



ORIGINAL ARTICLE

## Characterization of biatrial function in patients with atrial fibrillation reverted to sinus rhythm

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### ABSTRACT

**Introduction:** atrial fibrillation is a common cardiac rhythm disorder that accounts for about one third of hospital admissions due to cardiac arrhythmia. Its true incidence is underestimated because of the high percentage of asymptomatic cases, with diagnosis often being incidental.

**Objective:** to characterize biatrial function by echocardiography in patients with atrial fibrillation after recovery of sinus rhythm following pharmacological or electrical cardioversion.

**Methods:** an observational, descriptive, cross-sectional study was conducted in the cardiology service of the Provincial Clinical-Surgical Hospital "Celia Sánchez Manduley" of Manzanillo, Cuba, during the period 2020–2022. The study population consisted of all patients admitted to the cardiology ward with recent-onset atrial fibrillation (n=100). Descriptive statistics were used for data analysis, calculating absolute and relative frequencies.

**Results:** male sex was predominant (72 %), and ages between 55 and 64 years were the most affected (25 %). Pharmacological cardioversion was the most frequently used medical treatment in patients with atrial fibrillation (61 %). Echocardiographic parameters were found within normal values after the applied cardioversion.

**Conclusions:** atrial fibrillation represents a challenge for the medical community. It is more frequent after the fifth decade of life, and pharmacological cardioversion is the most commonly employed medical treatment. Echocardiographic parameters remain within normal values, with biatrial function stable after cardioversion.

**Keywords:** ARRHYTHMIAS, CARDIAC; ATRIAL FIBRILLATION; THERAPEUTICS.

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## INTRODUCTION

Cardiovascular diseases are the leading cause of death worldwide. Atrial fibrillation (AF) is a common heart rhythm disorder that accounts for approximately one-third of hospital admissions for cardiac arrhythmias, representing a significant subset within this condition. Its true incidence is underestimated due to the high percentage of asymptomatic cases, and its diagnosis is often incidental.<sup>(1,2,3)</sup>

Atrial fibrillation (AF) is defined by the lack of organized electrical and mechanical atrial activity. The loss of atrial contribution to ventricular filling and the rapid heart rate result in hemodynamic alterations that can lead to heart failure. Furthermore, the increased myocardial oxygen consumption, evidenced by a high ventricular response, can lead to secondary myocardial ischemia in patients with coronary artery disease.<sup>(3,4,5)</sup>

The clinical presentation may be asymptomatic or characterized by symptoms such as fatigue, palpitations, dyspnea, hypotension, syncope, and heart failure. Most patients with atrial fibrillation have comorbidities such as hypertension, which is currently the main risk factor for atrial fibrillation, heart failure, valvular heart disease, and ischemic heart disease.<sup>(6,7,8)</sup>

Worldwide, approximately 20 million men and over 12 million women suffer from atrial fibrillation (AF), with a higher incidence in developed countries. Its prevalence worldwide is approximately 2 to 5 % in people over 60 years of age and 10 % in those aged 80 and over.<sup>(9)</sup>

In Europe and the United States, one in four adults suffers from atrial fibrillation. It is estimated that by 2030 the population affected by this disease in the European Union will be 14-17 million, with 120,000-215,000 new cases diagnosed each year.<sup>(10)</sup> In Brazil, approximately 1.5 million people suffer from atrial fibrillation, in Venezuela it is estimated that there are 230,000 individuals with this arrhythmia, and in Colombia there are around 140,000 patients with this condition.<sup>(11,12)</sup>

In 2021, Cuba recorded 44,780 deaths from heart disease, making it the leading cause of death in the country. By 2022, this figure had decreased to 32,872 cases, data that demonstrate that the Cuban National Health System has focused its efforts on creating and implementing strategies to prevent morbidity and mortality from these diseases.<sup>(13)</sup>

In Granma province, in 2022, 2,028 people died from cardiovascular diseases, for a crude rate of 373.7 per 100,000 inhabitants.<sup>(13)</sup> These conditions are the leading cause of morbidity and mortality. Understanding the risk factors that contribute to the development of cardiovascular complications and/or mortality is essential for decision-making in these patients.

The need to identify individuals with absent atrial systole due to persistent stunning during the first 24 hours, and to incorporate them into cardiovascular rehabilitation programs overseen by rehabilitation staff, reduces the rates of cardiovascular events, the need for hospitalizations and surgical intervention, and improves the quality of life of patients with acute atrial fibrillation reverted to sinus rhythm. The objective of this study is to characterize biatrial function by echocardiography in patients with atrial fibrillation after recovery of sinus rhythm following pharmacological or electrical cardioversion at the Celia Sánchez Manduley Provincial Clinical Surgical Hospital in Manzanillo, Granma.

