Atrial Fibrillation Overview and Updates

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Disclosures

- Consultant
  - Biosense Webster
  - Medtronic

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Objectives

1. Review Atrial Fibrillation (AF) evaluation
2. Highlight Recent Guideline Updates
3. Recognize importance of lifestyle and risk factor modification
4. Discuss stroke prevention
5. Understand differences in rate and rhythm management
6. Review commonly used antiarrhythmic medications
7. Discuss the role of catheter ablation
8. Discuss the role of left atrial appendage occlusion

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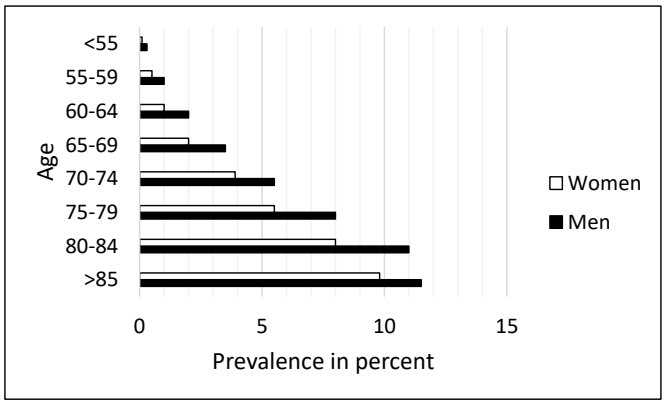
Why is AF important?

- 3-6 million people estimated to have AF in the US
- Projected to increase to 6-16 million by 2050
- Lifetime risk of developing AF from age 40-95:
  - 26% for men
  - 23% for women

Courtesy of Dr. Liu

Prevalence of AF by age



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Why is AF important?

- >467,000 annual hospitalizations
- 2x as likely to be hospitalized
- >99,000 deaths per year

- Adds $8,700 per year per patient
- Adds $26 billion to US healthcare annually

Courtesy of Dr. Liu

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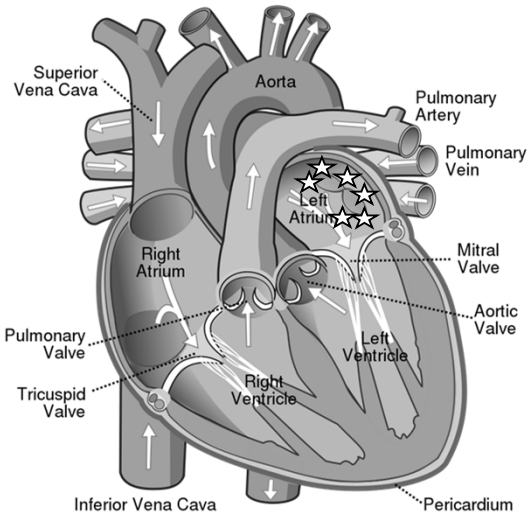
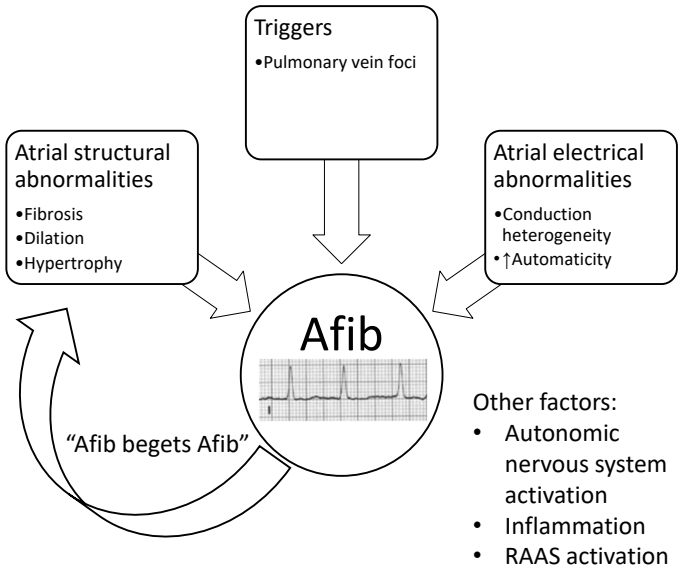
Pathophysiology





Other factors:
- Autonomic nervous system activation
- Inflammation
- RAAS activation

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Courtesy of Dr. Liu

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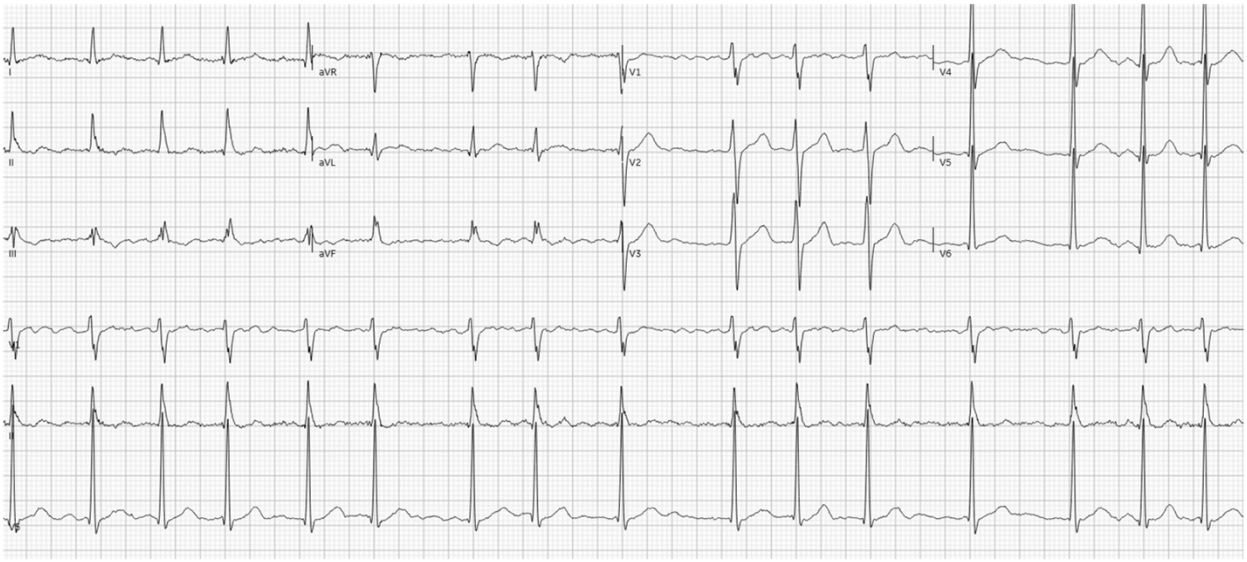
What is AF?



