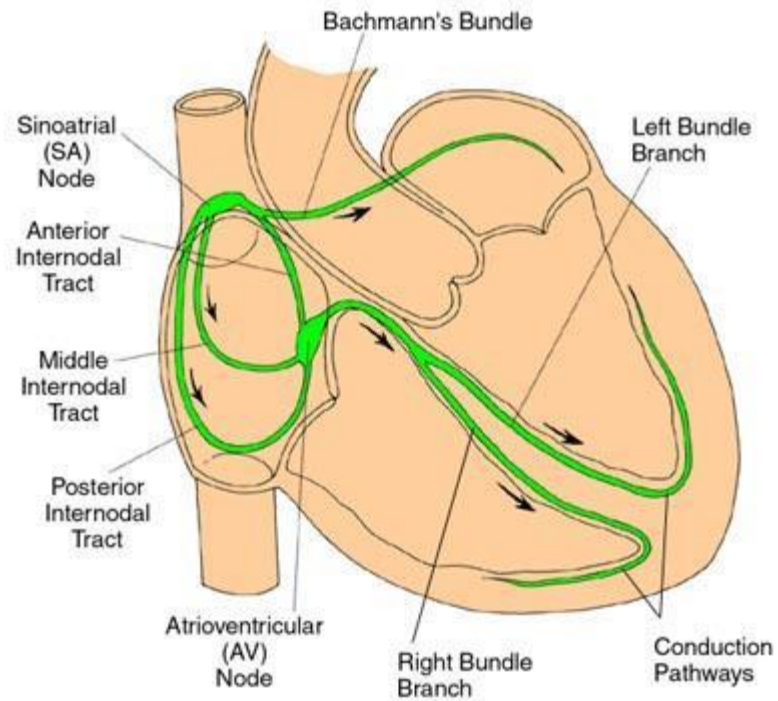


# Pacemakers and Implantable Defibrillators



"Feel my pacemaker if you don't believe me!"

## The Electrical System of the Heart



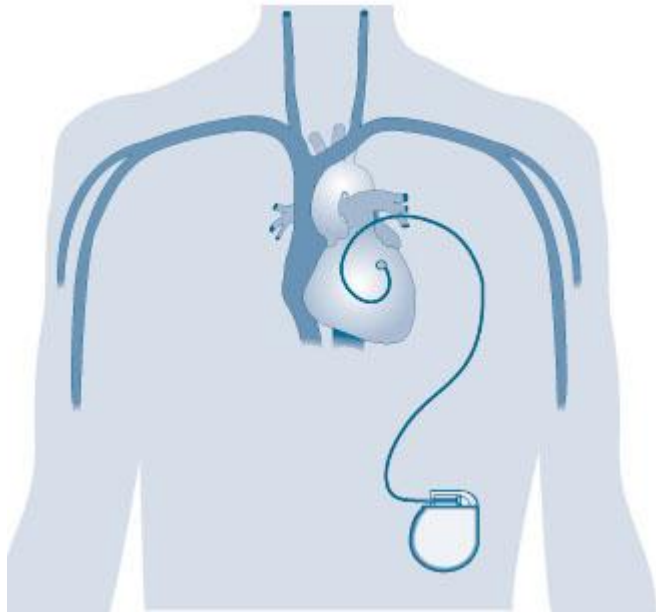
- Worldwide, > 250,000 permanent cardiac pacemakers implanted each year.
- The primary role of cardiac pacing is to augment or replace the heart's intrinsic electrical system.

# Pacemaker

- Temporary
- Permanent



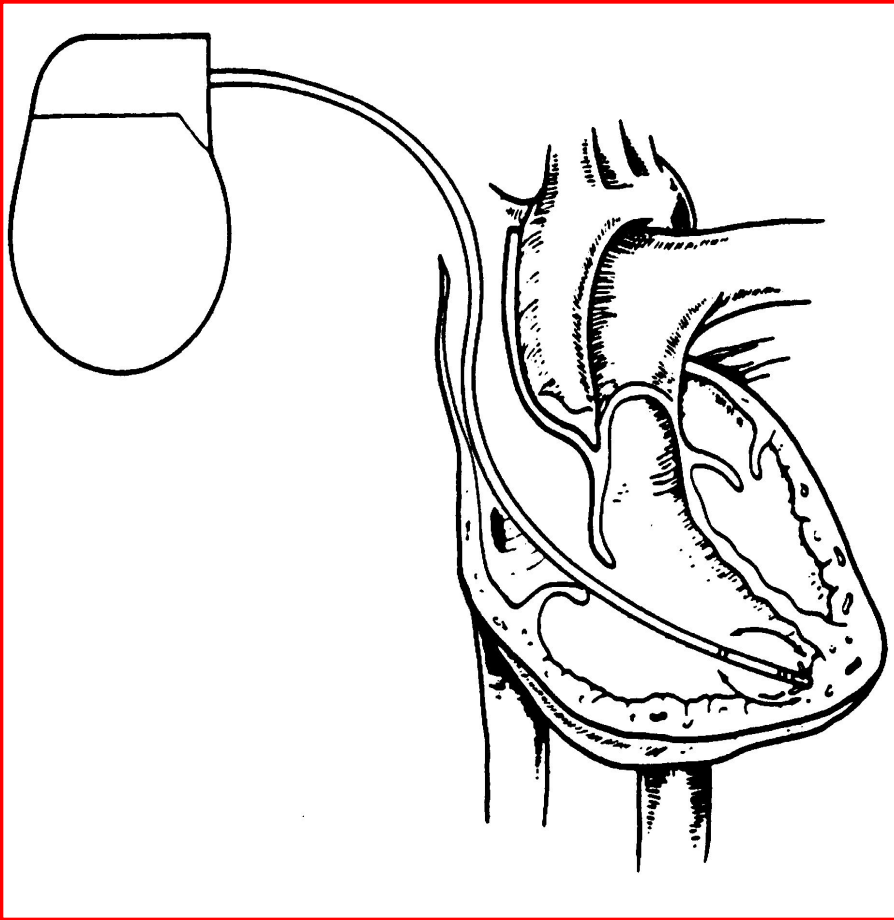
- Epicardial



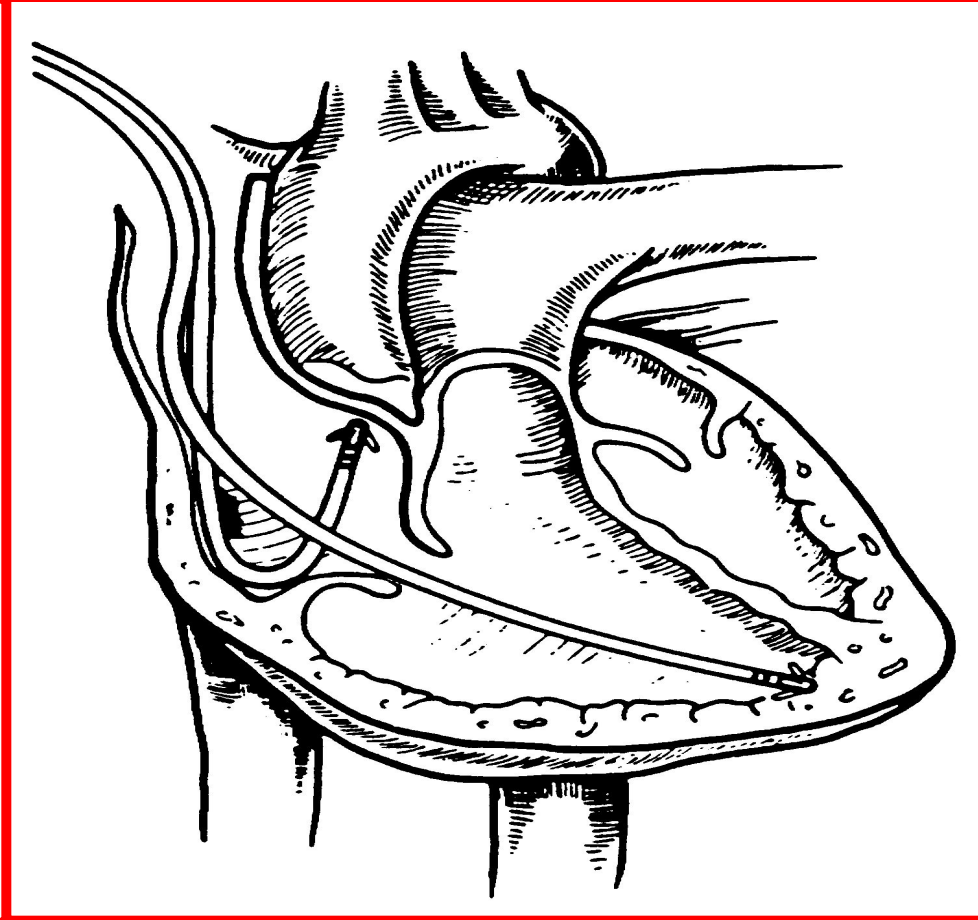
- Endocardial



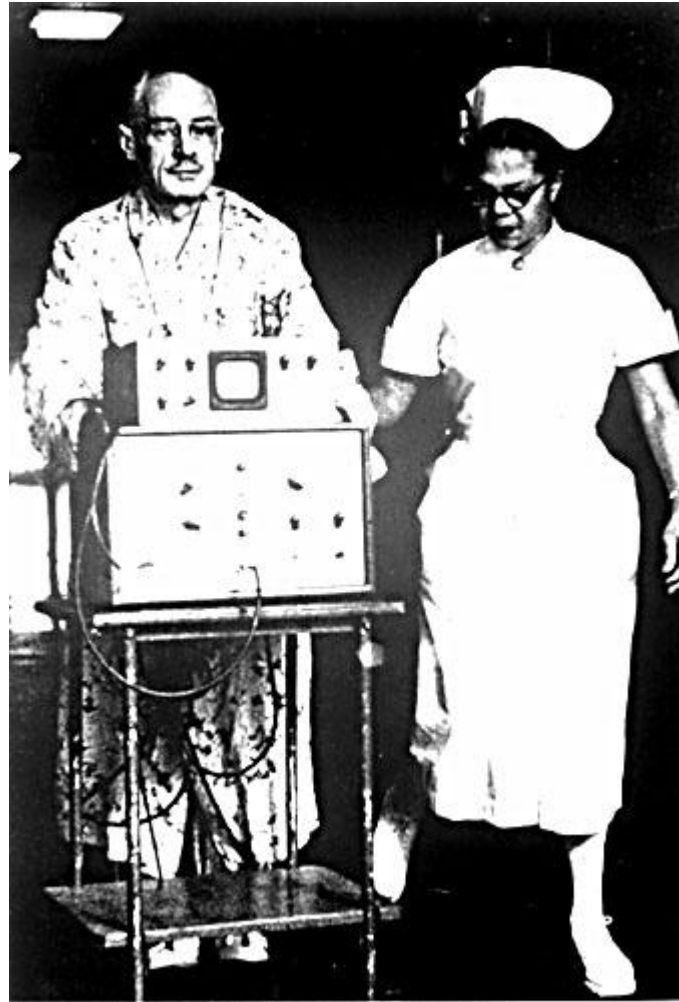
## Single-Chamber System •



## Dual-Chamber Systems •











IS-1/3.2

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TYPE SSIR MODEL 1176  
SN PG 301336