## METHODS

An observational, descriptive, and cross-sectional study was conducted in the cardiology service of the Celia Sánchez Manduley Provincial Clinical Surgical Hospital in Manzanillo, Granma, Cuba, during the period of 2020-2022. The study population consisted of all patients admitted to the cardiology ward with atrial fibrillation after the recovery of sinus rhythm following pharmacological or electrical cardioversion (n=100). Individuals with impaired left ventricular systolic function, significant valvular heart disease, readmission for atrial fibrillation, recurrence of atrial fibrillation (previously included), and atrial fibrillation of undetermined duration were excluded from the study.

### Study variables:

- Age: was considered according to years and grouped into a ten-year interval. Scales [age in years (25-34,35-44,45-54, 55-64, 65-74 and 75 or more)].
- Sex: defined by biological sex. Scales (male and female).
- Treatment: defined as the therapy used to treat atrial fibrillation. Scales: (pharmacological cardioversion, electrical cardioversion).
- Echocardiographic assessment: evaluated by the following electrocardiographic parameters:
  - Left atrial (LA) diameter: This was identified from the ultrasound window of the cephalocaudal diameter or LA length, measured from the posterior wall to an imaginary line extending from the edge of the anterior mitral leaflet to the edge of the posterior mitral leaflet. It was considered as: normal (2,7-3,8 cm); slightly enlarged [women (3,9-4,2 cm) and men (4,1-4,6 cm)]; moderately enlarged [women (4,3-4,6 cm) and men (4,7-5,2 cm)]; severely enlarged (women greater than 4,7 cm and men greater than 5,2 cm).
  - Left atrial area: measured by planimetry from the (4C) chamber views and the (2C) chamber view at the end of ventricular systole, when the atrial chamber is at its maximum dimension. The confluence of the pulmonary veins and the left atrial appendage were excluded. It was considered as: normal (less than 20 cm<sup>2</sup>); slightly increased (20-30 cm<sup>2</sup>), moderately increased (30-40 cm<sup>2</sup>) and severely increased (greater than 40 cm<sup>2</sup>).
  - Left atrial volume: measured as the volume of the left atrium (LA). The formula used was:  $\text{area} \times \text{length}$  (LA volume =  $8/3\pi \{(A1)(A2) / (L)\}$ ). Volumes were considered as: normal [women (22-52 ml) and men (28-58 ml)]. Slightly increased [women (53-62 ml) and men (59-68 ml)]. Moderately increased [women (63-72 ml) and men (69-78 ml)]. Severely increased [women (greater than 73 ml) and men (greater than 79 ml)].
  - Left atrial volume index: was considered as: normal (22-+6 ml/m<sup>2</sup>); slightly increased (29-33 ml/m<sup>2</sup>); moderately increased (34-39 ml/m<sup>2</sup>); severely increased (greater than 40 ml/m<sup>2</sup>).
  - Left ventricular ejection fraction was calculated using Simpson's method, according to recommendations from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. It was classified as: normal ( $\geq 55\%$ ); mildly depressed (45-54 %); moderately depressed (30-44 %); and severely depressed ( $< 30\%$ ).

Data collection was carried out using a form containing the study variables found in the medical records of patients with an electrocardiographic diagnosis of atrial fibrillation. The information obtained was first recorded manually and then processed automatically using Microsoft Excel for Windows version 6.0. Statistical analysis was then performed using SPSS for Windows version 7.5. Descriptive statistics were used to analyze the data, calculating absolute and relative percentage frequencies.

The research was conducted in accordance with the basic ethical principles of autonomy, beneficence, non-maleficence, and justice. The study was carried out with the approval of the ethics committee and scientific council of the Celia Sánchez Manduley Provincial Clinical Surgical Hospital in Manzanillo. The information obtained was used solely for scientific purposes.

## RESULTS

Table 1 showed that males were predominant, representing 72 %. The 55-64 age group was the most affected by the disease, accounting for 25 %.

**Table 1.** Distribution of patients according to age and sex. Celia Sánchez Manduley Provincial Clinical Surgical Hospital of Manzanillo, Granma.

| Age (years) | Male |      | Female |      | Total |      |
|-------------|------|------|--------|------|-------|------|
|             | No.  | %    | No.    | %    | No.   | %    |
| 25-34       | 2    | 2,0  | 1      | 1,0  | 3     | 3,0  |
| 35-44       | 7    | 7,0  | 3      | 3,0  | 10    | 10,0 |
| 45-54       | 19   | 19,0 | 5      | 5,0  | 24    | 24,0 |
| 55-64       | 19   | 19,0 | 6      | 6,0  | 25    | 25,0 |
| 65-74       | 12   | 12,0 | 6      | 6,0  | 18    | 18,0 |
| 75+         | 13   | 13,0 | 7      | 7,0  | 20    | 20,0 |
| Total       | 72   | 72,0 | 28     | 28,0 | 100   | 100  |

Table 2 showed that pharmacological cardioversion was the most used medical treatment in patients with atrial fibrillation (61 %).

