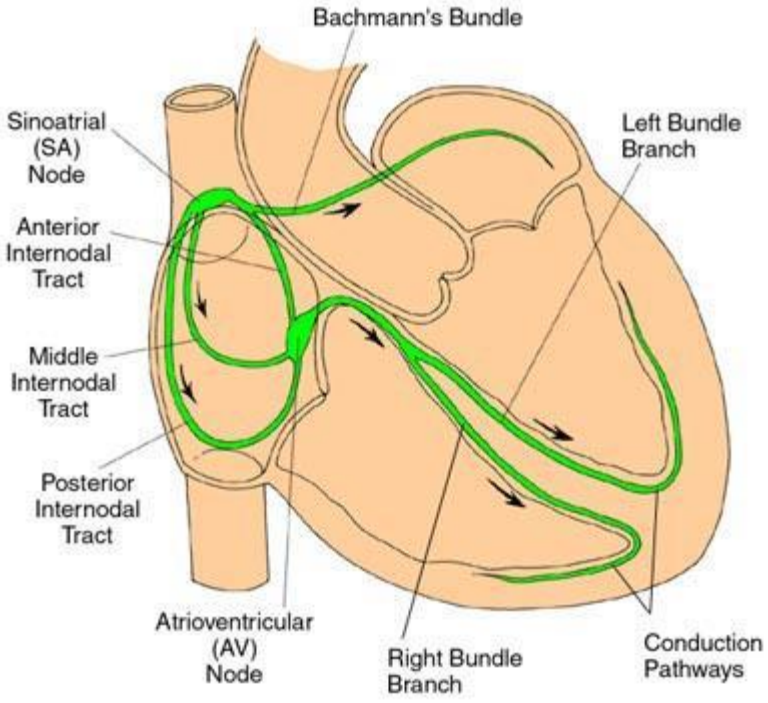
Pacemakers and Implantable Defibrillators

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

The Electrical System of the Heart

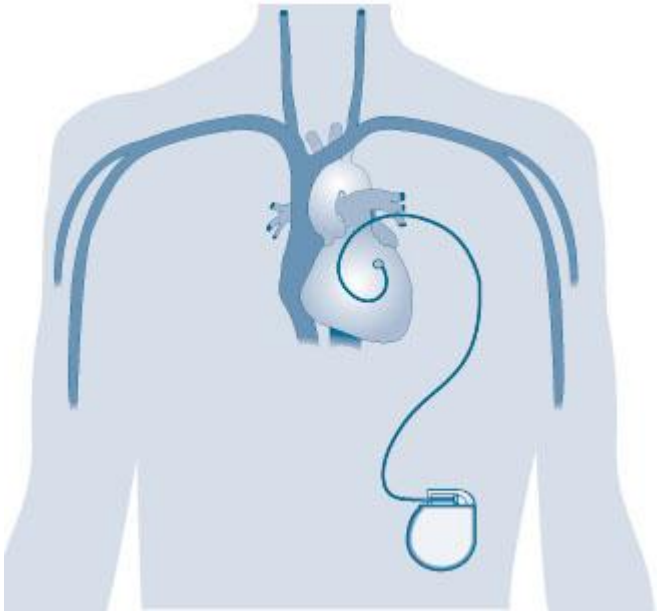


- Worldwide, > 250,000 permanent cardiac pacemakers implanted each year.
- The primary role of cardiac pacing is to augment or replace the heart's intrinsic electrical system.

