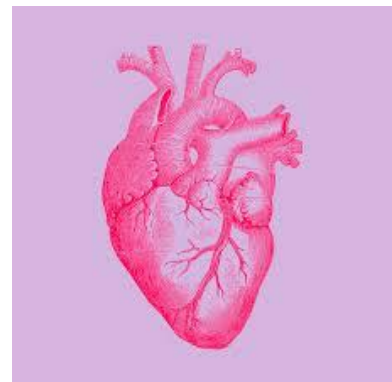


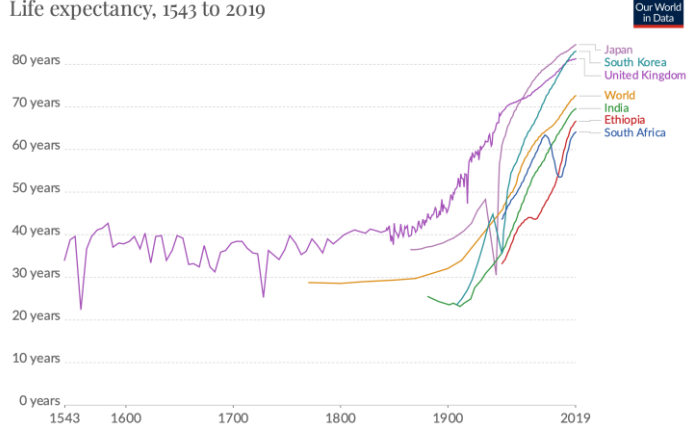
## The heart

- ▶ Is a pump its purpose is to delivery oxygenated blood to the body and deoxygenated blood to the lungs
- ▶ The average heart beats 100,000 times per day
- ▶ 3 billion times over the course of a lifetime (if we live until 80)



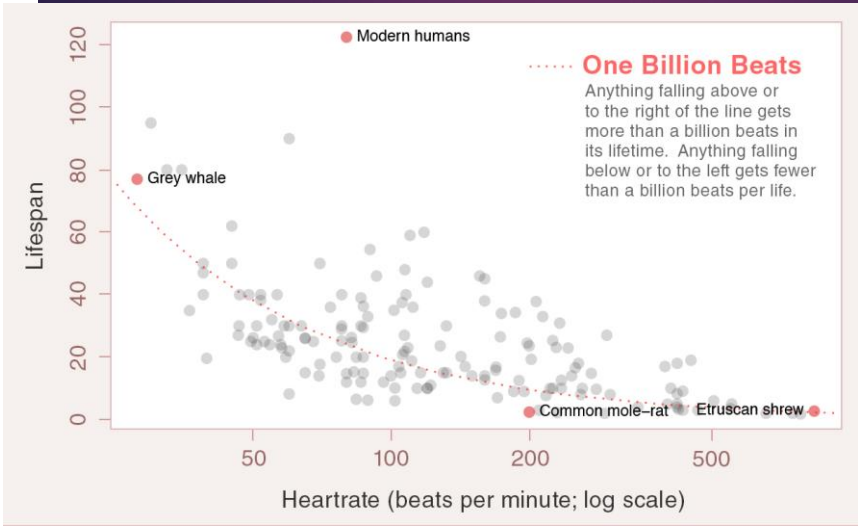
# Have we outgrown evolution?

Life expectancy, 1543 to 2019



Source: Riley (2005), Clio Infra (2015), and UN Population Division (2019) [OurWorldInData.org/life-expectancy](https://OurWorldInData.org/life-expectancy) • CC BY  
 Note: Shown is period life expectancy at birth, the average number of years a newborn would live if the pattern of mortality in the given year were to stay the same throughout its life.

# Life span vs. Heart rate



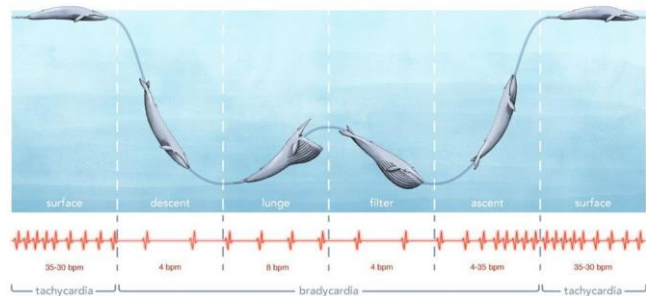
- This animal was only recently found to have heart rates that dip as low as 4 beats per minute (BPM)

