

## Refractory unstable atrial fibrillation in a young Ethiopian patient with rheumatic heart disease: insights and challenges

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### ABSTRACT

*We report a case of a 28-year-old female with chronic rheumatic valvular heart disease and poor medication adherence presenting with unstable, refractory atrial fibrillation. Initial bedside point-of-care ultrasound examination demonstrated significant bi-atrial dilatation, mitral valve thickening, moderate mitral regurgitation, and severe tricuspid regurgitation. Despite multiple attempts at electrical cardioversion, the patient was not successfully cardioverted. Intravenous amiodarone was subsequently administered as a form of chemical cardioversion, leading to stabilization and successful conversion to sinus rhythm. This single case suggests that significant structural and valvular heart disease in atrial fibrillation may be a negative predictive factor for unsuccessful electrical cardioversion. In these cases, consideration should be given to chemical cardioversion with medications such as amiodarone as a potential first-line strategy over electrical cardioversion.*

**Keywords:** atrial fibrillation, amiodarone, refractory atrial fibrillation, rheumatic heart disease

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## 1. Introduction

Atrial fibrillation is the most prevalent prolonged heart arrhythmia and is typified by irregular automatic firing with the existence of several interacting re-entry circuits that loop around the atria, which leads to suboptimal cardiac output. Rapid bursts of ectopic beats originating from sick atrial tissue or muscular sleeve tissue in the pulmonary veins frequently start atrial fibrillation episodes.<sup>(1)</sup>

Currently, rhythm and rate control medications and electrical cardioversion are the cornerstones of acute treatment. Amiodarone is the most effective medication for controlling rhythms.<sup>(1)</sup>

Electrical cardioversion is a safe and effective procedure in patients with tachyarrhythmias. With the procedural safety and effectiveness confirmed more than 40 years ago, it is now widely used in the management of unstable atrial fibrillation.<sup>(2)</sup> Here, we present a case of amiodarone's effectiveness as a pharmacologic cardioversion agent in acutely unstable atrial fibrillation with pre-existing structural and valvular heart disease.

## 2. Case report

A 28-year-old female with a history of chronic rheumatic valvular heart disease presented to the emergency department with one month of worsening shortness of breath, dry cough, generalized fatigue, and abdominal distension. She had recently self-discontinued her prescribed medications (furosemide 40 mg PO BID, spironolactone 25 mg PO daily, and metoprolol tartrate 25 mg PO daily) for an unspecified duration.

On presentation, her airway was patent, and she was breathing comfortably with a respiratory rate of 16 breaths per minute and oxygen saturation of 97% on room air. Supplemental oxygen at 3 L/min was initiated for patient comfort. Her blood pressure was 90/65 mmHg, and the apical heart rate was 160 beats per minute, irregularly irregular.

Physical examination revealed raised jugular venous pressure, an active precordium, and a grade IV holosystolic murmur best heard at the apex and radiating to the axilla. Her abdomen was distended with a positive fluid wave test, and there was trace bilateral pedal edema.

The patient was placed on continuous cardiac monitoring, and an electrocardiogram was completed, which demonstrated atrial fibrillation with rapid ventricular response (heart rate 160–184 bpm). The patient deteriorated clinically, as subsequent vitals revealed an apical heart rate of 180 bpm, persistent hypotension (at times an undetectable blood pressure on automatic monitors), and delayed capillary refill.

Bedside point-of-care ultrasound (POCUS) was performed during ongoing resuscitation and management using a Phillips Lumify device. POCUS findings included bilateral pleural effusions and free fluid in the abdomen. Four cardiac views were obtained, including subcostal, parasternal long, parasternal short, and apical four-chamber. Cardiac POCUS demonstrated significant bi-atrial dilatation with the left atrium larger than the right atrium (Figure 1). Valvular assessment revealed mitral valve thickening (posterior leaflet greater than the anterior leaflet) (Figures 2 and 3) with a hockey stick appearance of the anterior leaflet (Figure 2). Findings were consistent with suspected mitral stenosis. Qualitative assessment with color Doppler suggested moderate mitral regurgitation (Figure 4) and severe tricuspid regurgitation (Figure 5). Overall, findings were in keeping with the patient's history of rheumatic heart disease with significant bi-atrial dilatation as described.