Pacemaker

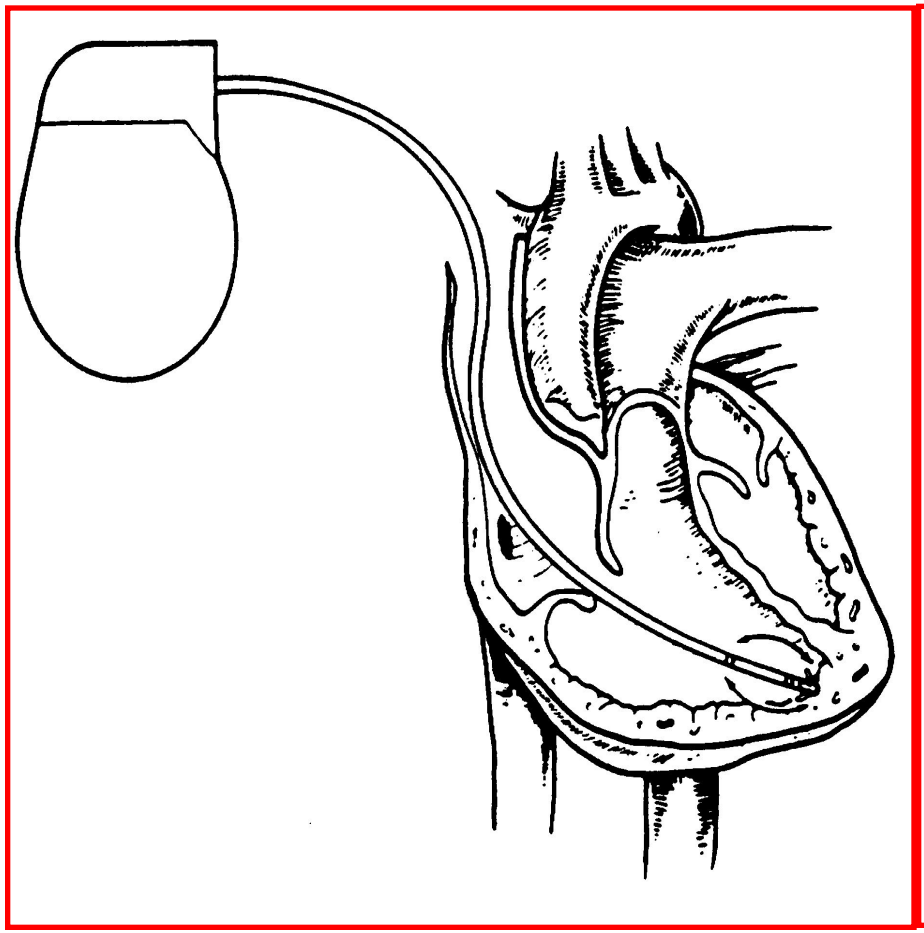
- Temporary
- Permanent

- Epicardial

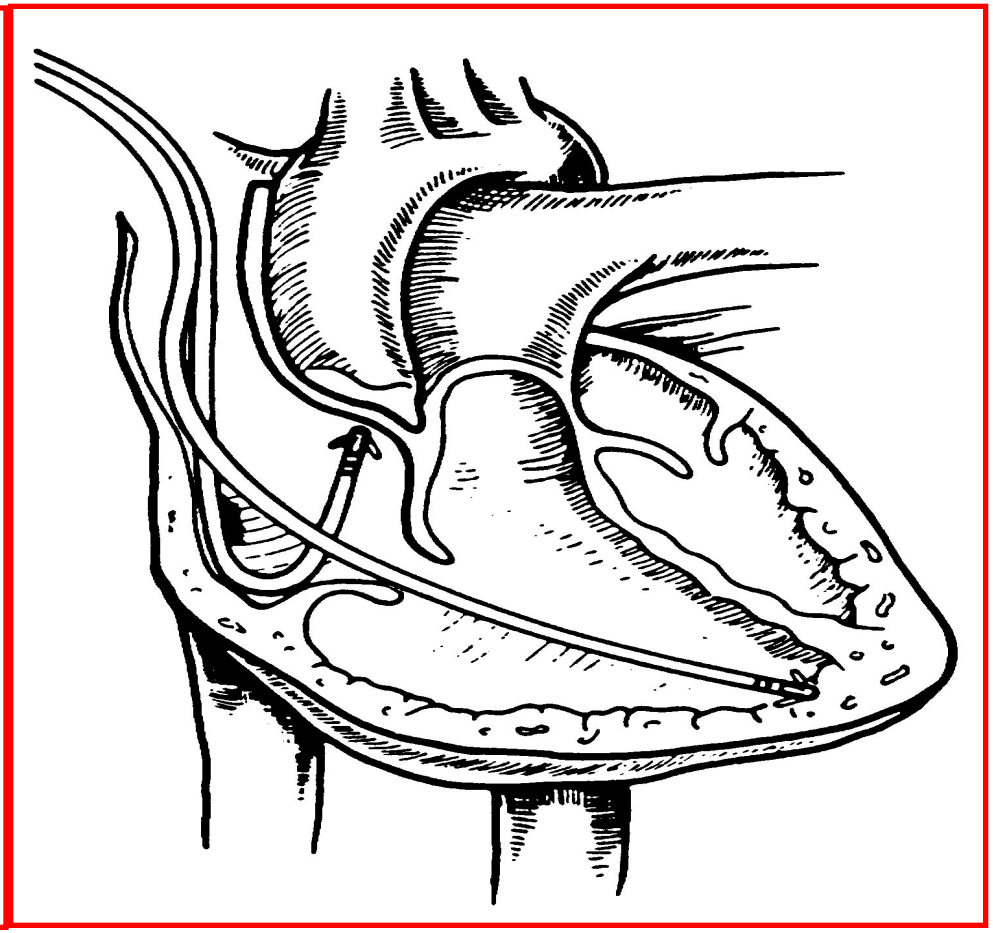


- Endocardial

Single-Chamber System •

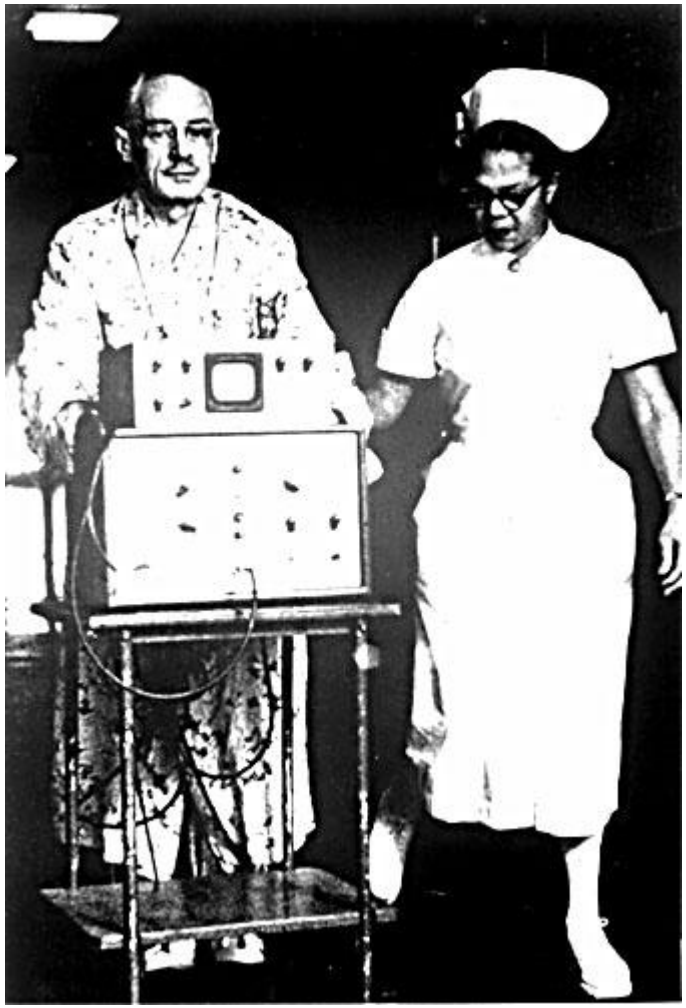


Dual-Chamber Systems •




Johnson Viking
PACEMAKER
TRANSMITTER


From the Archives
of CBC Television
Click to play

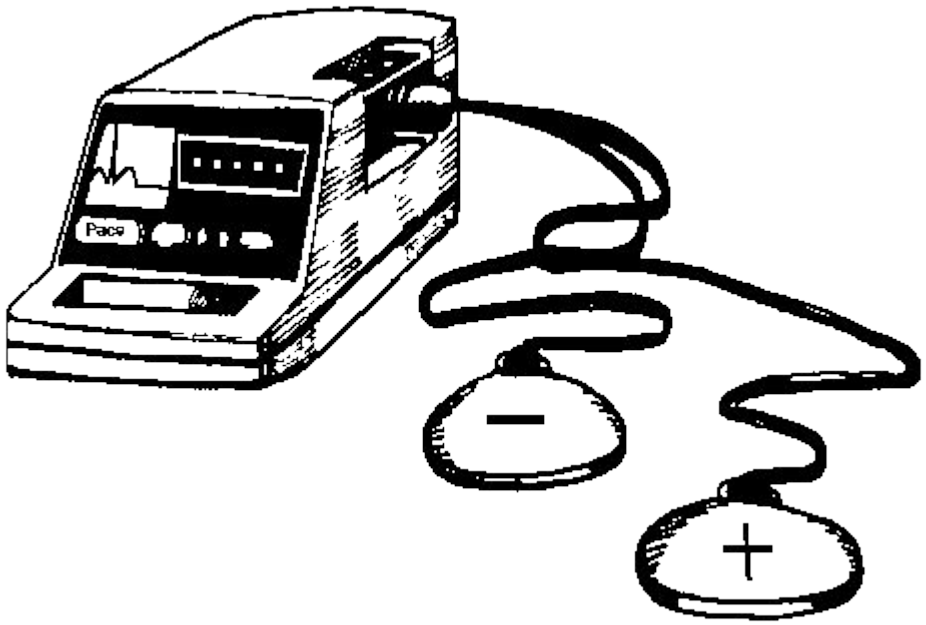



1
2
3
Germany
4
5
6
IS-1/3.2
MERIDIAN™ SR
TYPE SSIR MODEL 1176
SN PG 301336
GUIDANT
ST. PAUL, MN USA


foto JO
MEDTRONIC
CHARISMA
HOLLAND
CD-LC MD
INHIBITED
RATE TB
μPACER

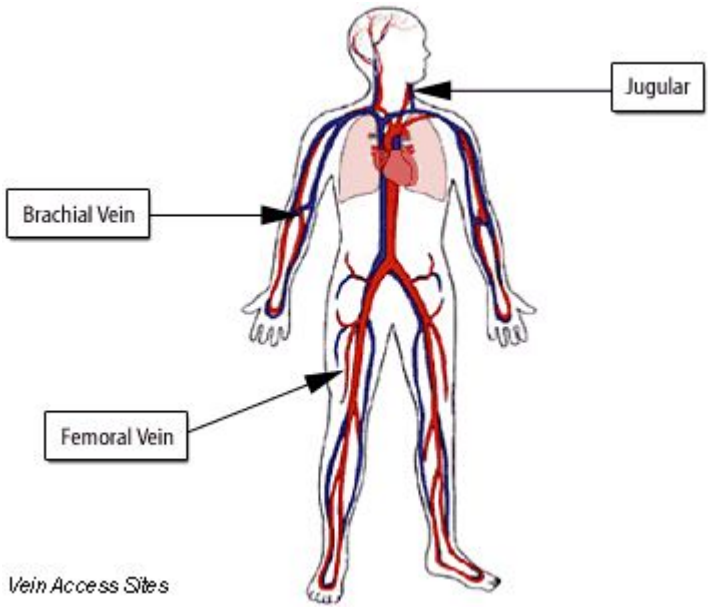
Temporary pacing

- Transcutaneous
- Transvenous



Transcutaneous pacing

Transvenous temporary pacing



Temporary pacemaker(2)

