Atrial Fibrillation: Basic Concepts and Clinical Considerations

Alejandro Alvarado-Gómez[1], Maximiliano Arturo de-la-Torre[1], María Esther Macías-Guzmán[1], Melissa Méndez-Rodríguez[1].

[1] Faculty of Medicine, Autonomous University of San Luis Potosí, San Luis Potosí, S.L.P., México.

Corresponding author: Alejandro Alvarado-Gómez, A342948@alumnos.uaslp.mx
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ABSTRACT

This article aims to provide an updated and comprehensive review of atrial fibrillation (AF), addressing its pathophysiological basis, clinical aspects, diagnosis, and treatment strategies to improve knowledge among both healthcare professionals and the general public.

AF is the most common sustained arrhythmia in adults, affecting 2-3% of the world's population. This work describes how the disorganization of atrial electrical discharges disrupts the normal heart rhythm, analyzing risk factors such as hypertension, age, and pre-existing cardiovascular disease. It details that the primary diagnosis is made via electrocardiogram, identifying the absence of P waves and irregular RR intervals for at least 30 seconds. Finally, therapeutic options focused on arrhythmia control and thromboembolism prevention through the use of anticoagulants are explored.

Early diagnosis and comprehensive management are essential to reduce associated morbidity and mortality, prevent serious complications such as strokes, and significantly improve patients' quality of life.

Keywords: atrial fibrillation, cardiac arrhythmia, electrocardiogram.

INTRODUCTION

Atrial fibrillation is a common heart condition, affecting millions of people worldwide. The importance of understanding atrial fibrillation lies in its high prevalence and serious health implications. It affects 2-3% of the world's population, with a trend toward increasing prevalence due to aging. In addition to the risk of stroke, it is associated with chronic fatigue and other complications if not treated promptly [1].

This article addresses clinical and pathophysiological aspects, available treatments, medical innovations, the socioeconomic impact, and prevention strategies.

Its aim is to provide a clear and up-to-date understanding, not only for healthcare professionals but also for those who wish to better understand this cardiovascular condition and its impact on daily life.

ATRIAL FIBRILLATION

Atrial fibrillation is a condition that affects the heart rhythm. It is characterized by irregular and rapid heartbeats originating in the atria instead of a normal rhythm.

In a person with AF, the electrical impulses in the atria that cause the heartbeat become asynchronous and disorganized, resulting in fibrillation. Atrial fibrillation can be caused by various factors (age, pre-existing heart conditions, high blood pressure, lung disease, excessive alcohol consumption, genetic factors, etc.) and can increase the risk of serious complications such as stroke (vascular disease) due to blood clots forming within the heart, as well as heart failure and other heart conditions.

AF has a significant impact on people's daily lives, both for those who suffer from it and for their families and society in general, for several reasons. It can affect quality of life, as symptoms such as palpitations, fatigue, and shortness of breath, among others, can be debilitating and very bothersome. Similarly, the depression and anxiety that can accompany AF often have psychological repercussions.

These patients are often advised to make lifestyle changes, such as reducing alcohol and tobacco consumption, adopting a healthier diet, and avoiding stressful situations. This involves making adjustments and modifications to their routines that can be difficult to manage.

Likewise, AF has also increased awareness about cardiovascular health in society; people may be more aware of the importance of controlling their blood pressure, maintaining a healthy weight according to their needs, and leading an active lifestyle to reduce the risk of developing AF or other heart conditions.

In summary, atrial fibrillation is a condition that has repercussions on the physical and mental health of those who suffer from it, so it is important to know the correct management and treatment of this disease along with the complications it can have, so that we can minimize its impact and improve the quality of life of patients.

ETIOLOGY

Atrial fibrillation is considered a multifactorial condition, as its exact etiology is still unknown. However, several factors are closely associated with an increased risk of its development.

In developed countries, AF is associated with coronary artery disease and hypertensive heart disease. Hypertension is the most frequent underlying cause of atrial fibrillation, while coronary artery disease does not cause AF unless it is complicated by an acute myocardial infarction, which can lead to the condition due to ischemia or atrial dilation secondary to heart failure (HF).

Likewise, any valvular disease that causes stenosis or regurgitation can be directly related to AF.

Heart failure and atrial fibrillation can occur simultaneously, and the incidence of AF generally increases considerably in those with more advanced HF. Atrial fibrillation is also associated with congenital heart disease involving the atria; however, it can be related to other conditions such as Ebstein's anomaly, pulmonary stenosis, or ventricular septal defects.