GUIDANT  
ST. PAUL, MN USA



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and ICD  
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400 Hz  
www.viaedel.com

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CORPORATION  
19200  
PACEMAKER  
19200-0019

CD-LO 100  
UNLIMITED  
RATE 78

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PACEMAKER  
Rate 70/min  
100 Hz

VIADEL  
PACEMAKER  
207/70  
Rate 70/min  
100 Hz

VIADEL  
PACEMAKER  
217/70  
Rate 70/min  
100 Hz

VIADEL

VIADEL

VIADEL  
PACEMAKER  
19200-0019

VIADEL

VIADEL

VIADEL  
PACEMAKER  
Rate 70/min  
100 Hz

VIADEL

VIADEL

UPACER I  
PACEMAKER  
Rate 70/min  
100 Hz

VIADEL  
PACEMAKER  
19200-0019

VIADEL

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Rate 70/min  
100 Hz

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PACEMAKER  
Rate 70/min  
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Rate 70/min  
100 Hz

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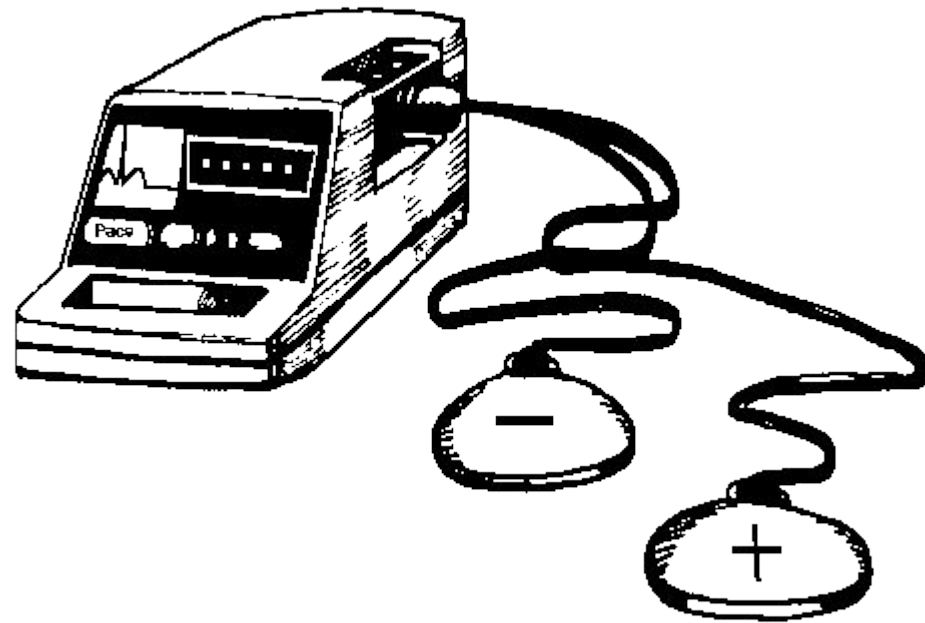
VIADEL

VIADEL

VIADEL  
PACEMAKER  
Rate 70/min  
100 Hz

# Temporary pacing

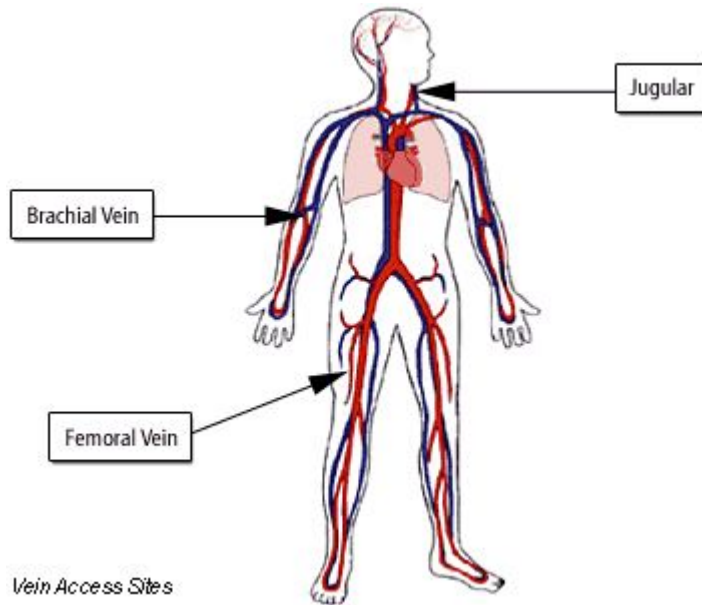
- Transcutaneous
- Transvenous



# Transcutaneous pacing



# Transvenous temporary pacing



# Temporary pacemaker(2)

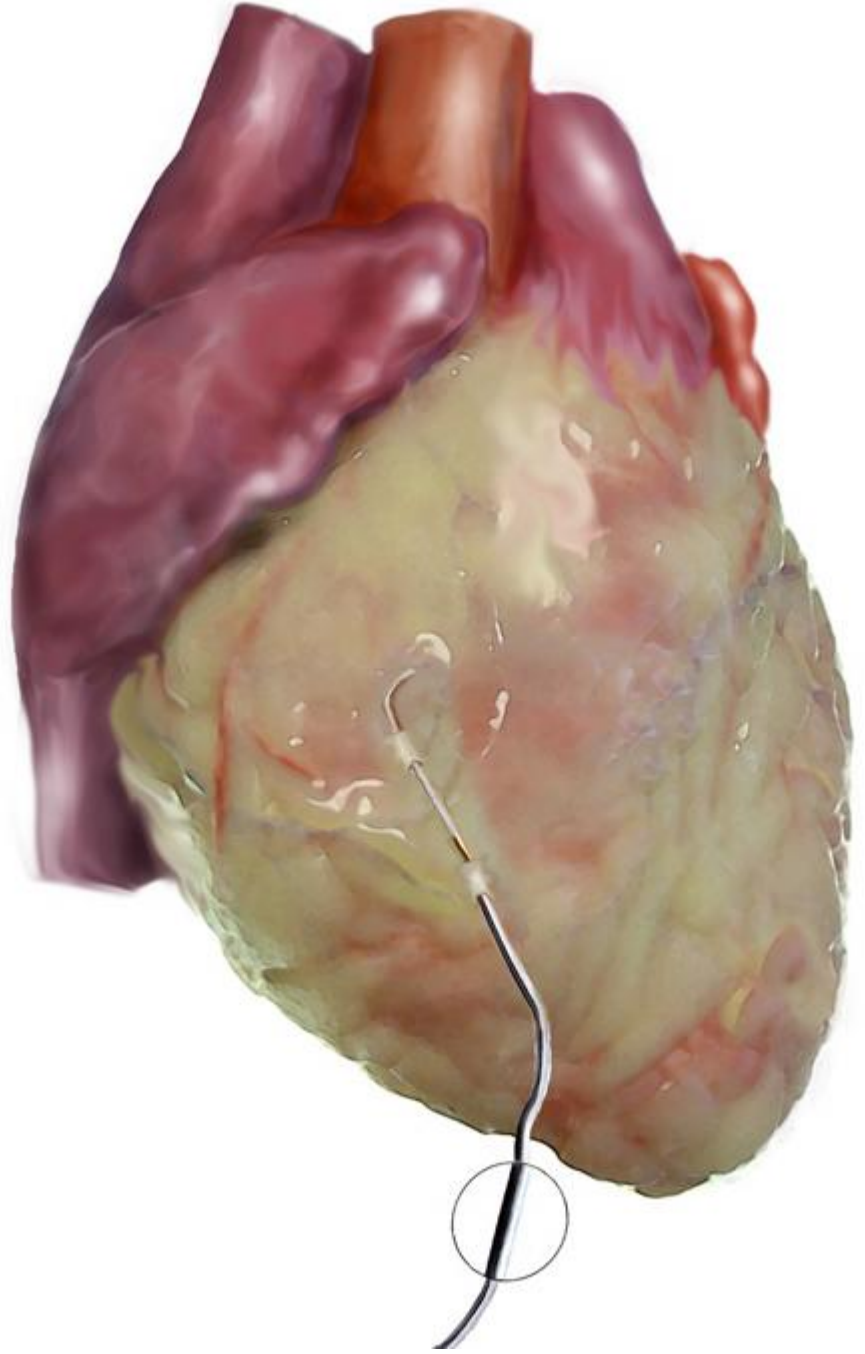
- **Transvenous**
  - Subclavian
  - Jugular
  - Femoral