- Transvenous

  -Subclavian

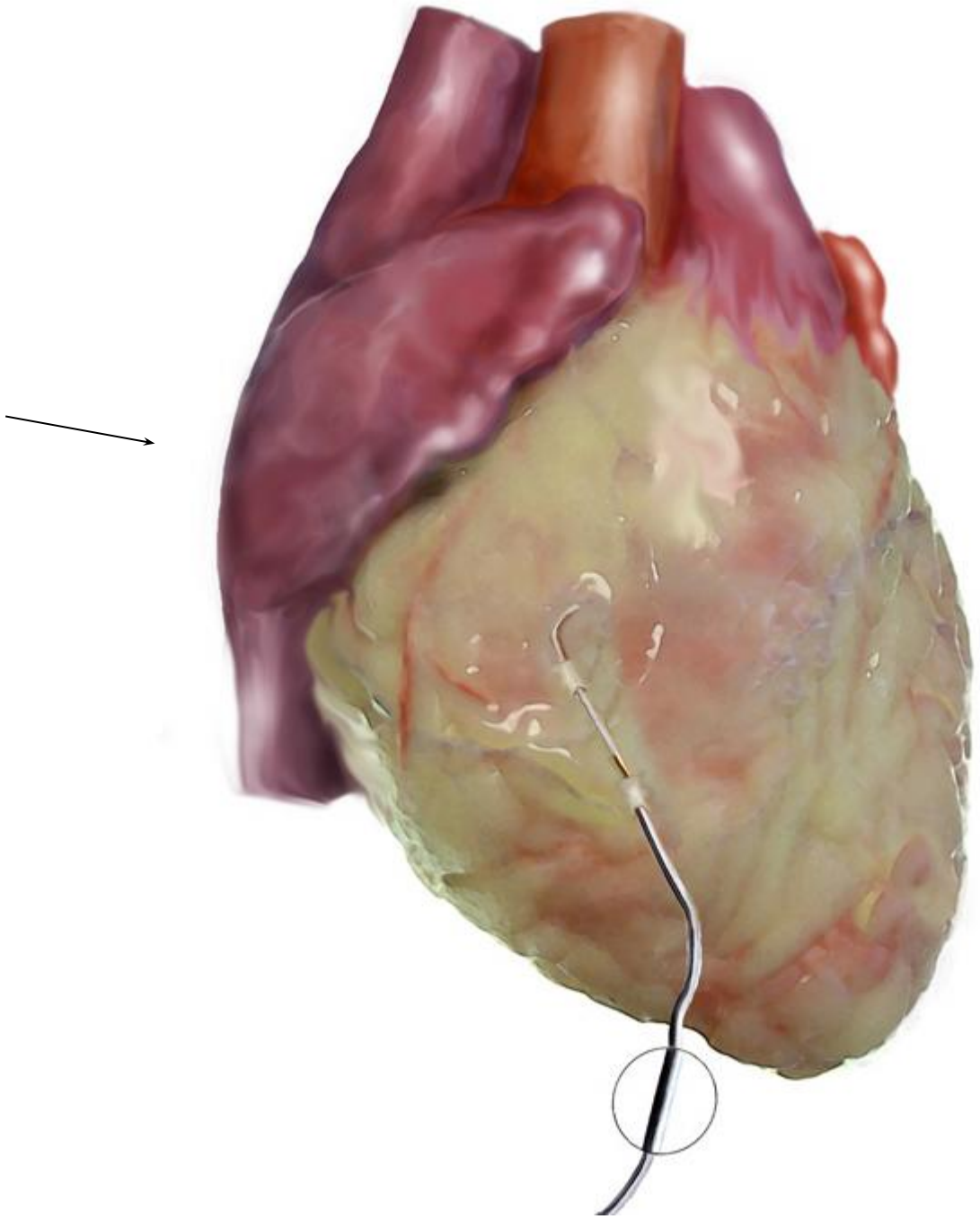
  -Jugular

  - Femoral

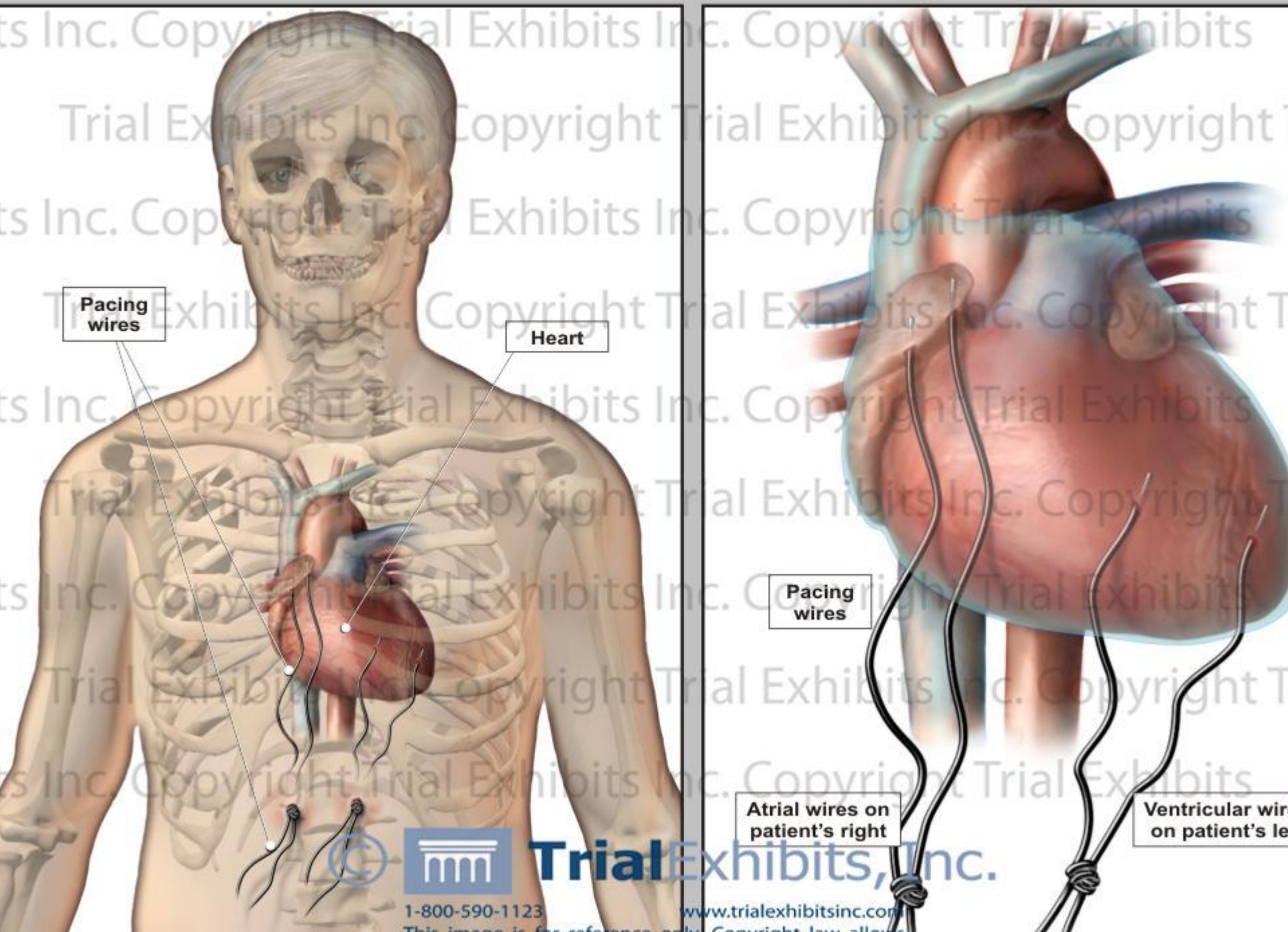
Common Indications for Temporary Pacing

- 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



Epicardial Pacing Wires



Permanent Pacemaker

Pacemaker Components

Pulse generator

Leads

programmer

Common Indications for Implantable Cardiac Pacemaker

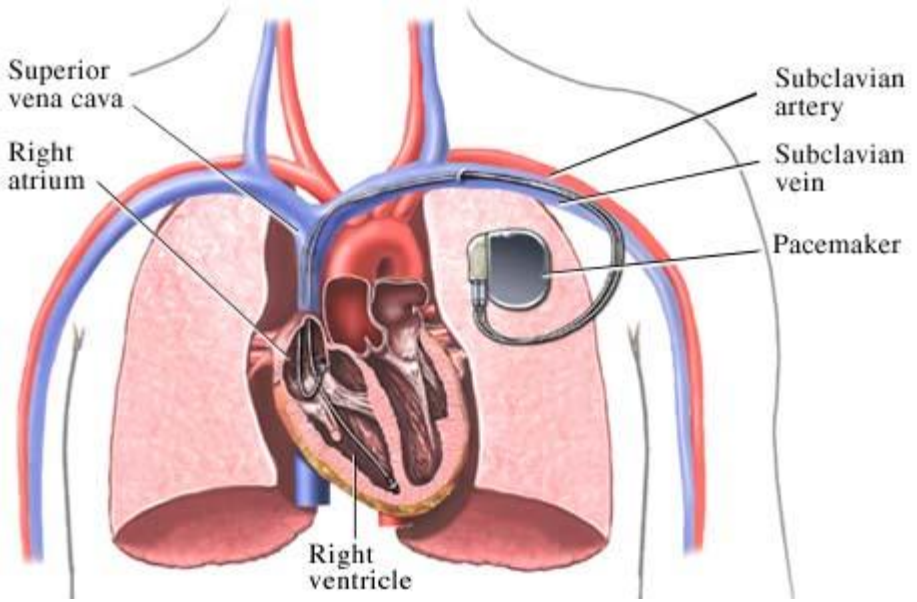
- Complete Heart Block or high grade 2^{nd} degree A-v block

- 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	

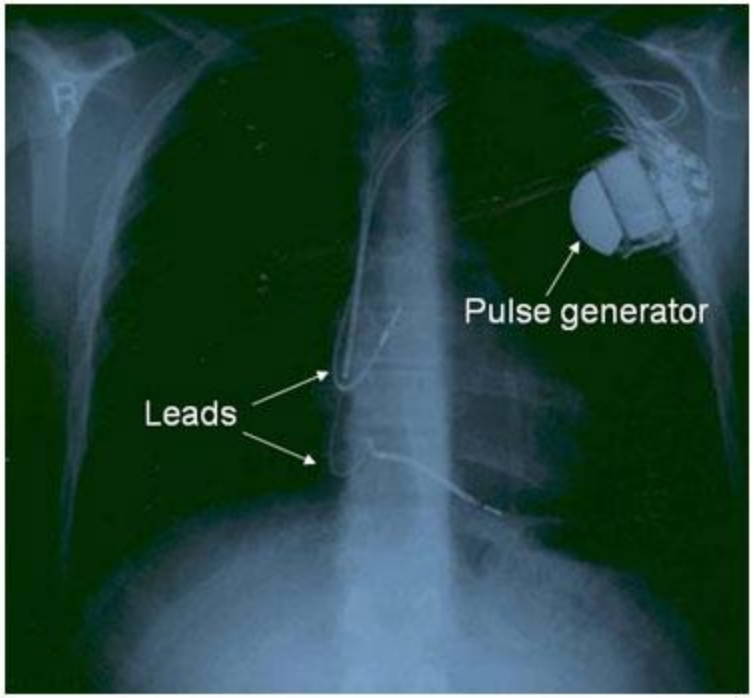
Ventricular Pacemaker (single chamber)

One spike producing a wide QRS (ventricular capture).