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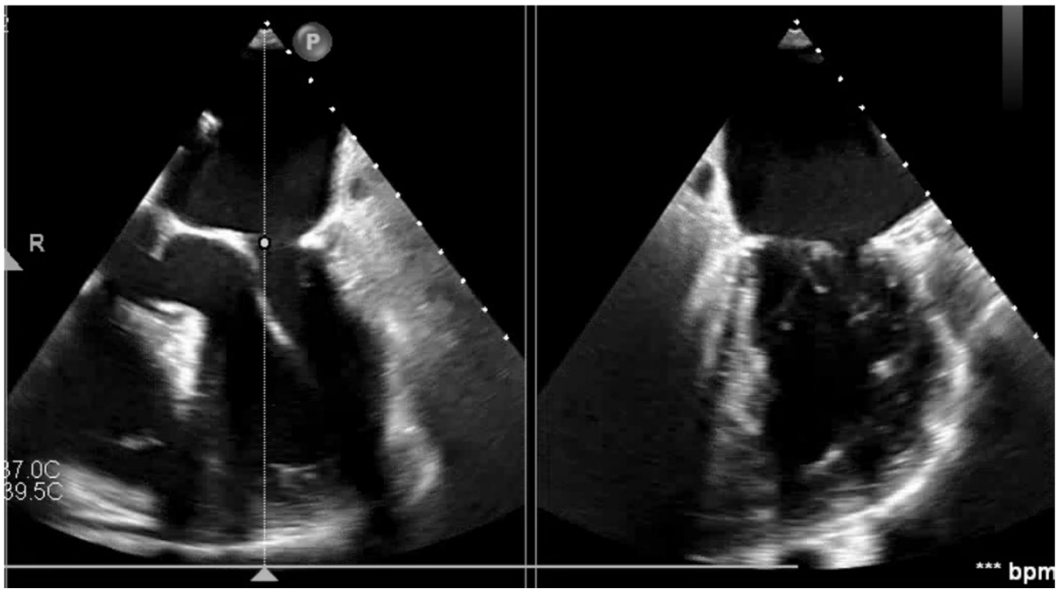
What is AF? Video



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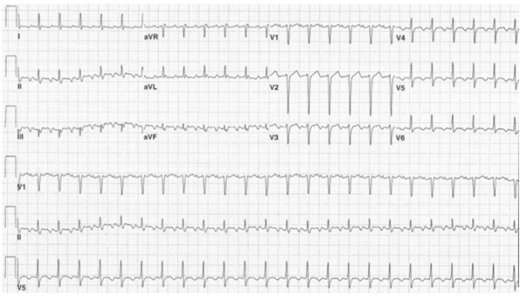
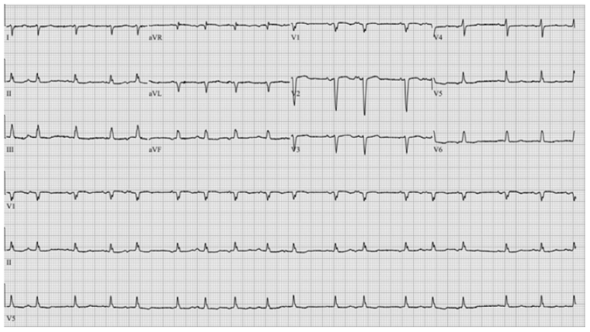
What is not Afib?

Artifact



Atrial flutter

Sinus with premature atrial contractions



Multifocal Atrial Tachycardia

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Evaluation

EKG
- Markers of other heart disease (LVH, ischemia)
- Pre-excitation
- QT interval (important for certain anti-arrhythmics)

Echo
- Assess LV function, valvular disease
- Left atrial size

Labs
- Chemistry, CBC
- Thyroid function

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Major Updates

2023 ACC/AHA/ACCP/HRS Guidelines

1. Stages of AF
2. AF Risk Factor Modification and Prevention
3. Flexibility of Stroke Prevention Risk Scores
4. Incorporation of Stroke Risk "Modifiers"
5. Early Rhythm Control
6. Class 1 Indication for AF Ablation in Select Populations
7. Class 1 Indication for AF Ablation in HFrEF
8. Device Detected AF Updates
9. Left Atrial Appendage Occlusion Recommendations (Increase to 2a for select populations)
10. Importance of AF Detected during an Acute Illness

Joglar, José A., et al. "2023 ACC/AHA/ACCP/HRS guideline for the diagnosis and management of atrial fibrillation: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines." Circulation 149.1 (2024): e1-e156.

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Stages of AF Disease Continuum

Prior	Current

• Paroxysmal
• Persistent
• Long-Standing Persistent
• Permanent
	• Stage 1: At Risk
	• Stage 2: Pre-AF
	• Stage 3: AF
	  • 3A:Paroxysmal
	  • 3B: Persistent
	  • 3C: Long-standing Persistent
	  • 3D: Successful Ablation
	• Stage 4 Permanent

12 Joglar, José A., et al. "2023 ACC/AHA/ACCP/HRS guideline for the diagnosis and management of atrial fibrillation: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines." Circulation 149.1 (2024): e1-e156.

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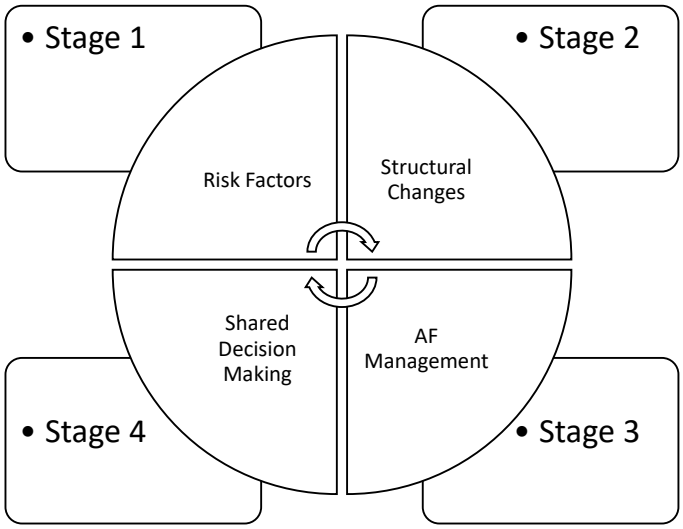
Stage Based Management

- Common Thread: Treat Modifiable Risk Factors



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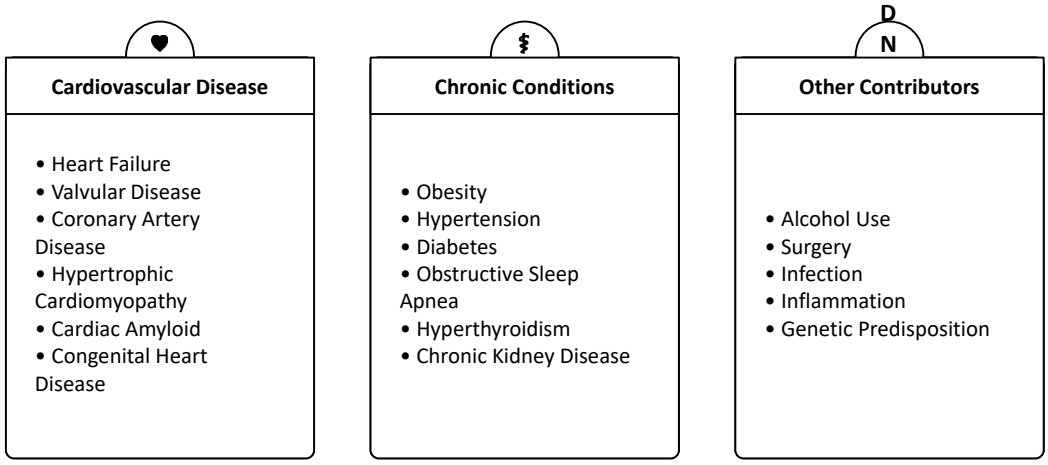
Risk factors for developing AF



Most AF risk factors are modifiable, highlighting opportunities for prevention and aggressive management of cardiovascular and metabolic disease.