# Common Indications for Temporary Pacing

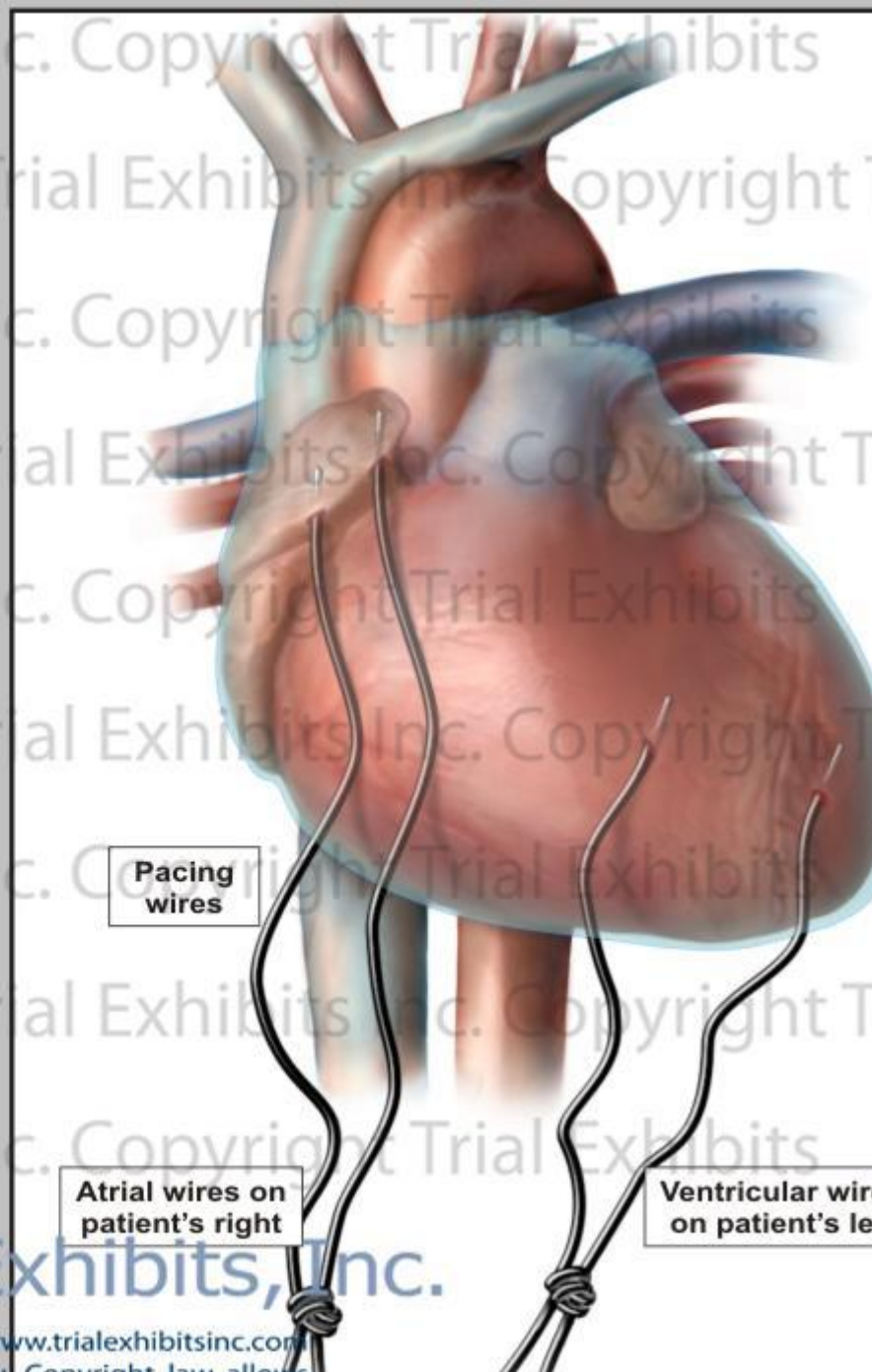
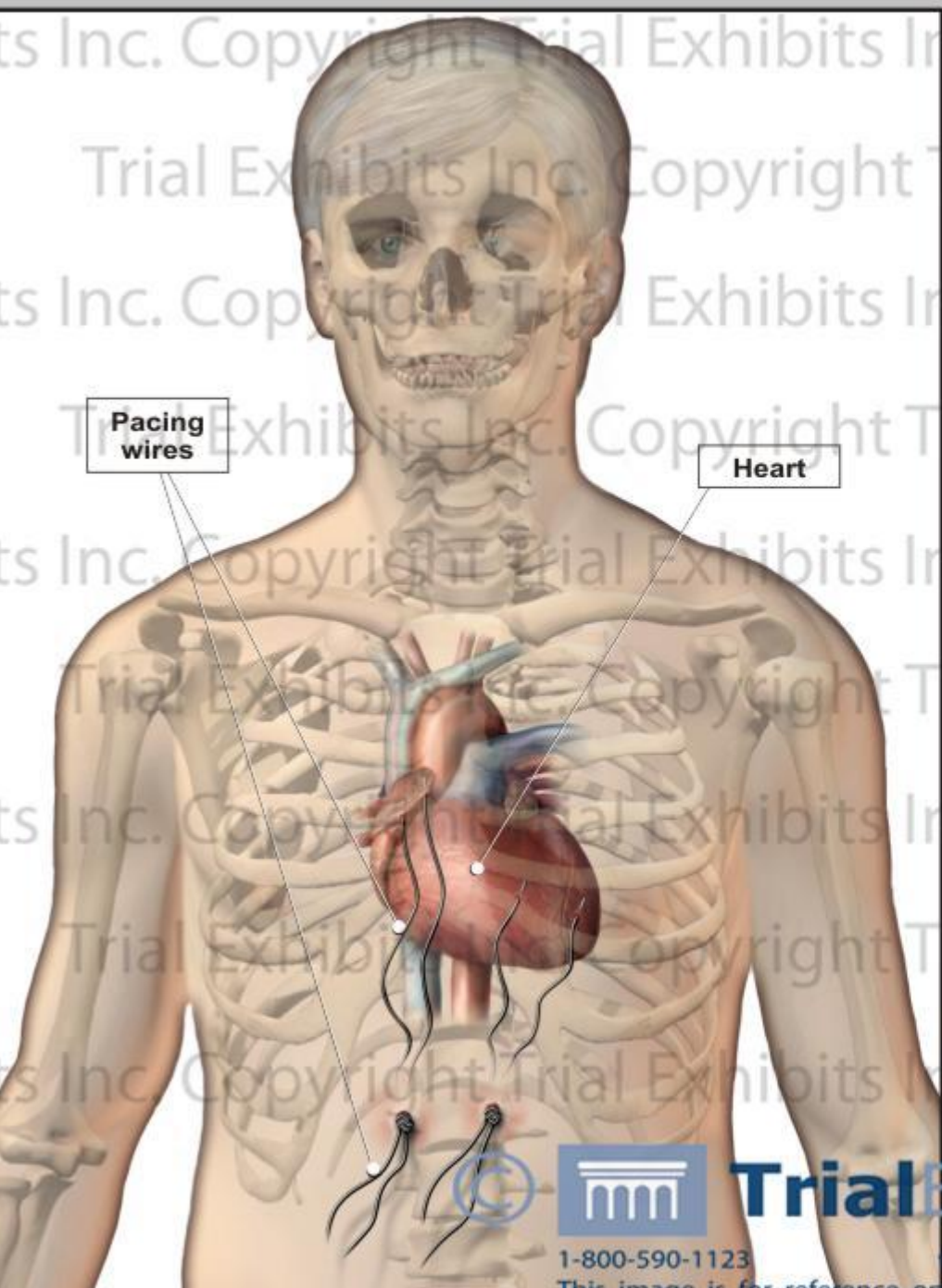
- Complete heart block
- Sinus bradycardia
- Prior to the implant/replacement of a permanent pacemaker
- Acute myocardial infarction complicated by heart block
- Temporary support of a patient after heart surgery

Epicardial pacing





# Epiproximal Pacing Wires



Pacing wires

Heart

Pacing wires

Atrial wires on patient's right

Ventricular wires on patient's left



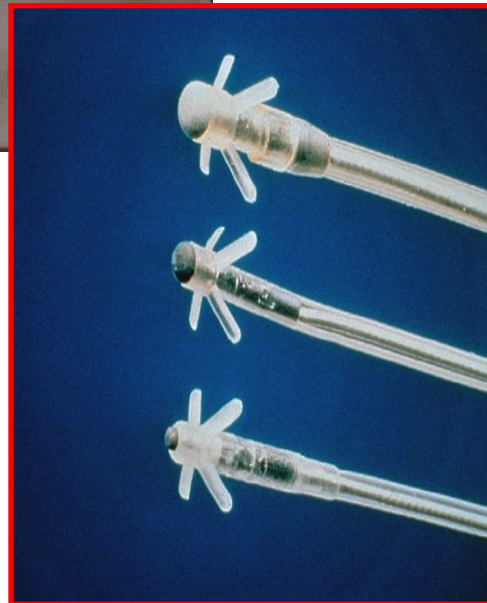
**Trial Exhibits, Inc.**

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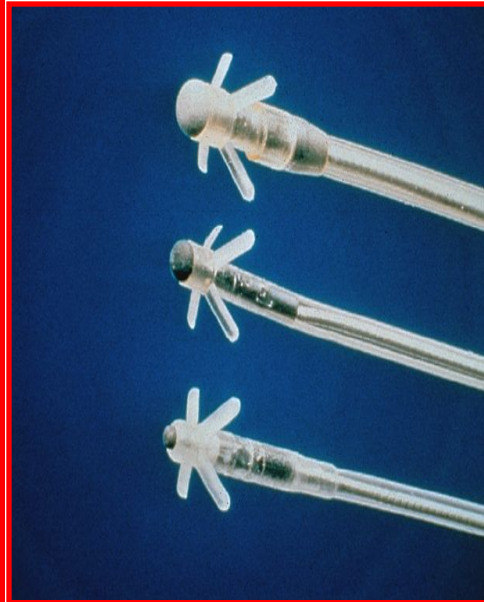
# Permanent Pacemaker



