Atrial Fibrillation

Chapter 258 | Harrison's 22e | Part 6 – Cardiovascular Disorders | DETAILED EDITION

KEY CLINICAL POINTS

1. See source text for full details

FIGURES IN THIS CHAPTER

RAW CONTENT

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Atrial

Fibrillation

1947

CHAPTER

258

FURTHER READING embolism, pericarditis, and cardiac surgery, where AF occurs in up to

Brugada J et al: 2019 ESC Guidelines for the management of patients 50% of patients postoperatively.

with supraventricular tachycardia. The task force for the management AF is clinically most typically defined by the pattern of episodes.

of patients with supraventricular tachycardia of the European Society Paroxysmal AF is defined as a pattern of AF episodes that occur and

of Cardiology (ESC) developed in collaboration with the Association terminate with a relatively short duration either spontaneously or by

for European Paediatric and Congenital Cardiology (AEPC). Eur pharmacologic or electrical cardioversion, most commonly defined as

Heart J 41:655, 2020. 7 days or less. Persistent AF refers to AF that occurs continuously for

Callans DJ: Josephson's Clinical Cardiac Electrophysiology: Techniques >7 days but <1 year, whereas long-standing persistent AF refers to AF

and Interpretations, 7th ed. Philadelphia, Wolters Kluwer, 2024. that has been persistent for >1 year. These descriptors for AF correlate

Jalife J, Stevenson W (eds): Zipes and Jalife's Cardiac Electrophysiol- somewhat with the underlying pathophysiology of AF. AF tends to be

ogy: From Cell to Bedside, 8th ed. Philadelphia, Elsevier, 2022. a progressive condition, with, at this point, no definitive "cure" that will

Joglar JA et al: 2023 ACC/AHA/ACCP/HRS Guideline for the completely eliminate AF durably in a predictable fashion. The patho-

Diagnosis and Management of Atrial Fibrillation: A report of the physiology of AF, however, remains incompletely understood. Most

American College of Cardiology/American Heart Association Joint data support a multifactorial process that leads to the development of

Committee on Clinical Practice Guidelines. J Am Coll Cardiol manifest AF. Clinical and epidemiologic studies have demonstrated

83:109, 2024. that, in addition to cardiovascular disease, age, alcohol use, obesity,

hypertension, diabetes mellitus, and sleep-disordered breathing are

associated with higher risk of developing AF. The proposed pathophys-

iology suggests a "final common pathway" of these risk factors leading

to electrophysiologic changes in atrial tissues. Alterations in regulation

of membrane channels and other proteins result in abnormal electrical

excitability. Atrial tissues, in particular pulmonary vein musculature,

exhibit enhanced automaticity, resulting in ectopic beats (premature

258 Atrial Fibrillation atrial contractions), as shown in Fig. 258-2. Bouts of rapid atrial ectopy

may then initiate either atrial tachycardia or frank AF. Additional cel-

William H. Sauer, Jorge E. Romero, lular and, eventually, tissue remodeling results in abnormal conduction

properties throughout the atria, including, in particular, shortening of

Paul C. Zei

atrial tissue refractory periods. This enables sustained AF through a

combination of rapid automaticity-based "drivers" and areas of func-

tional reentry. Further remodeling leads to the development of fibrosis

PATHOPHYSIOLOGY AND EPIDEMIOLOGY and left atrial enlargement (Table 258-1).

Atrial fibrillation (AF) is a cardiac arrhythmia characterized by seemingly These functional and anatomic changes in atrial tissues appear to

disorganized, rapid, and irregular atrial electrical activation, resulting in correlate with the progression of clinical AF. AF tends to be a progres-

loss of organized atrial mechanical contraction. These rapid and irregular sive disease in most, although exceptions occur. Typically, for a period

electrical signals input into the atrioventricular (AV) node, which deter- of time, patients experience sporadic ectopic beats and short runs of

mines ventricular activation and rate. The conducted ventricular rate is atrial tachycardia, likely originating from the pulmonary veins, preced-

variable, resulting in an irregular, usually rapid ventricular rate, ranging ing the onset of frank AF.

typically between 110 and 160 beats/min in most. In some patients, the Other regions of the atria have been demonstrated to produce ecto-

sustained ventricular rate can exceed 200 beats/min, whereas in others pic depolarizations that may trigger AF; these include the posterior

with either high vagal tone or AV nodal conduction disease, the ven- wall of the left atrium and muscular tissue sleeves within the superior

tricular rate may be excessively slow (Fig. 258-1). vena cava, coronary sinus, or the remnant of the vein of Marshall.