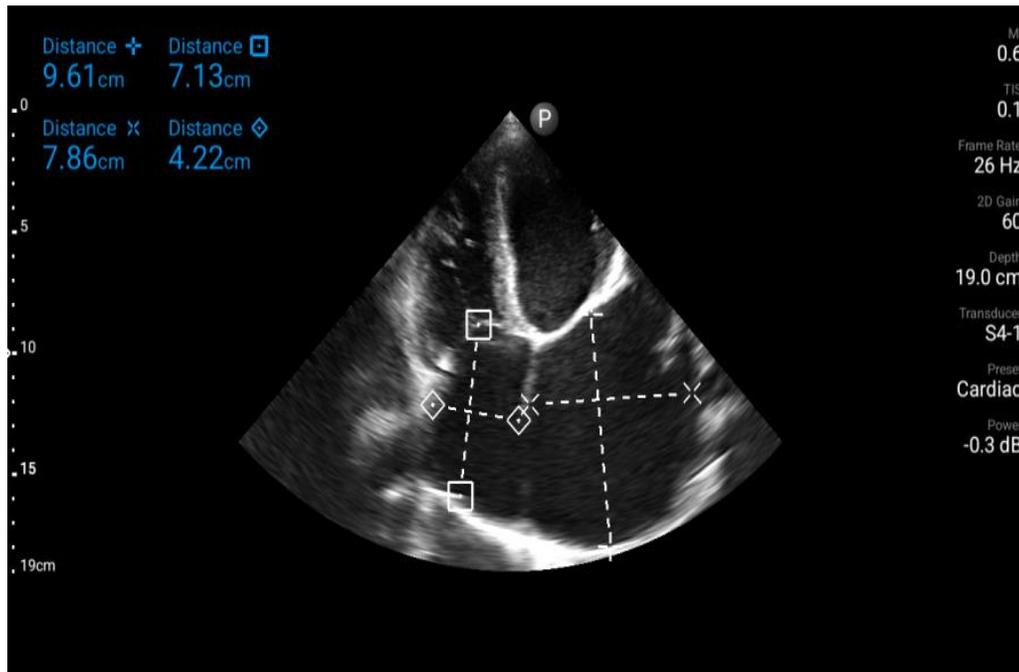


Figure 1. Apical four-chamber view with the left atria measuring 9.61cm x 7.86cm and the right atria measuring 7.13cm x 4.22cm.



Figure 2. Subcostal view demonstrating mitral leaflet thickening (posterior > anterior) and hockey stick appearance of anterior mitral leaflet.



Figure 3. Subcostal view showing left atrial dilation and mitral leaflet thickening.

