American Journal of Case Reports

e-ISSN 1941-5923
© Am J Case Rep, 2018; 19: 171-175
DOI: 10.12659/AJCR.907143

Received: 2017.09.15
Accepted: 2017.10.25
Published: 2018.02.15

Successful External Cardioversion via Fluoroscopic Electrode Positioning in Patients with Enlarged Trans-Thoracic Diameter

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEFG 1,2 Koroush Khalighi
ABCDEFG 2 Amirsina Talebian
ABCDEFG 2,3 Rubinder Singh Toor
ABCDEFG 4 Seyed Abbas Mirabbasi

1 Department of Cardiology, Easton Hospital, Drexel University School of Medicine, Easton, PA, U.S.A.
2 Easton Cardiovascular Associates, Cardiovascular Institute, Easton, PA, U.S.A.
3 Milken Institute School of Public Health, George Washington University, Washington, DC, U.S.A.
4 Department of Internal Medicine, Easton Hospital, Drexel University School of Medicine, Easton, PA, U.S.A.

Corresponding Author: Koroush Khalighi, e-mail: koroushkhalighi@gmail.com
Conflict of interest: None declared

Case series
Patient: Female, 71 • Male, 48 • Male, 74
Final Diagnosis: Failed cardioversion
Symptoms: Dizziness • dyspnea • fatigue • palpitations
Medication: Ace Inhibitors • Beta Blockers • Calcium Channel Blockers • Dronedarone • Novel Oral Anticoagulants • Warfarin
Clinical Procedure: Fluoroscopic cardioversion • radiofrequency catheter ablation
Specialty: Cardiology

Objective: Unusual setting of medical care

Background: Atrial fibrillation is the most common cardiac arrhythmia. It increases the risk of stroke by at least five-fold and is associated with higher risk for mortality and morbidity. Therefore, prompt diagnosis and treatment is crucial. In addition to anti-coagulation therapy, electrical and pharmacological cardioversion to restore sinus rhythm remains the standard of care. The most common and effective method for electrical cardioversion is achieved with placement of electrodes in the anteroposterior position.

Case Report: We present three cases of patients with initial unsuccessful cardioversion attempts for persistent atrial fibrillation. These patients had elevated body mass indices and large trans-thoracic diameters. Their initial external cardioversion via the conventional method was not successful for restoration of sinus rhythm. This failure may have been attributed to their body habitus. To ensure that the current would traverse through the atrial tissue, the electrode pads were applied using fluoroscopic guidance for adequate myocardial depolarization.

Conclusions: Optimal fluoroscopic placement of the electrode pads during external cardioversion procedure increases the odds of successful restoration of sinus rhythm when compared to the conventional method.

MeSH Keywords: Antiarrhythmic Agents • Anticoagulants • Atrial Fibrillation • Cardioversion • Catheter Ablation • Electric Countershock • Fluoroscopy

Full-text PDF: https://www.amjcaserep.com/abstract/index/idArt/907143

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Background

Among the various types of arrhythmia of the heart, atrial fibrillation (AF) is the most common and is associated with increased risk of ischemic heart disease, myocardial infarction and embolic stroke. In fact, the risk of embolic stroke is increased by up to five-fold [1,2]. AF is an atypical heart rhythm characterized by rapid and irregular beating [3].

The prevalence of AF increases with advancing age and is more common among men than women. Among patients 50 years of age and older, AF is more common among whites than blacks [4]. In 2010, the prevalence of AF in the United States was 2.7 million to 6.1 million and it is expected to increase to 12.1 million by 2030. In 2014, AF was responsible for more than 130,000 deaths [5].

There are different methods to convert patients with AF back into normal sinus rhythm. These include, but are not limited to, pharmacological and electrical methods. The electrical method is done by delivering a direct-current (DC) across the atrial myocardium. Electrical cardioversion can be achieved either with an external method or an internal transvenous intra-cardiac method via a percutaneous electrode placed under fluoroscopic guidance [6].

In general, for patients with AF, the conventional external method involves placement of the electrical pads in the anteroposterior position. This method reduces energy requirements and is more successful in converting patients to normal sinus rhythm versus the anterolateral position. However, if conventional electrode placement fails, fluoroscopic placement of electrode pads can improve the success rate for restoration of normal sinus rhythm [7]. The anteroposterior method involves application of self-adhesive electrode pads placed both anteriorly and posteriorly over the right aspect of the sternal body and inferior angle of the left scapula, respectively. This placement ensures that the current between the pads traverses through the atrial muscle [8].

