Arrhythmia 341

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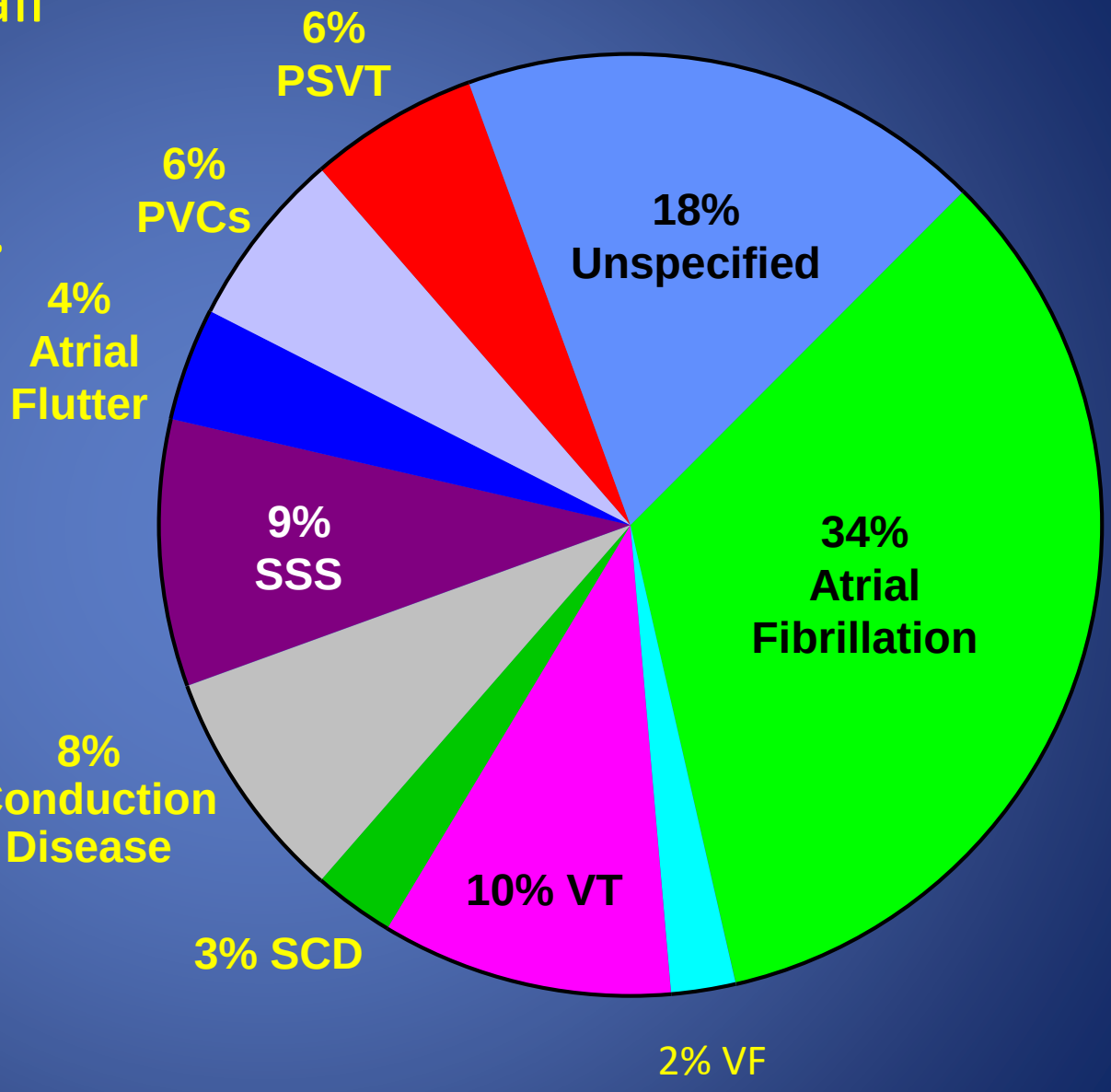
Objectives

- Identify mechanism of AF
- Recognize EKG of AF
- Discuss treatment options of AF
- Identify other forms of Arrhythmia

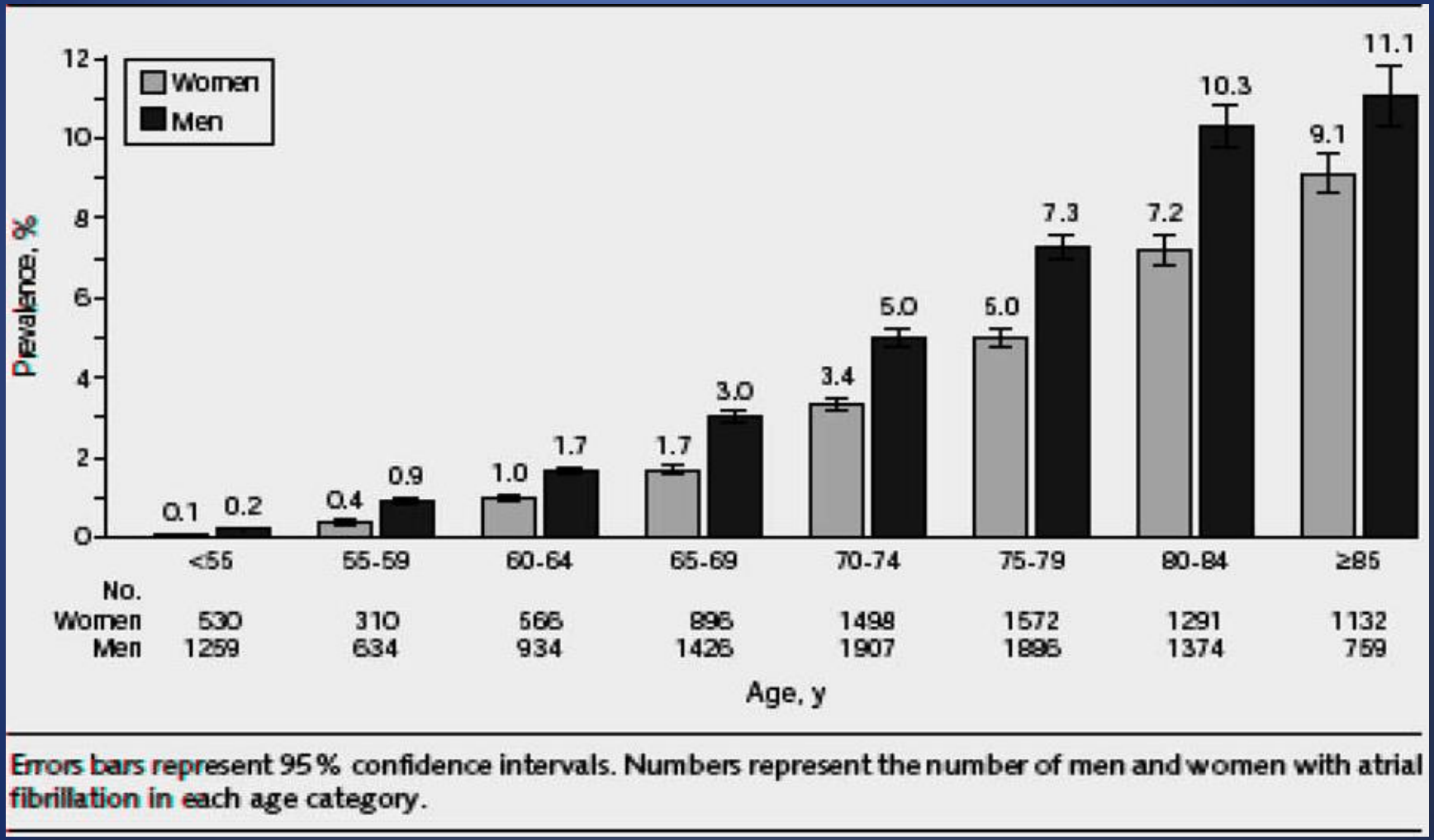
Atrial fibrillation accounts for 1/3 of all patient discharges with arrhythmia as principal diagnosis.



Epidemiology

- 2.3 million people in North America
- 4.5 million in EU
- In the 20 year AF admission have increased by 66%.
- $ 15.7 billion annually in EU
- Estimated prevalence of AF is 0.4% to 1% in the general pop. 8% in pt. >80 years

