsophagienne révèlent le fonctionnement distinct des appendices auriculaires gauche et droite, une nouvelle observation qui peut être utile à la détection de cette irrégularité du rythme.

Dissimilar atrial rhythms are defined by the coexistence of atrial fibrillation (AF) in one atrium and a more regular rhythm in the other.¹ Diagnosis can be accomplished through comparison of simultaneous surface, intracardiac, and/or distal esophageal electrograms, identifying electrical activity originating predominantly from either atrium.² The use of transesophageal echocardiography (TEE) in this context has not been described previously.

Case

An 88-year-old woman with a history of sick sinus syndrome with dual chamber permanent pacemaker and paroxysmal AF presented with 1 month of palpitations and dyspnea on exertion. Her heart rate was 85 beats per minute and regular; additional vitals and examination were unremarkable. Surface electrocardiogram (ECG) and interrogation of her dual-chamber pacemaker revealed typical atrial flutter with adequate rate control on beta-blockade. She was referred

for electrophysiology study with cavo-tricuspid isthmus ablation for definitive therapy of her atrial flutter, which was felt to be the most likely cause of her symptoms. Given her history of paroxysmal AF, concurrent TEE to rule out left atrial appendage (LAA) thrombus was planned before performing electrical cardioversion.

TEE was performed at the time of the procedure and revealed dissimilar contractile function between the right and left atria. The LAA was normal in size but virtually akinetic (Video 1 , view video online). There was no evidence of thrombus in the LAA, but emptying velocities were severely reduced (Fig. 1A). In contrast, the right atrial appendage (RAA) contracted well (Video 2 , view video online) with normal emptying velocities (Fig. 1B). Cycle lengths measured manually from the pulse wave Doppler waveforms were highly irregular in the LAA (70–280 ms) and were regular (180 ms) in the RAA. Surface electrograms revealed organized electrical activity in the right atrium, consistent with atrial flutter, but intracardiac electrograms revealed disorganized activity in the left atrium, consistent with AF (Fig. 2). Given the absence of thrombus in the LAA on TEE, synchronized direct current cardioversion was delivered at 100 joules, and the patient converted to sinus rhythm. Under electrical and 3D electro-anatomic guidance, a line of radiofrequency energy block was made across the cavo-tricuspid isthmus, creating a bidirectional block. Following this, burst pacing failed to induce further atrial flutter, and the patient remained in sinus rhythm in both atria based on surface ECG and intracardiac

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See page 508 for disclosure information.

Novel Teaching Points

- In addition to direct intracardiac electrogram evaluation on electrophysiologic study, dissimilar atrial rhythms can be identified by surface ECG leads, esophageal leads, and transthoracic echocardiography with pulsed-wave assessment and M-mode.
- Differential function of the LAA and RAA as identified by TEE can assist in the diagnosis of dissimilar atrial rhythms.
- RAA emptying velocities are generally lower than those in the LAA in both sinus rhythm and AF; alterations in this pattern suggest dissimilar atrial rhythms, acutely elevated atrial pressures, atrial enlargement, or atrial myopathy and remodeling.
- IAB, either functional and transient or manifest on ECG, is an important mechanism for initiating and propagating atrial arrhythmias, including simultaneous AF and atrial flutter in separate atria.

electrograms. Close examination of the surface electrograms after cardioversion revealed similar findings to prior sinus rhythm ECGs, including first-degree atrioventricular block with a PR interval of 236 msec, broad, upright p waves in lead II with a p-wave duration of 130 msec, and no additional conduction abnormalities. Complete voltage maps of the atria were not obtained. The catheters were removed at the conclusion of the procedure, and the patient was continued on her anticoagulation.