# Pacemaker Components



**Pulse generator**



**Leads**



**programmer**

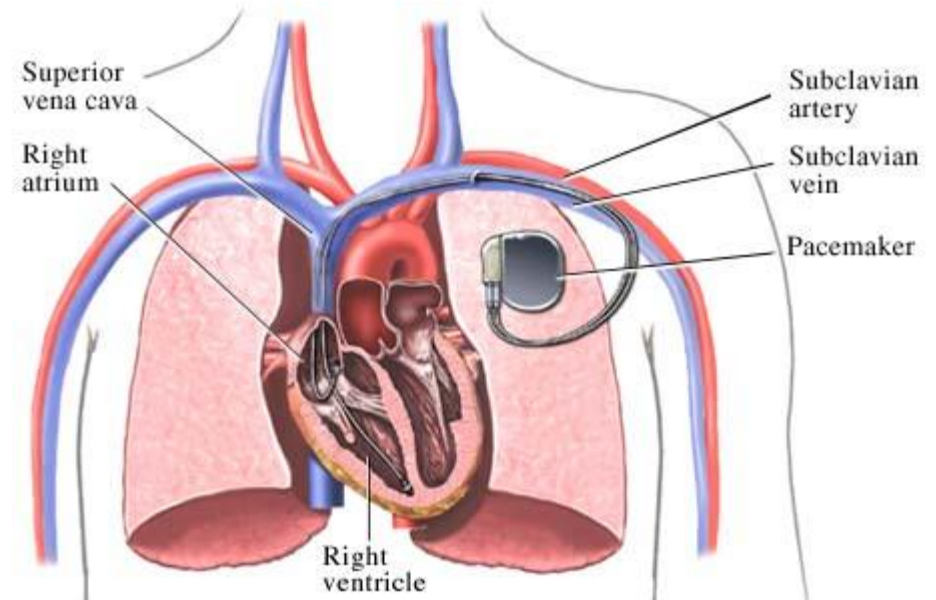
# Common Indications for Implantable Cardiac Pacemaker

- Complete Heart Block or high grade 2<sup>nd</sup> degree A-v block
- Sick Sinus Syndrome

# **: Most Pacemakers Perform Four Functions**

- Stimulate cardiac depolarization
- Sense intrinsic cardiac function
- Respond to increased metabolic demand by providing rate responsive pacing
- Provide diagnostic information stored by the pacemaker

- Pacing
- Sensing



# Pacemaker Nomenclature

I	II	III	IV	V
Chamber Paced	Chamber Sensed	Response to Sensing	Rate Modulation, Programmability	Anti-tachycardia Features
A=Atrium	A=Atrium	T=Triggered	P=Simple	P=Pacing
V=Ventricle	V=Ventricle	I=Inhibited	M=Multi-programmable	S=Shock
D=Dual	D=Dual	D=Dual	R=Rate Adaptive	D=Dual
O=None	O=None	O=None	C=Communicating	
			O=None	

### Ventricular Pacemaker (single chamber)



One spike producing a wide QRS (ventricular capture).