AF Prevalence in US Population

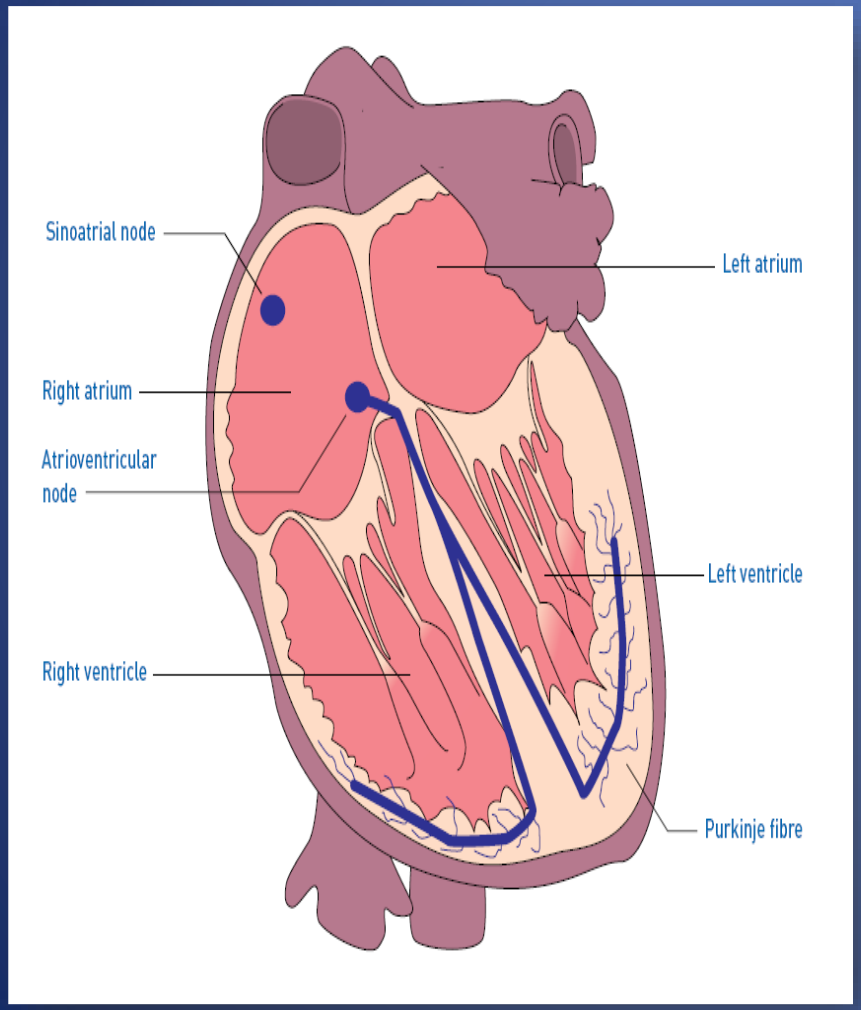


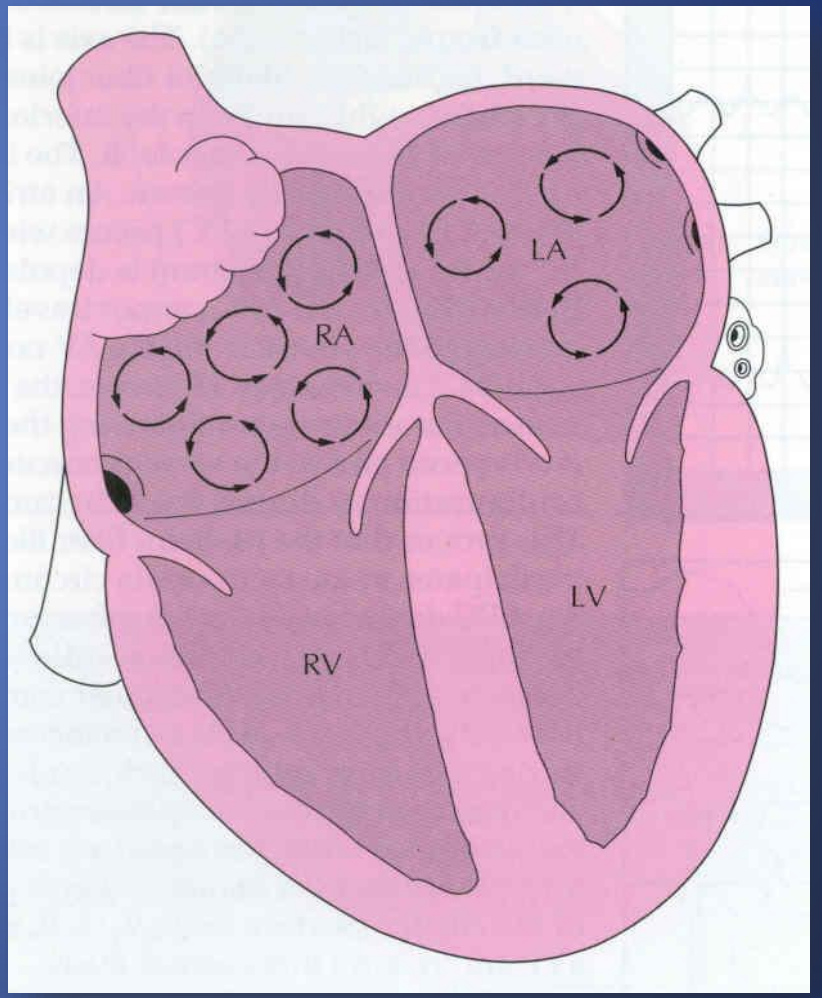
Errors bars represent 95% confidence intervals. Numbers represent the number of men and women with atrial fibrillation in each age category.

Pathophysiology of Atrial Fibrillation and associated Stroke

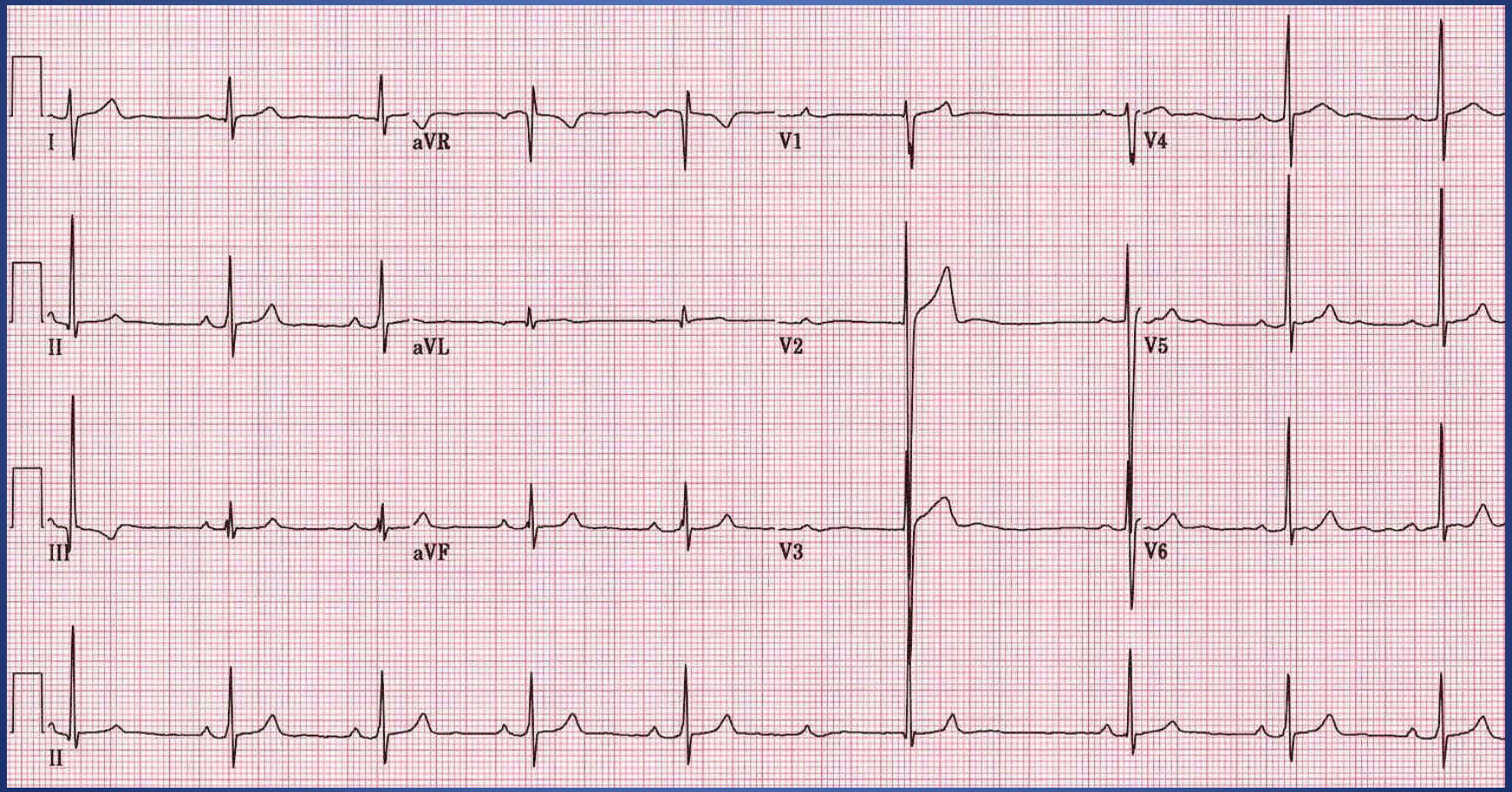
Normal regulation of heart rate and rhythm

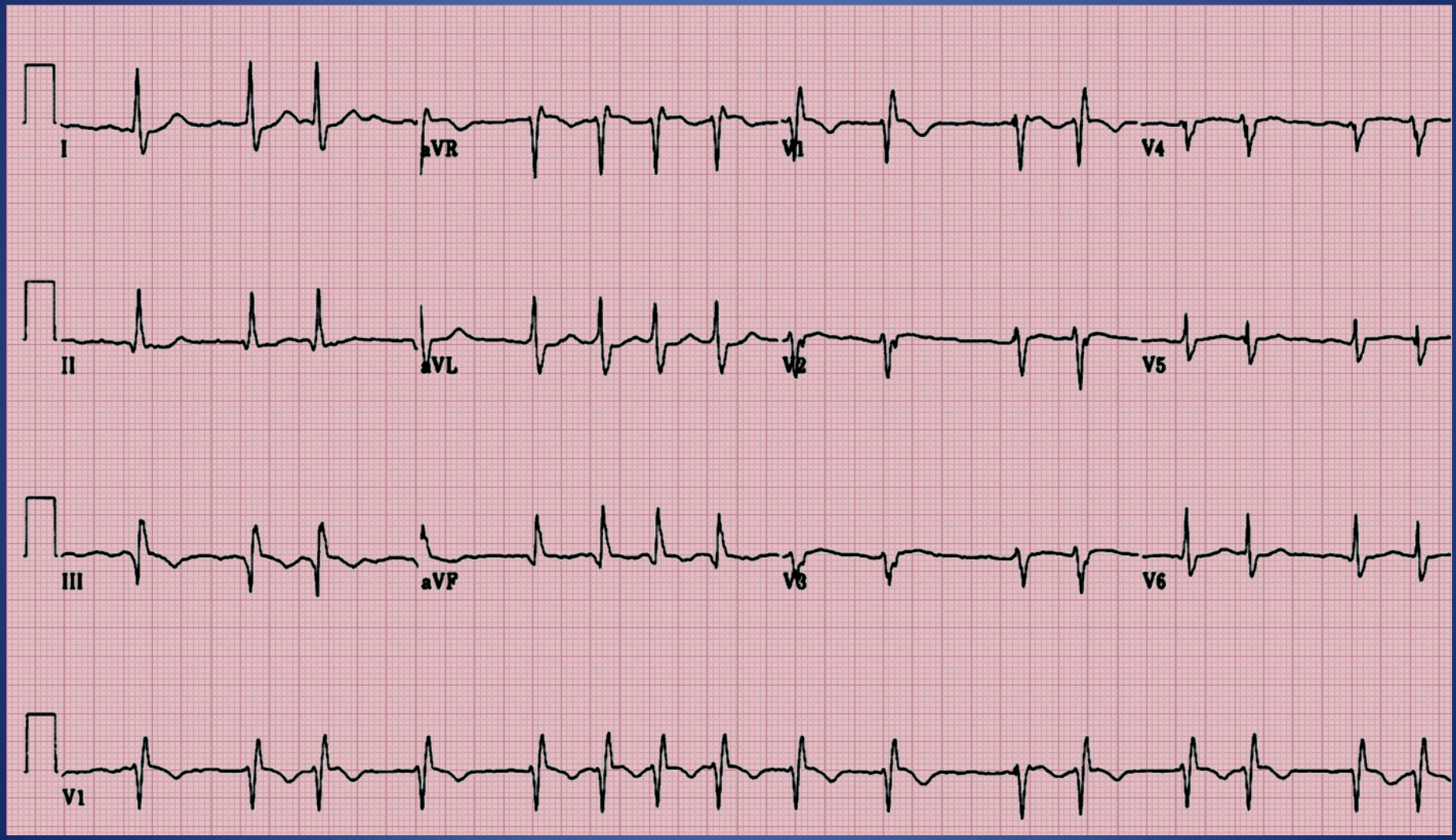
- Contraction is controlled by the sinoatrial (SA) node