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Risk Factor Modification and Prevention

Weight Management

≥10% Weight Loss

Target meaningful and sustained weight reduction

Physical Activity

≥210 min/week

Moderate-to-vigorous exercise

Smoking Cessation

Eliminate Tobacco Use

Offer guideline-directed cessation therapies

Alcohol Reduction

≤3 Drinks/Week

Avoid binge drinking; abstinence preferred

Cardiometabolic Optimization

Diabetes & Hypertension

Evidence-based risk factor control

Sleep Health

Screen for OSA

Identify and treat sleep disorders

Joglar, José A., et al. "2023 ACC/AHA/ACCP/HRS guideline for the diagnosis and management of atrial fibrillation: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines." Circulation 149.1 (2024): e1-e156.

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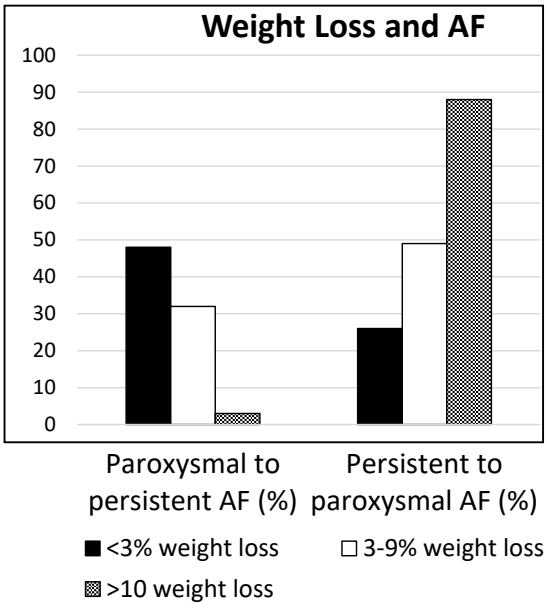
Obesity and AF

- Obesity is a strong risk factor for AF
- Target a weight loss of at least 10% to help reduce AF burden
- Bariatric surgery in obese patients has been associated with reduced risk of new AF and recurrence after ablation.
- For overweight and obese patients with AF, weight loss combined with risk factor modification is recommended.
- Role for GLP-1?



Circulation. 2020;141:e750–e772. DOI: 10.1161/CIR.0000000000000748

Courtesy of Dr. Liu with adaptation

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Caffeine Intake

No Benefit to Recommend Caffeine Abstinence to Prevent Recurrence (Class III)

May reduce symptoms in patients who report Caffeine triggers

Joglar, José A., et al. "2023 ACC/AHA/ACCP/HRS guideline for the diagnosis and management of atrial fibrillation: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines." Circulation 149.1 (2024): e1-e156.

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Stroke in AF

800,000 Strokes/Year

87% Ischemic

13% Hemorrhagic (10% ICH, 3% SAH)

AF is the most frequent major complication linked to stroke

5×

Higher stroke risk in non-valvular AF

8-36%

1-year mortality varies by age & sex

↑ Recurrence

More disability and increased mortality

Joglar, José A., et al. "2023 ACC/AHA/ACCP/HRS guideline for the diagnosis and management of atrial fibrillation: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines." Circulation 149.1 (2024): e1-e156.

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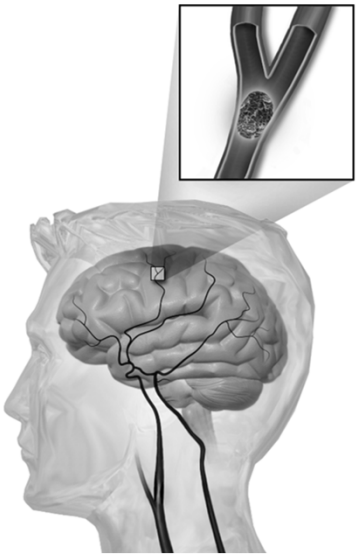
Stroke Prevention Video



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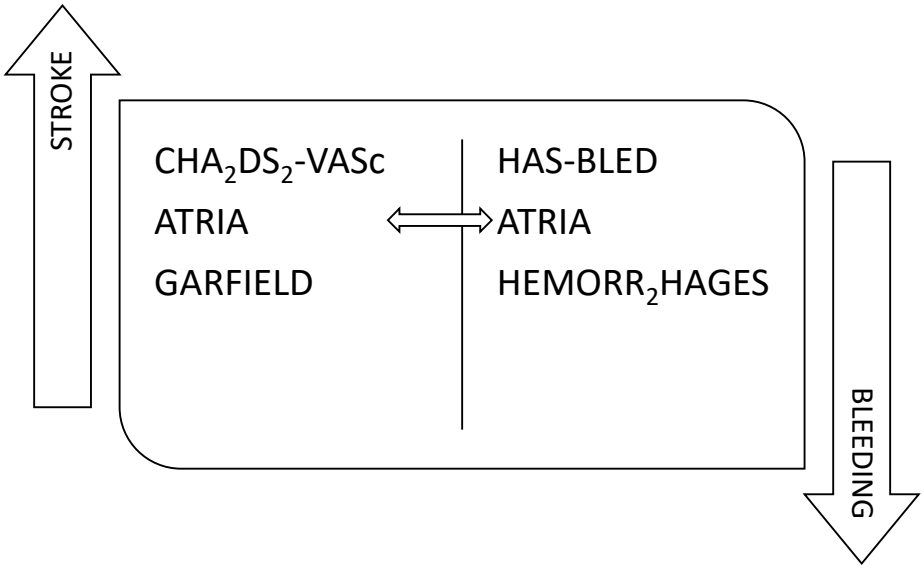
Stroke Risk Assessment



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CHA_2DS_2VASc Score

Letter	Risk factor	Score
C	Congestive heart failure	1
H	Hypertension	1
A_2	Age ≥ 75	2
D	Diabetes	1
S_2	Stroke, TIA, thromboembolism	2
V	Vascular disease (myocardial infarction, peripheral arterial disease, aortic plaque)	1
A	Age 65-74	1
S	Sex category (female sex)	1

CHA_2DS_2VASc Score	Annual Stroke Rate
0	0.2%
1	0.6%
2	2.2%
3	3.2%
4	4.8%
5	7.2%
6	9.7%
7	11.1%
8	11%
9	12.2%

Joglar, José A., et al. "2023 ACC/AHA/ACCP/HRS guideline for the diagnosis and management of atrial fibrillation: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines." Circulation 149.1 (2024): e1-e156.