Patients with cardiopulmonary diseases such as COPD, dilated cardiomyopathy, pericarditis (idiopathic or uremic), or obstructive sleep apnea syndrome (OSAS) have a higher risk of developing AF.

Chronic kidney disease is a significant risk factor for the development of AF, as the risk increases by approximately 32% in patients with a glomerular filtration rate (GFR) between 30 and 59 ml/min [2] compared to those with normal kidney function. Another associated factor is diabetes mellitus, with an increased risk of 10% in men and 50% in women [2].

An increased incidence of AF has been observed in patients undergoing cardiac surgery, with combined coronary artery bypass grafting (CABG) surgery carrying the highest increased risk for AF (60%) [2]. In patients with atrial fibrillation of unknown cause, it is important to measure thyrotropin levels, as the incidence of atrial fibrillation in patients with hyperthyroidism can reach 10–20% in adults over 60 years of age, with a higher frequency in men [2].

In conclusion, the main comorbidities associated with atrial fibrillation include: hypertension, ischemic heart disease, heart failure, diabetes mellitus, chronic kidney disease, and chronic obstructive pulmonary disease.

PATHOPHYSIOLOGY

Atrial fibrillation can occur in patients with or without structural heart disease. The latter is primarily caused by electrical abnormalities, triggered by electrical factors. These triggers are multiple foci of microreentry in the atrium.

The pathogenesis is not fully understood and is considered multifactorial; however, two components play an important role: a triggering factor and the anatomical substrate that favors the maintenance of the arrhythmia.

- **Triggering Factors**

These are associated with structural and electrophysiological abnormalities that promote the formation and propagation of abnormal impulses; in short, they function as "triggers" [3].

Most of the initiating foci are located in the pulmonary veins. At the junction of the left atrium and the pulmonary veins, there is a significant overlap of muscle fibers, making the veins thicker in their proximal portion and thus creating highly heterogeneous tissue. This results in a complex organization of muscle fibers, acting as a trigger [3].

- **Maintenance Mechanism**

Once AF has begun, several factors maintain this arrhythmia, such as the persistence of the arrhythmogenic discharge. In the absence of triggering foci, remodeling of the conduction and structural system can occur, leading to atrial dilation and shortening of the refractory period. These two factors can be part of the natural history of the disease or act as triggers.

- **Substrate**

AF often accompanies other systemic diseases such as hypertension, ischemic heart disease, heart failure, and hyperthyroidism. These comorbidities trigger an atrial adaptive response to maintain homeostasis. The main consequences of this response are chamber dilation and fibrosis.

These adaptive mechanisms are important in the development of AF. The aging process itself generates changes in electrical conduction, which also contributes as a substrate for the development of AF, whose progression is accelerated by the aforementioned comorbidities.

- **Inflammation**

There is evidence that inflammation of myocardial tissue is key in the pathogenesis of AF [3].

Furthermore, inflammation may be a consequence of AF, creating a vicious cycle where inflammation produces AF and the disease itself induces a greater inflammatory response.

In summary, in atrial fibrillation, the atrium loses its ability to contract due to triggering foci that cause atrial fibrillation. Over time, the resulting dilation and fibrosis further modify the myocardium and electrical conduction, perpetuating the condition.

The absence of normal contraction promotes a prothrombotic state due to blood stasis within the heart chambers, thus promoting clot formation. These clots can subsequently embolize into the systemic circulation, causing ischemic events. This is important because stroke is the main complication of AF, and its prevention is a cornerstone of disease management.

EPIDEMIOLOGY

Atrial fibrillation is the most common sustained arrhythmia in adults and is associated with significantly higher morbidity and mortality, making it important for both patients and healthcare systems.

The prevalence of AF in adults is 2-4% and is anticipated to increase 2-3 times [2]. Aging is a risk factor for AF, as are other comorbidities such as hypertension, diabetes mellitus, heart failure, coronary artery disease, chronic kidney disease, obesity, and obstructive sleep apnea.

The incidence, prevalence, and lifetime risk rates of AF are lower in women than in men. The lifetime risk of developing AF is estimated at 1 in 3 individuals of European descent by age 55.

The impact of AF and its association with other comorbidities indicate that early intervention and control of risk factors could reduce the incidence of AF.

CLINICAL MANIFESTATIONS

50-87% of patients with atrial fibrillation are initially asymptomatic, which can hinder timely diagnosis and lead to a less favorable prognosis. Those who do experience signs and symptoms often present with:

- Palpitations.
- Shortness of breath.
- Fatigue.
- Chest pain or pressure.
- Poor exercise tolerance.
- Dizziness.
- Syncope.
- Sleep disturbances.
- Anxiety and depression.