### Atrial Pacemaker (single chamber)

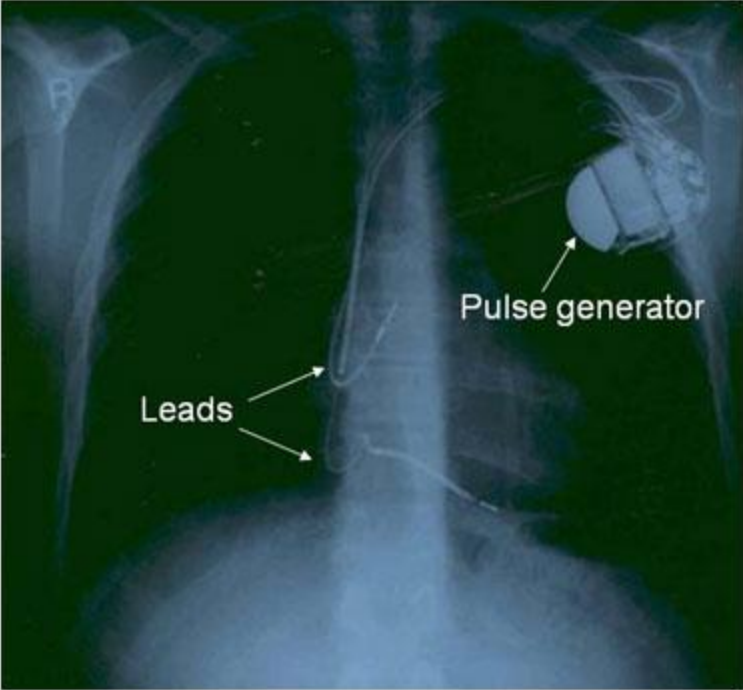


One spike producing an abnormal P wave (atrial capture) followed by a normal QRS



# Atrial and ventricular pacing

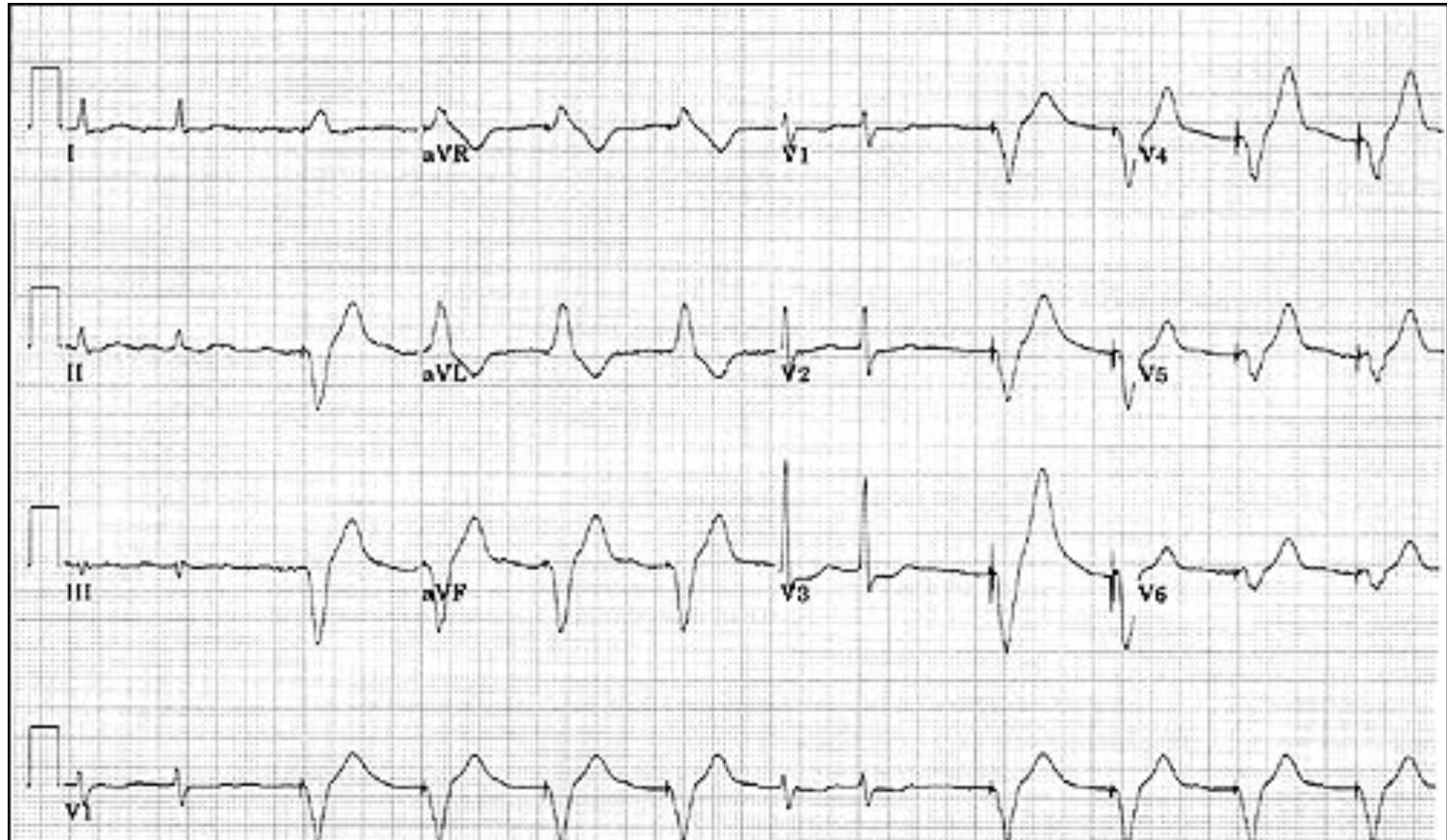




# Pacemaker interrogation and programming



# Example 1

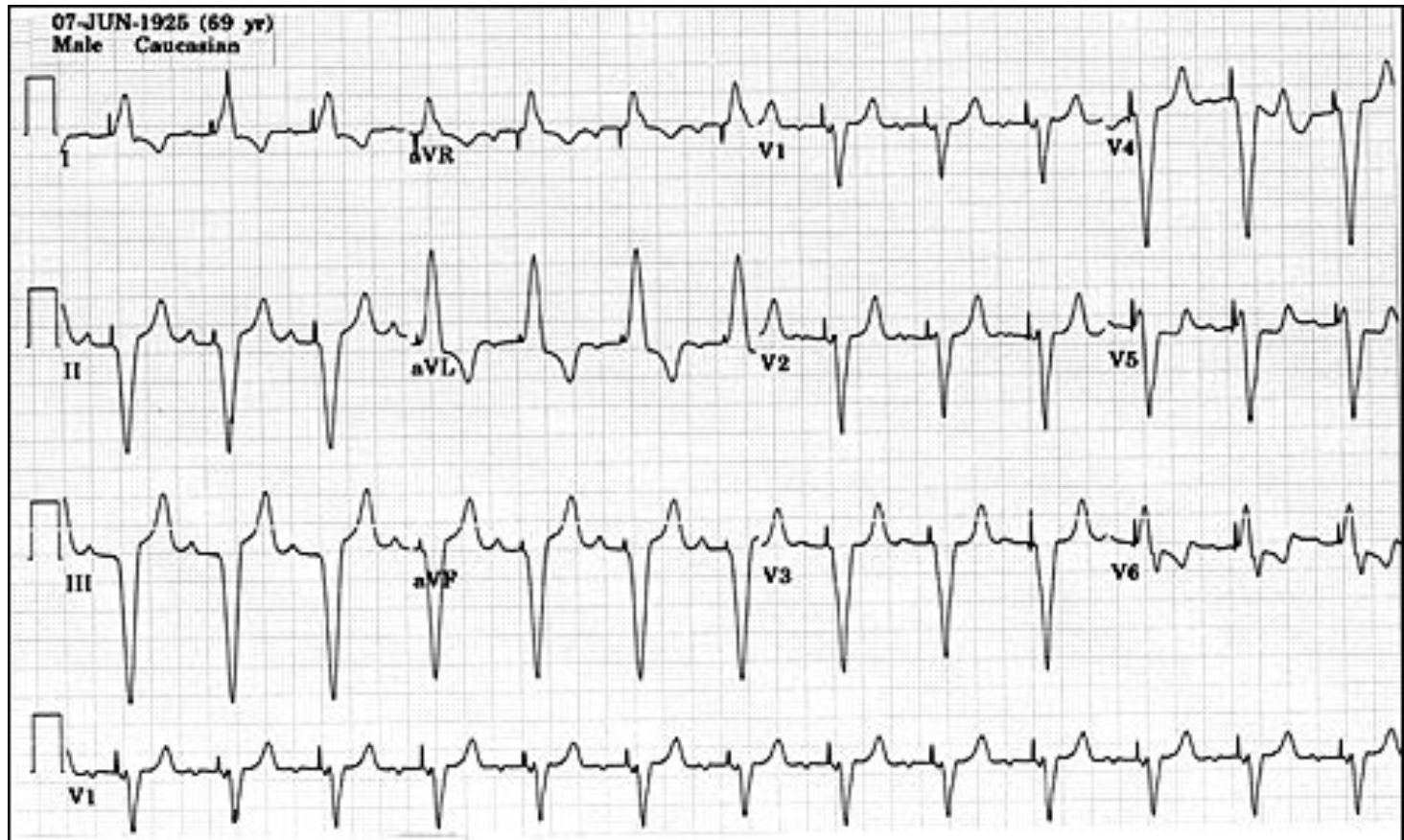


The Alan E. Lindsay ECG Learning Center ; <http://medstat.med.utah.edu/kw/ecg/>

Ventricular sensed, ventricular paced

Consistent with VVI

# Example 2



The Alan E. Lindsay ECG Learning Center ; <http://medstat.med.utah.edu/kw/ecg/>

Atrial sensed, ventricular paced

Consistent with DDD or VDD

# Example 4



The Alan E. Lindsay ECG Learning Center ; <http://medstat.med.utah.edu/kw/ecg/>

Failure to Pace

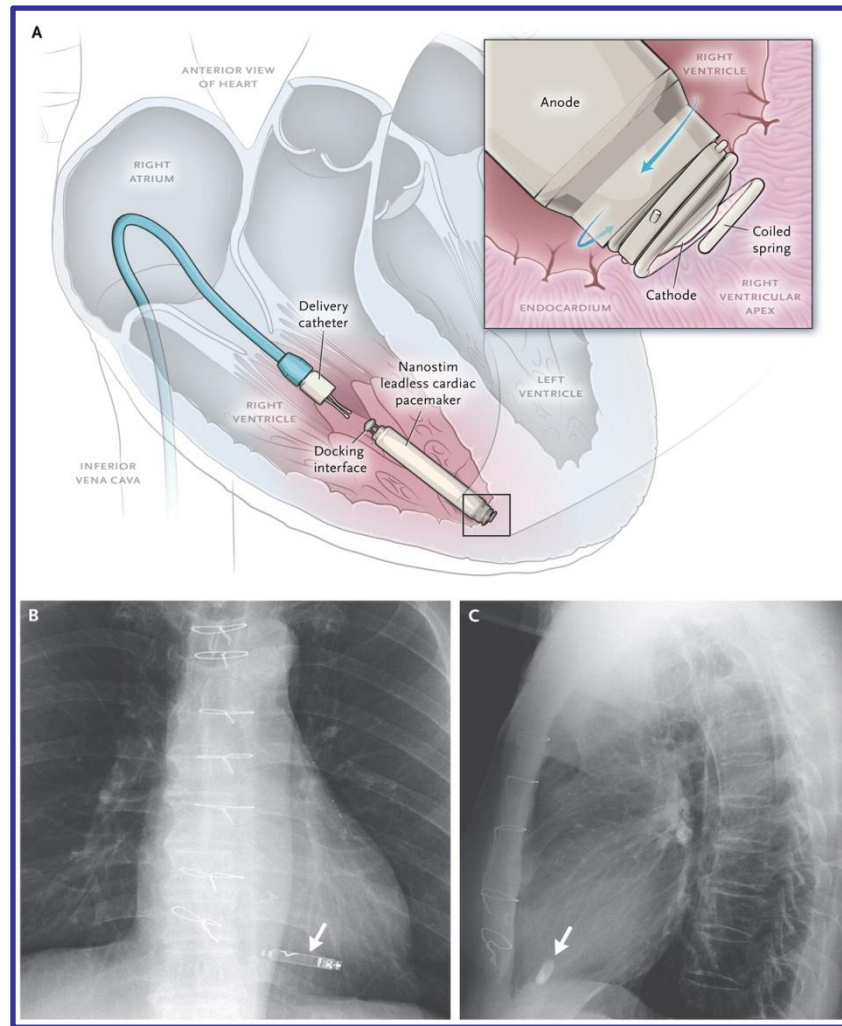
# Failure to capture



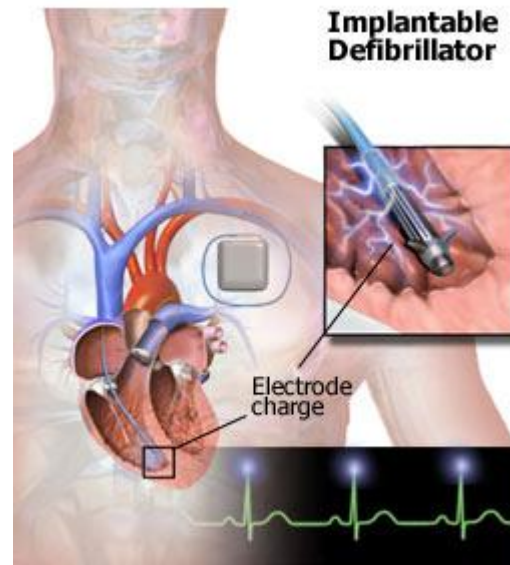
# Complications

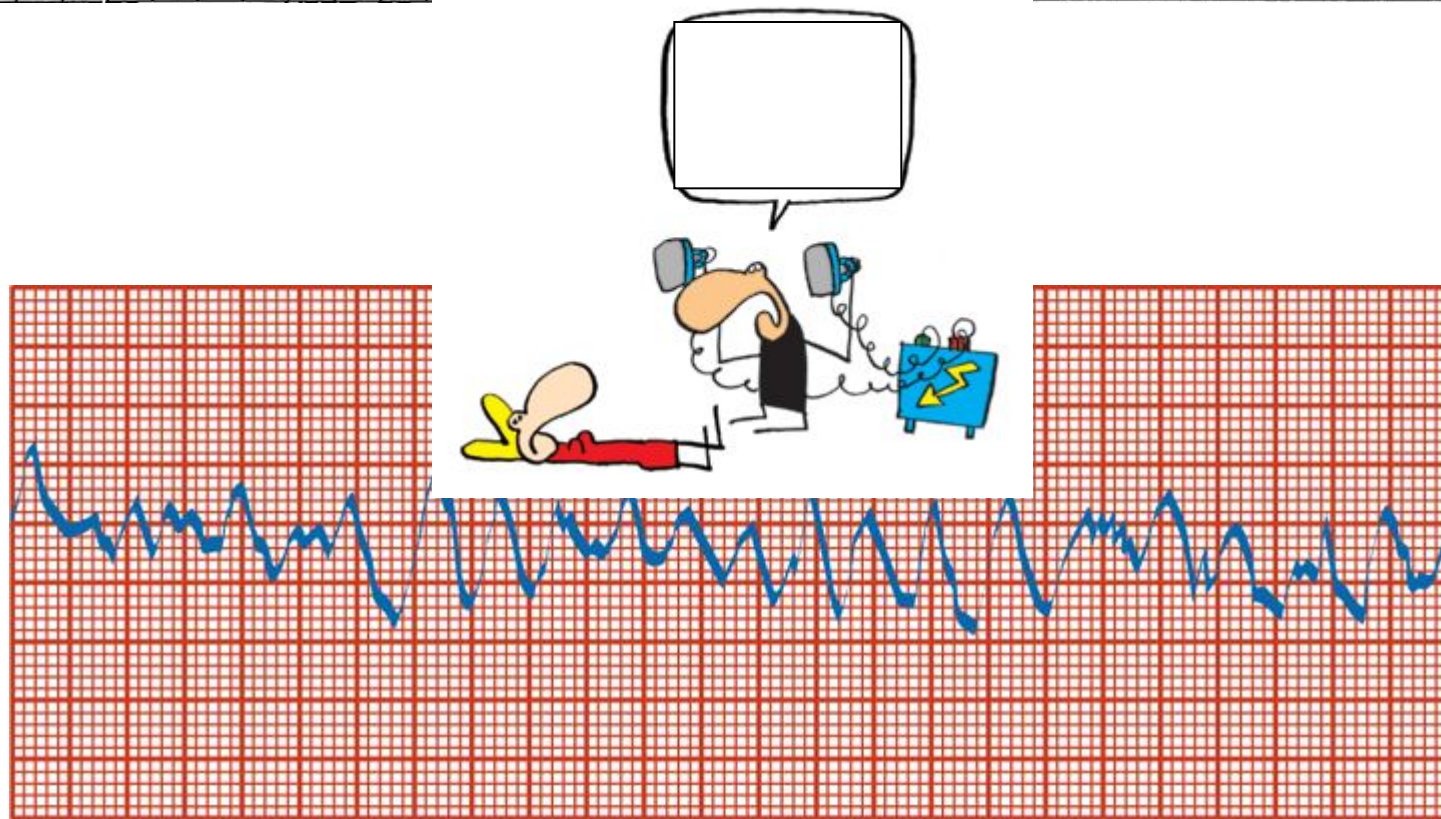
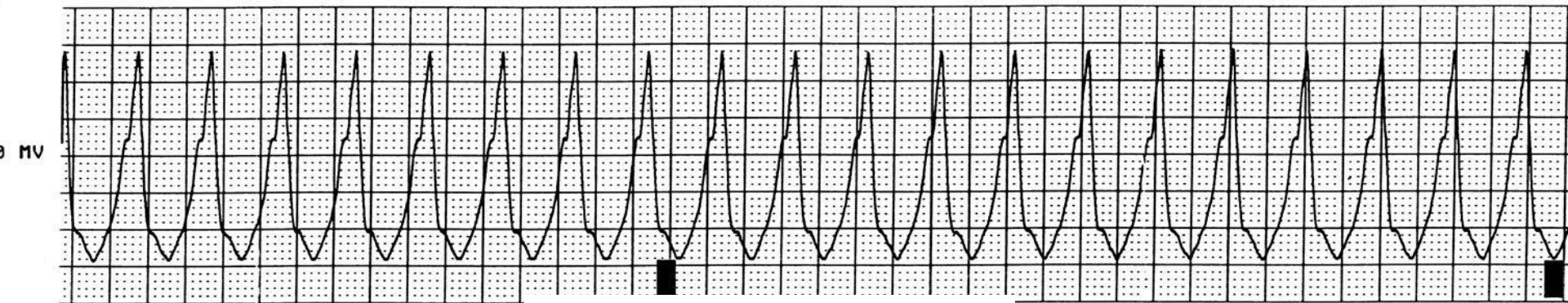
- Infection or erosion
- Hematoma
- Pneumothorax
- Lead dislodgment
- Lead malfunctions or fractures
- Electromagnetic interference