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Additional Risk Factors for Stroke

AF Burden

Persistent / Permanent AF

Obesity

Hypertrophic Cardiomyopathy

Poorly Controlled Hypertension

Chronic Kidney Disease
- eGFR ≤ 45 mL/min
- Proteinuria >150 mg/24 h

LEFT ATRIAL ENLARGEMENT
LA Volume ≥ 73 mL | Diameter ≥ 4.7 cm

Joglar, José A., et al. "2023 ACC/AHA/ACCP/HRS guideline for the diagnosis and management of atrial fibrillation: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines." Circulation 149.1 (2024): e1-e156.

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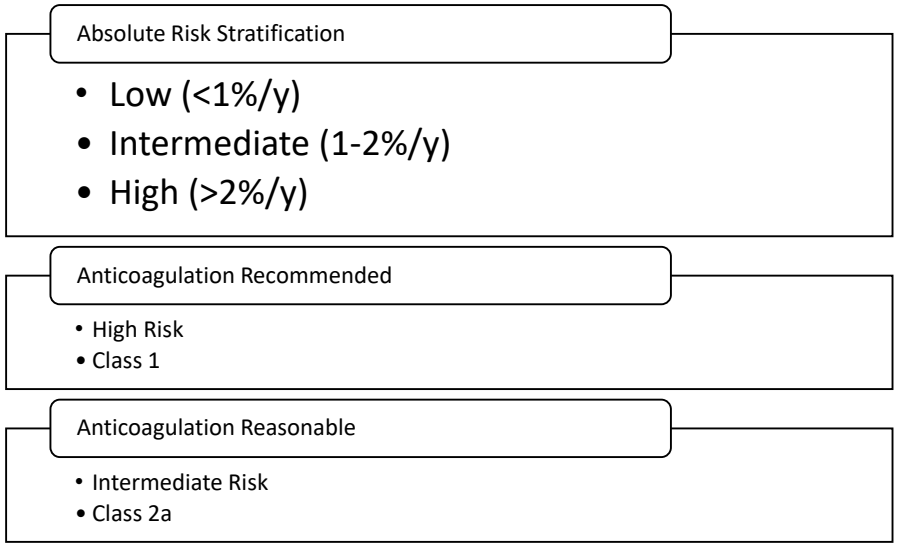
CHA_2DS_2VASc Score



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Anticoagulants

- Choices include
  - Warfarin
  - Dabigatran
  - Rivaroxaban
  - Apixaban
  - Edoxaban

  } Non-vitamin K oral anticoagulants (NOACs) or direct-acting oral anticoagulants (DOACs)

- **DOACs are recommended over warfarin in Afib patients without moderate-to-severe mitral stenosis or a mechanical heart valve.**
- For patients with Afib who have mechanical heart valves, warfarin is recommended.
- For patients who are unable to maintain therapeutic INR, DOAC is recommended.
- Aspirin No Longer Recommended

Courtesy of Dr. Liu

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DOACs for Afib

	Mechanism	Comparison to warfarin	Kinetics	Dosing	Dosing adjustments	Reversal agent
Dabigatran	Direct thrombin inhibitor	110mg: stroke rates similar to warfarin, lower major hemorrhage 150mg: stroke rate lower than warfarin, similar major hemorrhage	$T^1/_2$ = 12-17hrs Peak effect 2hrs	150mg BID	• 75mg BID if CrCl 15-30 mL/min • Avoid use if CrCl <15 mL/min	• Idarucizumab • Prothrombin complex concentrate (PCC)
Rivaroxaban	Direct factor Xa inhibitor	Non-inferior to warfarin for stroke prevention, no difference in major bleeding, less frequent ICH and fatal bleeding	$T^1/_2$ = 5-9hrs Peak effect 3hrs	20mg daily with largest meal of day (evening)	• 15mg daily with evening meal if CrCl 15-50 mL/min • Avoid use if CrCl ≤15 mL/min	• Andexanet alfa • PCC
Apixaban	Direct factor Xa inhibitor	Superior to warfarin for stroke prevention, less bleeding and lower mortality	$T^1/_2$ = 12hrs Peak effect 3hrs	5mg BID	• 2.5mg BID if 2 of the following: age ≥80 yrs, body weight ≤60 kg, or serum Cr ≥1.5 mg/dL • No other adjustment for ESRD	• Andexanet alfa • PCC
Edoxaban	Direct factor Xa inhibitor	Non-inferior to warfarin for stroke prevention, lower rates of bleeding	$T^1/_2$ = 10-14hrs Peak effect 2hrs	60mg daily	• Avoid use if CrCl >95 mL/min • 30mg daily if CrCl 15-50 mL/min • Avoid use if CrCl <15 mL/min	PCC

Courtesy of Dr. Liu

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Monitoring devices

Holter monitor

Event monitor/mobile cardiac telemetry

Implantable loop recorder

Pacemaker/defibrillator

Personal devices

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Device Detected Atrial Fibrillation

Initial Diagnosis

Electrocardiogram

Intracardiac Tracing (ie atrial pacemaker lead)

Wearable monitors are reasonable to detect duration and burden of AF with automated algorithms

Consumer based ECG data can be used for monitoring

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Device Detected Atrial High Rate Episode (AHRE)

AHRE >=24 hrs + CHADSVASC >= 2	Anticoagulation Reasonable
5min < AHRE < 24hrs + CHADSVASC >= 3	Anticoagulation Reasonable
AHRE <5min	No anticoagulation

Joglar, José A., et al. "2023 ACC/AHA/ACCP/HRS guideline for the diagnosis and management of atrial fibrillation: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines." Circulation 149.1 (2024): e1-e156.