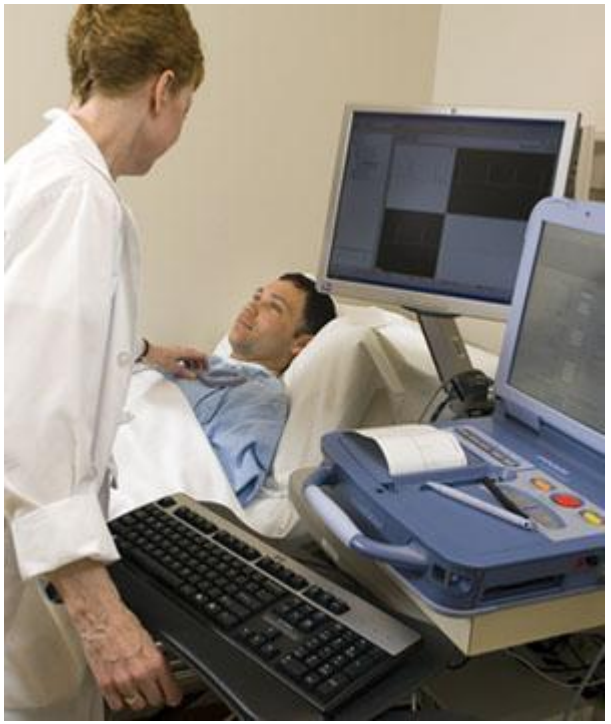
Atrial Pacemaker (single chamber)