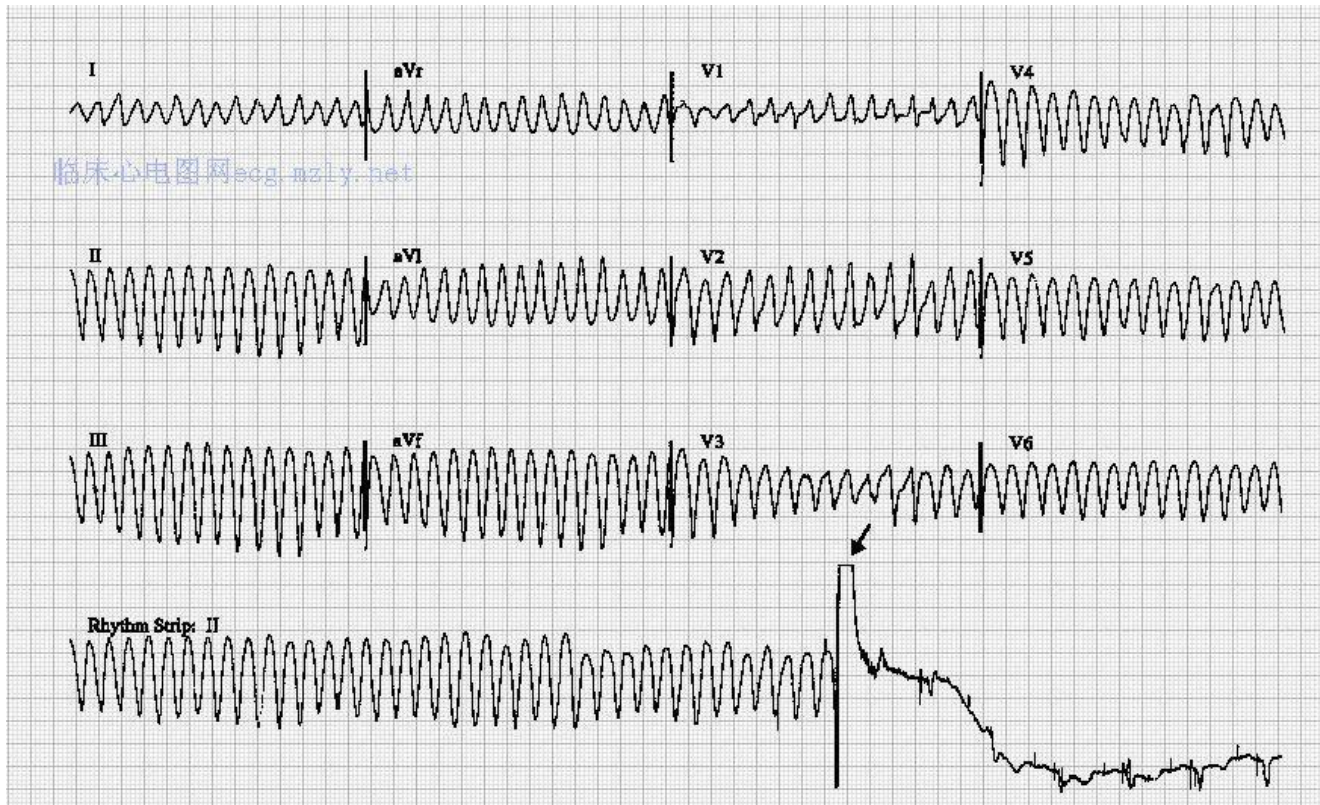
# Implantable Cardiac Defibrillator





**Figure 17-39** Ventricular fibrillation.

# Implantable Cardiac Defibrillator



# Inventor of the ICD



**Michel Mirowski,  
.M.D  
1924-1990**

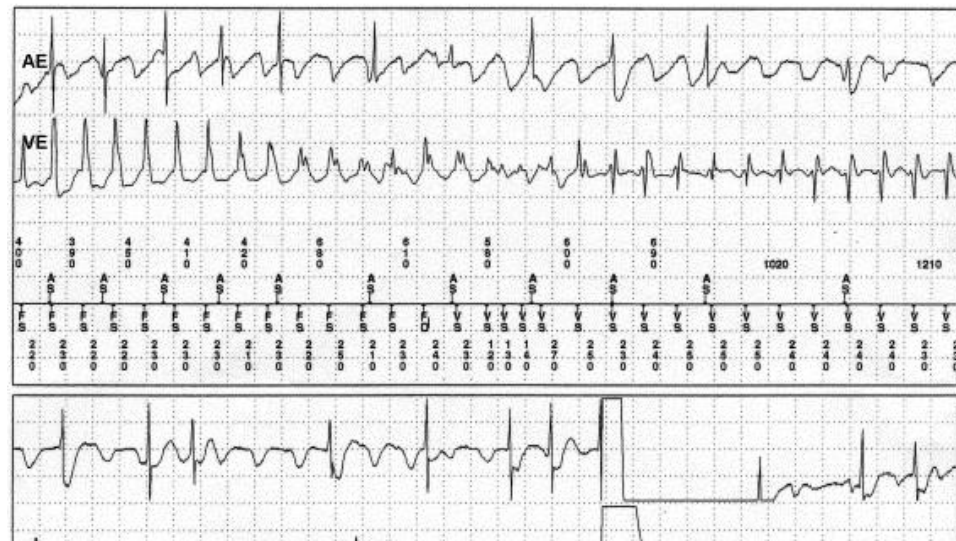
# Indications

- Cardiac arrest due to VF or VT not due to a transient or .1  
.reversible cause
- Spontaneous sustained VT in association with structural .2  
.heart disease
- Syncope of undetermined origin with clinically relevant, .3  
hemodynamically significant sustained VT or VF induced at  
electrophysiologic study
- Nonsustained VT in patients with coronary disease, prior .4  
myocardial infarction, LV dysfunction, and inducible VF or  
sustained VT at electrophysiologic study
- Spontaneous sustained VT in patients without structural .5  
heart disease