More than 60% of patients with AF experience a significant decline in their quality of life, although only 17% suffer disabling symptoms. This decline is more pronounced in women, younger individuals, and those with comorbidities.

In addition to the typical signs and symptoms, hemodynamically unstable individuals may present with more significant clinical manifestations:

- Symptomatic hypotension.
- Acute heart failure with or without pulmonary edema.
- Developing myocardial ischemia.
- Cardiogenic shock.

DIAGNOSIS

Early diagnosis of atrial fibrillation is important, as the condition can be asymptomatic or the symptoms can be mild. Some people experience palpitations, shortness of breath, fatigue, or dizziness, but in other cases, AF may not present any symptoms until a complication arises. Therefore, early diagnosis allows for the initiation of appropriate treatment to prevent complications and, sometimes, even reverse the arrhythmia.

According to the European Society of Cardiology (ESC) guidelines, diagnosis requires electrocardiogram documentation of an AF episode that must last at least 30 seconds and show a loss of P waves and irregular RR intervals (Figure 1).

Additionally, several tools are available to help complete the diagnosis (Table 1).



Figure 1. Electrocardiogram with absence of P waves and irregular RR intervals.

CLASSIFICATION

According to the European Society of Cardiology guidelines, atrial fibrillation is complex and presents in various forms, both in patients with heart disease and in apparently healthy individuals.

The classification of AF involves terms such as "lone AF" and "idiopathic AF," and these can be differentiated. Lone AF refers to the onset of the arrhythmia in individuals under 60 years of age who do not present with clinical or echocardiographic manifestations of any other disease. These individuals generally have a more favorable prognosis regarding common AF complications, such as the risk of blood clots and mortality. However, either due to the passage of time or because signs of heart disease begin to appear, these patients will no longer be considered to have lone AF, and therefore, the risk of complications will increase.

Idiopathic atrial fibrillation implies a lack of certainty regarding its origin, regardless of age or the presence of any underlying cardiovascular problem.

The recommended classification for AF focuses on clinical relevance. A distinction is made between the first detected episode of AF, whether symptomatic or brief, and recurrent episodes. Recurrent episodes are divided into paroxysmal AF, when the arrhythmia stops spontaneously or with intervention within 7 days of onset, and persistent AF, when it lasts for more than 7 days and requires cardioversion to terminate.

Persistent AF can be the first presentation or the result of uncontrolled recurrent episodes. Furthermore, long-standing persistent AF is defined as AF that continues for more than 1 year even after the use of heart rhythm control strategies.

Permanent AF is considered to be AF that persists long-term without attempts at reversion.

It is crucial to differentiate secondary AF, which occurs as a result of a triggering condition, such as a heart attack, cardiac surgery, or other diseases. Treating the underlying condition, along with controlling AF, usually leads to AF elimination.

Table 1. Diagnostic tools for AF, as a complement to the electrocardiogram, for classification and therapeutic management.

Diagnostic tool	Description
Medical history	Collects the patient's medical history, symptoms, risk factors, triggers, and the type of atrial fibrillation.
Physical examination	Looks for pulse irregularity, presence of heart murmurs, edema, or signs of heart failure.
Holter monitor	Portable electrocardiogram that continuously records the heart's electrical activity for 24 to 48 hours or more. Looks for episodes of irregular heart rhythm.
Event recorder	Records specific episodes. However, instead of recording continuously, it is activated manually. It is useful in patients with infrequent episodes.
Implantable loop recorder	Implanted under the skin, it continuously monitors cardiac activity for up to 3 years. It activates automatically when it detects changes in heart rhythm.
Echocardiogram	Implantation method that can show structural abnormalities, cardiac function, and the presence of blood clots in the atria.
Stress test	It allows us to evaluate the heart's response to physical exertion. It helps us determine if atrial fibrillation develops or worsens with exercise.
Chest X-ray	The findings can vary, and there are no pathognomonic findings for AF, but some patients may present with: atrial enlargement, signs of heart failure, visible clots as opacities, and areas of pulmonary consolidation.

As can be seen, the ESC classification is based on the duration of episodes and the presence or absence of triggers and is extremely important for managing AF, as treatment must be individualized (Table 2).

TREATMENT

The pharmacological treatment of AF is based on two key objectives: the prevention of embolism through anticoagulation and the control of the arrhythmia.

- **Pharmacological Treatment Focused on Thromboembolism Prevention**

Regarding the first objective, vitamin K antagonists (VKAs) have been shown to be more effective in reducing embolic risk, while acetylsalicylic acid (ASA) lacks significant benefits. New oral anticoagulants (NOACs) such as dabigatran, rivaroxaban, apixaban, and edoxaban have proven to be favorable options for the prophylactic treatment of patients with atrial fibrillation.