Case Report

Case 1

A 71-year-old morbidly obese female presented with a history of hypertensive cardiovascular disease, coronary artery

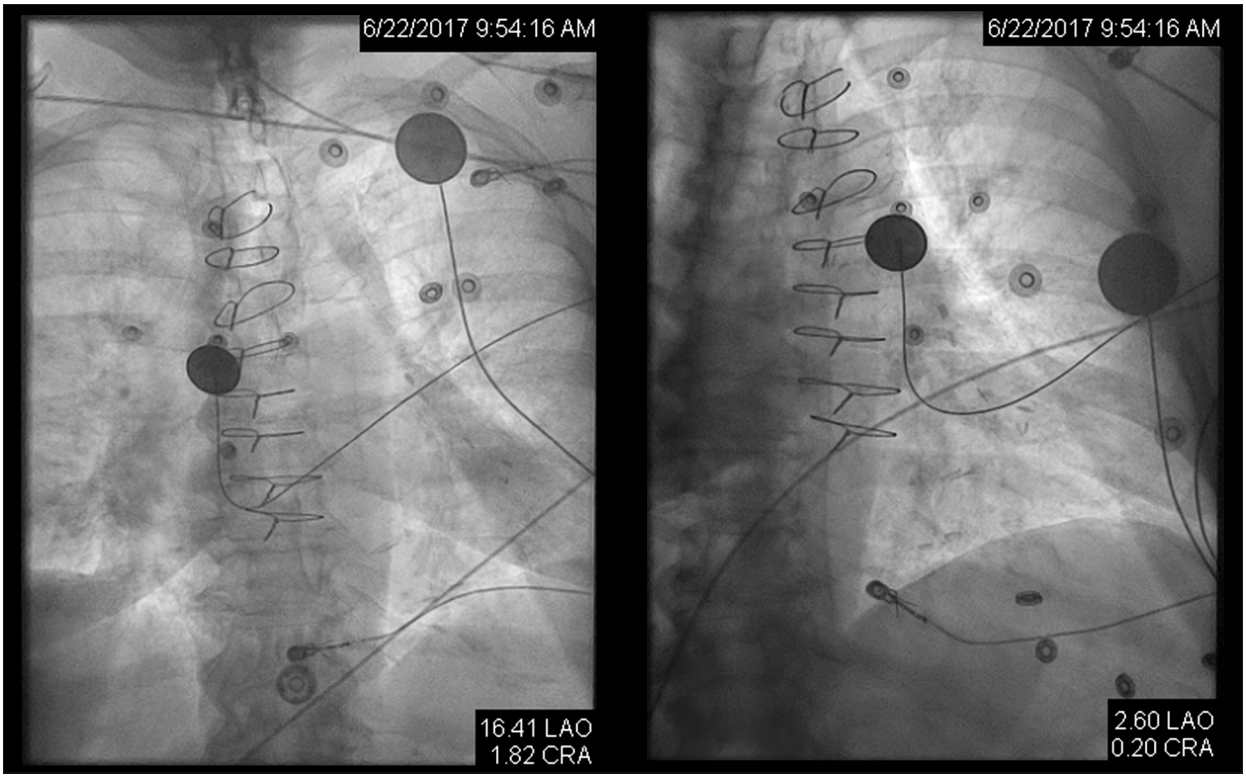

Figure 1. LAO view. The left photograph depicts the electrodes placed in anteroposterior position. The larger circle is the anterior electrode and the smaller circle is the posterior electrode. This conventional positioning of electrodes failed to convert the patient to normal sinus rhythm. The right photograph depicts the electrodes placed by fluoroscopic guidance. The larger circle is the anterior electrode and the smaller circle is the posterior electrode. This position of the electrodes allowed the current to transverse between the electrodes through the atria and converted the patient to sinus rhythm.

