



# REVISTA BRASILEIRA DE ANESTESIOLOGIA

Publicação Oficial da Sociedade Brasileira de Anestesiologia  
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## CLINICAL INFORMATION

# Transesophageal echocardiography in perioperative period guiding the decision making during hemodynamic instability due to atrial fibrillation<sup>☆</sup>



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Received 5 February 2018; accepted 12 February 2018

Available online 25 June 2018

### KEYWORDS

Transesophageal  
echocardiography;  
Atrial fibrillation;  
Perioperative;  
Thromboembolism;  
Anesthesia

### Abstract

*Background and objective:* Atrial fibrillation is the most common cardiac arrhythmia, which may occur during the perioperative period and lead to hemodynamic instability due to loss of atrial systolic function. During atrial fibrillation management, electrical cardioversion is one of the therapeutic options in the presence of hemodynamic instability; however, it exposes the patient to thromboembolic event risks. Transesophageal echocardiography is a diagnostic tool for thrombi in the left atrium and left atrial appendage with high sensitivity and specificity, allowing early and safe cardioversion. The present case describes the use of transesophageal echocardiography to exclude the presence of thrombi in the left atrium and left atrial appendage in a patient undergoing non-cardiac surgery with atrial fibrillation of unknown duration and hemodynamic instability.

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*Case report:* Male patient, 74 years old, hypertensive, with scheduled abdominal surgery, who upon cardiac monitoring in the operating room showed atrial fibrillation undiagnosed in pre-operative electrocardiogram, but hemodynamic stable. During surgery, the patient showed hemodynamic instability requiring norepinephrine at increasing doses, with no response to heart rate control. After the end of the surgery, transesophageal echocardiography was performed with a thorough evaluation of the left atrium and left atrial appendage and pulsed Doppler analysis of the left atrial appendage with mean velocity of  $45 \text{ cm}\cdot\text{s}^{-1}$ . Thrombus in the left atrium and left atrial appendage and other cardiac causes for hemodynamic instability were excluded. Therefore, electrical cardioversion was performed safely. After returning to sinus rhythm, the patient showed improvement in blood pressure levels, with noradrenaline discontinuation, extubation in the operating room, and admission to the intensive care unit.

*Conclusion:* In addition to a tool for non-invasive hemodynamic monitoring, perioperative transesophageal echocardiography may be valuable in clinical decision making. In this report, transesophageal echocardiography allowed the performance of early and safely cardioversion, with reversal of hemodynamic instability, and without thromboembolic sequelae.

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## PALAVRAS-CHAVE

Ecocardiografia transesofágica;  
Fibrilação atrial;  
Período perioperatório;  
Tromboembolismo;  
Anestesia

## Uso da ecocardiografia transesofágica no período perioperatório orientando a tomada de decisão durante a instabilidade hemodinâmica desencadeada por fibrilação atrial

### Resumo

*Justificativa e objetivos:* A fibrilação atrial é a arritmia cardíaca mais comum, pode ocorrer durante todo período perioperatório e gerar instabilidade hemodinâmica devido à perda da função sistólica atrial. No manejo da fibrilação atrial, a cardioversão elétrica é uma das opções terapêuticas quando há instabilidade hemodinâmica, entretanto expõe o paciente a risco de eventos tromboembólicos. A ecocardiografia transesofágica é uma ferramenta que diagnostica trombos no átrio esquerdo e apêndice atrial esquerdo com alta sensibilidade e especificidade e permite a cardioversão precoce e segura. O presente caso descreve o uso da ecocardiografia transesofágica para excluir a presença de trombos no átrio esquerdo e apêndice atrial esquerdo em um paciente submetido à cirurgia não cardíaca com fibrilação atrial de duração desconhecida e instabilidade hemodinâmica.