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

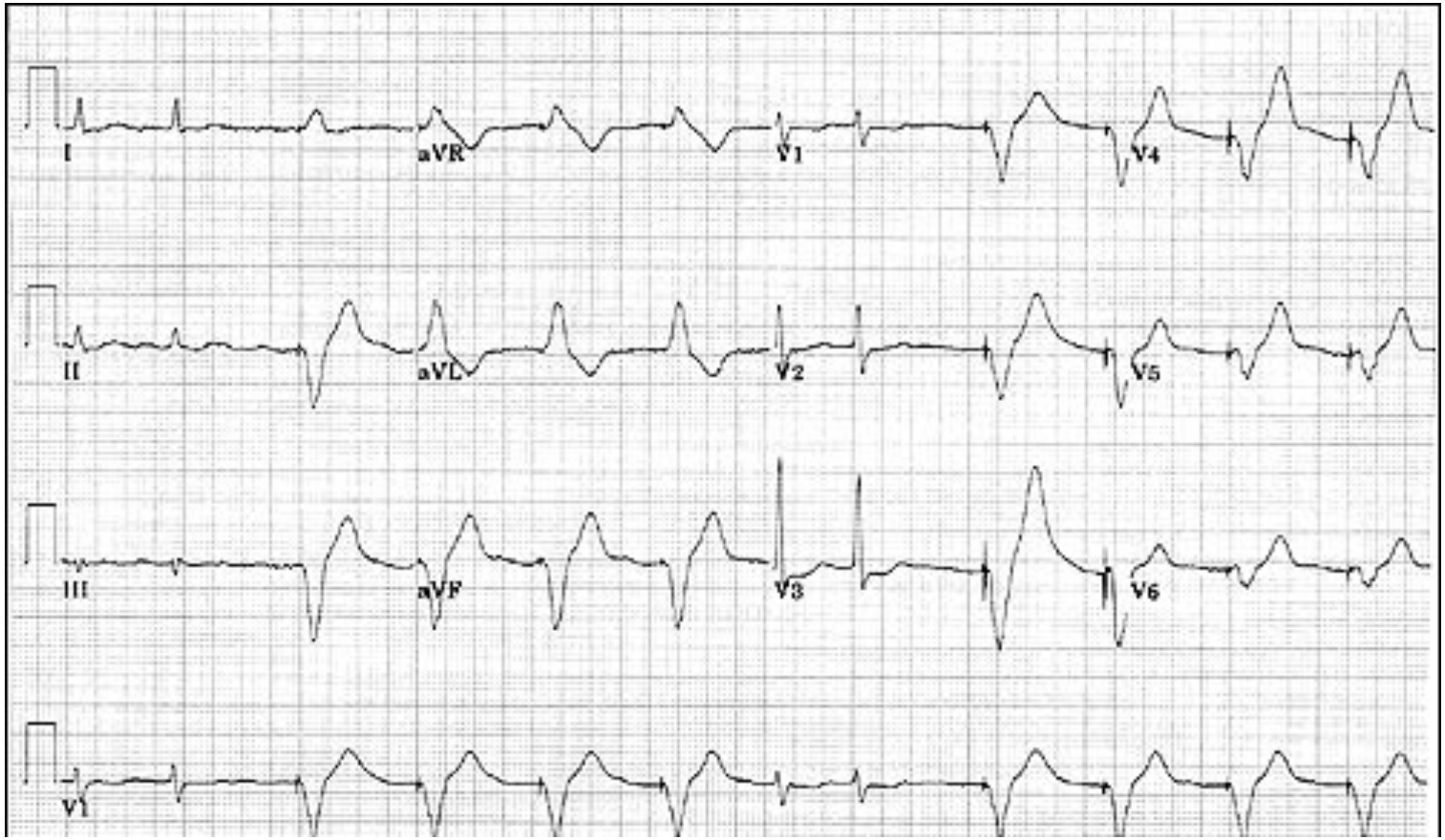
Atrial and ventricular pacing


Pulse generator
Leads

Pacemaker interrogation and programming



Example 1

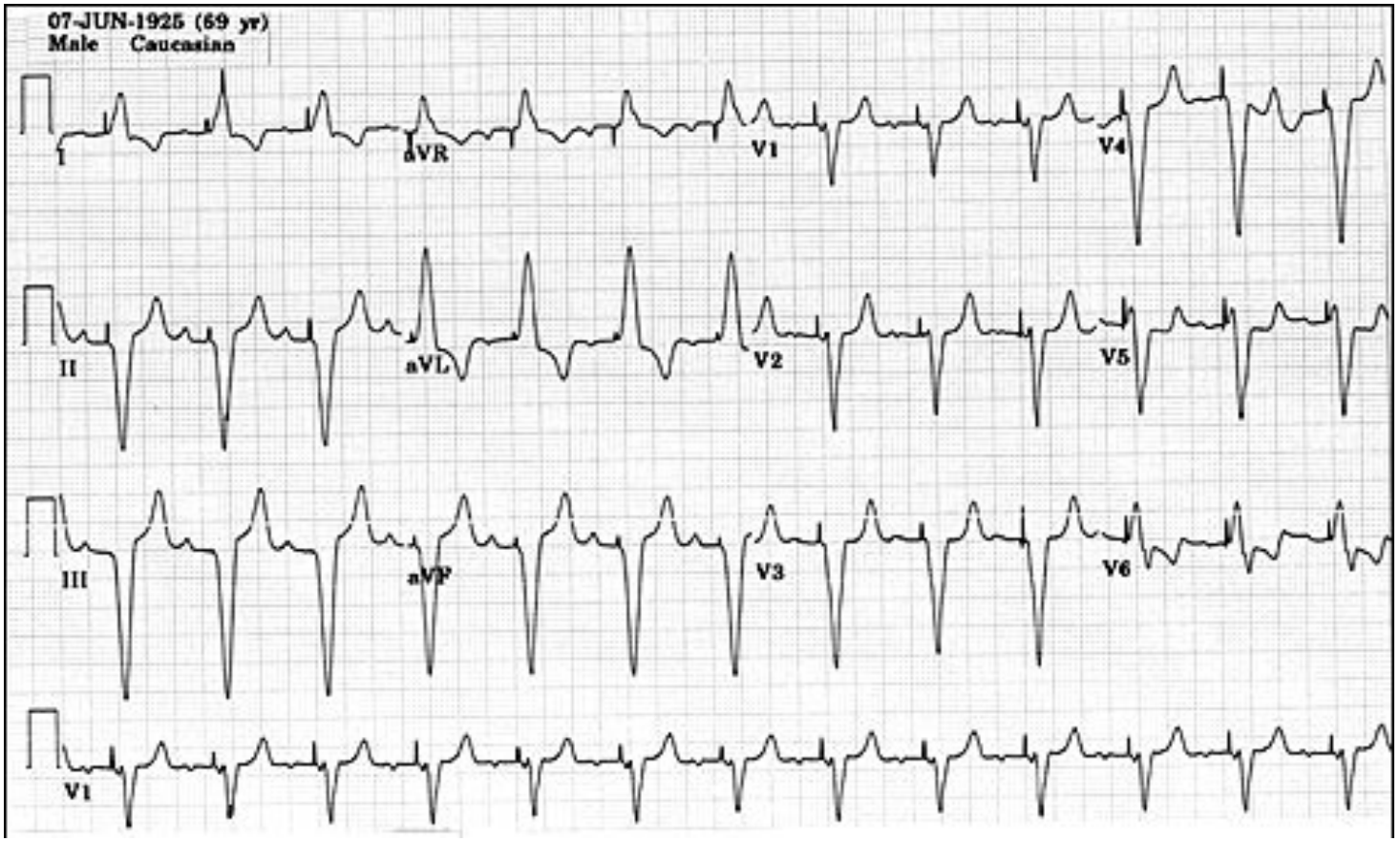


The Alan E. Lindsay ECG Learning Center ; http://medstat.med.utah.edu/kw/ecg/

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

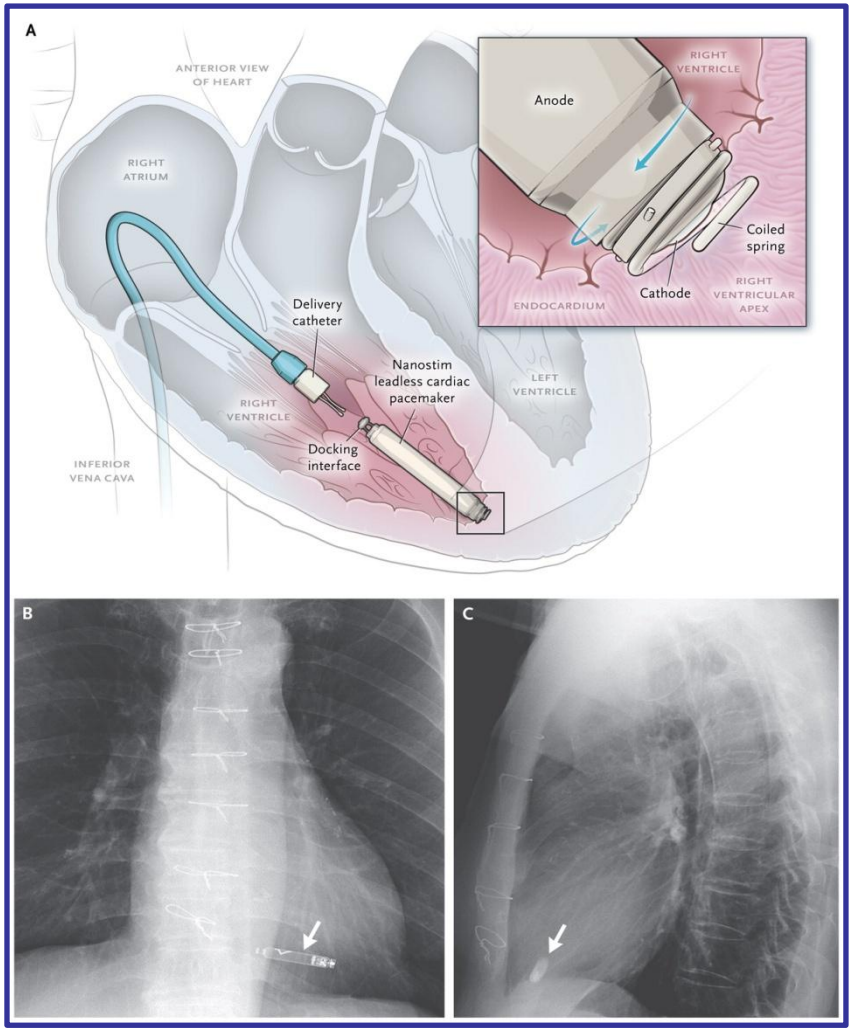
The Alan E. Lindsay ECG Learning Center ; http://medstat.med.utah.edu/kw/ecg/

Failure to Pace

Failure to capture

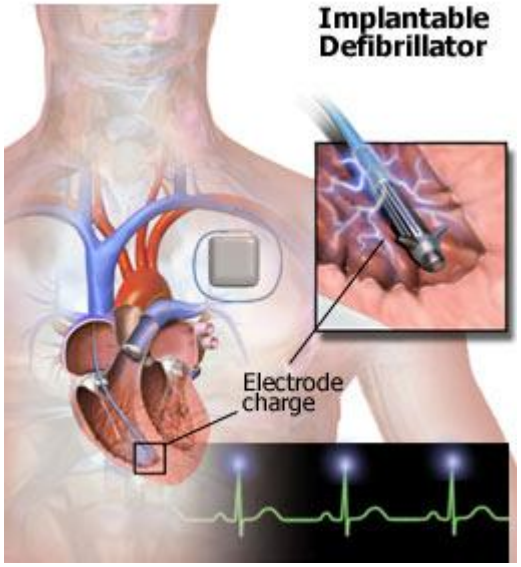
Complications

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



.Reddy VY et al. N Engl J Med 2015;373:1125-1135

Implantable Cardiac Defibrilator



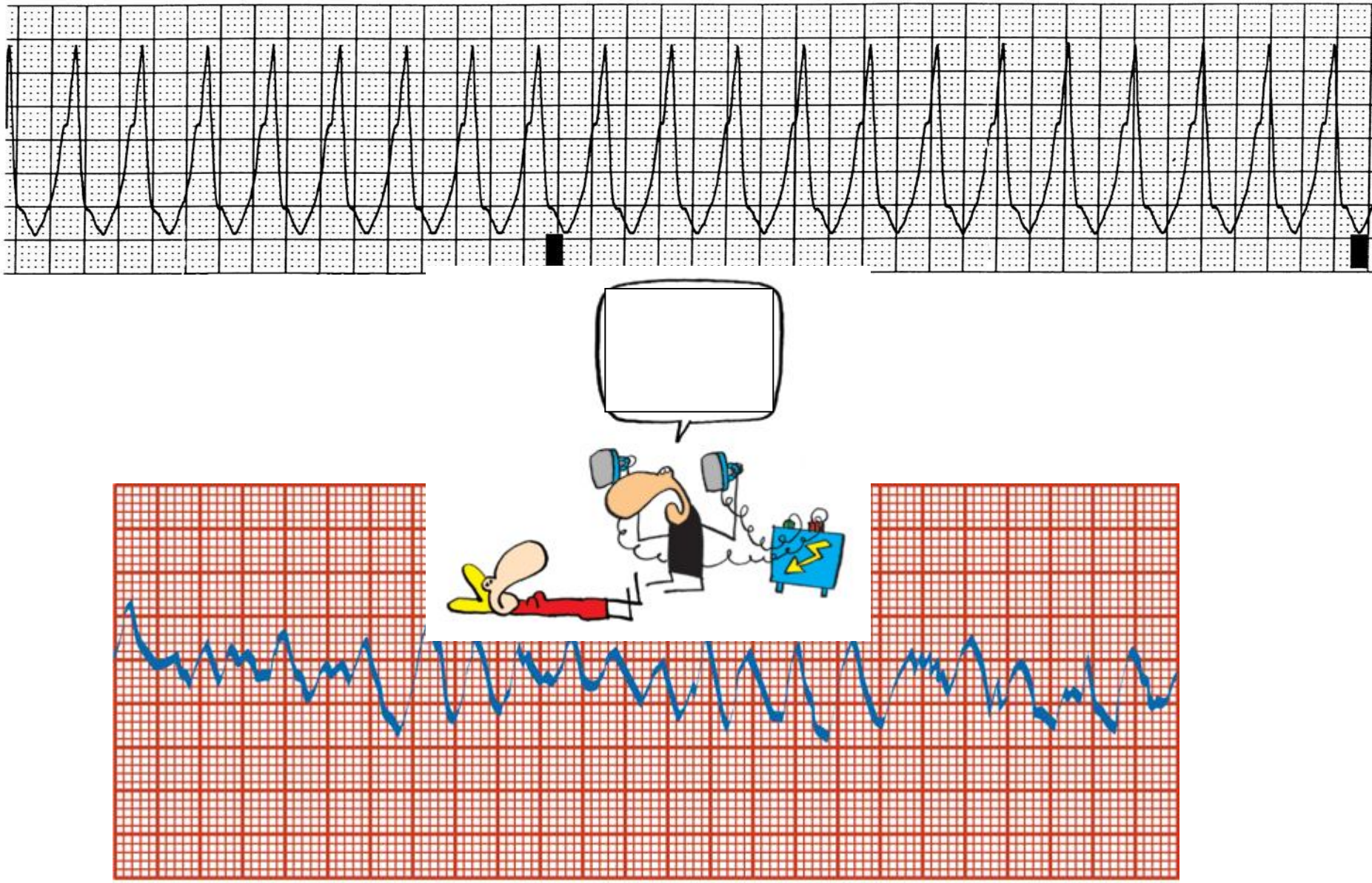
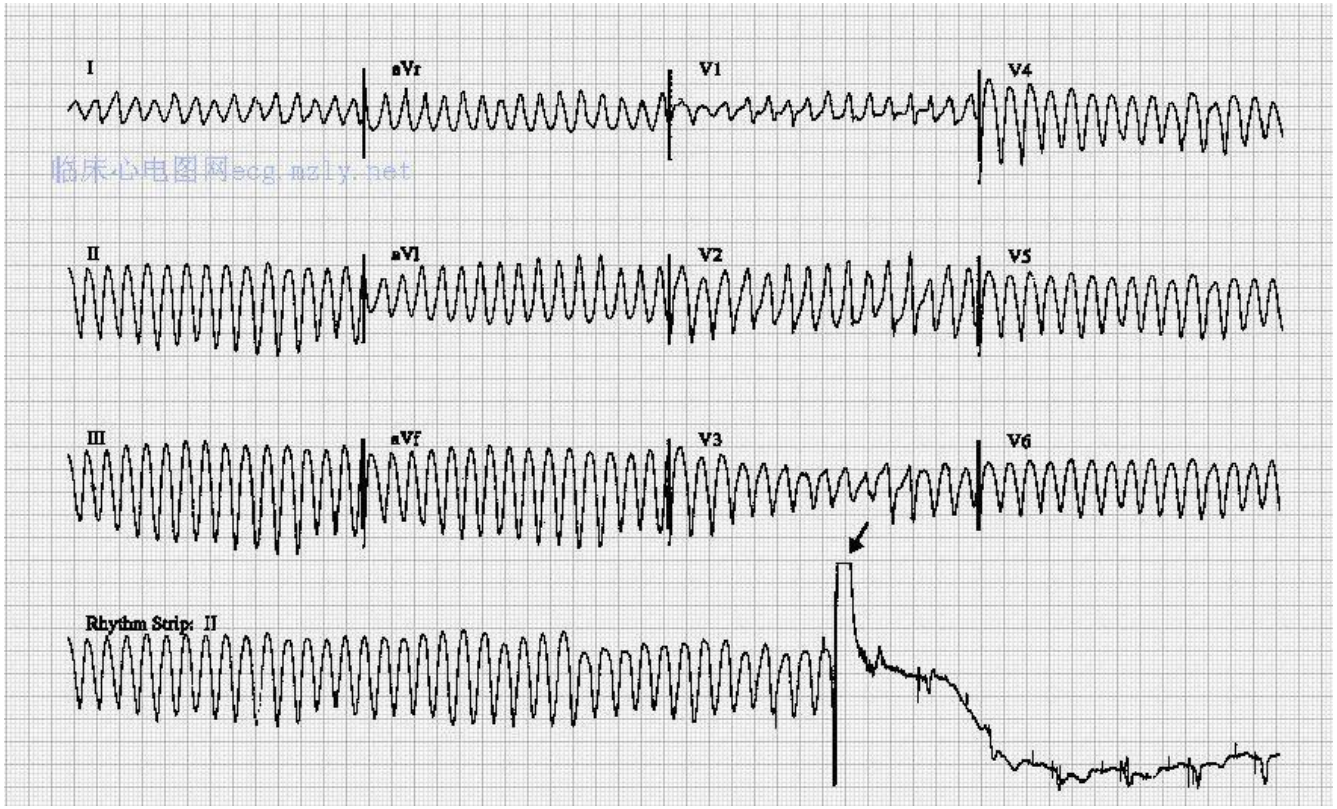