The disorganized atrial activation is best appreciated in lead V for When enough frequent bursts of ectopic beats/tachycardia and/or

1

this patient. AF is the most common sustained arrhythmia; as a result, changes in underlying substrate support the maintenance of AF for

it is a major public health issue. Prevalence increases with age, with short periods, the patient develops episodes of paroxysmal AF. In the

>95% of AF patients >60 years of age. The prevalence in humans over untreated patient, over time, as the electrical, contractile, and structural

age 80 is ~20%. The lifetime risk of developing AF for men aged 40 years remodeling continues to progress, episodes of paroxysmal AF may be

old is ~25%. AF is slightly more common in men than women and prolonged to the point of not terminating spontaneously, the hallmark

more common in whites than blacks. Risk factors for developing AF in of persistent AF. After further remodeling, not only do patients con-

addition to age and underlying cardiac disease include hypertension, tinue to long-standing persistent AF but also the efficacy of therapeutic

diabetes mellitus, cardiac disease, family history of AF, obesity, thyroid interventions to restore sinus rhythm diminishes.

disease, and sleep-disordered breathing. AF is not a benign condition,

CLINICAL PRESENTATION AND

with a 1.5- to 1.9-fold increased risk of mortality after controlling for

underlying cardiac disease. Perhaps the most important consequence MANIFESTATIONS

of AF is a significantly increased risk of stroke compared to the general The clinical manifestations of AF result from (1) symptoms related

population, causing ~25% of all strokes. AF has been detected up to to the irregular, often rapid but sometimes slow ventricular rates that

8.9% of patients within 6 months following cryptogenic stroke using result; (2) the hemodynamic consequences of altered cardiac function;

insertable cardiac monitors. (3) the consequences of cardioembolic phenomena; and/or (4) the

The risk of dementia is increased in patients with AF, as is the risk impact of AF on cardiovascular function over time. AF is diagnosed

of magnetic resonance imaging (MRI)-detected asymptomatic embolic by electrocardiogram (ECG), either by 12-lead standard ECG, limited

infarct. AF, most often when ventricular rate remains uncontrolled for lead ambulatory monitor ECG and implantable loop recorders, with

prolonged periods, increases the risk of developing congestive heart findings of lack of organized atrial activity (no P wave), with an irregu-

failure and cardiomyopathy. Moreover, as a corollary, patients with lar ventricular response. The role of screening populations for AF is

underlying heart disease, in particular cardiomyopathy and conges- evolving with the use of wearable monitors and home ECG capabilities.

tive heart failure, are at higher risk for developing AF. AF is a marker With irregular, rapid ventricular rates, there is variable cardiac dis-