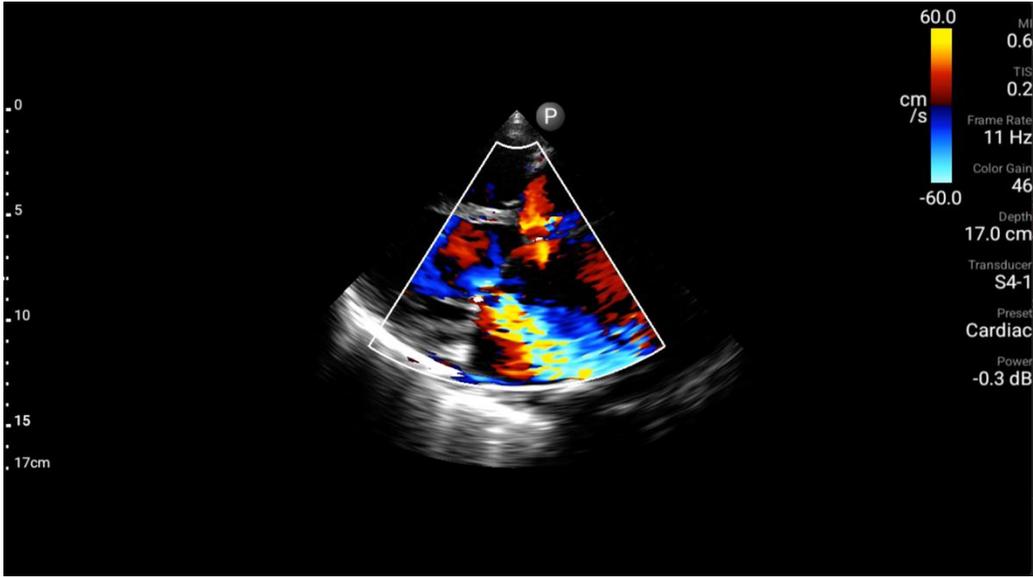
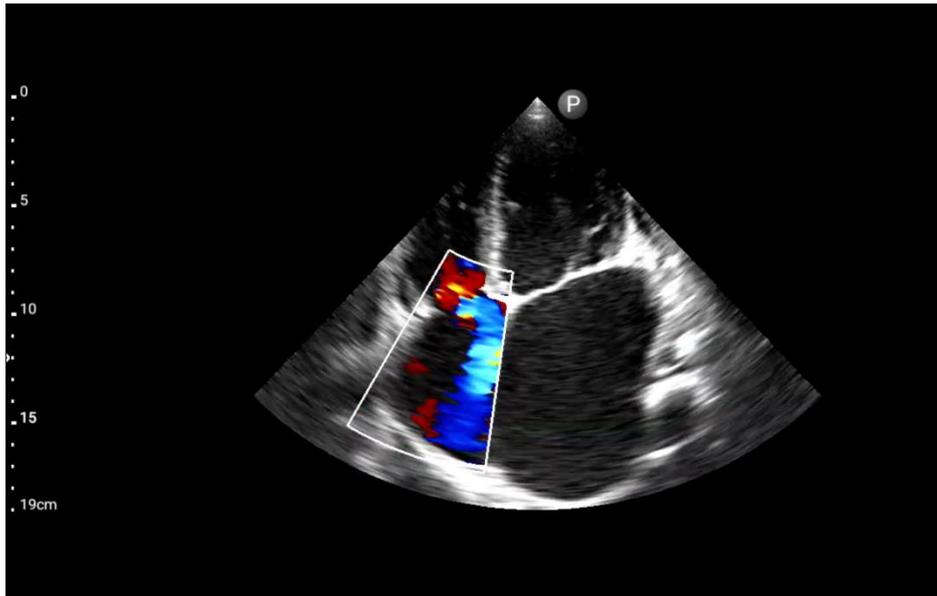


Figure 4. Parasternal long view with color doppler demonstrating moderate mitral regurgitation.



**Figure 5. Apical four-chamber view with color Doppler showing severe tricuspid regurgitation**

Due to the patient's unstable hemodynamics, synchronized electrical cardioversion was attempted after obtaining informed consent from the patient and her family. Ketamine 100 mg IV was administered for sedation, and unfractionated heparin 5000 IU IV was given for anticoagulation. The first attempt at cardio-version with 100 Joules (J) was unsuccessful. Subsequent attempts with escalating energy levels (150 J, 200 J x3) did not convert the patient's dysrhythmia. Despite five rounds of attempted cardioversion, the rhythm remained atrial fibrillation at a rate of 160-184bpm, with ongoing hypotension that was undetectable by the monitor.