Normal EKG




I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1

Normal heart rhythm is disrupted in AF

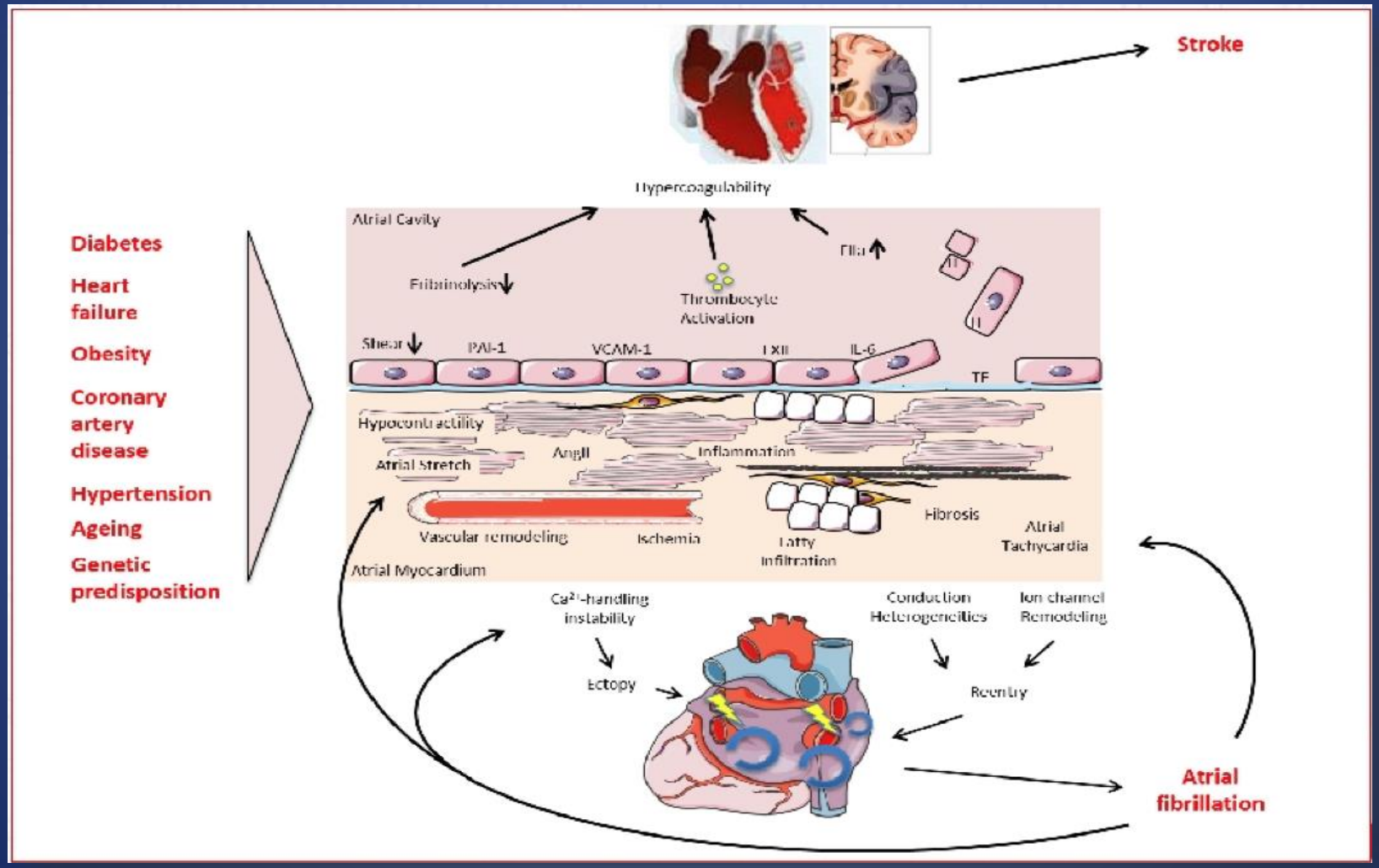
- AF is characterized by:
  - Rapid (350–600 beats/min) and irregular atrial rhythm
  - Reduced filling of the left and right ventricles
- Conduction of most impulses from the atria to ventricles is blocked at the AV node
- Contraction of the ventricles can be:
  - Irregular and rapid (110–180 beats/min; tachycardia)
  - Irregular and slow (<50 beats/min; bradycardia)
  - Normal
- Cardiac output can be reduced

AF begets AF

- AF causes remodelling:
  - **Electrical**: shortening of refractory period
  - **Structural**: enlargement of atrial cavities
- Many episodes of AF resolve spontaneously
- Over time AF tends to become persistent or permanent.

Wijffels MC et al. Circulation 195;92:1954–68

AF begets AF


Stroke
Hypercoagulability
Diabetes
Heart failure
Obesity
Coronary artery disease
Hypertension
Ageing
Genetic predisposition
Atrial Cavity
Fibrinolysis
Thrombocyte Activation
IIa
Shear
PAI-1
VCAM-1
TXII
IL-6
TF
Hypocontractility
AngII
Inflammation
Atrial Stretch
Vascular remodeling
Ischemia
Fibrosis
Fatty Infiltration
Atrial Tachycardia
Atrial Myocardium
Ca2+-handling instability
Conduction Heterogeneities
Ion channel Remodeling
Ectopy
Reentry
Atrial fibrillation

Consequences of AF

Event	Association with AF
Death	Increased mortality, especially cardiovascular mortality due to sudden death, heart failure or stroke.
Stroke	20–30% of all strokes are due to AF. A growing number of patients with stroke are diagnosed with 'silent', paroxysmal AF.
Hospitalizations	10–40% of AF patients are hospitalized every year.
Quality of life	Quality of life is impaired in AF patients independent of other cardiovascular conditions.
Left ventricular dysfunction and heart failure	Left ventricular dysfunction is found in 20–30% of all AF patients. AF causes or aggravates LV dysfunction in many AF patients, while others have completely preserved LV function despite long-standing AF.
Cognitive decline and vascular dementia	Cognitive decline and vascular dementia can develop even in anticoagulated AF patients. Brain white matter lesions are more common in AF patients than in patients without AF.

Diagnosis of Atrial Fibrillation

Atrial Fibrillation: Cardiac Causes

- Hypertensive heart disease
- Ischemic heart disease
- Valvular heart disease
  - Rheumatic: mitral stenosis
  - Non-rheumatic: aortic stenosis, mitral regurgitation
- Pericarditis
- Cardiac tumors: atrial myxoma
- Sick sinus syndrome
- Cardiomyopathy
  - Hypertrophic
  - Idiopathic dilated (? cause vs. effect)
- Post-coronary bypass surgery

Atrial Fibrillation: Non-Cardiac Causes

- Pulmonary
  - COPD
  - Pneumonia
  - Pulmonary embolism
- Metabolic
  - Thyroid disease: hyperthyroidism
  - Electrolyte disorder
- Toxic: alcohol (‘holiday heart’ syndrome)

Diagnosis of AF

- Signs and symptoms
- Electrocardiography
- Transthoracic echocardiography
- Laboratory tests
- Holter monitoring
- Transoesophageal echocardiography
- Exercise testing
- Chest radiography

Heterogeneous clinical presentation of AF

- With or without detectable heart disease
- Episodic
  - Symptoms may be absent or intermittent
  - Up to 90% of episodes may not cause symptoms
- Symptoms vary according to
  - Irregularity and rate of ventricular response
  - Functional status
  - AF duration
  - Patient factors
  - Co-morbidities

Fuster V et al. Circulation 2006;114:e257–e354;
Page RL et al. Circulation 1994;89:224–7

Signs and symptoms

Cause	Sign/symptom
Irregular heart beat	Irregularly irregular pulse Palpitations
Decreased cardiac output	Fatigue Diminished exercise capacity Breathlessness (dyspnoea) Weakness (asthenia)
Hypotension	Dizziness and fainting (syncope)
Cardiac ischaemia	Chest pain (angina)
Increased risk of clot formation	Thromboembolic TIA, stroke

Fuster V et al. Circulation 2006;114:e257–354

History and physical examination

- Clinical conditions associated with AF
  - Underlying heart conditions (e.g. valvular heart disease, heart failure, coronary artery disease, hypertension)
  - Other reversible conditions
- Family history
  - Familial AF (lone AF in a family)
  - AF secondary to other genetic conditions (familial cardiomyopathies)
- Type of AF
  - First episode, paroxysmal, persistent, permanent
  - Triggers – e.g. emotional stress, alcohol, physical exercise, gastroesophageal disease
  - Specific symptoms
  - Response to any treatments administered

Fuster V et al. Circulation 2006;114:e257–354;
de Vos CB et al. Eur Heart J 2008;29:632–9

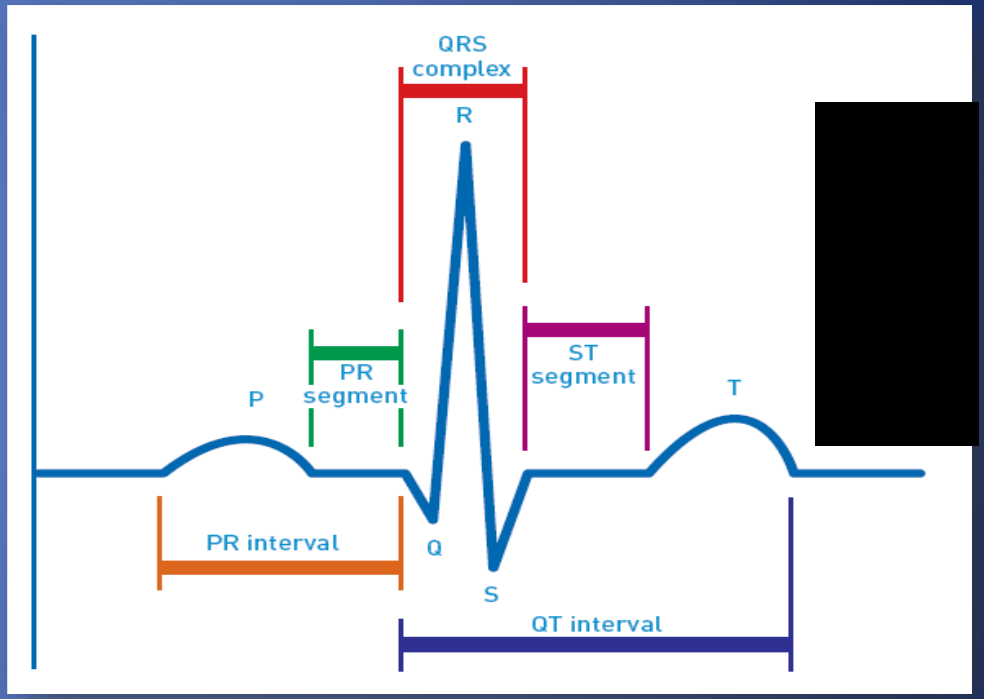
Electrocardiogram

- Assesses the electrical activity of the heart
- Essential for all patients with suspected AF, to identify
  - Abnormal heart rhythm (verify AF)
  - Left ventricular hypertrophy
  - Pre-excitation
  - Bundle-branch block
  - Prior MI
  - Differential diagnosis of other atrial arrhythmias

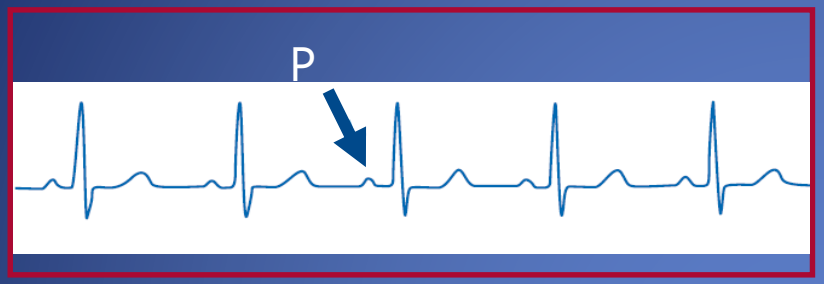
Fuster V et al. Circulation 2006;114:e257–354