*Relato de caso:* Paciente, masculino, 74 anos, hipertenso, com cirurgia abdominal programada, que à monitoração cardíaca em sala operatória apresentava ritmo de fibrilação atrial não documentada em eletrocardiograma pré-operatório, porém estável hemodinamicamente. Durante a cirurgia, apresentou instabilidade hemodinâmica com necessidade de noradrenalina em doses crescentes, sem resposta ao controle de frequência cardíaca. Após o término da cirurgia, a ecocardiografia transesofágica foi feita com uma avaliação minuciosa do átrio esquerdo e apêndice atrial esquerdo e análise Doppler pulsado do apêndice atrial esquerdo com velocidade média de  $45 \text{ cm}\cdot\text{s}^{-1}$ . Foram excluídos trombo em átrio esquerdo e apêndice atrial esquerdo e outras causas cardíacas para instabilidade hemodinâmica. Dessa forma, foi feita cardioversão elétrica com segurança. Após retorno ao ritmo sinusal, o paciente apresentou melhoria dos níveis pressóricos com retirada da noradrenalina, extubação em sala operatória e transferência para unidade de terapia intensiva.

*Conclusão:* Além de ferramenta para monitoração hemodinâmica pouco invasiva, a ecocardiografia transesofágica no perioperatório pode ser valiosa na tomada de decisões clínicas. Nesse relato, a ecocardiografia transesofágica permitiu que a cardioversão fosse feita precocemente e com segurança, revertendo o quadro de instabilidade hemodinâmica sem sequelas tromboembólicas.

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## Introduction

Atrial fibrillation (AF) is one of the most common cardiac arrhythmias among all types of arrhythmias. It is characterized by a very rapid (greater than 300 beats.min<sup>-1</sup>), irregular, and disorganized atrial depolarization that induces a random and usually rapid ventricular response.<sup>1</sup> AF can occur in every perioperative period and its incidence increases with age, up to 12% in patients over 75 years of age.<sup>1</sup>

In atrial fibrillation, the combination of rapid heart rate and loss of atrial systolic function associated with altered ventricular relaxation in the elderly may result in clinical deterioration with a significant reduction in cardiac output.<sup>2</sup>

Transesophageal echocardiography (TEE) is a tool that assists with the diagnosis of left atrial (LA) thrombi and left atrial appendage (LAA) with high sensitivity and specificity allowing early electrical cardioversion.<sup>3</sup> This case report aims to describe the use of TEE to exclude the presence of thrombi in LA and LAA in a patient with AF of unknown duration, which made the option of electrical cardioversion (EC) safer to treat acute hemodynamic instability in the perioperative period.

## Case report

Written consent was obtained to report this case.

A 74-year-old male patient, 62 kg, ASA physical status 2 due to arterial hypertension, taking bisoprolol and amlodipine, was scheduled for biliodigestive shunt surgery due to unresectable papillary adenocarcinoma. In the preoperative evaluation of cardiovascular risk one month before the procedure, he was hemodynamically stable, resting echocardiography showed preserved biventricular function, ejection fraction of 67%, slightly increased left atrium (41 mm), mild mitral and tricuspid valve insufficiency. Pharmacological stress test with dipyridamole and myocardial scintigraphy showed no signs of ischemia and the electrocardiogram showed sinus rhythm, rate of 61 bpm, and blockage of the anteroposterior division of the left bundle branch. Laboratory tests showed no changes.

During operating room monitoring, the patient was at an AF rate, with heart rate (HR) of 95 bpm, invasive blood pressure (BP) of 159 × 80 mmHg, and asymptomatic from a cardiovascular standpoint. It was decided to proceed considering the hemodynamic stability. Subarachnoid anesthesia was performed with morphine (60 mcg), clonidine (60 mcg) and sufentanil (5 mcg) injected into the intrathecal space, associated with general anesthesia with sufentanil (30 mcg), etomidate (12 mg), rocuronium (36 mg) and lidocaine (60 mg) without vasoconstrictor. Anesthesia was maintained with titrated sevoflurane to maintain the bispectral index between 45 and 60.