Digoxin 0.25 mg IV was administered, but because of its longer half-life, it did not rapidly control heart rate or improve hemodynamics. Amiodarone 150 mg IV in 100ml of D5W over 10 minutes was then administered as a loading dose, successfully converting the rhythm to sinus and stabilizing the heart rate between 100 and 120 bpm. The patient

also received 2 g of magnesium sulfate IV to address suspected electrolyte imbalances, as initial laboratory investigations were not immediately available.

Subsequent laboratory investigations revealed hyponatremia (128 mmol/L), hypokalemia (3.25 mmol/L), slightly elevated magnesium of 2.65 mg/dL (normal range: 1.7-2.10 mg/dL), and low ionized calcium of 1.06 mmol/L (normal range: 1.1-1.35 mmol/L). Hematological analysis demonstrated thrombocytopenia with a platelet count of 73,000/ $\mu$ L (reference range: 182,000–369,000/ $\mu$ L), a hemoglobin level of 11.4 g/dL (reference range: 11.2–15.7 g/dL), and a hematocrit of 32.7% (reference range: 34.1–44.9%). The white blood cell count was mildly elevated at 10,640/ $\mu$ L (reference range: 3.98–10.04/ $\mu$ L), with a neutrophil predominance of 62.4% and elevated liver enzymes (ALT 175 IU/L, AST 169 IU/L). The patient was transferred to the cardiac ICU for further management, with an amiodarone infusion initiated at

1mg/minute over six hours and 0.5 mg/minute over the next 18hours.

### 3. Discussion

Approximately one-third of hospitalizations for cardiac rhythm abnormalities are due to atrial fibrillation, making it the most prevalent arrhythmia in clinical practice.<sup>(3)</sup> As the population ages and the prevalence of chronic heart disease rises, hospital admissions for atrial fibrillation are expected to increase further.<sup>(4)</sup>

The prevalence of atrial fibrillation in sub-Saharan African patients aged >40 and >70 was 4.3% and 0.7%, respectively. Risk factors for atrial fibrillation in the African population were valvular heart disease, hypertension, and cardiomyopathy.<sup>(5)</sup> A study in Bahirdar, Ethiopia, in 2023 looked at patients with rheumatic heart disease and found an even higher prevalence of atrial fibrillation at 43%, which is relevant to our case.<sup>(6)</sup>

Acute atrial fibrillation treatment objectives may include 1) AV nodal blocking agents to regulate ventricular rate, 2) anticoagulants to prevent thromboembolic events, and 3) first- and third-class antiarrhythmic medications to convert dysrhythmias to normal sinus rhythm (NSR). The preferred treatment of atrial fibrillation for hemodynamically unstable patients presented with syncope, hypotension, and chest pain is emergent electrical cardioversion. Therefore, pharmaceutical conversion techniques are only recommended for patients who are resistant to electrical cardioversion or who do not exhibit urgent symptoms.<sup>(7)</sup>

Atrial fibrillation is the most frequent electrically converted arrhythmia. In addition to patient-specific characteristics, transthoracic impedance, electrode positioning, and waveform type are the main determinants of electrical cardioversion success<sup>(2)</sup>. Initial success of electrical cardioversion may not be predicted by the patient's age. Long

atrial fibrillation duration (>3 months), left atrium chamber size greater than 4.5, and prolonged alcohol use may be linked to a lower electrical cardioversion success rate, and serial electrical cardioversion may yield better results. According to multiple studies, the initial success rate of electrical cardioversion for atrial fibrillation ranges from 50% to 90%; however, only 50% of patients maintain sinus rhythm after a year.<sup>(8)</sup> The success rate of outpatient electrical cardioversion was found to be 88.6%, and the complication rate was low. However, atrial fibrillation recurred in 55.5% within 3 months.<sup>(9)</sup>