Figure 17-39 Ventricular fibrillation.

Implantable Cardiac Defibrilator



Inventor of the ICD

Michel Mirowski, .M.D

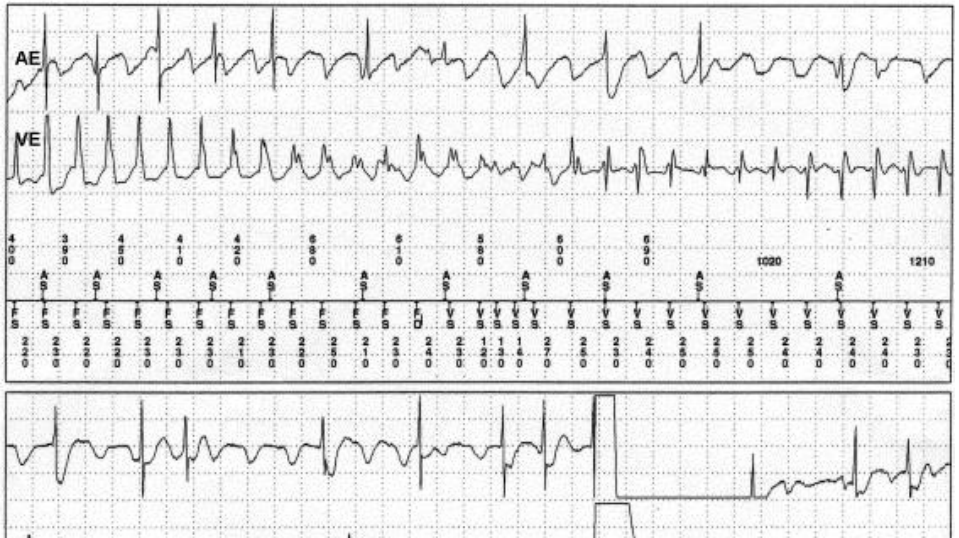
1924-1990

Indications

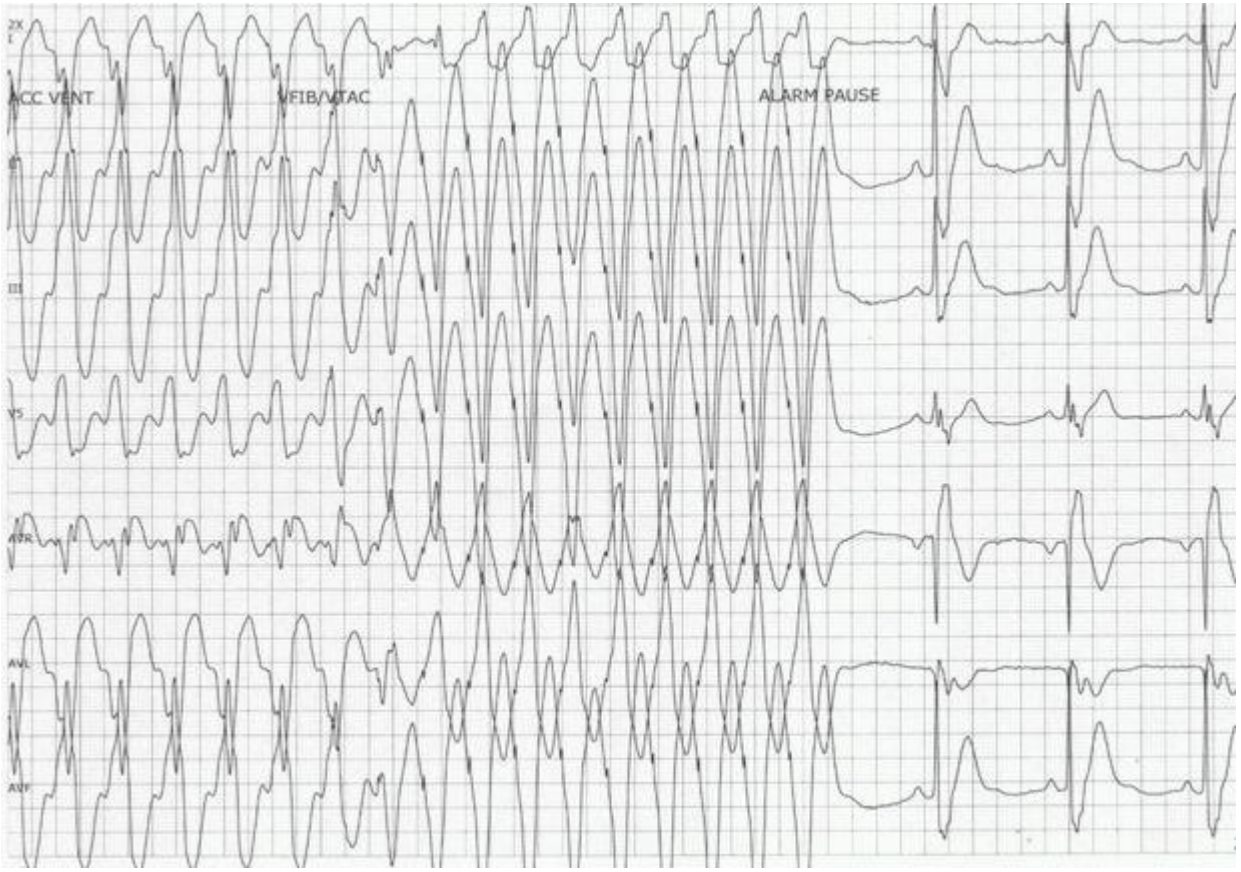
1. Cardiac arrest due to VF or VT not due to a transient or reversible cause
2. Spontaneous sustained VT in association with structural heart disease
3. Syncope of undetermined origin with clinically relevant, hemodynamically significant sustained VT or VF induced at electrophysiologic study
4. Nonsustained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