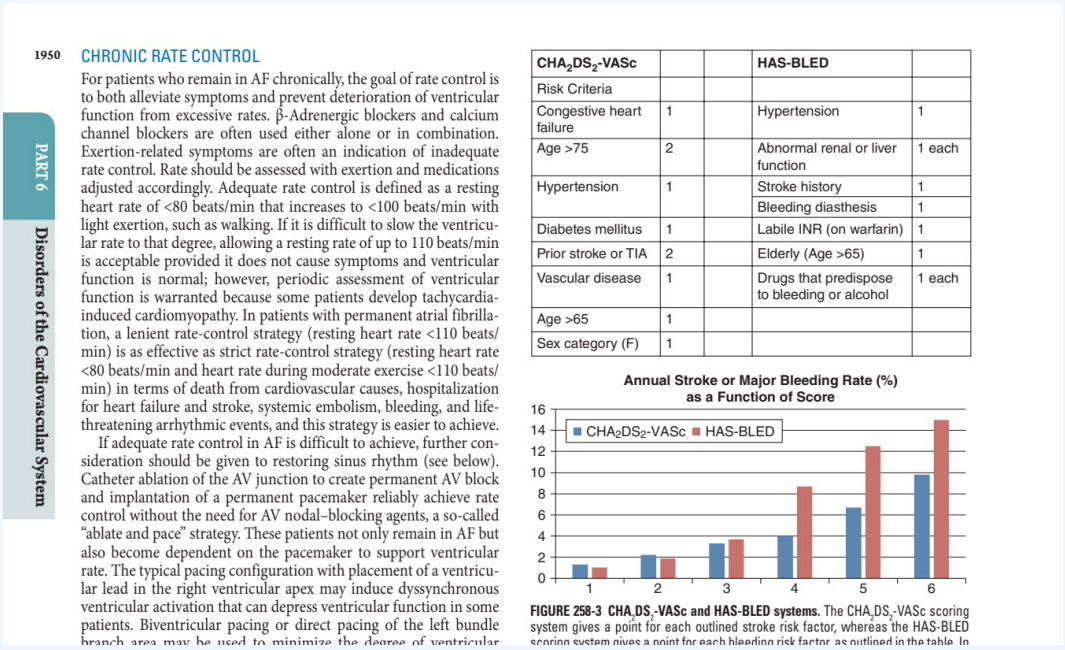
for worsened morbidity and mortality in patients with existing heart placement and contraction, resulting in the sensation of palpitations

disease, although the precise extent of the independent risk increase and awareness of the heartbeat, when of course, in a normal rhythm,

associated with AF in heart disease is unclear. AF may, on occasion, be most humans do not sense each heartbeat. Interestingly, many patients

associated with an identifiable precipitating fac

FIGURES & ILLUSTRATIONS — FROM HARRISON'S



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CHRONIC RATE CONTROL

For patients who remain in AF chronically, the goal of rate control is to both alleviate symptoms and prevent deterioration of ventricular function from excessive rates. β-Adrenergic blockers and calcium channel blockers are often used either alone or in combination. Exertion-related symptoms are often an indication of inadequate rate control. Rate should be assessed with exertion and medications adjusted accordingly. Adequate rate control is defined as a resting heart rate of <80 beats/min that increases to <100 beats/min with light exertion, such as walking. If it is difficult to slow the ventricular rate to that degree, allowing a resting rate of up to 110 beats/min is acceptable provided it does not cause symptoms and ventricular function is normal; however, periodic assessment of ventricular function is warranted because some patients develop tachycardia-induced cardiomyopathy. In patients with permanent atrial fibrillation, a lenient rate-control strategy (resting heart rate <110 beats/min) is as effective as strict rate-control strategy (resting heart rate <80 beats/min and heart rate during moderate exercise <110 beats/min) in terms of death from cardiovascular causes, hospitalization for heart failure and stroke, systemic embolism, bleeding, and life-threatening arrhythmic events, and this strategy is easier to achieve.

If adequate rate control in AF is difficult to achieve, further consideration should be given to restoring sinus rhythm (see below). Catheter ablation of the AV junction to create permanent AV block and implantation of a permanent pacemaker reliably achieve rate control without the need for AV nodal–blocking agents, a so-called "ablate and pace" strategy. These patients not only remain in AF but also become dependent on the pacemaker to support ventricular rate. The typical pacing configuration with placement of a ventricular lead in the right ventricular apex may induce dyssynchronous ventricular activation that can depress ventricular function in some patients. Biventricular pacing or direct pacing of the left bundle branch area may be used to minimize the degree of ventricular

CHA_2DS_2-VASc			HAS-BLED	
Risk Criteria				
Congestive heart failure	1		Hypertension	1
Age >75	2		Abnormal renal or liver function	1 each
Hypertension	1		Stroke history	1
			Bleeding diasthesis	1
Diabetes mellitus	1		Labile INR (on warfarin)	1
Prior stroke or TIA	2		Elderly (Age >65)	1
Vascular disease	1		Drugs that predispose to bleeding or alcohol	1 each
Age >65	1			
Sex category (F)	1			