After anesthetic induction, the patient had a HR increase to 140–160 bpm and progressive BP decline, even with repeated doses of metaraminol. To maintain hemodynamic stability, continuous infusion of noradrenaline was started at 0.1 mcg.kg<sup>-1</sup>.min<sup>-1</sup> and increasing doses of metoprolol to control HR. During the procedure, despite the reduction in heart rate (90–100 bpm), there was a progressive need to increase the noradrenaline dose to 0.25 mcg.kg<sup>-1</sup>.min<sup>-1</sup>,

and intraoperative laboratory tests showed an increase in arterial lactate.

The surgical procedure lasted 2 h, with minimal blood loss. The total infusion of Ringer's Lactate solution was 1500 mL and diuresis of 250 mL.

After the end of the procedure a second anesthesiologist performed TEE examination to exclude thrombi or clots in LA and LAA in order to proceed with electrical cardioversion for atrial fibrillation more safely. Thus the TEE probe (X7-2t transesophageal catheter, Philips Healthcare®, Andover, Massachusetts) was positioned and examination of cardiac function and structure was performed, which showed no signs of another etiology for hemodynamic instability. After analysis of LA and LAA in mid-esophageal two chambers (ME 2C) (Fig. 1A), mid-esophageal four chambers (ME 4C) (Fig. 1B), and mid-esophageal aortic valve axis (Fig. 1C) views, the presence of thrombi in LA and LAA was excluded (Fig. 1).

AF rhythm was confirmed by LAA movement and transmural pulsed Doppler flow without A wave. A pulsed Doppler was performed in LAA, which showed flows with an average velocity of 45 cm.s<sup>-1</sup> (Fig. 2). After examination, 10,000 IU of unfractionated heparin was administered and EC was performed with 100 J with sinus rhythm return with bradycardia followed by rate normalization after a few minutes.

After returning to sinus rhythm, the patient presented improvement in blood pressure levels with complete withdrawal of noradrenaline. He was extubated in the operating room and taken to the Intensive Care Unit (ICU). He evolved without signs or symptoms of thromboembolism and was discharged after three days of hospitalization, with full anticoagulation for four weeks and follow-up by an arrhythmologist.

## Discussion

Atrial fibrillation management in emergency situations should aim to control the rapid ventricular rate, which can be achieved both with the use of drugs that block atrioventricular conduction, such as beta blockers and digitalis, calcium channel blockers (Recommendation: Class I, LOE:B),<sup>3,4</sup> and by sinus rhythm restoration through electrical cardioversion (Recommendation: Class I; LOE:C).<sup>4,5</sup> Return to sinus rhythm may present a risk of thromboembolism, particularly if arrhythmia is present for more than 48 h.<sup>5</sup>

Our patient had no previous diagnosis of AF and, therefore, the date of arrhythmia onset was unknown. As a first step after intraoperative hemodynamic instability we attempted to control ventricular rate with increasing doses of beta-blocker, which did not lead to an improvement in hemodynamic status. In such cases electric cardioversion would be recommended for heart rate control.<sup>4</sup> However, because the presence of thrombi in LA or LAA was not known we opted to wait for the end of the surgery and perform TEE examination to exclude the presence of thrombi, in addition to excluding other causes of cardiac origin for hemodynamic instability.

One of the great advantages of TEE is that it provides enhanced visibility of posterior heart structures, such as LA and LAA. The sensitivity and specificity of TEE for left atrial thrombi are 100% and 99%, respectively.<sup>6</sup> An organized thrombus is echocardiographically defined as a



Figure 1 ME 2C (A), ME 4C (B), and ME AV short axis (C) LAA evaluation.