Discussion

Dissimilar atrial rhythms have been described in the literature since the early 1900s.¹ Diagnosis based on surface electrograms alone can be challenging. An esophageal lead can improve the identification of electrical activity in the left atrium, which can then be compared to surface electrograms.³ Intracardiac electrograms, which can obtain direct and concurrent electrical signals from the atria, confirm the diagnosis.¹ Echocardiographic assessment of the atria, however, may provide supportive and less-invasive evaluation of dissimilar atrial rhythms.

We demonstrate a case in which TEE performed on a patient with symptomatic atrial arrhythmias demonstrated dissimilar function of the RAA and LAA; intracardiac electrograms confirmed dissimilar rhythms. The pathophysiology of dissimilar atrial rhythms is not always clear. It has been proposed that true interatrial dissociation and independent activity may not be necessary and that impulses from the fibrillating atrium could produce the more regular activity in the other atrium.¹ However, more recent recognition of the prevalence of interatrial block (IAB) and its role in reentrant atrial arrhythmias suggests a possible mechanism in this case.⁴

IAB is defined by conduction delay between the right and left atria and demonstrated by a p-wave duration of greater than 110 msec on surface ECG, typically localized to specialized atrial conduction tissue pathways, such as Bachmann's bundle. IAB is highly associated with AF and atrial flutter, likely due to mechanisms facilitating reentry circuits.⁴ This patient's ECG demonstrated p-wave prolongation but otherwise normal p-wave morphology in lead II, suggestive of partial IAB, which may have been the substrate for her atrial arrhythmias and findings of dissimilar rhythms. No findings on echocardiography or history suggested structural or anatomic etiology for IAB. IAB, however, is not necessary for dissimilar atrial rhythms to occur, as the existence of a functional block has been demonstrated in cases of simultaneous occurrence of AF and atrial flutter.⁵

Thorough evaluation of both the RAA and LAA, including using pulsed-wave Doppler analysis, is rarely done during TEE, and a paucity of literature exists to describe comparative findings at baseline or in patients with atrial arrhythmias. Thromboembolic events originating from the RAA are less frequently observed than those originating from the LAA, a finding attributed to differences in structure and function. Limited data suggest that emptying velocities of the RAA are generally lower than those of the LAA in both sinus rhythm and AF.⁶ In this case, however, RAA emptying velocities were higher and more organized than those in the LAA in the same patient, a finding potentially attributable to dissimilar rhythms.

Alternative explanations for similar observed echocardiographic findings may exist. Both an acute and chronic "myopathy" of the LAA have been implicated in thrombus formation in the LAA and are a potential culprit in the context

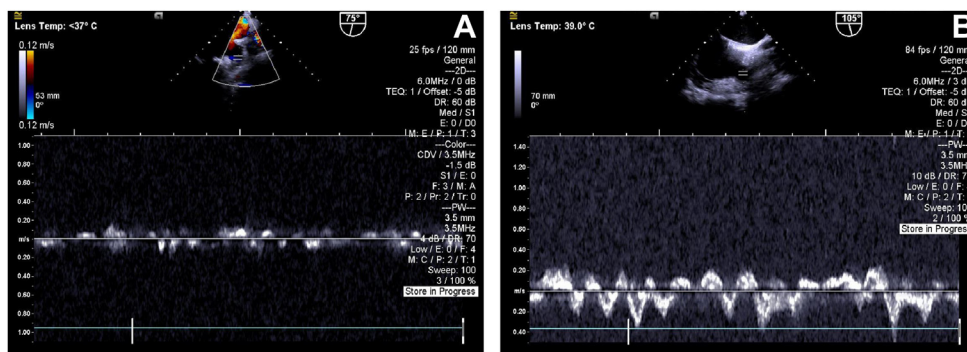


Figure 1. Transesophageal echocardiography (TEE) images during dissimilar atrial rhythms. (A) TEE still image of a pulsed-wave Doppler signal positioned near the opening of the left atrial appendage. Very low emptying velocities (< 0.1 m/s) are noted. (B) TEE still image of a pulsed-wave Doppler signal positioned near the opening of the right atrial appendage. Normal emptying velocities (> 0.2 mm/s) are noted.