**Table 2.** Distribution of patients according to the type of cardioversion applied.

| Type of cardioversion | Number |    |
|-----------------------|--------|----|
|                       | No.    | %  |
| Electric              | 21     | 21 |
| Pharmacological       | 61     | 61 |
| Spontaneous           | 18     | 18 |

Table 3 showed that both the diameter and area of the left atrium in most patients were within normal values for 69 % and 74 % respectively.

**Table 3.** Distribution of patients according to diameter and area of the left atrium after cardioversion.

| Variable             |                      | Type of cardioversion applied |      |     |      |     |      | Total |      |
|----------------------|----------------------|-------------------------------|------|-----|------|-----|------|-------|------|
|                      |                      | EC                            |      | CF  |      | CS  |      |       |      |
|                      |                      | No.                           | %    | No. | %    | No. | %    | No.   | %    |
| Left atrium diameter | Normal               | 0                             | 0    | 58  | 58,0 | 11  | 11,0 | 69    | 69,0 |
|                      | Slightly increased   | 16                            | 16,0 | 0   | 0    | 2   | 2,0  | 18    | 18,0 |
|                      | Moderately increased | 5                             | 5,0  | 3   | 3,0  | 5   | 5,0  | 13    | 13,0 |
| Left atrium area     | Normal               | 5                             | 5,0  | 58  | 58,0 | 11  | 11,0 | 74    | 74,0 |
|                      | Slightly increased   | 15                            | 15,0 | 3   | 3,0  | 7   | 7,0  | 25    | 25,0 |
|                      | Moderately increased | 1                             | 1,0  | 0   | 0    | 0   | 0    | 1     | 1,0  |

**Grades:**EC (Electrical cardioversion); CF (Pharmacological cardioversion); CS (Spontaneous cardioversion)

Table 4 showed that both the volume and ejection fraction of the left atrium in most patients were within normal values for 71 % and 79 % respectively.

**Table 4.** Distribution of patients according to volume and left atrial ejection fraction after the cardioversion was applied.

| Variable                           |                      | Type of cardioversion applied |      |     |      |     |      | Total |       |
|------------------------------------|----------------------|-------------------------------|------|-----|------|-----|------|-------|-------|
|                                    |                      | EC                            |      | CF  |      | CS  |      |       |       |
|                                    |                      | No.                           | %    | No. | %    | No. | %    | No.   | %     |
| Left atrial volume                 | Normal               | 2                             | 2,0  | 58  | 58,0 | 11  | 11,0 | 71    | 71,0  |
|                                    | Slightly increased   | 18                            | 18,0 | 3   | 3,0  | 7   | 7,0  | 28    | 28,0  |
|                                    | Moderately increased | 1                             | 1,0  | 0   | 0    | 0   | 0    | 1     | 1,0   |
| Left ventricular ejection fraction | Normal               | 11                            | 11,0 | 58  | 58,0 | 10  | 10,0 | 79    | 79,0  |
|                                    | Slightly increased   | 6                             | 6,0  | 2   | 2,0  | 6   | 6,0  | 14    | 14,0, |
|                                    | Moderately increased | 4                             | 4,0  | 1   | 1,0  | 2   | 2,0  | 7     | 7,0   |

**Grades:**EC (Electrical cardioversion); CF (Pharmacological cardioversion); CS (Spontaneous cardioversion)

## DISCUSSION

The authors of this research consider atrial fibrillation to be a significant challenge for healthcare professionals, especially cardiologists. However, new therapeutic methods are currently being used that can reduce or eradicate this health problem. In this study, males were the most affected. This result is consistent with the research by Moreno et al.,<sup>(14)</sup> which found that, out of a total of 40

patients, 70 % were men. Similarly, Cadavid et al.,<sup>(15)</sup> showed that men represented 55,8 % of all patients with atrial fibrillation.

However, other studies showed opposite results, with females predominating, as in the case of the research by Torres et al.,<sup>(16)</sup> where women stood out at 36 % with paroxysmal atrial fibrillation. The authors believe that the predominance of sex is due to the relationship each patient presents with the predisposing risk factors for the onset of the disease. Likewise, it is due to the prior existence of comorbidities that favor the development of cardiovascular diseases.