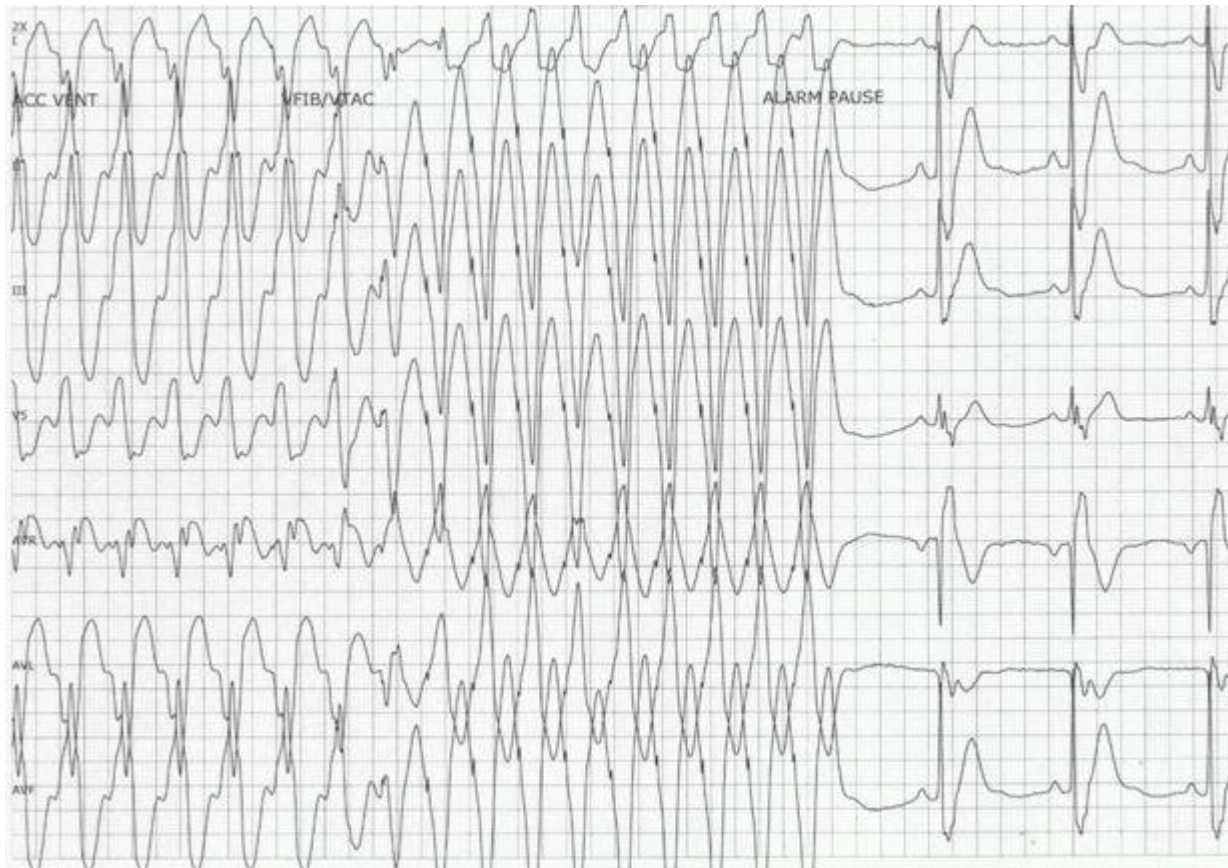
A



B



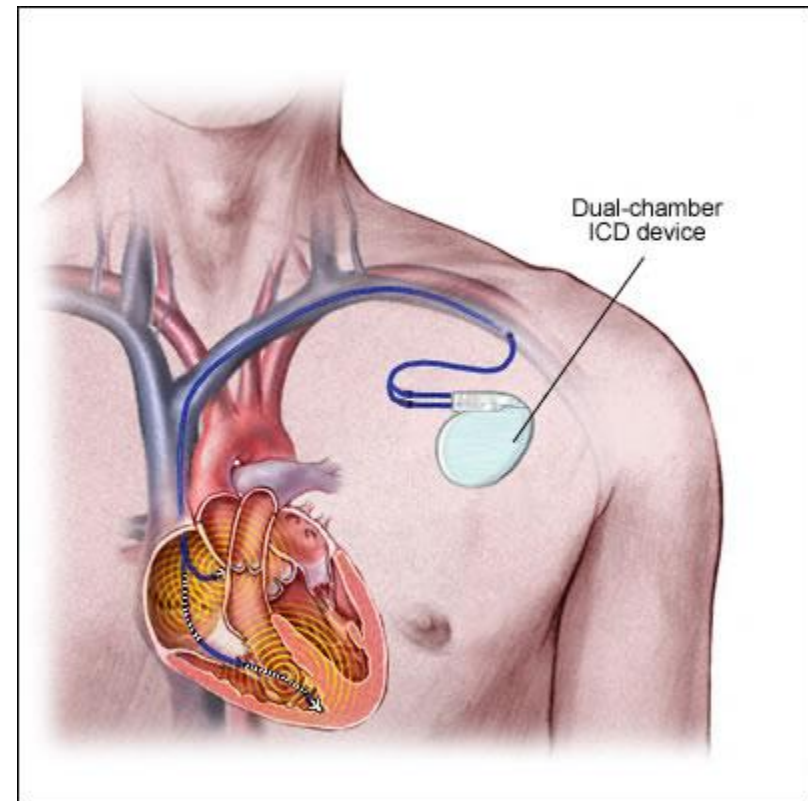
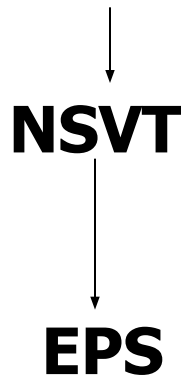
# Antitachycardia pacing



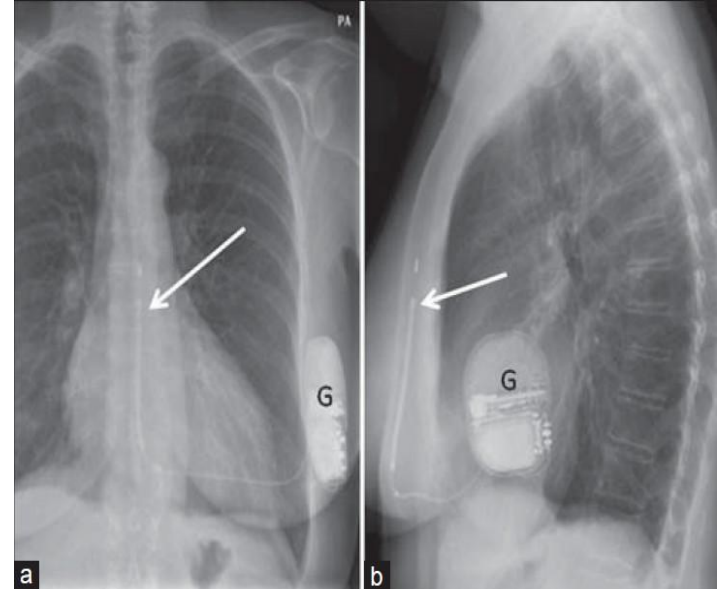
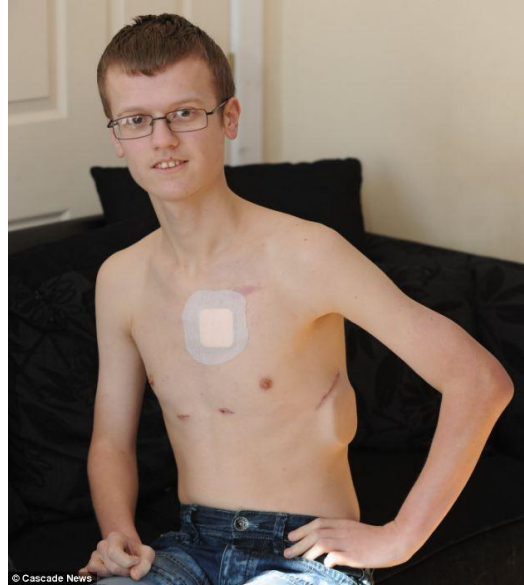
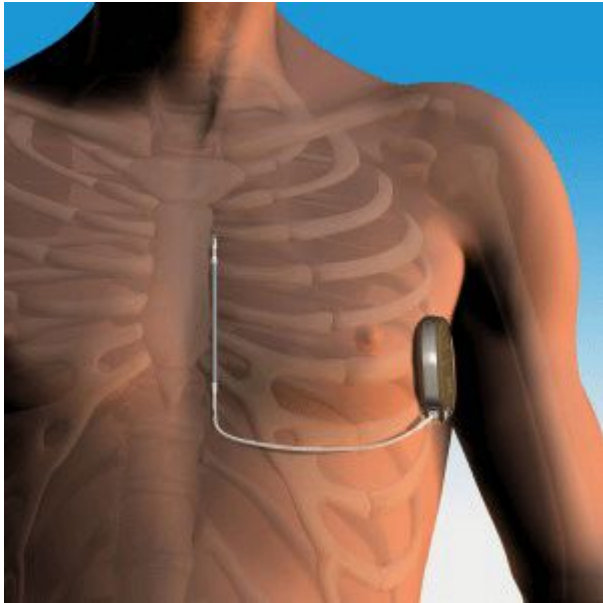


# LV dysfunction

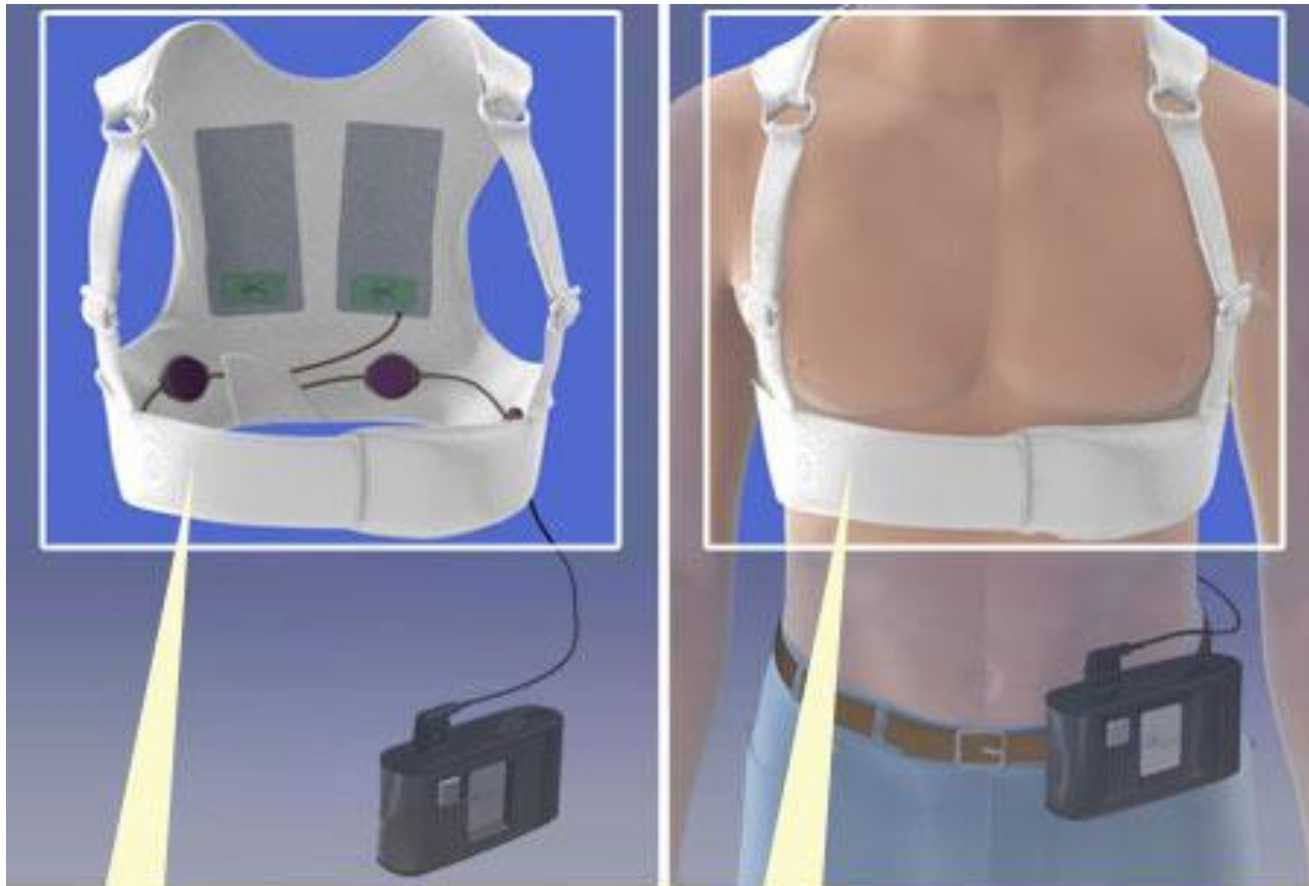
- EF < 30% - ICD implantation
- EF 30-40% - Monitor