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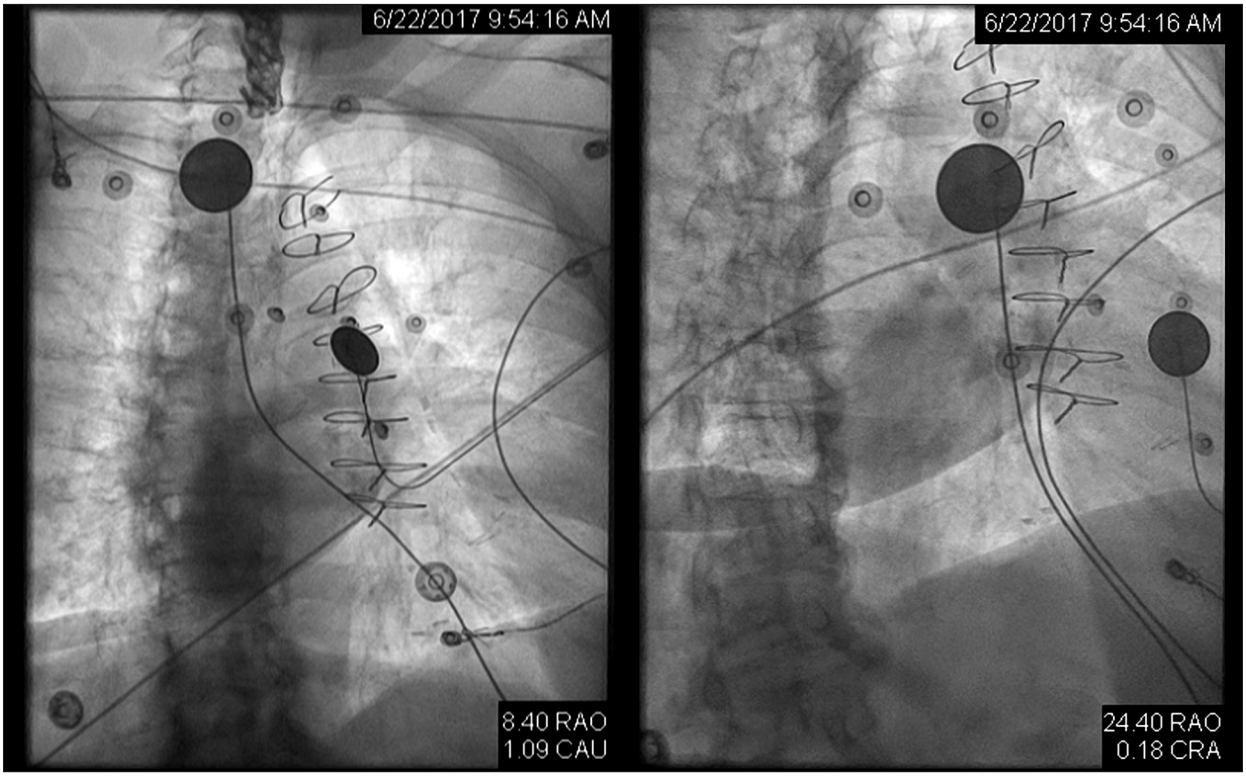

Figure 2. RAO view. The left photograph depicts the electrodes placed in anteroposterior position. The larger circle is the anterior electrode and the smaller circle is the posterior electrode. This conventional positioning of electrodes failed to convert the patient to normal sinus rhythm. The right photograph depicts the electrodes placed by fluoroscopic guidance. The larger circle is the anterior electrode and the smaller circle is the posterior electrode. This position of the electrodes allowed the current to transverse between the electrodes through the atria and converted the patient to sinus rhythm.

disease and status-post coronary artery bypass grafting surgery. She also had insulin-dependent diabetes mellitus, diabetic nephropathy, congestive heart failure due to diastolic dysfunction, and paroxysmal AF. Being five feet two inches tall with a weight of 256 pounds her body mass index (BMI) was 46.8 kg/m^2. She was anticoagulated with warfarin and her blood pressure was treated with carvedilol and lisinopril.

Initially, she underwent an unsuccessful external cardioversion with synchronized 200, 360 and again at 360 joules biphasic DC counter-shocks. She was then prescribed dronedarone to improve the odds of restoring sinus rhythm. Two weeks later, she had another failed cardioversion attempt. Subsequently, she had a successful cardioversion after applying the electrode pads fluoroscopically so that the current vector would traverse the atrial myocardium more effectively (Figures 1, 2). She later underwent a successful radiofrequency catheter ablation with pulmonary vein isolation to prevent future episodes of recurrent AF.

Case 2

A 48-year-old morbidly obese male with a history of hypertensive cardiovascular disease, severe obstructive sleep apnea and gastroesophageal reflux disease presented with recurrent symptomatic AF. Being six feet nine inches tall with a weight of 448 pounds his BMI was 48 kg/m^2. He was anticoagulated with apixaban.

He was initially diagnosed with paroxysmal AF in 2010 with brief spontaneous episodes. Four years later, he underwent an elective conventional external cardioversion due to persistent symptomatic AF. Several weeks later, he required flecainide therapy and cardioversions using up to 360 joules biphasic DC counter-shocks. On subsequent recurrences of AF, an attempted cardioversion was unsuccessful, possibly related to recent weight gain and non-compliance to healthy lifestyle modification. Successful conversion to sinus rhythm was achieved by external cardioversion using the fluoroscopic placement of electrode pads with synchronized biphasic 360 joules DC counter-shock (Figure 3). Due to his young age, and since he did not want to be on chronic anti-arrhythmic therapy, he underwent a radiofrequency catheter ablation with pulmonary vein isolation to prevent future episodes of recurrent AF.