VKAs have been a key element in reducing embolic strokes in patients with AF of all types; however, NOACs have shown promise in the current context. The reduction in the incidence of cerebral bleeding (estimated to be 2 to 3 times lower than with VKAs) and a higher rate of treatment adherence are some of the determining factors for initiating anticoagulation with a NOAC instead of a VKA as the first-line treatment.

- **Antiarrhythmic Treatment**

Choosing the right antiarrhythmic drug is a fundamental pillar in the management of patients with atrial fibrillation. This decision must be made considering several relevant factors, such as the type of arrhythmia, the progression of the disease, associated heart conditions, the patient's medical history, comorbidities, and the antiarrhythmic's safety profile.

The Spanish Journal of Cardiology offers an overview of recommended drugs based on some of the aforementioned criteria, as well as the non-pharmacological strategies employed depending on the context (summarized in Tables 3, 4, 5, and 6).

Table 2. Classification of AF according to the 2020 ESC guidelines.

AF Pattern	Description
AF diagnosed for the first time	AF has not been previously diagnosed, regardless of the duration of the arrhythmia or the presence and severity of related symptoms.
Paroxysmal AF	AF resolves spontaneously or with intervention within the first 7 days.
Persistent AF	AF persists for more than 7 days, including episodes terminated by pharmacological or electrical cardioversion after more than 7 days.
Long-standing persistent AF	AF continues for more than 1 year after a cardiac rhythm control strategy is implemented.
Permanent FA	The patient and physician accept the AF, and no further measures are taken to restore or maintain sinus rhythm.**
Terminology to Avoid	
Isolated AF	Advances in the understanding of AF pathophysiology show that there is a specific cause for AF in each patient. Therefore, this historical terminology can be misleading and should not be used.
Valvular / Non-valvular AF	It differentiates patients with moderate/severe mitral stenosis or mechanical heart valves from other patients with AF, but it can be confusing and should not be used.
Chronic AF	It has several definitions and should not be used to describe populations of patients with AF.

***Permanent AF represents more of a therapeutic approach by the patient and physician than an inherent pathophysiological attribute of AF. This term should not be used in the context of a rhythm control strategy with antiarrhythmic drugs or catheter ablation. If rhythm control measures are implemented, the arrhythmia would be reclassified as "long-standing persistent AF."*

EXAMPLES AND METAPHORS

To better understand what happens when there is atrial fibrillation, we can imagine that the heart is like a group of people dancing a choreographed routine.

Like in any dance group, there is a choreographer who guides everyone and tells them how to move so that everything goes well and everyone follows the correct steps. The choreographer is the sinoatrial node. However, in atrial fibrillation, the choreographer is impaired and cannot tell them how or where to move, so the dancers begin to dance without coordination. Some get ahead, some fall behind, and some make mistakes. Therefore, the choreography is disorganized, uncoordinated, full of errors, and becomes chaotic.

Another example to better understand what happens in people with AF is to imagine that the heart is like a person driving a manual car and trying to start the car and maintain a constant speed. To do this, the driver must first press the clutch and then the accelerator pedal. Therefore, in AF, the driver begins to release the clutch pedal while simultaneously pressing the accelerator, then presses both pedals at the same time, then presses neither. This causes the car to not maintain a constant speed and may even stall.

KEY POINTS AND CONCLUSION

Atrial fibrillation (AF) is a common heart condition, affecting approximately 2-3% of the world's population. The importance of understanding atrial fibrillation lies in its high prevalence and serious health implications, which include, but are not limited to, chronic fatigue and an increased risk of stroke.

AF is a condition characterized by irregular and rapid heartbeats originating in the atria instead of a normal rhythm. The electrical discharges in the atria that generate the heartbeat become asynchronous and disorganized, resulting in fibrillation. There are several risk factors and predisposing factors for atrial fibrillation, such as a history of previous heart disease, high blood pressure, lung disease, age, and some modifiable factors, such as excessive alcohol consumption.

It is considered a multifactorial condition, and its exact etiology is unknown. However, there are factors closely associated with an increased risk of its incidence. The main comorbidities related to atrial fibrillation include hypertension, ischemic heart disease, heart failure, diabetes mellitus, chronic kidney disease, and chronic obstructive pulmonary disease.

Early diagnosis allows for the initiation of appropriate treatment to prevent complications and, in some cases, reverse the arrhythmia. Although the electrocardiogram is the primary method for diagnosing AF, there are additional tools that support the confirmation of the diagnosis, such as medical history, physical examination, Holter monitor, echocardiogram, and chest X-ray, among others.