Eletrocardiogram: normal sinus rhythm

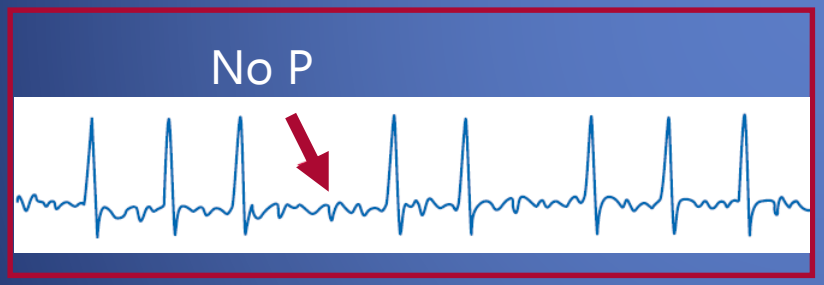
- Impulse from sinoatrial (SA) node stimulates myocardium to contract
- P-wave: atrial depolarization
- QRS complex: ventricular depolarization
- T-wave: ventricular repolarization



Electrocardiogram: loss of P wave in AF



- Normal sinus rhythm
  - Normal heart rate
  - Regular rhythm
  - P Waves
  - Steady baseline

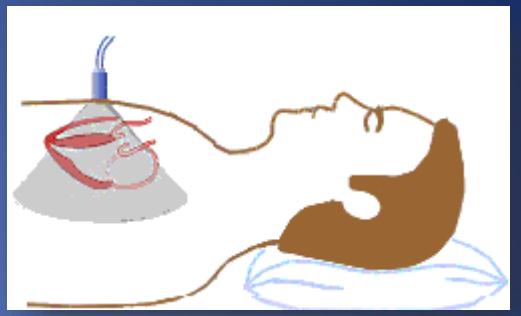


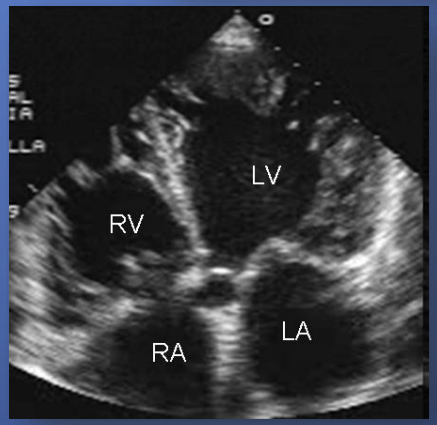
- AF
  - Heart rate increased (tachyarrhythmia)*
  - Irregular rhythm
  - No P wave
  - Irregular baseline

*Reduced heart rate (bradyarrythmia) may also be observed

Transthoracic echocardiography (TTE)

- Non-invasive
- Used to identify
  - Size and functioning of atria and ventricles
  - Ventricle hypertrophy
  - Pericardial disease
  - Valvular heart disease



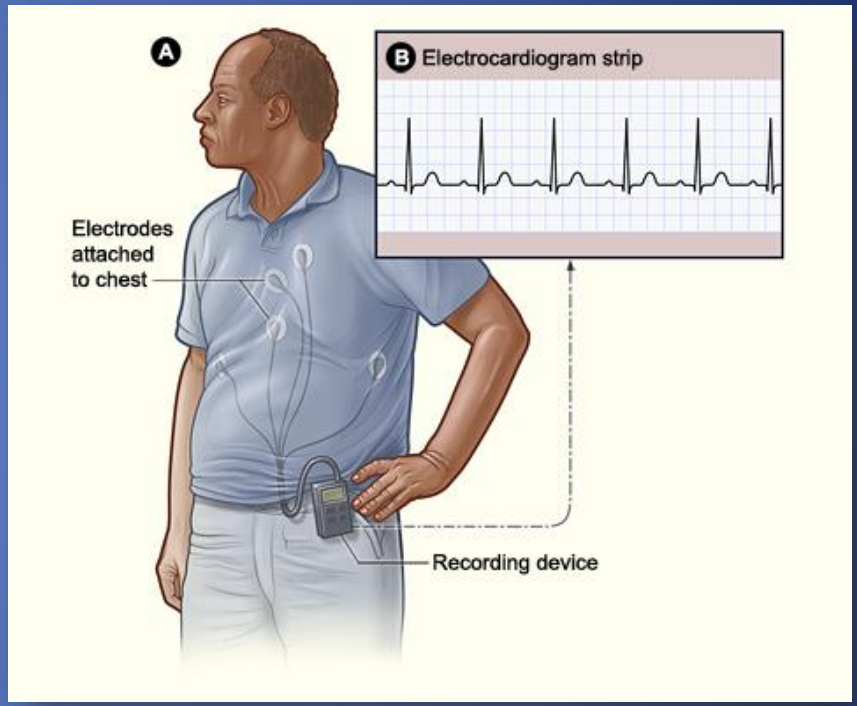


Laboratory tests

- Routine blood tests should be carried out at least once
  in patients with AF
- Important parameters to assess include:
  - Thyroid function
  - Renal function
  - Hepatic function
  - Serum electrolytes
  - Complete blood count

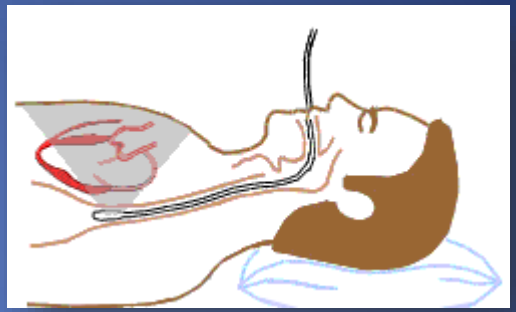
Holter monitor

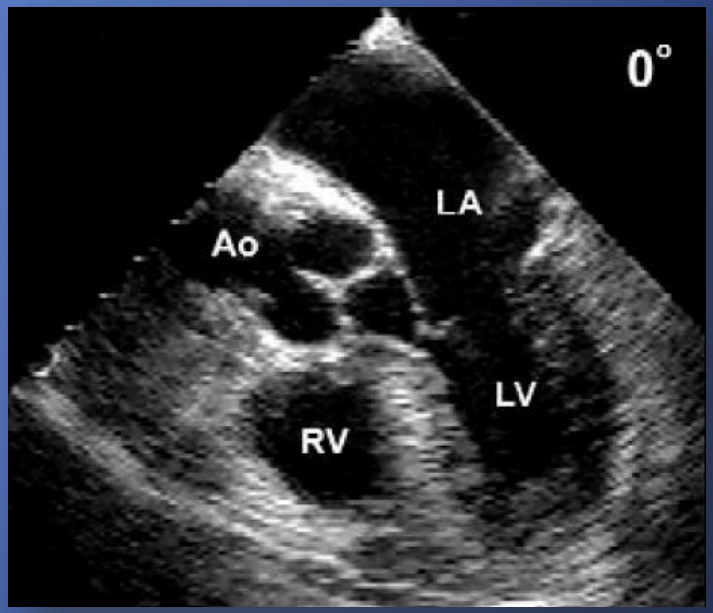
- Portable ECG device
- Continuous monitoring for a short period of time (typically 24 hours)
- Useful for
  - Detecting asymptomatic AF
  - Evaluating patients with paroxysmal AF
  - Associating symptoms with heart rhythm disturbance
  - Assessing response to treatment



Transoesophageal echocardiogram (TEE)

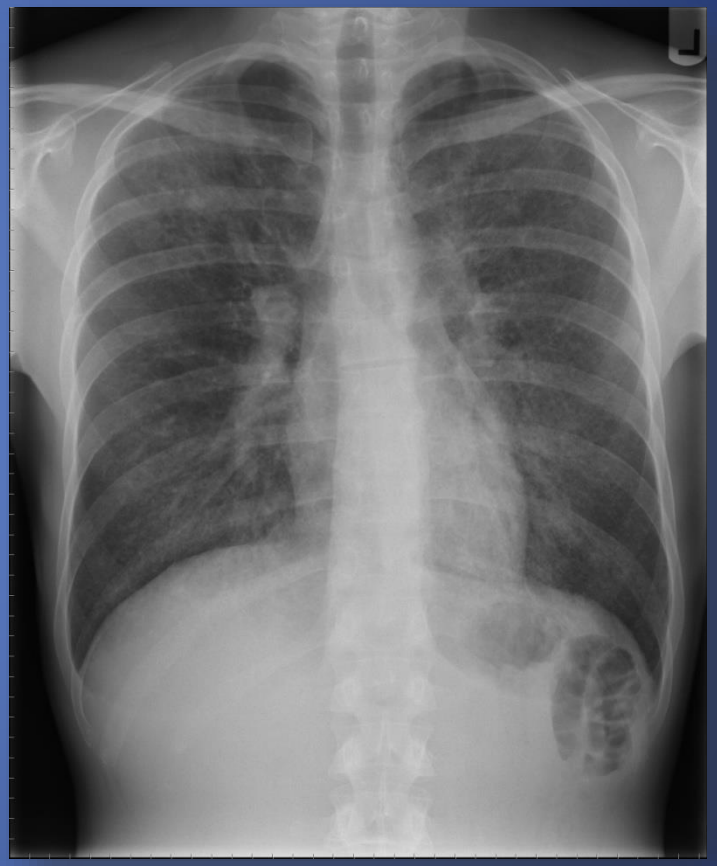
- Ultrasound transducer positioned close to the heart using an endoscope-like device
- High quality images of cardiac structure and function
  - Particularly the left atrial appendage, the most common site of thrombi in patients with AF
- Not routinely used but useful for:
  - Accurate assessment of risk of stroke
  - Detection of low flow velocity ('smoke' effect)
  - Sensitive detection of atrial thrombi





Chest Radiography

- When clinical findings suggest an abnormality chest radiography may be used to
  - Evaluate pulmonary pathology and vasculature
  - Detect congestive heart failure
  - Assess enlargement of the cardiac chambers