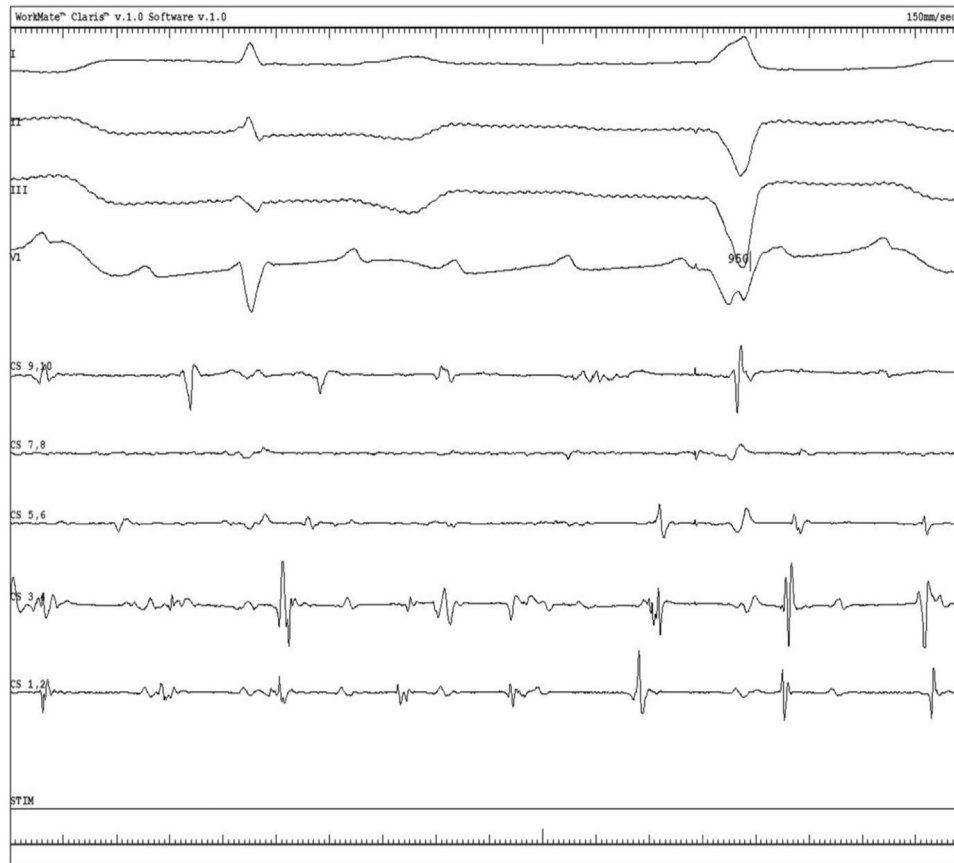


Figure 2. Intracardiac electrograms during dissimilar atrial rhythms. Electrograms were obtained at the time of transesophageal echocardiography and prior to electrical cardioversion. A decapolar catheter is present in the coronary sinus. Surface electrograms (leads I, II, III, V1 in the top 4 channels) reveal organized flutter waves originating from the right atrium as best shown in V1. Intracardiac electrograms from the coronary sinus catheter (CS 1-10) reveal faster, more irregular, and disorganized atrial activity originating from the left atrium, consistent with atrial fibrillation.

of longstanding paroxysmal AF.^{7,8} Elevated ventricular and atrial pressures as well as chamber enlargement also may differentially affect appendage function, although this was not observed in our patient's case.

Case reports have demonstrated the utility of transthoracic M-mode echocardiography to identify dissimilar atrial rhythms.² Given that TEE is frequently performed to exclude LAA thrombus, additional assessment of RAA structure and function can provide information regarding thromboembolic risk as well as arrhythmias, which may be suitable for ablation and not readily identifiable on the surface ECG.

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Disclosures

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Supplementary Material

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