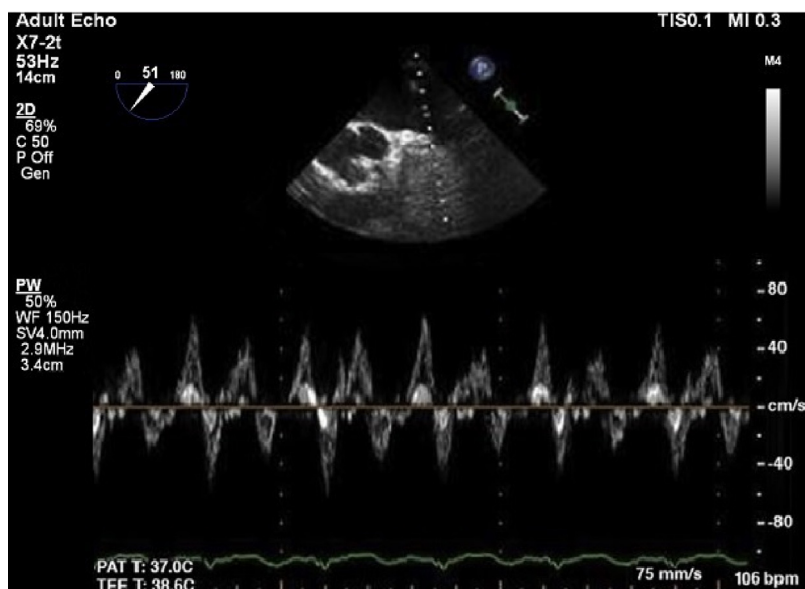


Figure 2 Pulsed Doppler LAA evaluation.

well-circumscribed mass of uniform consistency and a texture different from that of the atrial wall.<sup>7</sup> In addition to thrombus evaluation, TEE can identify the presence of spontaneous contrast (SC) in LA, which presents as a non-circumscribed, dynamic localization image with the appearance of “cigarette smoke”.<sup>7</sup> This image phenomenon occurs due to the slowing of blood flow and is considered a predictor for thrombus formation.<sup>8</sup>

The most easily views to assess LA are the mid-esophageal ones, such as: ME 4C, ME 2C, ME AV short axis, mid-esophageal long axis (ME long axis), and mid-esophageal bicaval.<sup>7</sup> LAA is best viewed in ME 2C (80–100%) and ME AV short axis (30–60%), and are recommended for this structure evaluation in most patients.<sup>8</sup> Additional cross-sections for LAA analysis can be achieved using the ME AV short axis view (30–60%) and then probe anteflexion and multiplanar angle rotation progressively from 0° to 180°. This allows complete delineation of LAA anatomy.<sup>8</sup> In the present case, LA and LAA were meticulously examined through ME 4C, ME 2C, ME AV short axis, mid-esophageal long axis (ME long axis) and mid-esophageal bicaval, excluding the presence of thrombi and EC.

Blood flow velocity in LAA should be analyzed, as this measurement can provide a risk assessment for thrombi formation. Pulsed Doppler should be placed 1–2 cm from the LAA ostium, and velocities below  $27 \text{ cm}\cdot\text{s}^{-1}$  are associated with the formation of spontaneous contrast, thrombi, and thromboembolic events.<sup>7</sup> The blood flow pattern during AF in LAA often appears as “saw tooth” waves with varying amplitude and regularity. As a result, the measured velocity values should be calculated as the average of 5–10 beats.<sup>8</sup> In this case report, the average LAA flow velocity measured was  $45 \text{ cm}\cdot\text{s}^{-1}$ ; therefore, above the values considered as risk for thrombus formation.

Early TTE-guided cardioversion in patients with AF of unknown or more than 48 h duration without prior anticoagulation may be considered if TEE shows absence of left atrial thrombi (Recommendation: Class IIa; LOE:B).<sup>4</sup> In this early approach, patients should be anticoagulated during and after cardioversion for four weeks.<sup>4</sup> In the present case, TEE excluded the presence of thrombi, and attack dose of non-fractionated venous heparin was given before electrical cardioversion and anticoagulation was maintained in ICU.

## Conclusion

With the popularization and training of TEE in the peri-operative period, besides being used as a noninvasive hemodynamic monitor, this tool can be valuable in clinical decision making. Faced with an AF with hemodynamic instability, TEE allowed cardioversion to be performed safely and reversed the hemodynamic instability without thromboembolic sequelae.

## Conflicts of interest

The authors declare no conflicts of interest.

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