Classification of atrial fibrillation

Classification of AF

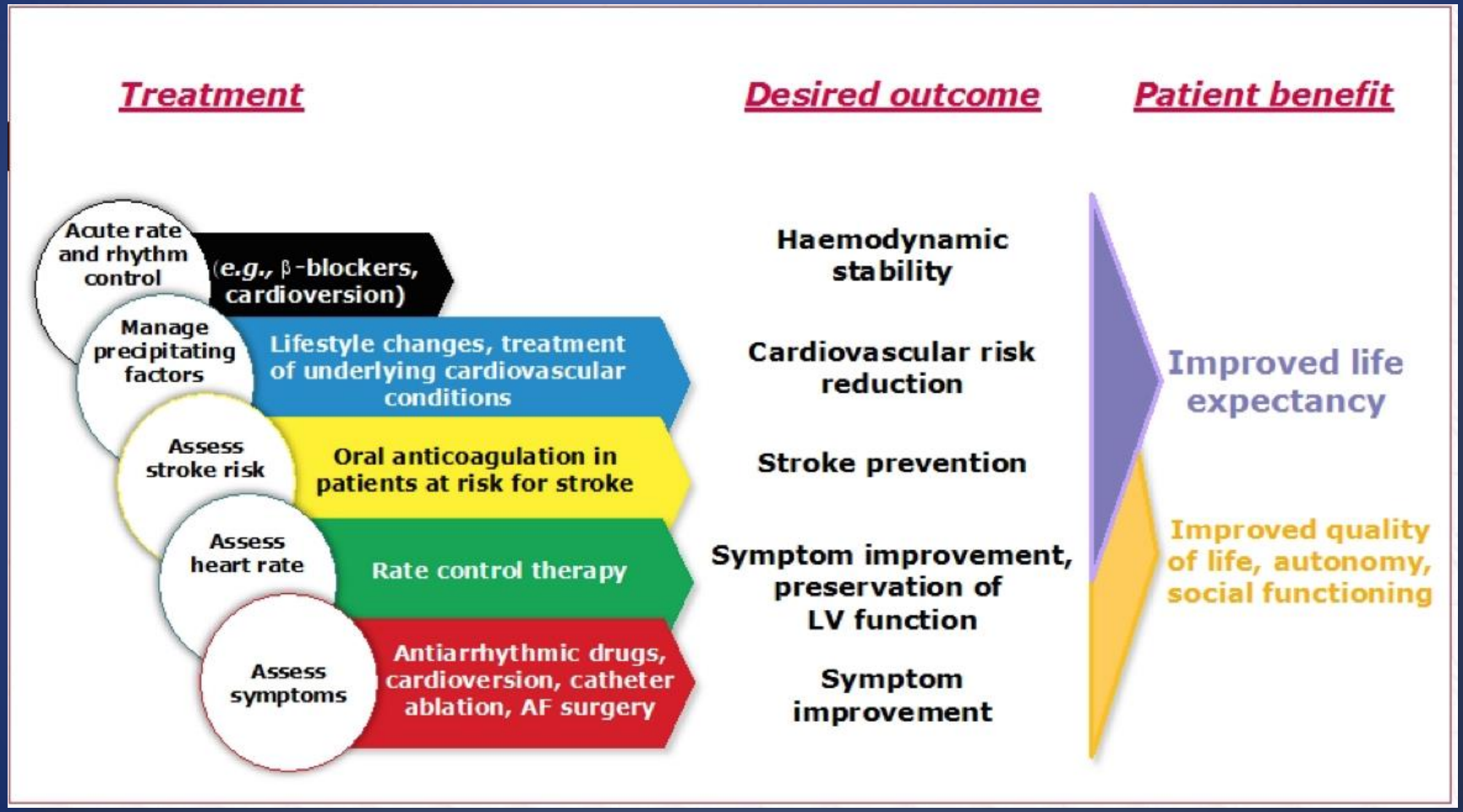
AF pattern	Definition
First diagnosed AF	AF that has not been diagnosed before, irrespective of the duration of the arrhythmia or the presence and severity of AF-related symptoms.
Paroxysmal AF	Self-terminating, in most cases within 48 hours. Some AF paroxysms may continue for up to 7 days. AF episodes that are cardioverted within 7 days should be considered paroxysmal.
Persistent AF	AF that lasts longer than 7 days, including episodes that are terminated by cardioversion, either with drugs or by direct current cardioversion, after 7 days or more.
Long-standing persistent AF	Continuous AF lasting for ≥1 year when it is decided to adopt a rhythm control strategy.
Permanent AF	AF that is accepted by the patient (and physician). Hence, rhythm control interventions are, by definition, not pursued in patients with permanent AF. Should a rhythm control strategy be adopted, the arrhythmia would be re-classified as 'long-standing persistent AF'.

Classification of AF

Classification	Definition
Lone or primary	AF without clinical/ECG evidence of cardiopulmonary disease
Secondary	AF associated with cardiopulmonary disease (e.g. myocardial infarction or pneumonia)
Non-valvular	AF that is not associated with damage to the heart valves (e.g. rheumatic mitral valve disease, prosthetic heart valve or mitral valve repair)

Treatment Atrial Fibrillation

The Five Domains of Integrated AF Management



3 Strategies

- Prevention of thromboembolism
- Rate control
- Restoration and maintenance of sinus rhythm

Treatment options for AF

STROKE PREVENTION	CONTROL OF HEART RATE	MAINTENANCE OF SINUS RHYTHM
PHARMACOLOGIC	PHARMACOLOGIC	PHARMACOLOGIC
• Warfarin • Aspirin • Dabigatran • Apixaban • Rivaroxaban • Rivaroxaban	• Ca^{2+}-channel blockers • β-blockers • Digoxin	• Antiarrhythmic drugs – Class IA – Class IC – Class III: e.g. amiodarone, dronedarone
NON-PHARMACOLOGIC	NON-PHARMACOLOGIC	NON-PHARMACOLOGIC
• Removal/isolation of left atrial appendage, e.g. WATCHMAN® device or surgery	• Ablate/pace	• Ablation • Surgery (MAZE)

ACE = angiotensin-converting enzyme

Prevention of Thromboembolism

The $CHADS_2$ Index

Stroke Risk Score for Atrial Fibrillation

	Score (points)	Prevalence (%)*
Congestive Heart failure	1	32
Hypertension	1	65
Age >75 years	1	28
Diabetes mellitus	1	18
Stroke or TIA	2	10
Moderate-High risk	≥2	50-60
Low risk	0-1	40-50

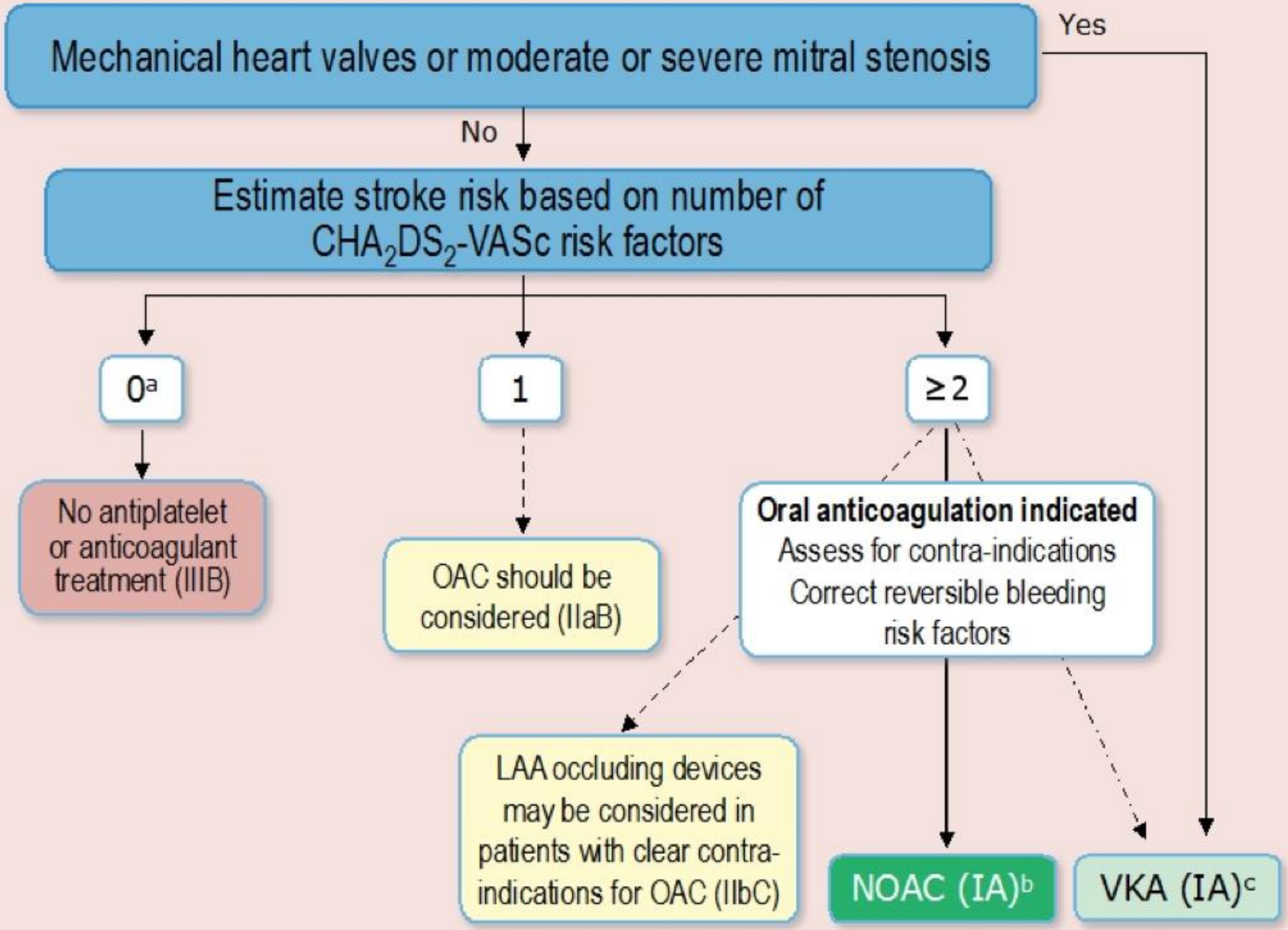
VanWalraven C, et al. *Arch Intern Med* 2003; 163:936.
* Nieuwlaat R, et al. (EuroHeart survey) *Eur Heart J* 2006 (E-published).

The CHA_2DS_2VASc Index

Stroke Risk Score for Atrial Fibrillation

	Weight (points)
Congestive heart failure or LVEF ≤ 35%	1
Hypertension	1
Age >75 years	2
Diabetes mellitus	1
Stroke/TIA/systemic embolism	2
Vascular Disease (MI/PAD/Aortic plaque)	1
Age 65-74 years	1
Sex category (female)	1
Moderate-High risk	≥ 2
Low risk	0-1

Lip GYH, Halperin JL. *Am J Med* 2010; 123: 484.



[a] Includes women without other stroke risk factors
[b] IIaB for women with only one additional stroke risk factor
[c] IB for patients with mechanical heart valves or mitral stenosis