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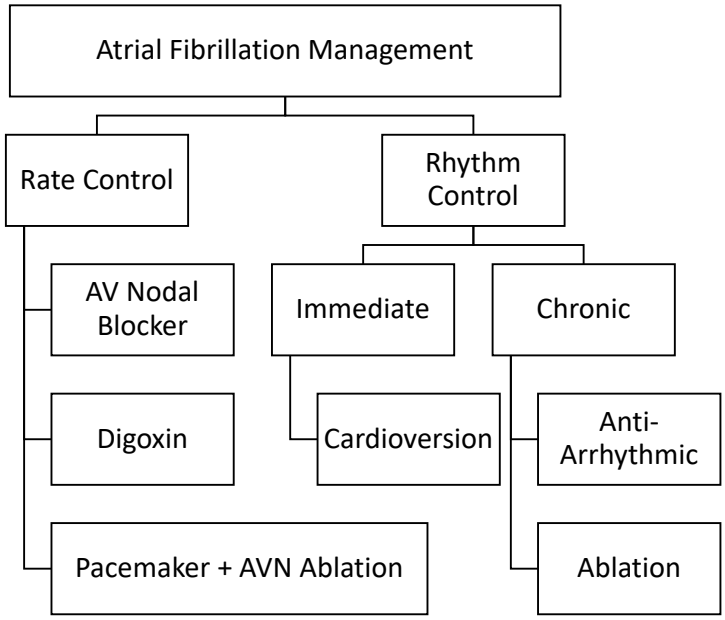

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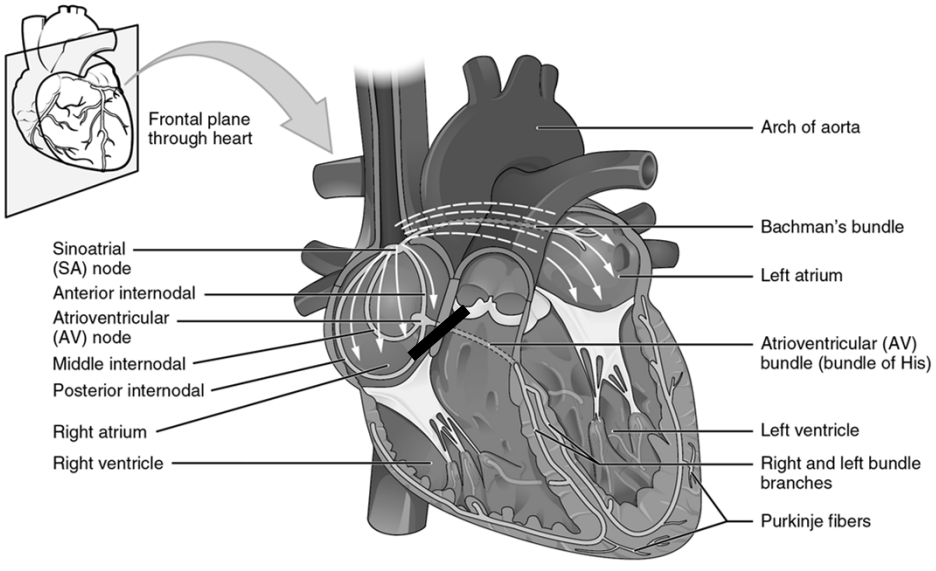
Rate Control



Anterior view of frontal section

Anatomy & Physiology, Connexions Web site. http://cnx.org/content/col11496/1.6/, Jun 19, 2013.

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Rate Control

- **Patient Population**
  - Permanent atrial fibrillation
  - Asymptomatic
  - Preserved LV function
- **Acute Management**
  - IV beta blocker or nondihydropyridine calcium channel blocker
  - Avoid nondihydropyridine calcium channel blocker in decompensated heart failure
- **Chronic HR Goal**
  - Resting heart rate < 80bpm
  - If asymptomatic and normal LV function, can consider a more lenient goal (<110bpm)

January, Craig T., et al. "2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society." *Journal of the American College of Cardiology* 64.21 (2014): e1-e76.

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Class	Example	Mechanism	Side Effects
Beta Blocker	• Metoprolol • Carvedilol • Atenolol • Propranolol	Rate control achieved by inhibiting beta-1 receptors	• Depression • Erectile Dysfunction • Bradycardia • Fatigue
Nondyhdropyridine Calcium Channel Blocker	• Diltiazem • Verapamil	Inhibits calcium ion entry during depolarization	• Constipation • Lower Extremity Edema
Cardiac Glycoside	Digoxin	Suppression of AV node conduction via inhibition of Na/K ATPase -> increased intracellular Ca	• Too many to list • Requires drug level monitoring • Toxicity may require Digi-Fab

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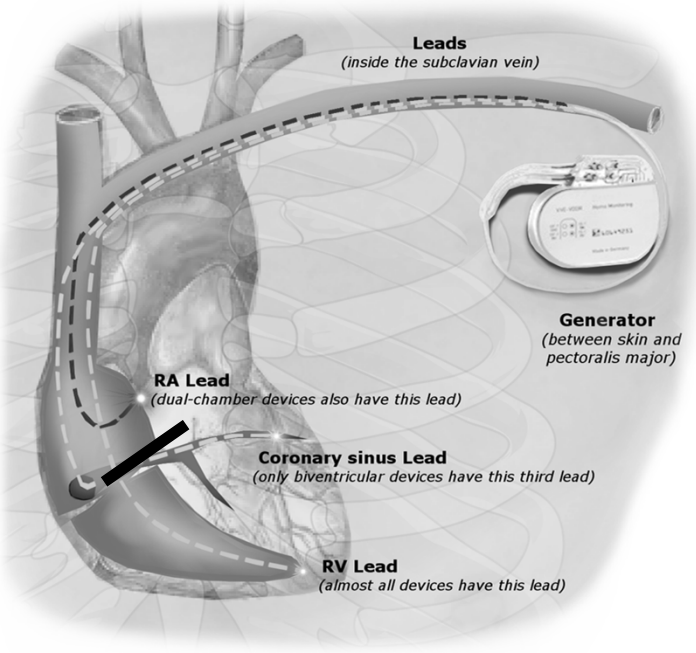

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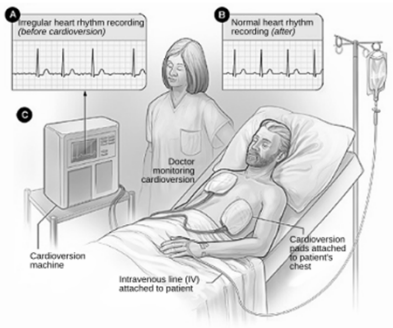
Rhythm Control



- **Patient Population**
  - Symptomatic
  - LV dysfunction and heat failure
  - Non permanent atrial fibrillation
- **Acute Management**
  - Electrical or chemical cardioversion
  - Prior to cardioversion
    - 3-4 weeks of uninterrupted anticoagulation regardless of CHADSVASC score or onset within 48 hours of cardioversion
    - Transesophageal echo or CT pulmonary vein showing no left atrial or left atrial appendage thrombus
  - Following Cardioversion
    - 4 weeks of uninterrupted anticoagulation, regardless of CHADSVASC score

- January, Craig T., et al. "2014 AHA/ACC/HRS guideline for the management of patients with atrial fibrillation: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society." *Journal of the American College of Cardiology* 64.21 (2014): e1-e76.
- https://commons.wikimedia.org/wiki/File:Cardioversion.svg - National Heart Lung and Blood Insitute (NIH) – Author - Jmarchn