FIGURE 258-3 CHA_2DS_2-VASc and HAS-BLED systems. The CHA_2DS_2-VASc scoring system gives a point for each outlined stroke risk factor, whereas the HAS-BLED scoring system gives a point for each bleeding risk factor, as outlined in the table. In

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FIGURE 258-3 CHADS-VASc and HAS-BLED systems. The CHADS-VASc scoring system gives a poin 2 t fo 2 r each outlined stroke risk factor, where 2 as 2 the HAS-BLED scoring system gives a point for each bleeding risk factor, as outlined in the table. In the chart below the table, the corresponding risk of stroke (CHADS-VASC) or major 2 2 bleed event (HAS-BLED) is plotted as a percent risk per annum as a function of score. F, female; INR, international normalized ratio; TIA, transient ischemic attack.

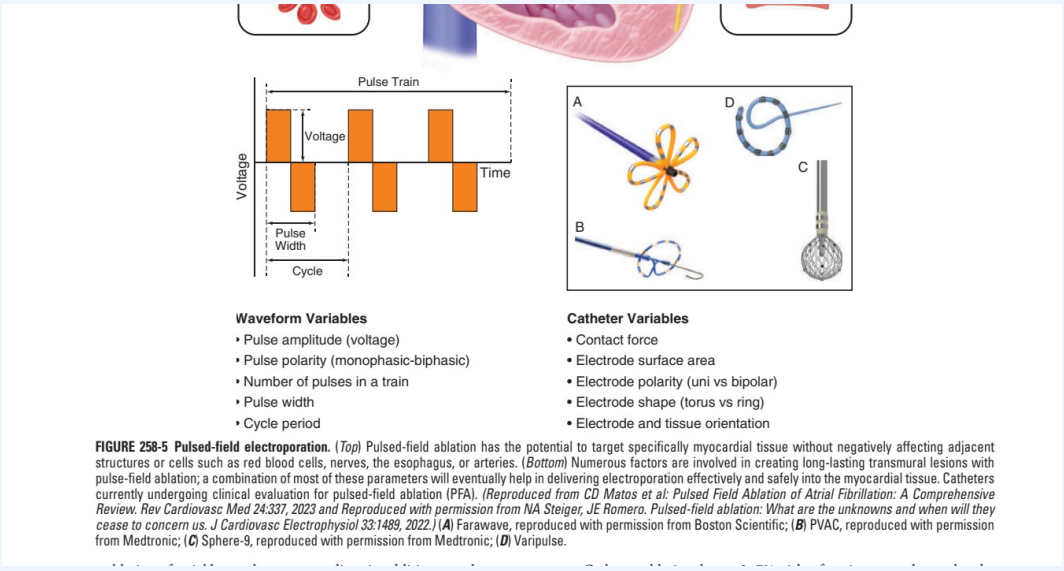

FIGURE 258-5 Pulsed-field electroporation. (*Top*) Pulsed-field ablation has the potential to target specifically myocardial tissue without negatively affecting adjacent structures or cells such as red blood cells, nerves, the esophagus, or arteries. (*Bottom*) Numerous factors are involved in creating long-lasting transmural lesions with pulse-field ablation; a combination of most of these parameters will eventually help in delivering electroporation effectively and safely into the myocardial tissue. Catheters currently undergoing clinical evaluation for pulsed-field ablation (PFA). *(Reproduced from CD Matos et al: Pulsed Field Ablation of Atrial Fibrillation: A Comprehensive Review. Rev Cardiovasc Med 24:337, 2023 and Reproduced with permission from NA Steiger, JE Romero. Pulsed-field ablation: What are the unknowns and when will they cease to concern us. J Cardiovasc Electrophysiol 33:1489, 2022.)* (***A***) Farawave, reproduced with permission from Boston Scientific; (***B***) PVAC, reproduced with permission from Medtronic; (***C***) Sphere-9, reproduced with permission from Medtronic; (***D***) Varipulse.