A

B



Antitachycardia pacing

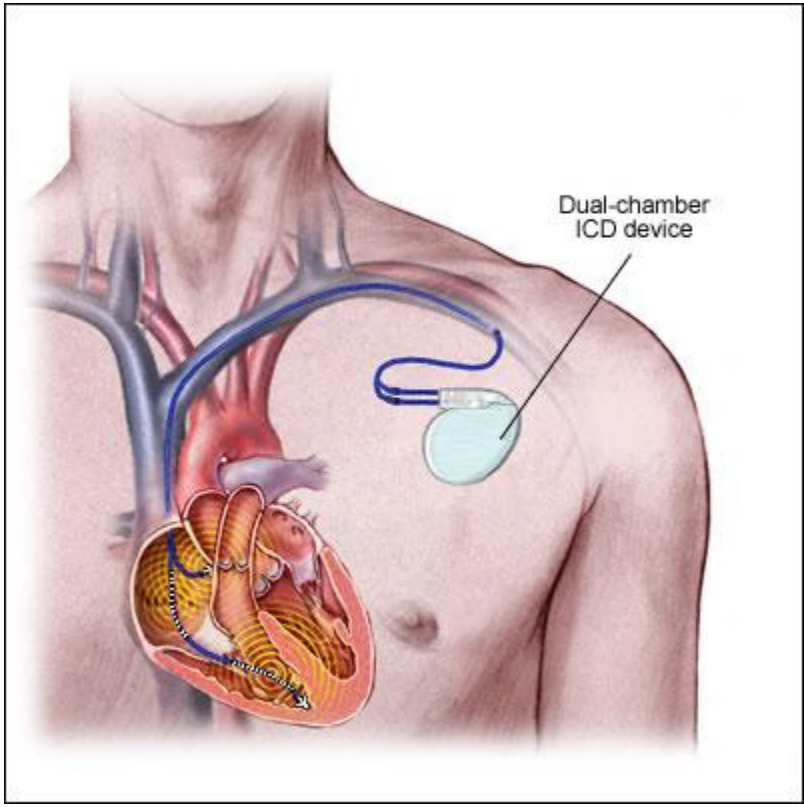


LV dysfunction

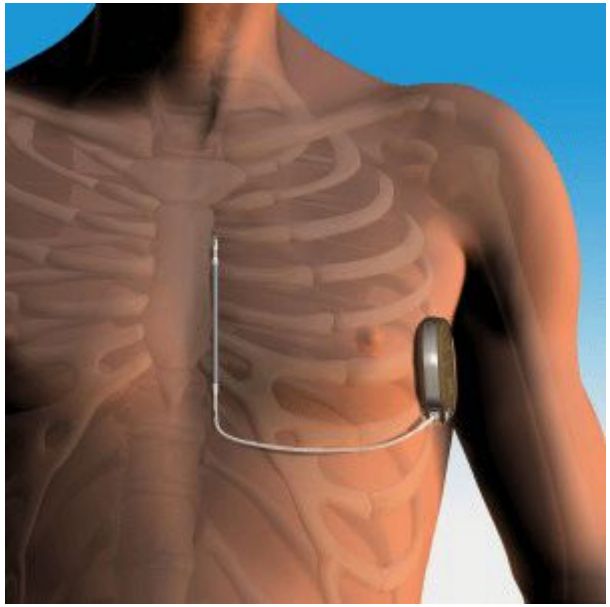
- EF < 30% - ICD implantation
- EF 30-40% -Monitor