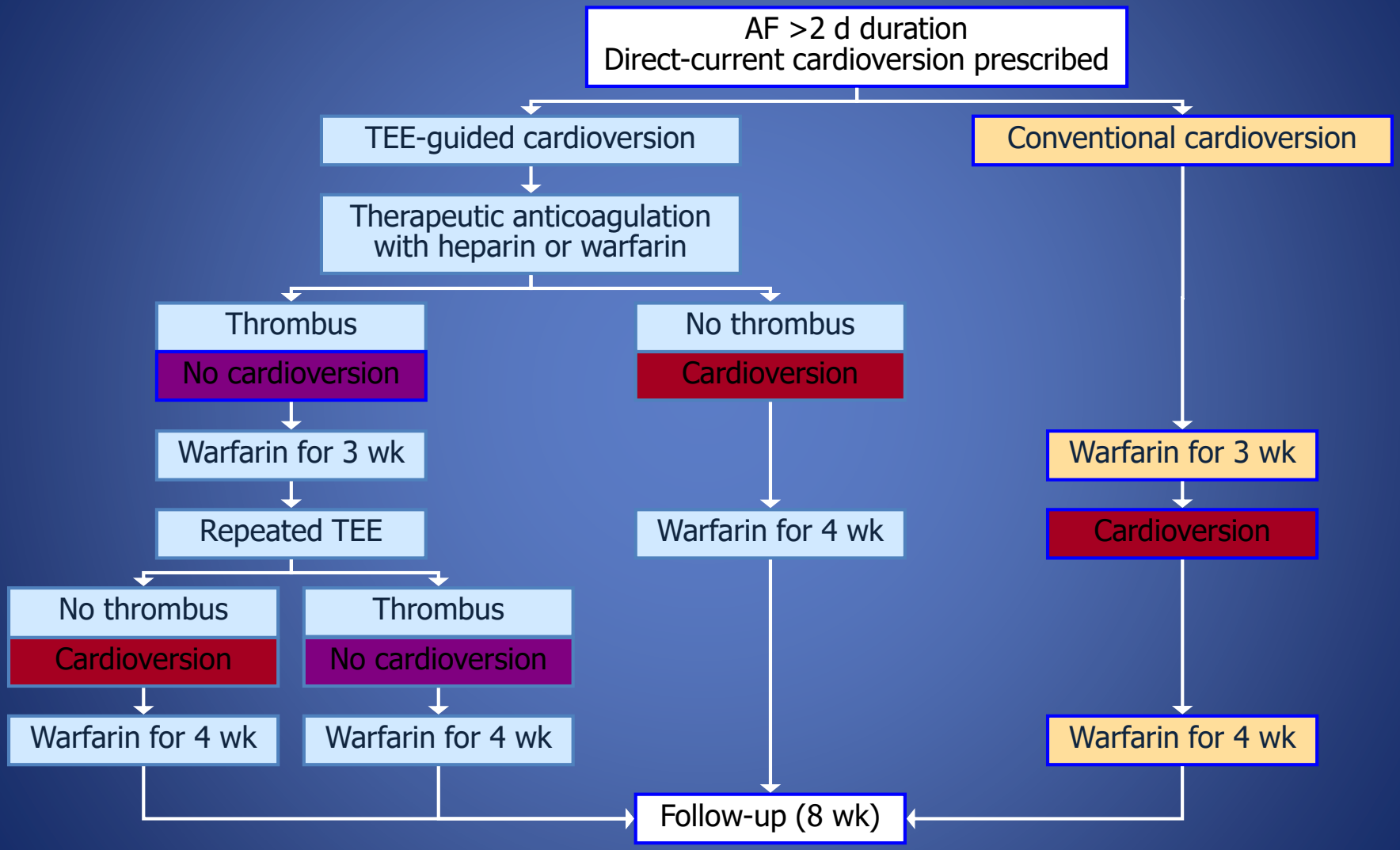
Restoration of Sinus Rhythm

Rhythm-control therapies

- The objective of rhythm-control therapy is to restore (cardioversion) and maintain normal sinus rhythm
- Cardioversion can be achieved by:
  - Pharmacotherapy with antiarrhythmic agents
  - Electrical shocks (direct-current cardioversion)
- Direct-current cardioversion is generally more effective than pharmacotherapy
- Likelihood of successful cardioversion decreases with the duration of AF
  - Pharmacological cardioversion is most effective when initiated within 7 days of AF onset
- Cardioversion can dislodge thrombi in the atria, increasing the risk of stroke
  - Thromboprophylaxis is recommended for ≥3 wk before and for at least 4 wks after cardioversion in patients with AF that has persisted for ≥48 h

Fuster V et al. Circulation 2006; 114:e257–354

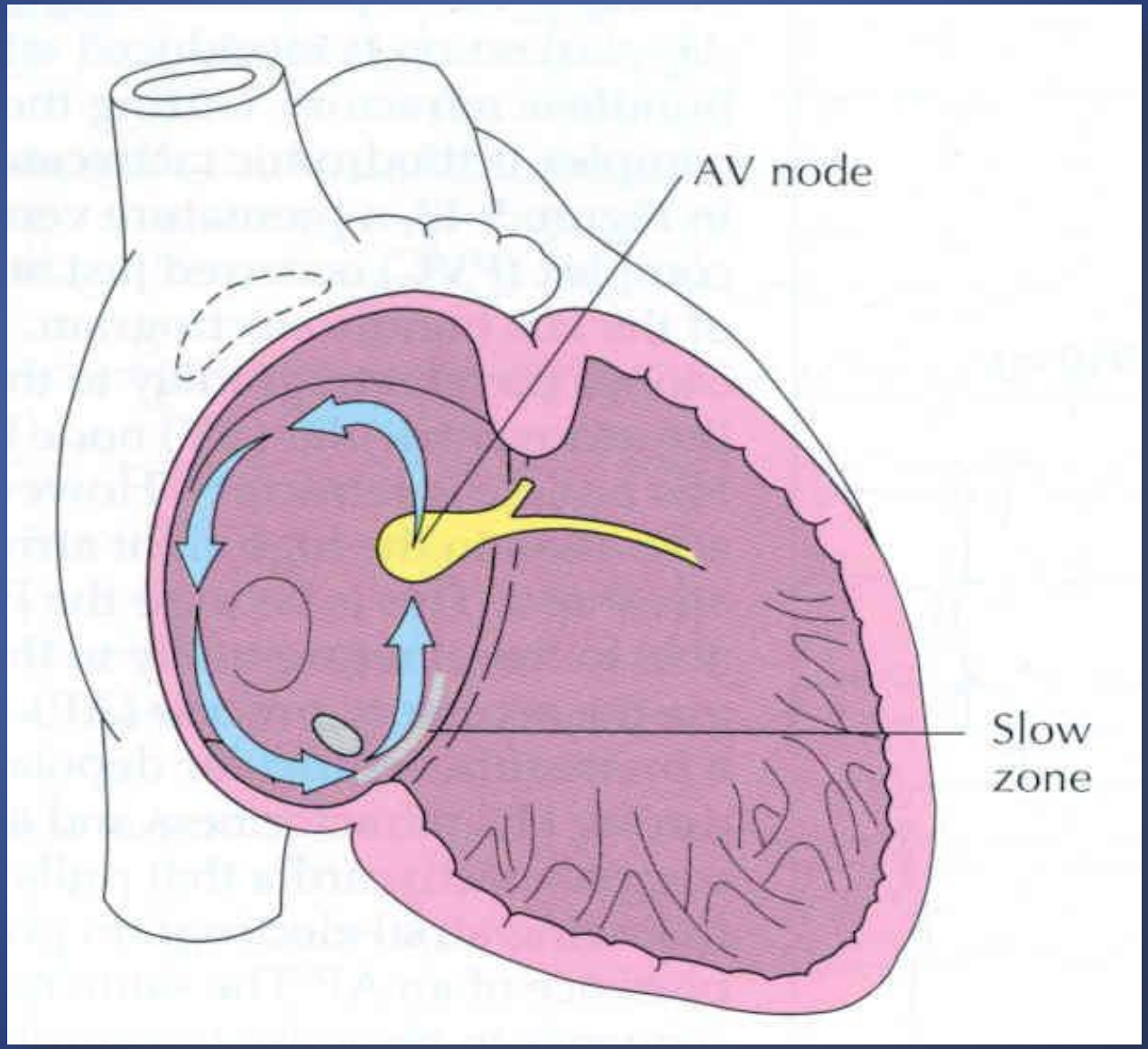
TEE-guided cardioversion: ACUTE study design