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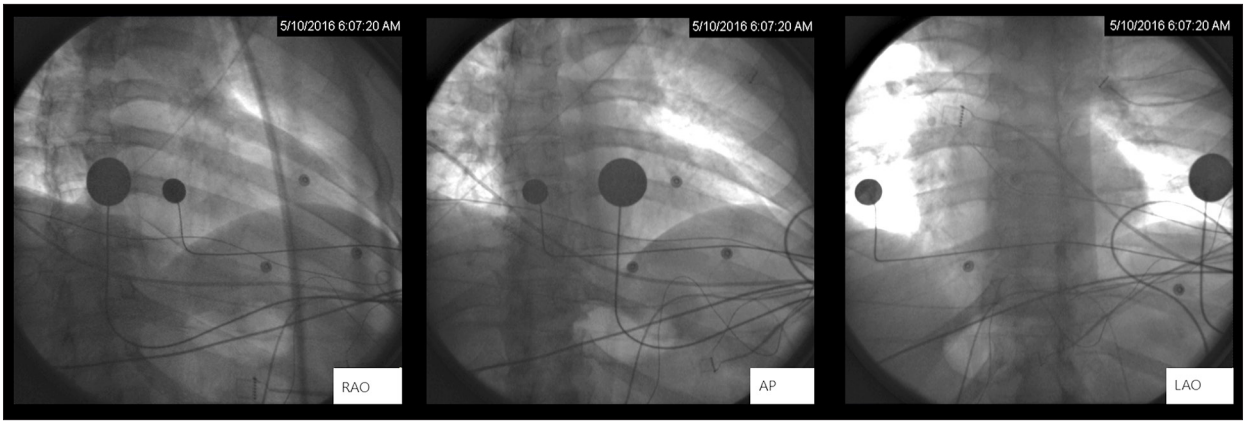

Figure 3. The left photograph is the RAO view; the middle photograph is the AP view; the right photograph is the LAO view. The electrodes were placed under fluoroscopic guidance to ensure that the current between the electrodes traversed the atria efficiently. This positioning converted the patient to sinus rhythm.

Case 3

A 74-year-old morbidly obese male presented with a history of hypertensive cardiovascular disease, coronary artery disease, status-post percutaneous coronary angioplasty, dyslipidemia, moderate obstructive sleep apnea and recurrent AF. Being five feet eight inches tall with a weight of 270 pounds his BMI was 41 kg/m^2. He was anticoagulated with apixaban. He had also been treated with beta-blockers, ACE inhibitors and calcium channel blockers (diltiazem) for over one year.

He presented to the emergency department with palpitations, fatigue and dizziness. The patient was first treated with a conventional external cardioversion which was unsuccessful. The electrode pads were then placed under fluoroscopic guidance which resulted in restoration of sinus rhythm with a biphasic 360 joules DC counter-shock. He was treated with dronedarone to maintain sinus rhythm and later underwent a successful radiofrequency catheter ablation with pulmonary vein isolation to prevent future episodes of AF.

Discussion

AF is the most common cardiac arrhythmia. According to the Framingham Heart Study, AF has a 1.5 to 1.9-fold increase in mortality risk, after adjusting for coexisting cardiovascular conditions. Common conditions associated with mortality in AF include congestive heart failure and systemic thromboembolism [9,10].

According to the American College of Cardiology (ACC) and the American Heart Association (AHA) guidelines, treatment for AF consists of pharmacological therapy for rate and rhythm control. For anticoagulated patients who have persistent AF with symptoms, electrical and/or pharmacological cardioversion is recommended. Radiofrequency catheter ablation as well as cryoablation both have high success rates in maintenance of sinus rhythm and are considered the best alternatives for patients who have failed medical therapy. Although all the aforementioned procedures are targeted for symptomatic relief, several studies have demonstrated significant mortality and morbidity benefits by these methods [6,9,11].

Up to 30% of patients with persistent AF may fail to convert to sinus rhythm via conventional external DC cardioversion [12]. The success rate can be significantly increased for external DC cardioversion when the electrode pads are readjusted to the anteroposterior position and by applying manual pressure to the pads [6]. Chest size is an important factor in determining trans-thoracic impedance and it has been found that using larger electrode pads and applying manual pressure to them can increase the chance of successful external cardioversion [13]. Success rate of external DC cardioversion is further increased when positioning the electrodes with fluoroscopic guidance [7]. If external DC cardioversion is not successful despite repositioning electrodes under fluoroscopic guidance, internal cardioversion may be attempted and has shown to be more effective than external cardioversion for restoration of sinus rhythm [7,14,15].

Our patients initially underwent unsuccessful conventional external DC cardioversions. This failure may have been due to the patients being obese and having an increased trans-thoracic diameter. When the electrode pads were adjusted based on fluoroscopic guidance, to ensure the maximum atrial myocardial mass depolarization, sinus rhythm was restored.

Conclusions

Optimal fluoroscopic placement of the electrode pads during external cardioversion procedure can increase the odds for

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successful restoration of sinus rhythm. This report includes three cases where utilization of fluoroscopic imaging enhanced cardioversion success rate. For further validation of this technique, additional prospective studies with a larger sample size may be required.

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