However, other researchers suggest that women are more likely to develop AF because they are more prone to high blood pressure, valvular heart disease, and stroke. Similarly, women with atrial fibrillation have fewer opportunities to undergo electrical cardioversion, and are therefore referred later for catheter ablation of AF than men, which results in the disease appearing at older ages in women.<sup>(3)</sup>

In the study, patients aged between 55 and 64 years were the most representative. A similar result was shown in the research by Sánchez et al.,<sup>(17)</sup> where the 56-65 age group predominated (31 %). However, other studies exhibited opposite results. In the study by Moreno et al.,<sup>(14)</sup> the majority of patients were between 75 and 84 years old (50 %), while in the Quintana research and cols,<sup>(18)</sup> patients aged between 65 and 74 years were the most affected with AF in 51,2 %.

Regarding age, the authors of the current research plan that aging induces myocardial modifications; the electrical variations that occur as a consequence of age itself are linked to cellular and tissue alterations, which include numerous changes such as myocyte dystrophy, fibrosis, cellular hypertrophy, and apoptosis.

In the study, pharmacological cardioversion was the most frequently used treatment of choice in patients with atrial fibrillation (AF). The authors believe this treatment should be used in patients with atrial fibrillation of less than 48 hours' duration. Hindricks cols,<sup>(3)</sup> proposed that pharmacological cardioversion to sinus rhythm is an elective treatment for hemodynamically stable individuals. Its efficacy is demonstrated by the spontaneous restoration of sinus rhythm within the first 48 hours of hospitalization in 76-83 % of individuals with newly diagnosed atrial fibrillation (10-18 % within the first three hours (h), 55-66 % within the first 24 hours, and 69 % within the first 48 hours).

In this study, pharmacological cardioversion was the most frequently used antiarrhythmic treatment, with amiodarone and propafenone being the most commonly used drugs. In Lerech's cols,<sup>(19)</sup> 52,6 % of patients received rhythm control therapy. Likewise, in Herrera's, cols,<sup>(2)</sup> this therapeutic alternative was the most used in 75 % of patients with AF. These results were consistent with those of the present study.

In patients with atrial fibrillation, various complications can arise, including cognitive impairment, which may be associated with strokes, cerebral microembolisms, and cardioembolic events. The majority of individuals studied in this research did not experience complications, a result that demonstrates the effectiveness of the treatment used.

In the study, after applying different types of cardioversion to patients with atrial fibrillation (AF), normal echocardiographic parameters were obtained in the majority of patients. These results demonstrated the efficacy of this treatment for the disease. Although the present study evaluated the echocardiographic results found in patients after the type of cardioversion applied, the authors found no other research addressing these parameters to assess patient outcomes. Nevertheless, the researchers of the current study believe that cardioversion should be used in AF patients based on the duration of the disease and the clinical and electrocardiographic manifestations observed in each patient.

In patients with unstable hemodynamics, electrical cardioversion is the treatment of choice. During the procedure, blood pressure should be controlled prior to sedation of the patient with intravenous midazolam, propofol, or etomidate.<sup>(3)</sup> The authors of this research believe that, in the case of patients with stable hemodynamics, the treatment to be used will depend on the time elapsed since the patient's diagnosis.

For stable patients, both pharmacological and electrical cardioversion can be attempted; pharmacological cardioversion is less effective but does not require sedation. Pretreatment with antiarrhythmic drugs (AADs) may improve the efficacy of elective electrical cardioversion.<sup>(3)</sup>

Among the main limitations that prevented a more detailed study of the research is the lack of research material on atrial fibrillation, especially the echocardiographic variables that the authors of the present research addressed, but we did not find other similar studies that would allow us to characterize or evaluate the results of cardioversion in patients with atrial fibrillation reverted to sinus rhythm.

## CONCLUSIONS

Atrial fibrillation presents a challenge to the medical community. It is more common after the age of 50, and pharmacological cardioversion with amiodarone and propafenone is the most frequently used medical treatment. In most patients, the diameter, area, volume, and ejection fraction of the left atrium remain within normal limits, and biatrial function remains stable after cardioversion.

## Declaration of Conflicts of Interest

The authors declare that there are no conflicts of interest.

## Authors' Contribution

**KYMF:** conceptualization, data curation, formal analysis, research, project management, resources, supervision, validation, visualization, writing-revision and editing.

**PASG:** data curation, formal analysis, research, project management, methodology, resources, supervision, validation, visualization, writing-revision and editing.

**YMP:** Software, research, validation, visualization, writing – original draft, writing – revision and editing.

**JLIL:** software, resources, monitoring, validation, visualization, writing-revision and editing.

**SYNV:** Software, research, validation, visualization, writing – original draft, writing – revision and editing.

**LCAE:** Software, research, validation, visualization, writing – original draft, writing – revision and editing.

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