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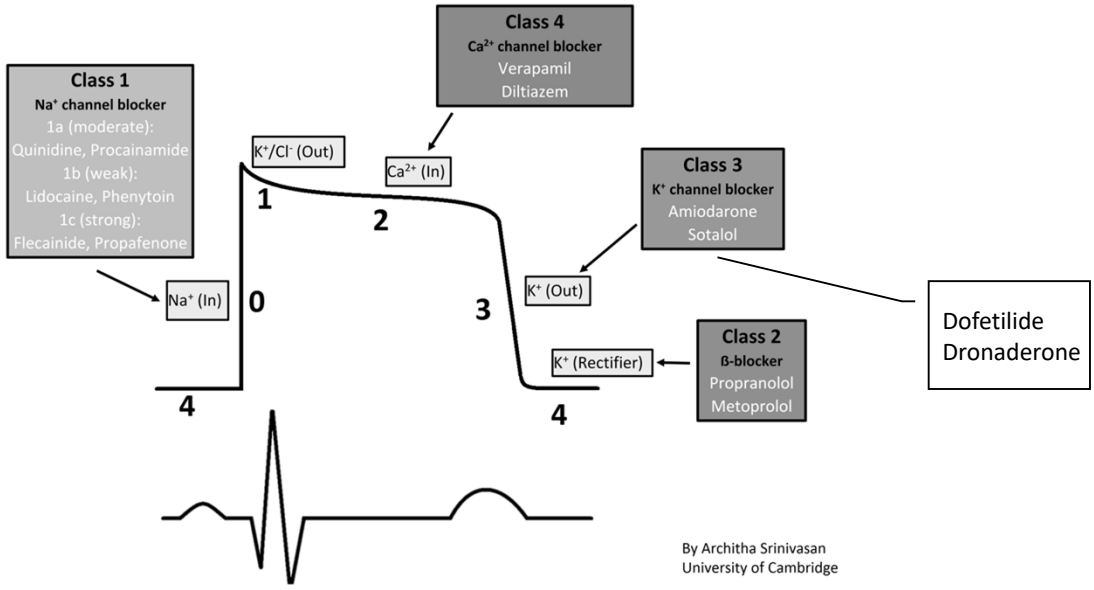
Drugs Affecting the Cardiac Action Potential



https://upload.wikimedia.org/wikipedia/commons/a/a9/Cardiac_action_potential.png

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Antiarrhythmic Maintenance of Sinus Rhythm

Class	Mechanism	Drug	Monitoring	Contraindications	Notes
1c	Na Channel Blockade	• Flecainide • Propafenone	• Baseline ECG Stress Test • Renal and Liver	• Structural heart disease • Conduction disease	**Must** be taking with an AV nodal blocking agent
III	K Channel Blockade	• Sotalol • Dofetilide • Dronaderone	• QT/QTc • Renal Function	• ESRD • Prolonged QT • Bradyarrhythmia	Do not use dronaderone in symptomatic heart failure, NYHA IV or permanent AF
Many	Na, K, CCB, and BB	Amiodarone	• Thyroid • Liver • Pulmonary (CXR and DLCO)	• Pulmonary and liver disease • Hyperthyroid • Heart block • Iodine hypersensitivity	• Photosensitivity • Ocular and neurologic involvement

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Pill in the Pocket

- Class 1C AAD
- Give AV nodal blocking agent (diltiazem, verapamil, metoprolol, etc) and DOAC
- 30 minutes later given Class 1c agent
  - Propafenone 600mg (>70kg) or 450mg (≤70kg)
  - Flecainide 300mg (>70kg) or 200mg (≤70kg)
- Monitor for 6 hours on telemetry post first dose
- BP every 30 min
- ECG every 2 hours
- If QRS increases >50%, stop therapy
- Severe toxicity treated with hypertonic sodium bicarb

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Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) Trial

- 2002 in New England Journal of Medicine
- Compared mortality in rate vs rhythm control strategy in ~4000 patients
- Majority of rate control- beta blocker and digoxin
- Majority of rhythm control- amiodarone and **sotalol**
- Higher incidence in rhythm control:
  - pulmonary event (7.3 vs 1.3)
  - gastrointestinal event (8.0 vs 2.1)
  - bradycardia (6.0 vs. 4.2)
  - prolonged QTc (1.9 vs 0.3)
- Conclusion- “Management of atrial fibrillation with the rhythm-control strategy offers no survival advantage over the rate-control strategy, and there are potential advantages, such as a lower risk of adverse drug effects, with the rate-control strategy”

Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) Investigators. "A comparison of rate control and rhythm control in patients with atrial fibrillation." *New England Journal of Medicine* 347.23 (2002): 1825-1833.

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Why Choose Rhythm Control?

- Much has changed since 2002
- Only 14 patients received an AF ablation
- Therapeutic INR in only 62.3%
- Sotalol downgraded to a 2b recommendation

- **Follow-up Analysis**
  - 5 year follow-up showed a greater risk of heart failure in rate control strategy (21.4% vs 16.4%)
  - Increase in total mortality (HR 2.83), cardiac mortality (4.27) and hospitalization (HR 3.04)
  - Risk factors for heart failure
    - Rate >80 bpm
    - AF burden, especially >75%

- Slee A, Saksena S. Impact of initial heart failure emergence on clinical outcomes of atrial fibrillation patients in the AFFIRM trial. Am Heart J. 2020 Feb;220:1-11. doi: 10.1016/j.ahj.2019.10.005. Epub 2019 Oct 28. PMID: 31756389.
- Atrial Fibrillation Follow-up Investigation of Rhythm Management (AFFIRM) Investigators. "A comparison of rate control and rhythm control in patients with atrial fibrillation." *New England Journal of Medicine* 347.23 (2002): 1825-1833.
- https://commons.wikimedia.org/wiki/File:2016_Fiat_Ducato_42_Maxi_West_Midlands_Ambulance_Service_3.0.jpg – Author – Makizox CC BY-SA 4.0

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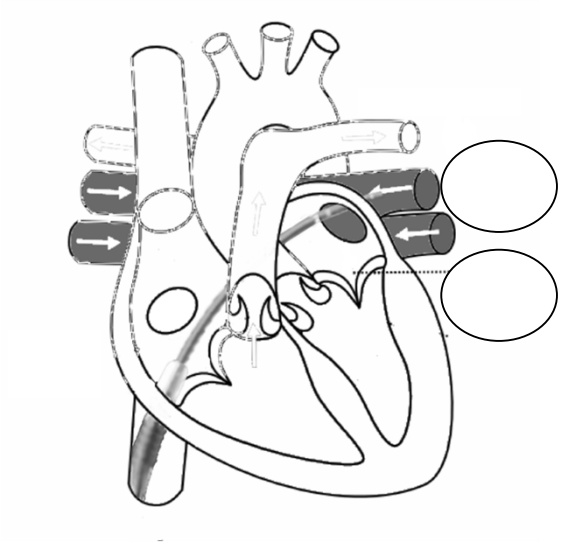
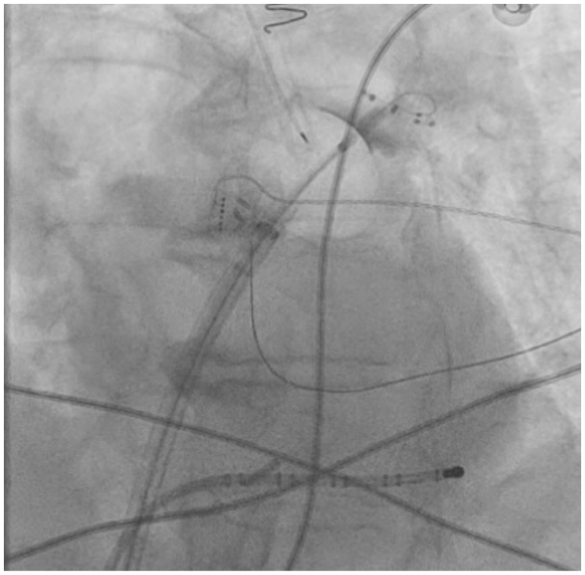
Atrial Fibrillation Ablation