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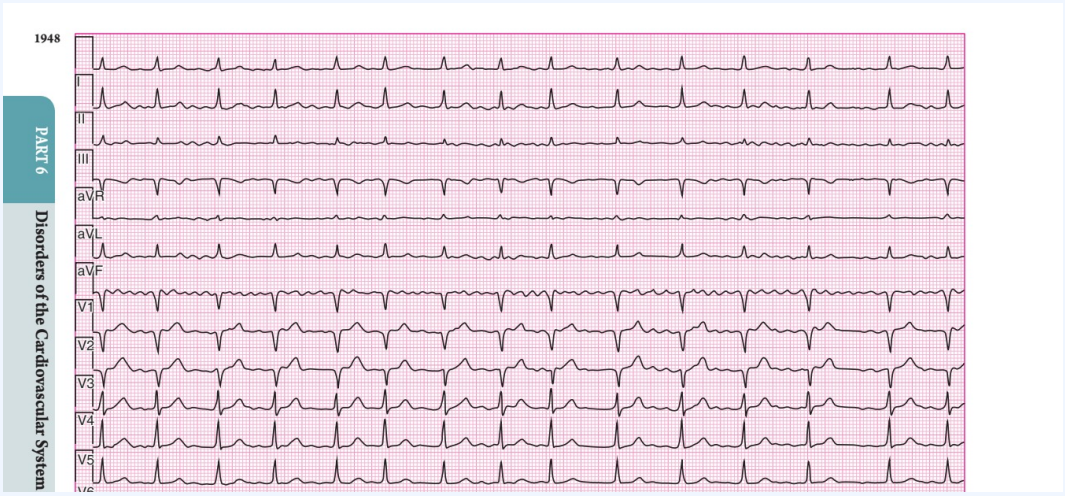
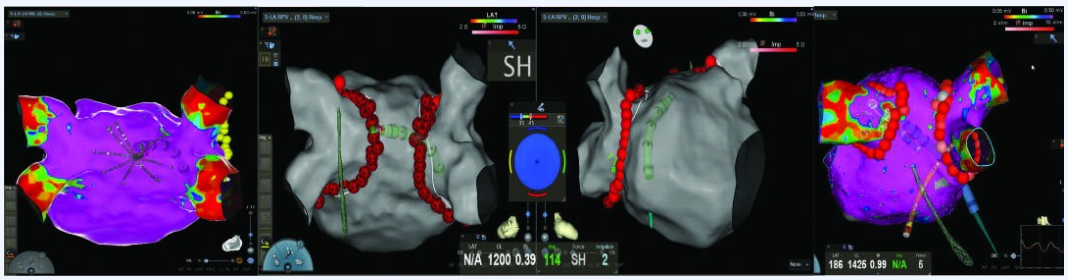
FIGURE 258-5 Pulsed-field electroporation. (Top) Pulsed-field ablation has the structures or cells such as red blood cells, nerves, the esophagus, or arteries. (Bottom) pulse-field ablation; a combination of most of these parameters will eventually help in currently undergoing clinical evaluation for pulsed-field ablation (PFA). (Reproduced Review. Rev Cardiovasc Med 24:337, 2023 and Reproduced with permission from NA cease to concern us. J Cardiovasc Electrophysiol 33:1489, 2022.) (A) Farawave, from Medtronic; (C) Sphere-9, reproduced with permission from Medtronic; (D) Varipulse. ablation of atrial low-voltage myocardium in addition to pulmonary vein isolation significantly improved outcomes in patients with persistent AF in one study. Similarly, in patients with persistent AF,



Harrison's 22e · Figure 3

FIGURE 258-1 Electrocardiogram of an irregularly irregular heart rhythm without for this patient.



Harrison's 22e · Figure 4

FIGURE 258-4 A. (Left) Electroanatomic map superimposed on a cardiac computed this chamber. (Middle) Final radiofrequency lesion set around the pulmonary veins. (Right) vein (PV) ectopy initiating fibrillatory conduction contained within the isolated vein while

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Figure 5