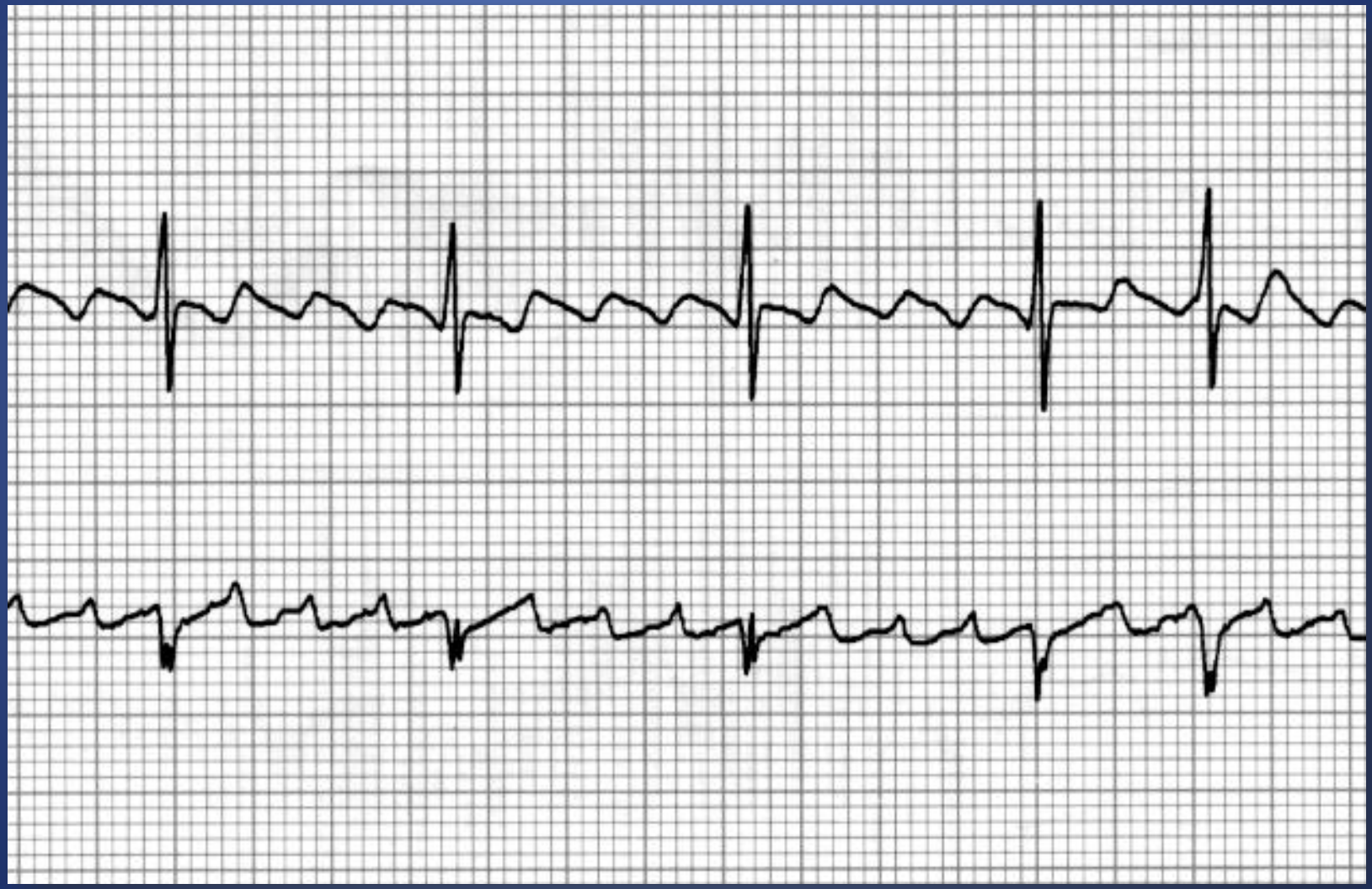


DC = direct-current; TEE = transoesophageal echocardiography

Klein AL et al. N Engl J Med 2001;344:1411–20

Atrial Flutter


AV node
Slow
zone



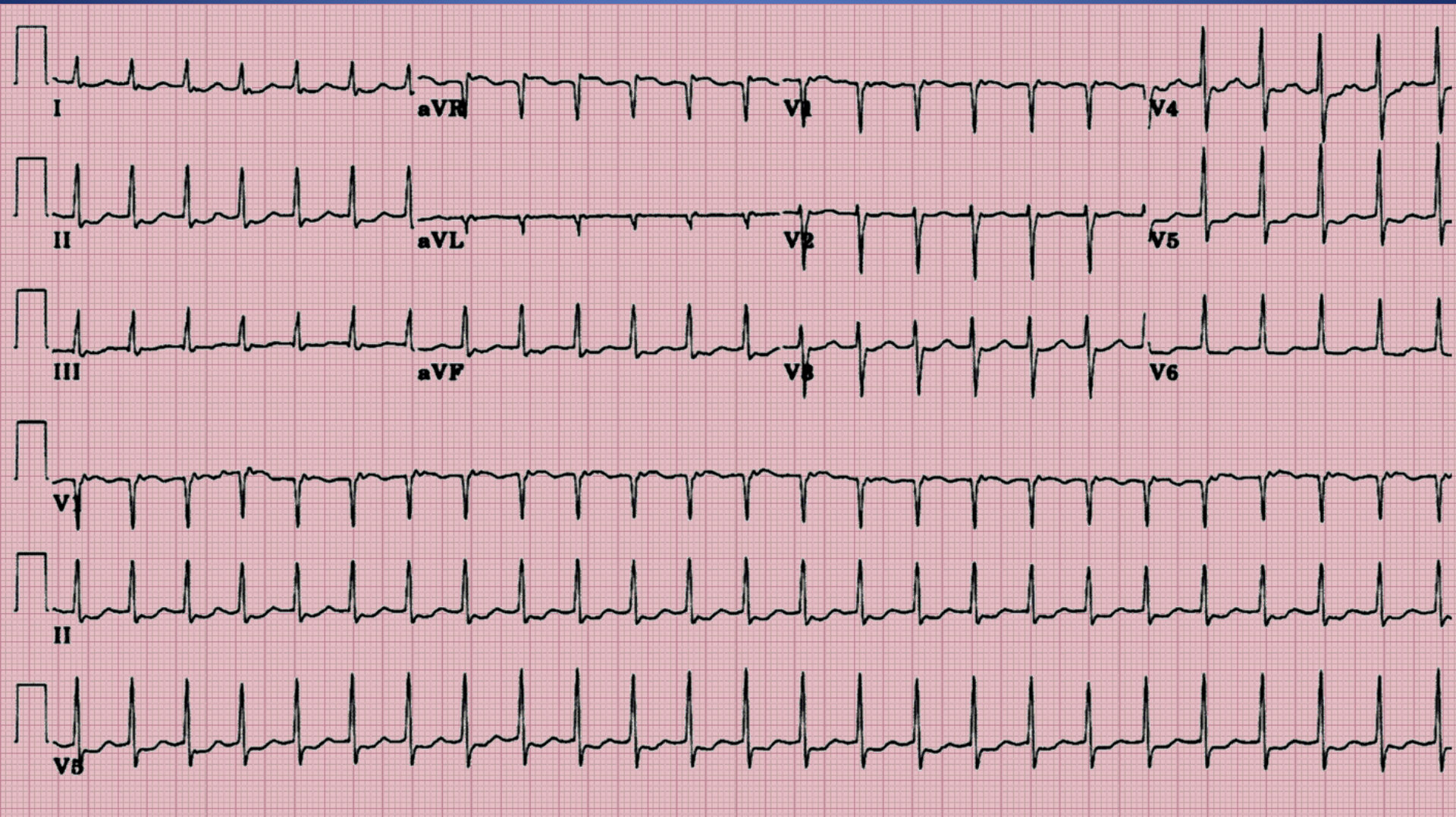
Rx – Atrial Flutter

- ***Unstable*** pt (i.e. low BP / CP / AMS):
  - Synchronized cardioversion as per ACLS
  - 50J → 100J → 200J → 300J → 360J

- ***Stable*** pt:
  - Rate control - just like atrial fibrillation (AFib)
  - Elective cardioversion - just like AFib
  - Anti-coagulation – just like AFib
  - Refer for Ablation

SVT

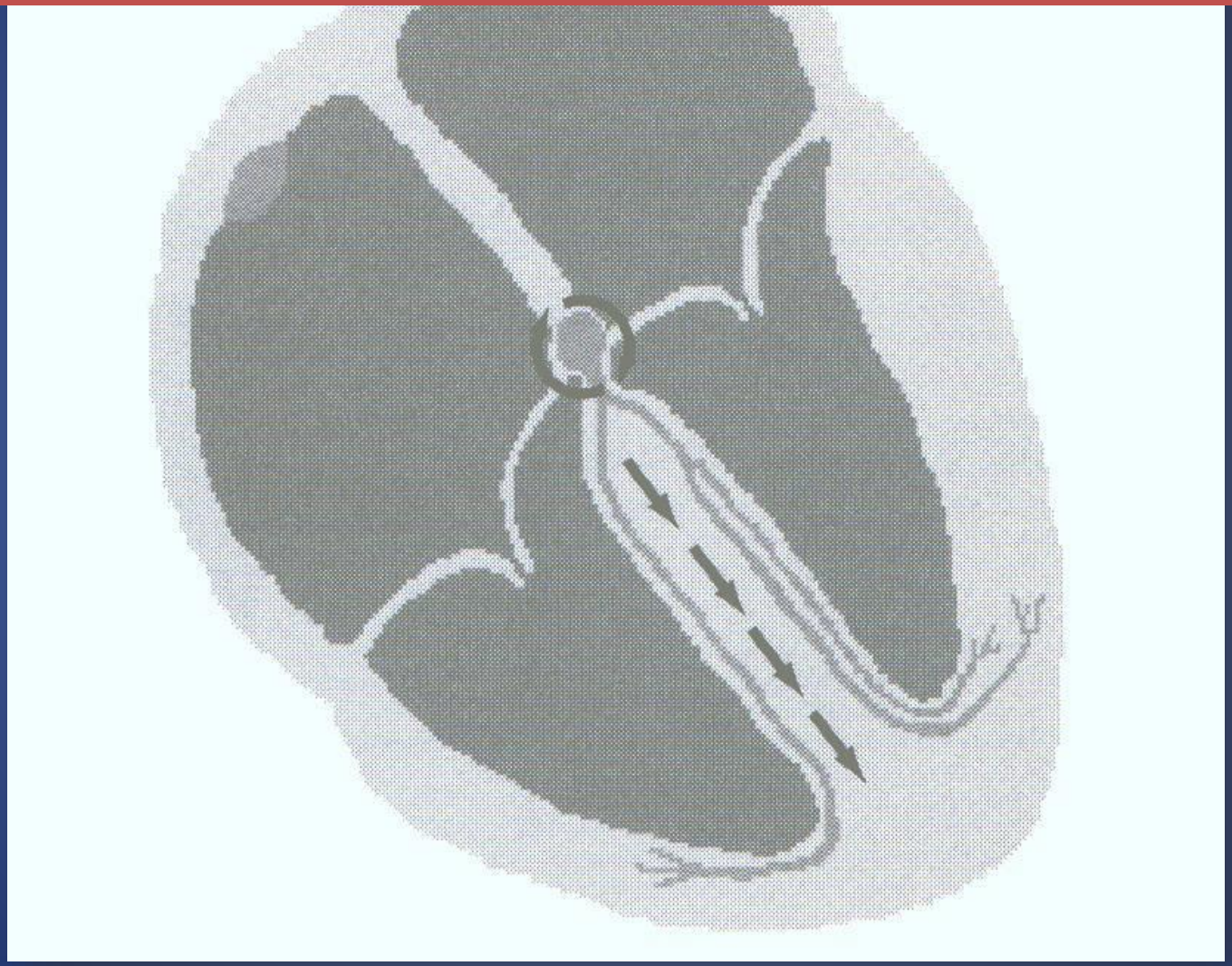
AVRT-Narrow complex



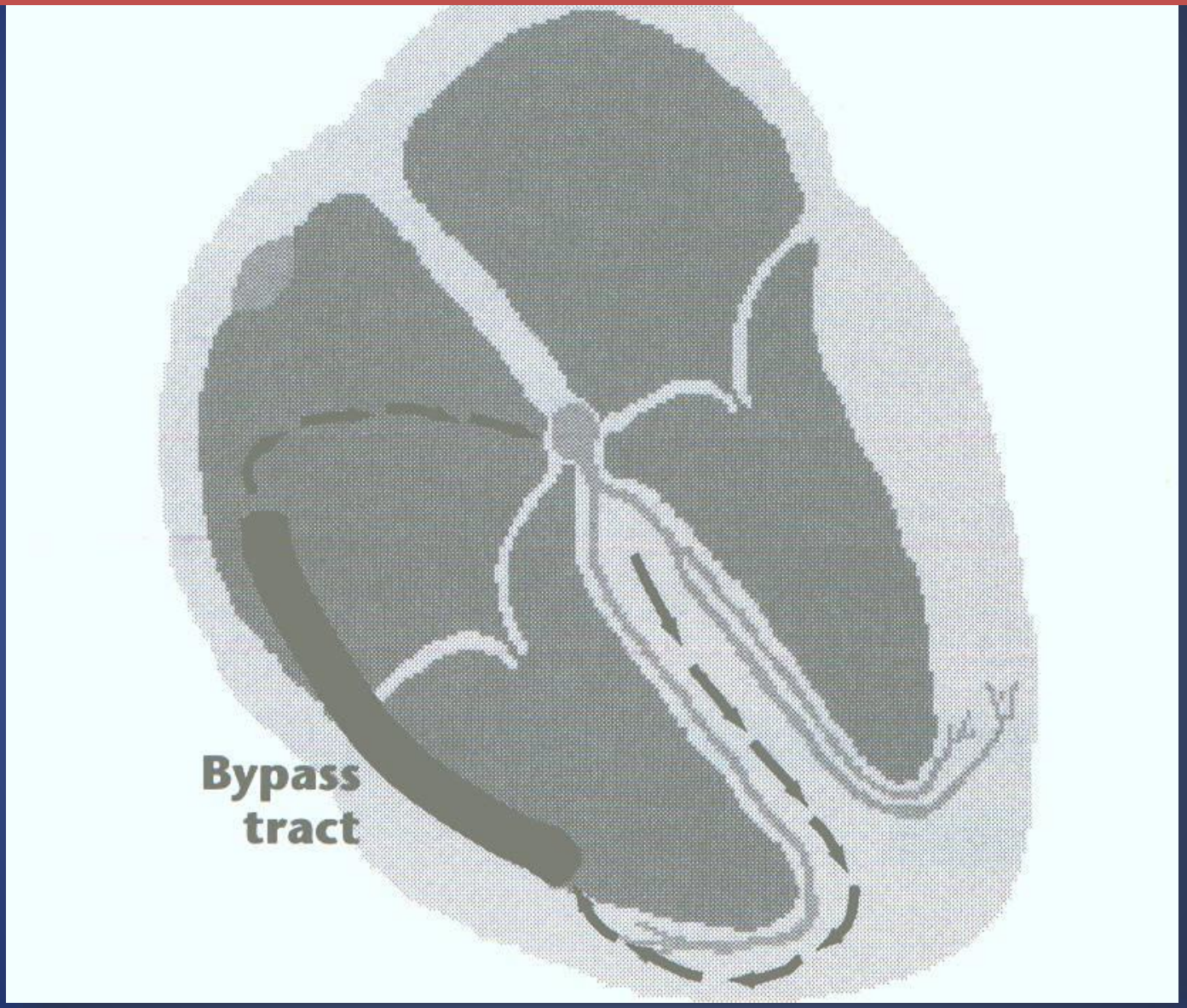
So What Is Actually Meant By Supraventricular Tachycardia?