https://commons.wikimedia.org/wiki/File:Herz_Lungenvenenablation.png

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Pulsed Field Ablation (PFA)

NONTHERMAL • TISSUE SELECTIVE
Electroporation causes cell death while minimizing collateral injury

Mechanism

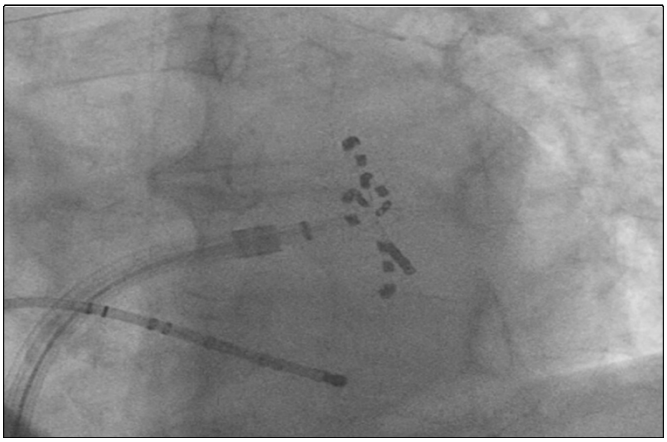
Electrical field applied to cells
↑ membrane permeability
Cell death

Advantages

Similar efficacy
Increased procedural efficiency
Lower phrenic nerve & esophageal injury

Risks

Coronary vasospasm
Hemolysis
Stroke



Key Message: Pulsed field ablation offers tissue-selective lesion creation with improved efficiency and a favorable safety profile compared with thermal ablation technologies.

Hartl, Stefan, et al. "Pearls and pitfalls of pulsed field ablation." Korean circulation journal 53.5 (2023): 273-293.

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Early AF Ablation

↓33%	↓16%	54% vs 29%	42.9% vs 67.8%
Stroke Reduction	Mortality Reduction	Symptom Improvement	AF Recurrence

Timing

EAST-AFNET 4: Early rhythm control reduced stroke by one-third and lowered all-cause mortality by 16%.

Symptoms & Burden

STOP AF: 54% symptom improvement vs 29% with AAD.
EARLY AF:
1-year recurrence 42.9% with ablation vs 67.8% with AAD.

Key Message: Earlier AF ablation is associated with improved clinical outcomes, symptom relief, and lower recurrence compared with antiarrhythmic drug therapy.

- Kirchhof, Paulus, et al. "Early rhythm-control therapy in patients with atrial fibrillation." New England Journal of Medicine 383.14 (2020): 1305-1316.
- Wazni, Oussama M., et al. "Cryoballoon ablation as initial therapy for atrial fibrillation." *New England Journal of Medicine* 384.4 (2021): 316-324.
- Andrade, Jason G., et al. "Cryoablation or drug therapy for initial treatment of atrial fibrillation." *New England Journal of Medicine* 384.4 (2021): 305-315.

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AF Ablation and Mortality

CABANA: No difference in all cause mortality
Improvement in hospitalization and AF recurrence

CASTLE-AF: Significant improvement in mortality in systolic heart failure (HR 0.56)

- Packer DL, Mark DB, Robb RA, et al. Effect of Catheter Ablation vs Antiarrhythmic Drug Therapy on Mortality, Stroke, Bleeding, and Cardiac Arrest Among Patients With Atrial Fibrillation: The CABANA Randomized Clinical Trial. *JAMA.* 2019;321(13):1261–1274. doi:10.1001/jama.2019.0693
- https://commons.wikimedia.org/wiki/File:Family_Concierge_beach_cabana_at_Paradisus_by_Meli%C3%A1_Bali.jpg
- Marrouche, Nassir F., et al. "Catheter ablation for atrial fibrillation with heart failure." *New England Journal of Medicine* 378.5 (2018): 417-427.
- https://commons.wikimedia.org/wiki/File:Neuschwanstein_Castle_2024.jpg

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Left Atrial Appendage Closure

Candidates

Non-compliant or labile INR

High risk lifestyle

Severe Bleeding due to Non-reversible cause

Spontaneous intracranial or intraspinal bleeding

Serious bleeding due to recurrent falls

Evaluation

CHADSVASC ≥ 2

Suitable for anticoagulation

Appropriate candidate

No other need for anticoagulation (mechanical valve, left ventricular thrombus, etc.)

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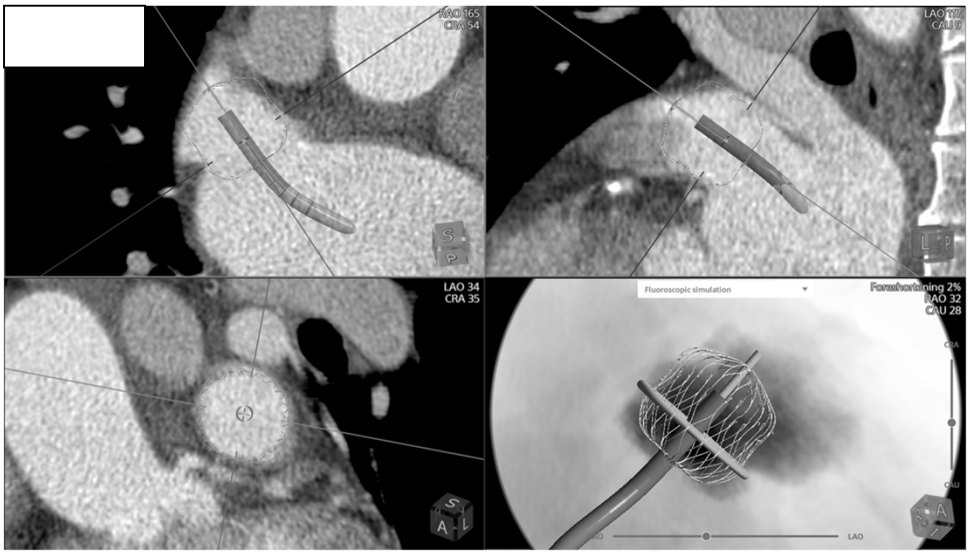
CT Preplanning