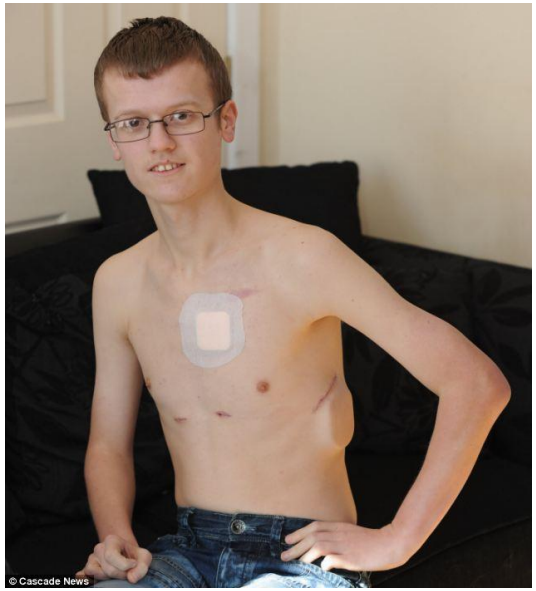
NSVT

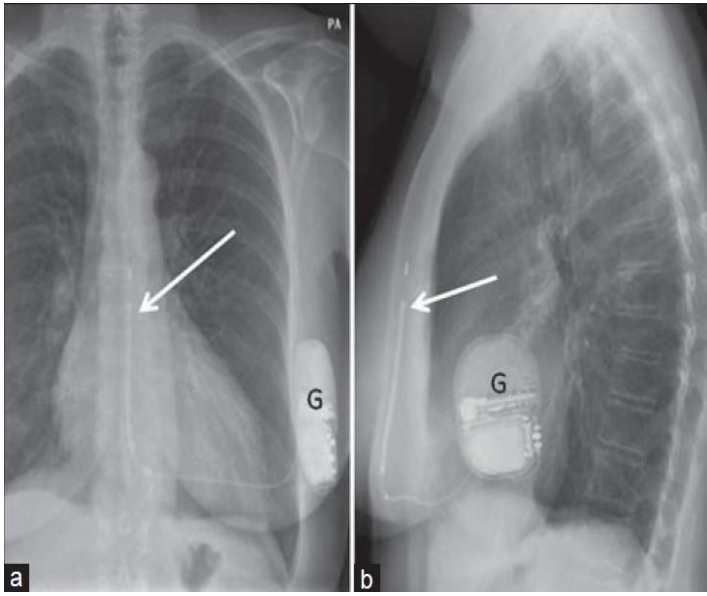
EPS



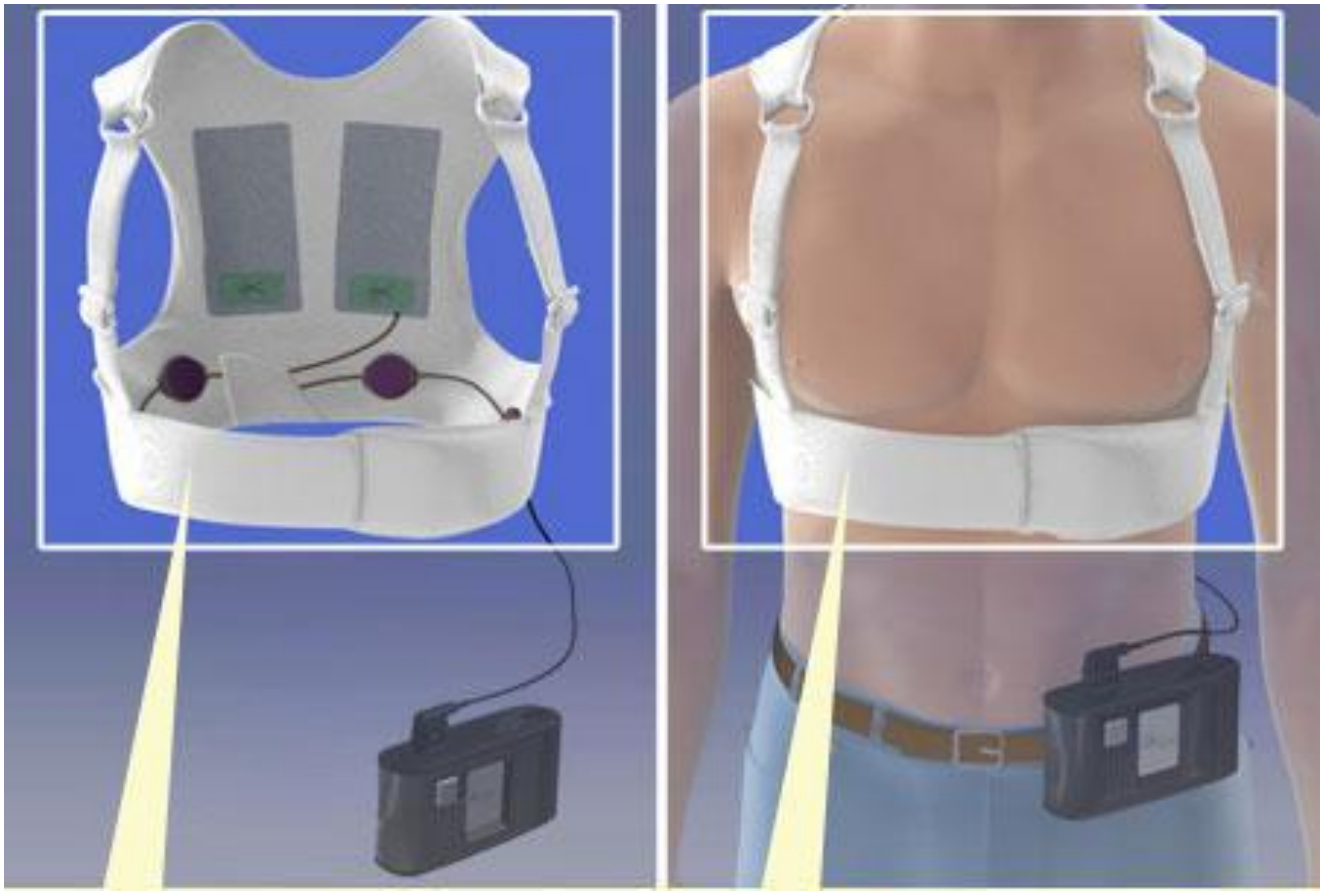
Subcutaneous defibrilator



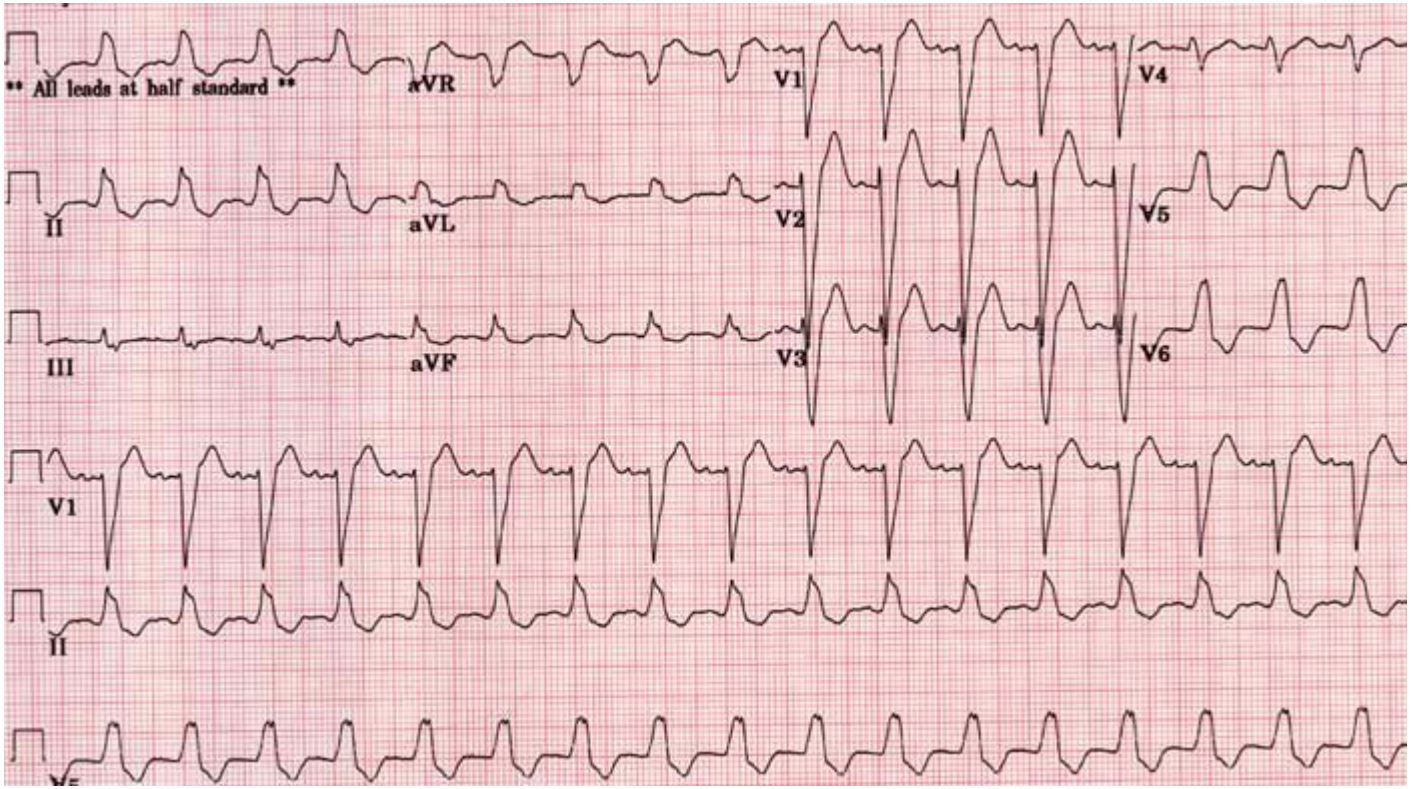




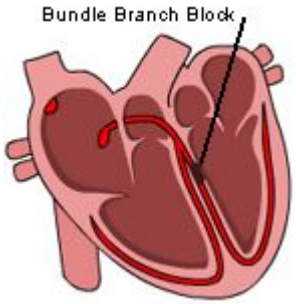
External vest defibrilator

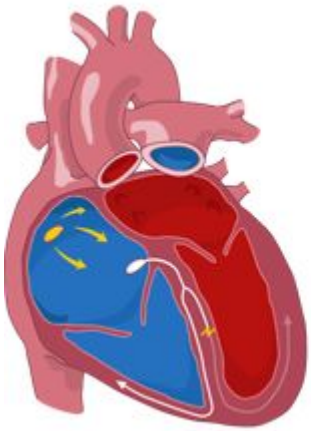


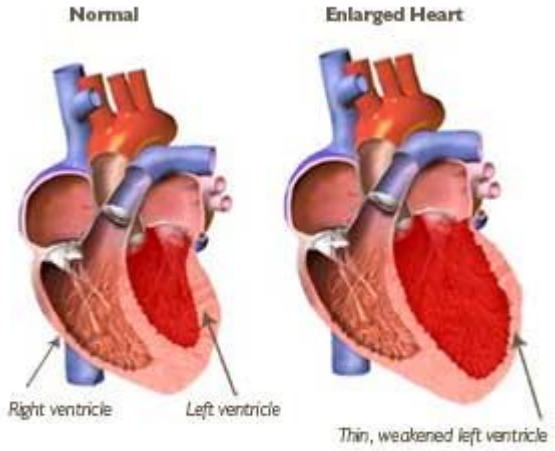
CLBBB


** All leads at half standard **
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
V1
II

LV dysfunction + wide QRS

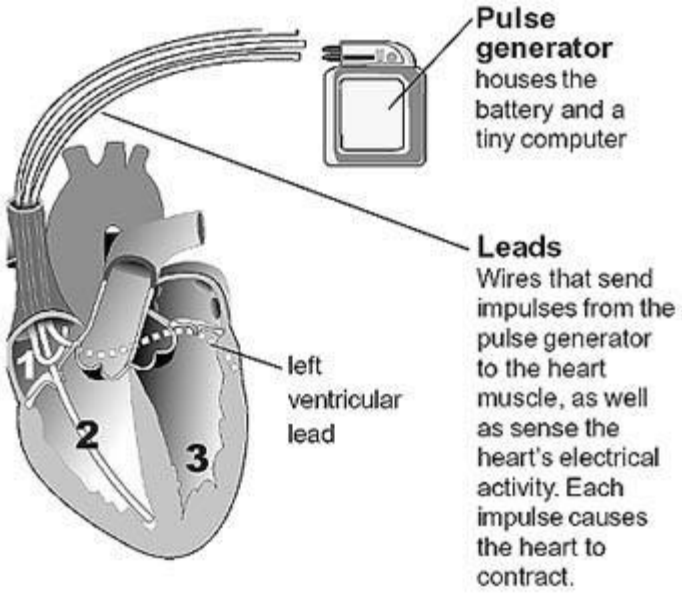


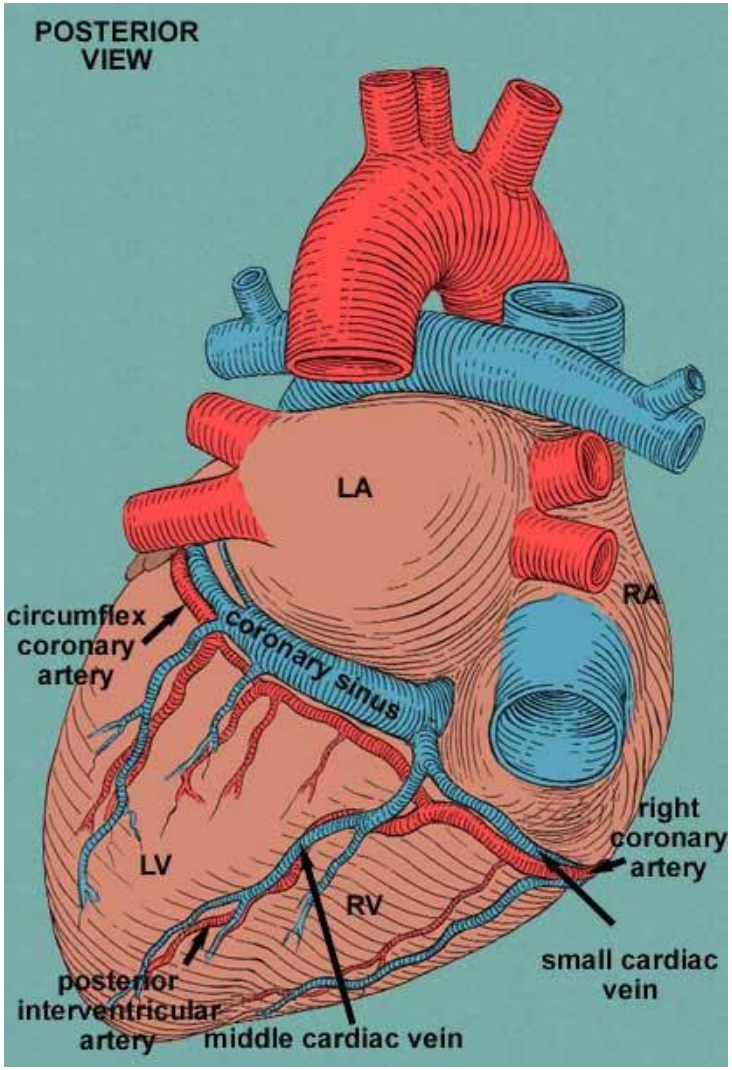


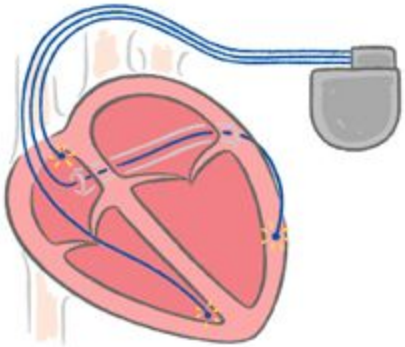


A type of cardiomyopathy. An enlarged heart is a sign that the heart may be overworked.

Cardiac resyncronization




POSTERIOR
VIEW
LA
RA
circumflex
coronary
artery
coronary sinus
right
coronary
artery
LV
RV
small cardiac
vein
posterior
interventricular
artery
middle cardiac vein



heart failure pacemaker