A common antiarrhythmic drug used in practice for both ventricular and atrial arrhythmias is amiodarone. It affects every stage of the cardiac action potential and is predominantly categorized as a class III antiarrhythmic.<sup>(10)</sup> The pharmacokinetics includes wide tissue distribution (40-84 L/kg), slow total body clearance (90-158 mL/h/kg), long terminal elimination half-life (20-47d), and extensive hepatic metabolism. Amiodarone is comparatively safe for patients with structural heart disease and patients with reduced left ventricular function. However, amiodarone is not superior to other antiarrhythmic medications typically used for pharmacological cardioversion of new-onset atrial fibrillation, such as flecainide and propafenone.<sup>(10)</sup> Despite being one of the safest antiarrhythmic drugs for patients with a low ejection fraction or clinical heart failure, amiodarone has notable negative inotropic effects that might cause hypotension in patients with depressed cardiac function. Individuals most at risk for this complication include patients who have had cardiac surgery, critically ill patients in shock, and patients with heart failure with an ejection fraction less than 35%<sup>(11)</sup>. It can also cause moderate hypotension, bradycardia, phlebitis, and allergic reactions.<sup>(9)</sup>

There are a variety of other antiarrhythmic drugs that are frequently used in the treatment of atrial

fibrillation. Flecainide and propafenone are both Class Ic sodium channel blockers that have slow association and dissociation of these channels in the myocardium. They are often administered to prevent paroxysmal atrial fibrillation episodes but are contraindicated in individuals with structural heart disease, such as our case patient, due to the risk of ventricular arrhythmia according to the Cardiac Arrhythmia Suppression Trials.<sup>(12)</sup>

Another antiarrhythmic that is frequently used for immediate pharmacologic cardioversion is procainamide, a Class Ia agent. While therapeutic levels are quickly achieved, it is known to cause hypotension with rapid administration and exacerbate heart failure symptoms in patients with pre-existing congestive heart failure.<sup>(13)</sup> Ibutilide, a Class III potassium channel blocker, has also demonstrated a significant conversion rate of up to 75-80% in patients with recent onset atrial fibrillation.<sup>(14)</sup> However, a notable adverse complication is monomorphic ventricular tachycardia, which is estimated to be as high as 4.9%. Therefore, the use of ibutilide requires at least 4 hours of post-infusion monitoring, which is suboptimal in a crowded, bed-blocked emergency department setting. Moreover, in a meta-analysis comparing the efficacy and safety profiles of amiodarone and ibutilide for the treatment of atrial fibrillation, the time to successful cardioversion was shorter in the amiodarone group, and the rate of cardiovascular adverse effects was higher in those treated with ibutilide.<sup>(15)</sup> Amiodarone appears to be the most effective and recommended drug in patients with frequent, recurrent, symptomatic atrial fibrillation, especially in the presence of structural heart disease.<sup>(16)</sup>

Maintaining normal sinus rhythm in patients with AF can be particularly challenging. In this case report, we present a patient with refractory atrial fibrillation likely secondary to advanced structural and valvular heart disease as possible predictive factors for unsuccessful electrical cardioversion.

Here, we demonstrated that amiodarone was successfully used to chemically cardiovert the atrial fibrillation to sinus rhythm.

#### 4. Conclusion

In this case, a 28-year-old female with chronic rheumatic valvular heart disease and severe mitral regurgitation presented with acute atrial fibrillation with rapid ventricular response. Initial management with digoxin and electrical cardioversion was unsuccessful, highlighting the challenges of achieving rate, rhythm control, and hemodynamic stability in patients with significant structural heart disease and persistent AF.

Amiodarone, administered as an intravenous bolus followed by infusion, successfully stabilized the heart rate and converted AF to sinus rhythm. This case underscores the importance of tailored management strategies in complex AF cases, especially in patients with underlying valvular pathology. The findings support the use of amiodarone as an effective option for pharmacologic cardioversion in similar clinical scenarios, while also emphasizing the need for careful monitoring of potential adverse effects.

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#### Competing interests

The authors declare no conflicts of interest.

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