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Transseptal with ICE Guidance

Video

46 | Trade Secret, Confidential, Proprietary, Do Not Copy | OSU Wexner Medical Center © 2018

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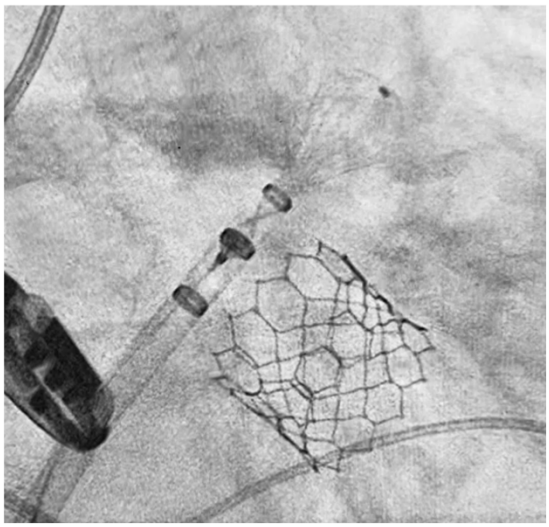
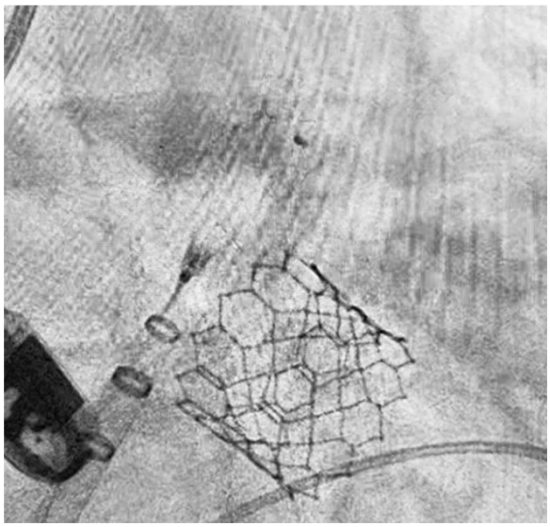
Videos

Deployment



Tug Test



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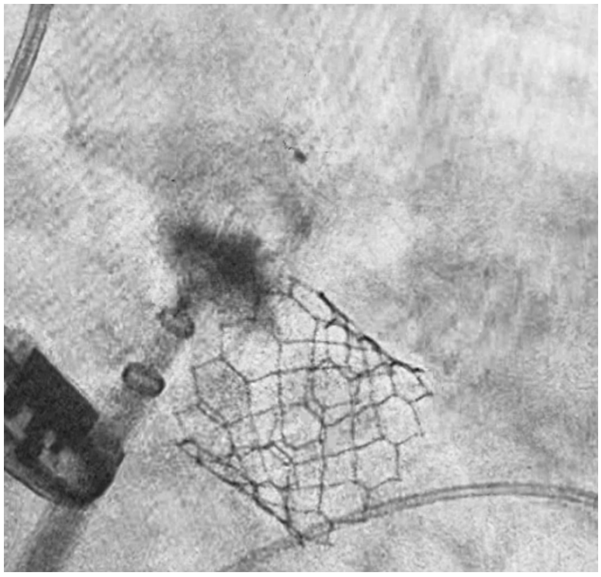
Contrast Injection

Video



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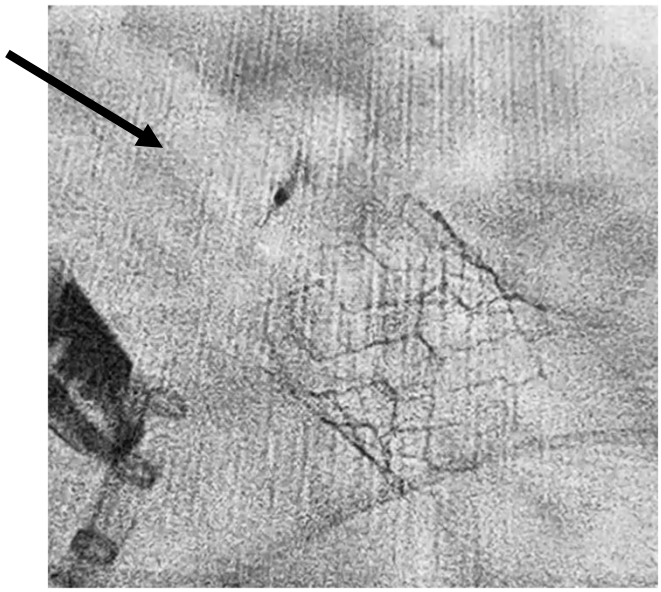
Deployment

Video



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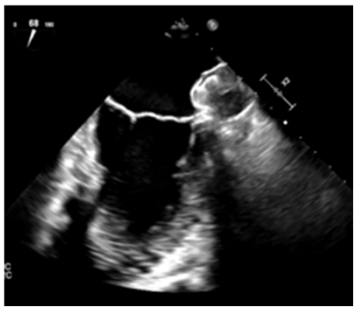
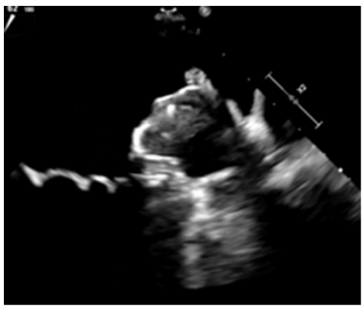
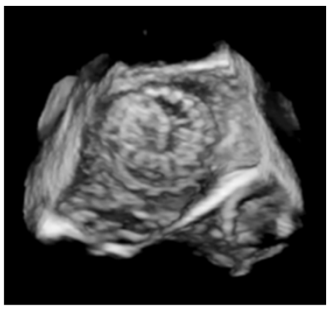
Post LAAO Management

Implant	6 weeks	6 months
• Continue NOAC	• TEE • DAPT	• SAPT







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AF in Acute Illness

- Significant risk of recurrent AF when diagnosed during an acute illness
  - Recurrence rates range from 39% - 68 %
- Outpatient follow-up specifically focused on AF risk recommended
  - Higher rates of HF, stroke, death
- Anticoagulation benefit is uncertain in acute illness due to sepsis during critical illness
  - No significant association with stroke or bleeding at 3 year

https://commons.wikimedia.org/wiki/File:Dr._Moosa_Kunhi_04.jpg

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Conclusions

- Atrial fibrillation remains a significant burden for patients and the medical system
- Appropriate prevention of stroke based on risk factors is of utmost importance
- Risk factor modification can have a significant improvement in atrial fibrillation burden
- Rhythm control options, especially early in the course of disease can reduce the burden of disease and improve outcomes
- Ablation therapy is safe and efficacious, with a larger role in the management of atrial fibrillation
- Left Atrial Appendage Occlusion is an option for high risk patients

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