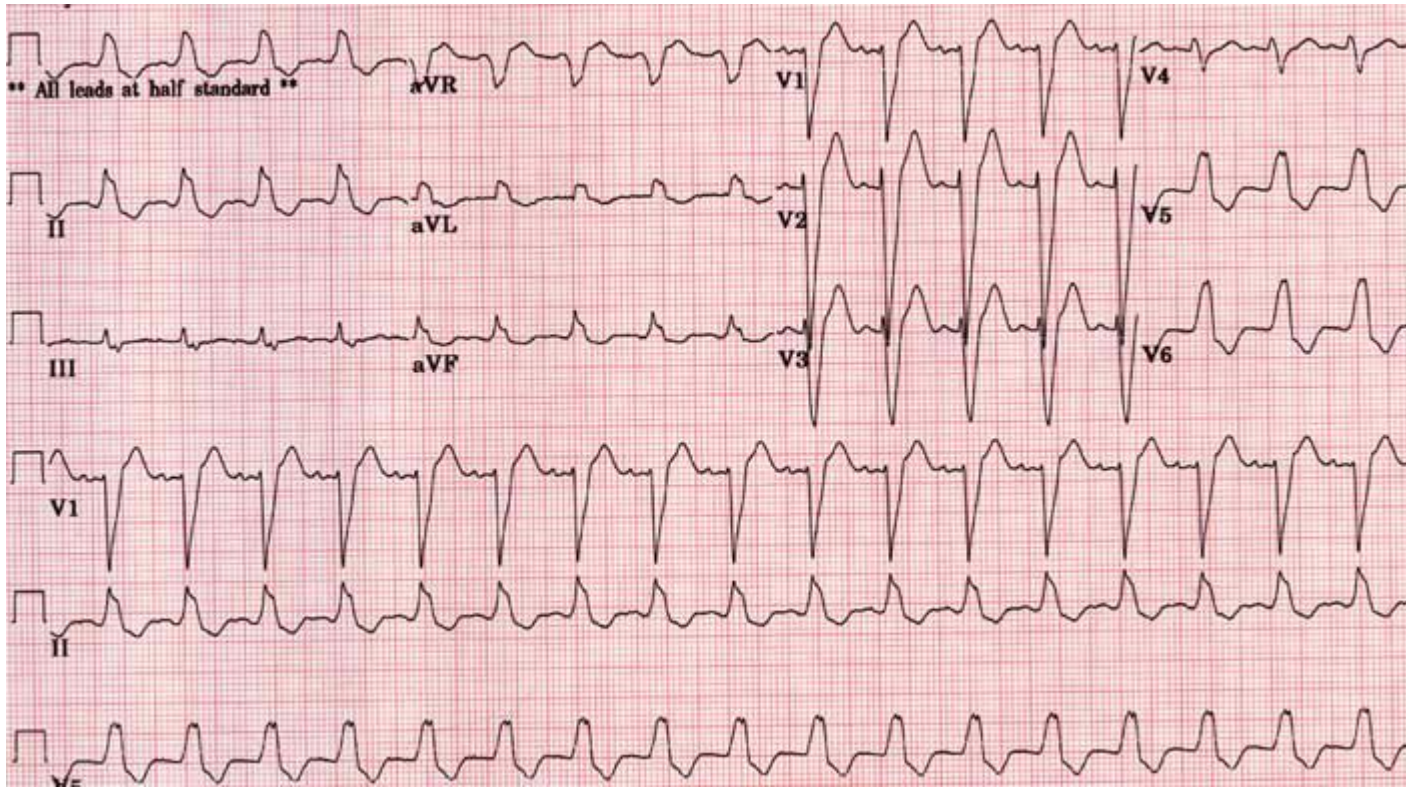
# Subcutaneous defibrillator



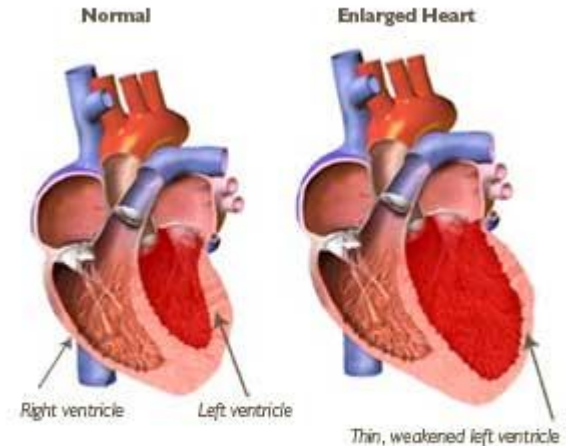
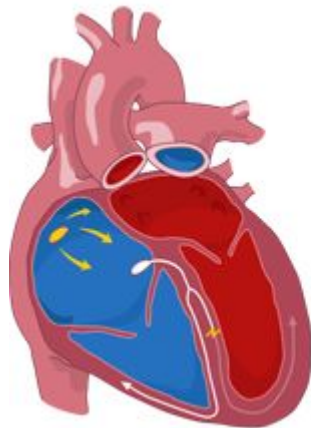
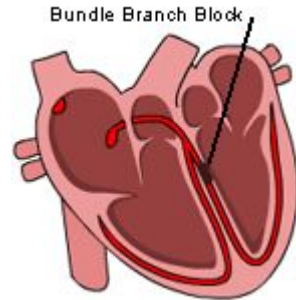
# External vest defibrillator



# CLBBB

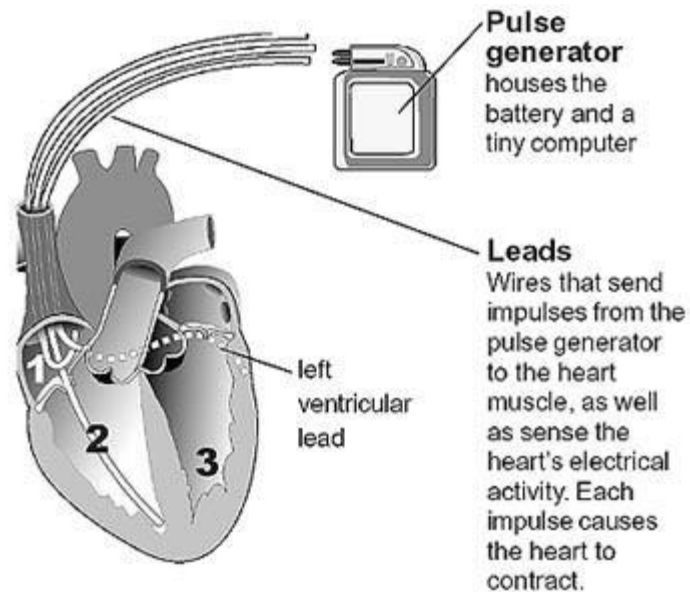


# LV dysfunction + wide QRS

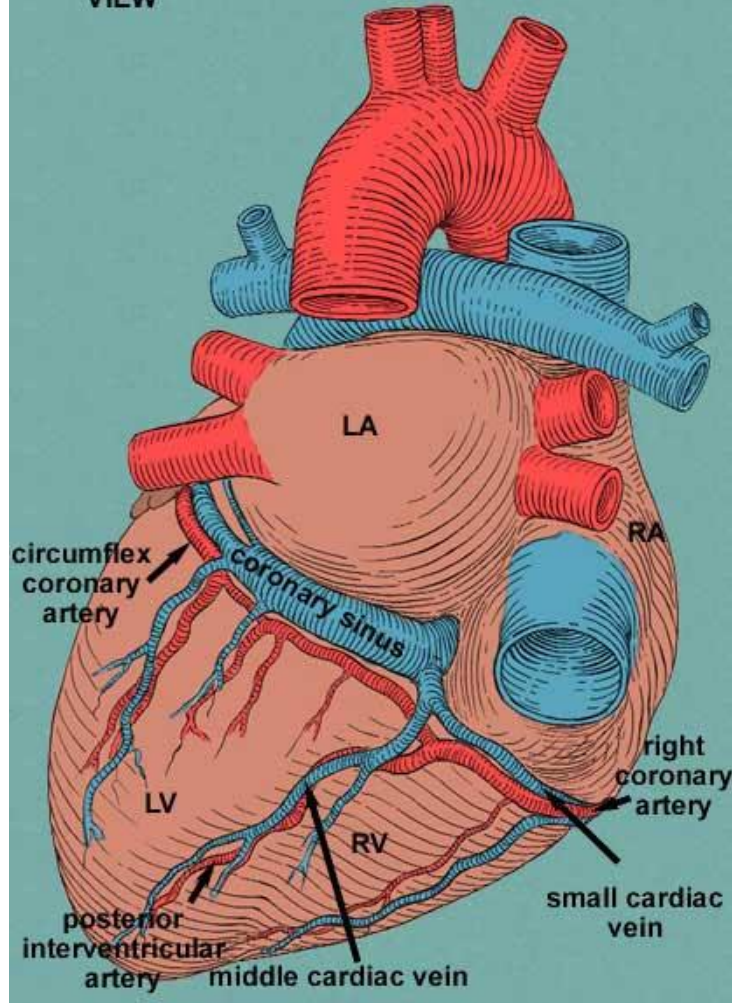


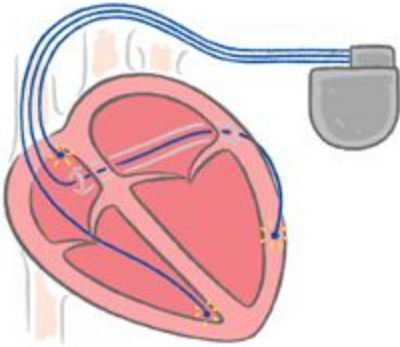
A type of cardiomyopathy. An enlarged heart is a sign that the heart may be overworked.

# Cardiac resynchronization



**POSTERIOR  
VIEW**





*heart failure pacemaker*