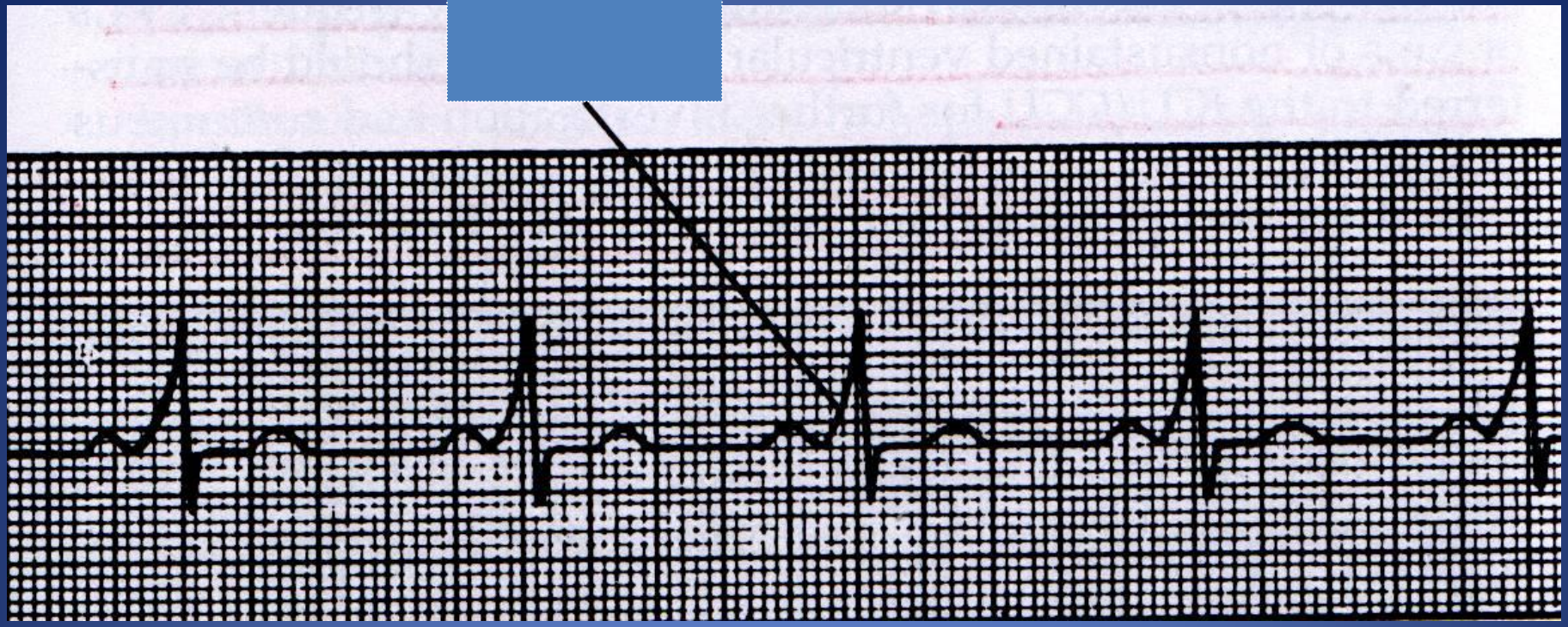
- Arrhythmias of supraventricular origin using a re-entrant mechanism with abrupt onset & termination
- AVNRT (60%)
- AVRT (30%)
- Atrial tachycardia (10%)

Atrioventricular Nodal Re-entrant Tachycardia (AVNRT)



Atrioventricular Re-entrant Tachycardia (AVRT)





Wolf-Parkinson-White (WPW) Syndrome

Treatment options

- Medical therapy
- Radio Frequency Ablation

Other Arrhythmias

- Ventricular Tachycardia
- Ventricular Fibrillation

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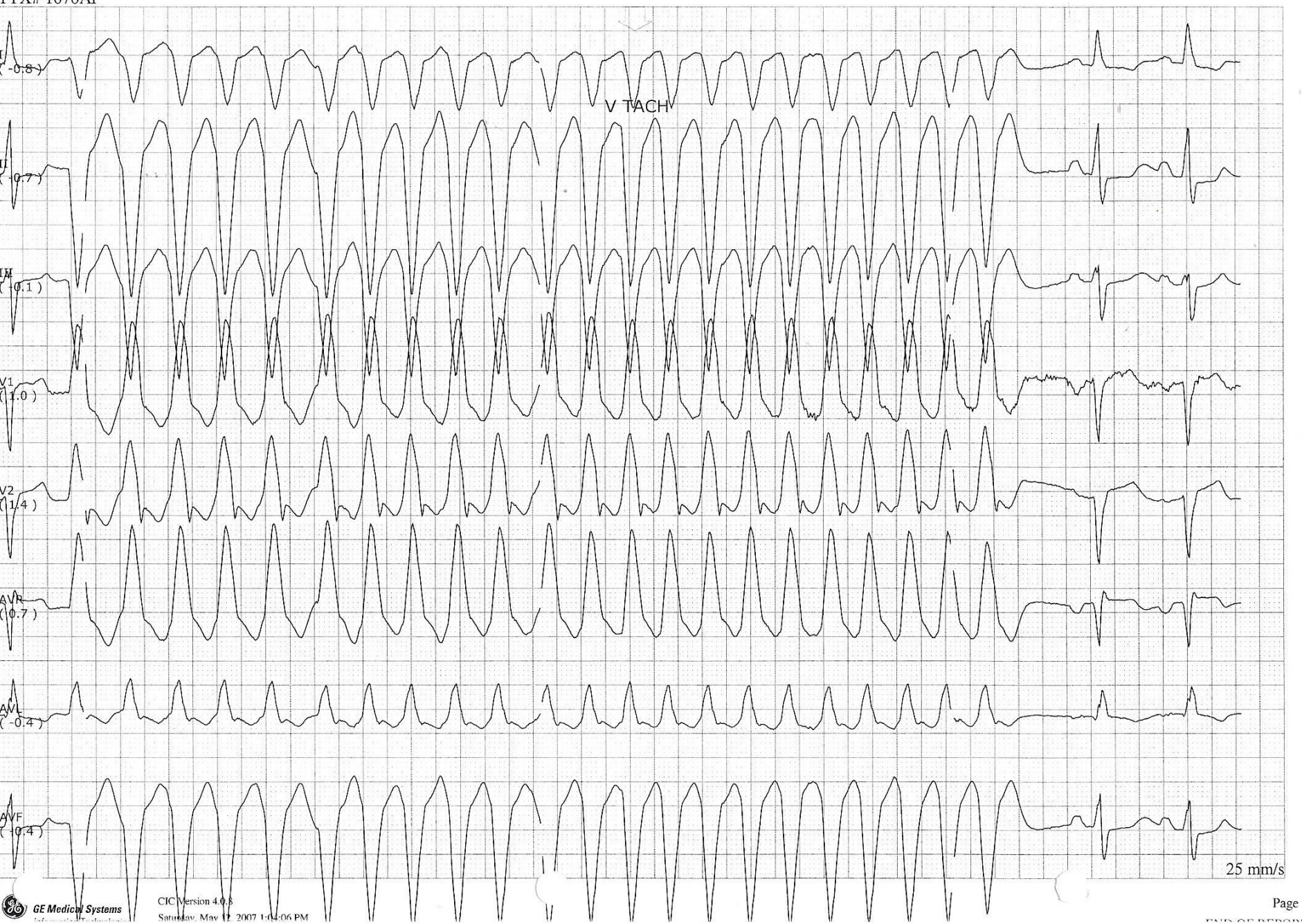
V TACH HR 130 PVC 7 ST V1 1.0 mm

TTX# 1070AP



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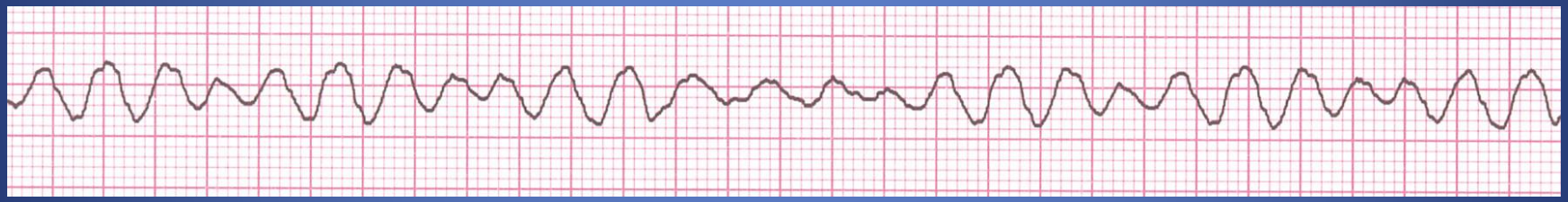
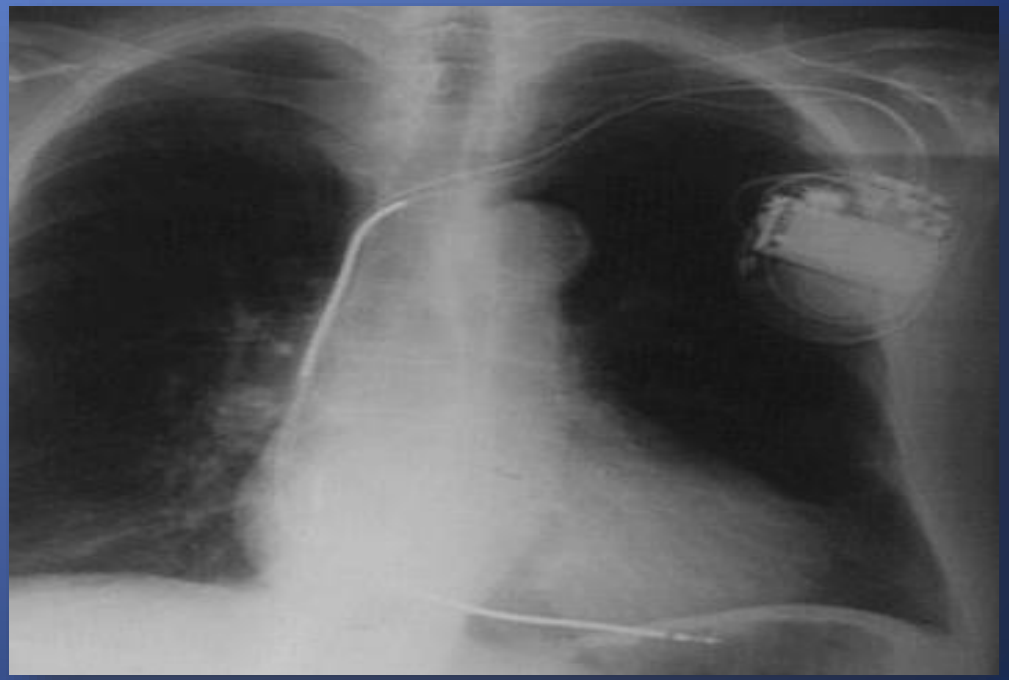


Treatment options

- Treat the underlying cause
- Automatic Implantable defibrillators



Thank You