Atrial fibrillation is the most common sustained arrhythmia in adults and is associated with significantly higher morbidity and mortality, making it important for both patients and healthcare systems. It is a condition that has repercussions on the physical and mental health of those who suffer from it.

Table 3. Comprehensive therapeutic approach to atrial fibrillation according to the 2020 ESC guidelines.

Therapeutic Aim	Initial Assessment	Initial Interventions
Prevention of Thromboembolic Events	Collect the patient's medical history, symptoms, risk factors, triggers, and type of AF.	Oral anticoagulation with direct oral anticoagulants or vitamin K antagonists, depending on the patient's characteristics.
Symptom Control	Determine clinical impact based on symptoms, ventricular rate, and type of AF.	Heart-rate control or rhythm control strategy, depending on individual characteristics.
Cardiovascular Optimization and Comorbidities	Identify factors associated with AF progression.	Manage hypertension, obesity, diabetes, obstructive sleep apnea, sedentary lifestyle, smoking, and alcohol consumption.

Table 4. Pharmacological treatment of atrial fibrillation according to therapeutic objective according to the 2020 ESC guidelines.

Aim	Pharmacological Group	Main Drugs	Considerations
Prevention of Thromboembolic Events	Direct Oral Anticoagulants	Apixaban, dabigatran, edoxaban, rivaroxaban	Preferred over vitamin K antagonists in most eligible patients.
	Vitamin K Antagonists	Warfarin	Indicated primarily in mechanical valves or significant mitral stenosis.
Heart-rate Control	β-blockers	Metoprolol, bisoprolol, carvedilol.	Frequent first-line treatment; especially useful in patients with ischemic heart disease or heart failure.
	Non-dihydropyridine Calcium Channel Blockers	Diltiazem, verapamil.	Useful in patients with preserved ventricular function; avoid in heart failure with reduced ejection fraction.
	Cardiac Glycosides	Digoxin	Can be used particularly in sedentary patients or those with heart failure.
Rhythm Control	Antiarrhythmic Drugs to Restore and Maintain Sinus Rhythm		Drug selection depends on the presence of structural heart disease and associated comorbidities. The main antiarrhythmics and their indications are described in Table 5.

Table 5. Antiarrhythmic drugs for rhythm control in atrial fibrillation according to patient clinical characteristics, according to the 2020 ESC guidelines.

Drug	Vaughan-Williams Class	Candidate Patient	Considerations
Flecainide	Class IC (sodium channel blocker)	Atrial fibrillation (AF) in patients without significant structural heart disease.	Avoid in coronary artery disease, left ventricular dysfunction, or significant ventricular hypertrophy due to proarrhythmic risk.
Propafenone	Class IC (sodium channel blocker with mild β-blocking activity)		Same restrictions as flecainide; It can be combined with AV node blocking agents to prevent 1:1 conduction of atrial flutter.
Dronedarone	Class III (multichannel blocker: K^+, Na^+, and Ca^{2+})	Paroxysmal or persistent AF in selected patients without advanced heart failure.	Less effective than amiodarone; contraindicated in heart failure with severe ventricular dysfunction or permanent atrial fibrillation.
Sotalol	Class III (potassium channel blocker with β-blocking activity)	Selected patients with preserved ventricular function.	Requires monitoring of the QT interval due to the risk of *torsades de pointes*.
Amiodarone	Class III (multichannel blocker)	Patients with structural heart disease, heart failure, or when other antiarrhythmics are not suitable.	Highly effective for maintaining sinus rhythm; limited by pulmonary, thyroid, hepatic, and ocular toxicity.

Table 6. Non-pharmacological strategies for restoration and maintenance of sinus rhythm according to the 2020 ESC guidelines.

Strategy	General Indications	Key Aspects
Electrical Cardioversion	Symptomatic patients, hemodynamic instability, or need for rapid restoration of sinus rhythm.	Greater immediate efficacy compared to pharmacological cardioversion.
Catheter Ablation	Selected symptomatic patients with paroxysmal or persistent AF.	May be superior to antiarrhythmics for maintaining sinus rhythm in certain patients.
Modification of Risk Factors	All patients with AF.	Weight reduction, physical activity, management of sleep apnea, hypertension, and alcohol consumption.

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Conflict of interest

The authors declare no conflicts of interest.

Ethical considerations

This work did not involve the participation of human subjects or animals, nor the collection of primary data; therefore, it did not require approval from a research ethics committee. All data used came from previously published and publicly accessible secondary sources.

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