## ■ Blue Whale

**SMARTNEWS** Keeping you current

### Researchers Measure a Wild Blue Whale's Heart Rate for the First Time

The team found the world's largest mammal pushes its heart to its limits



- This bird has the second fastest heart rate in the animal kingdom



Hummingbird 1200 BPM

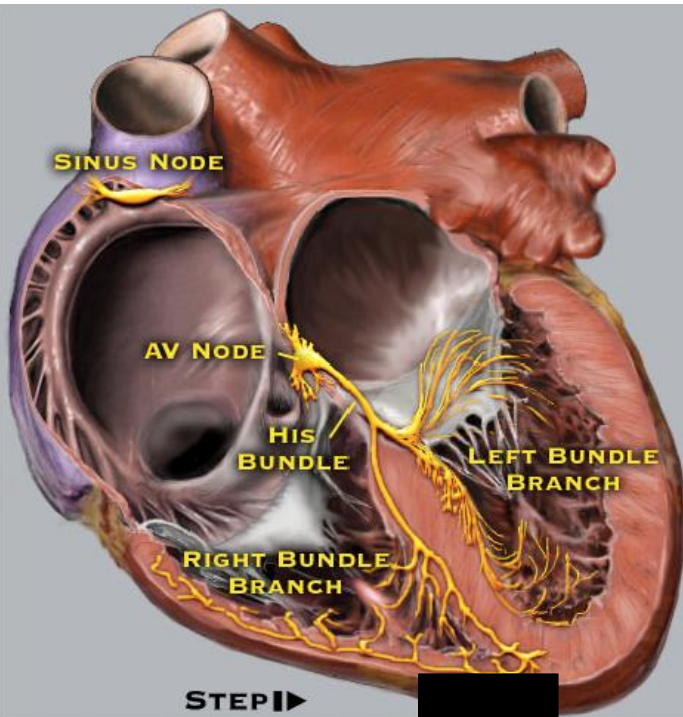


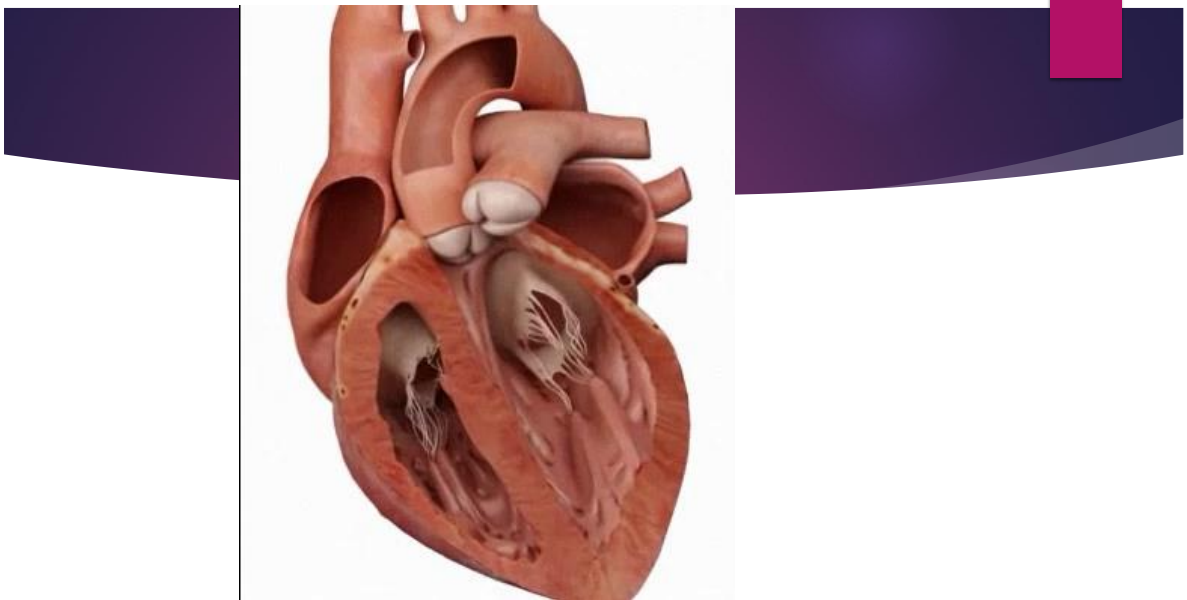
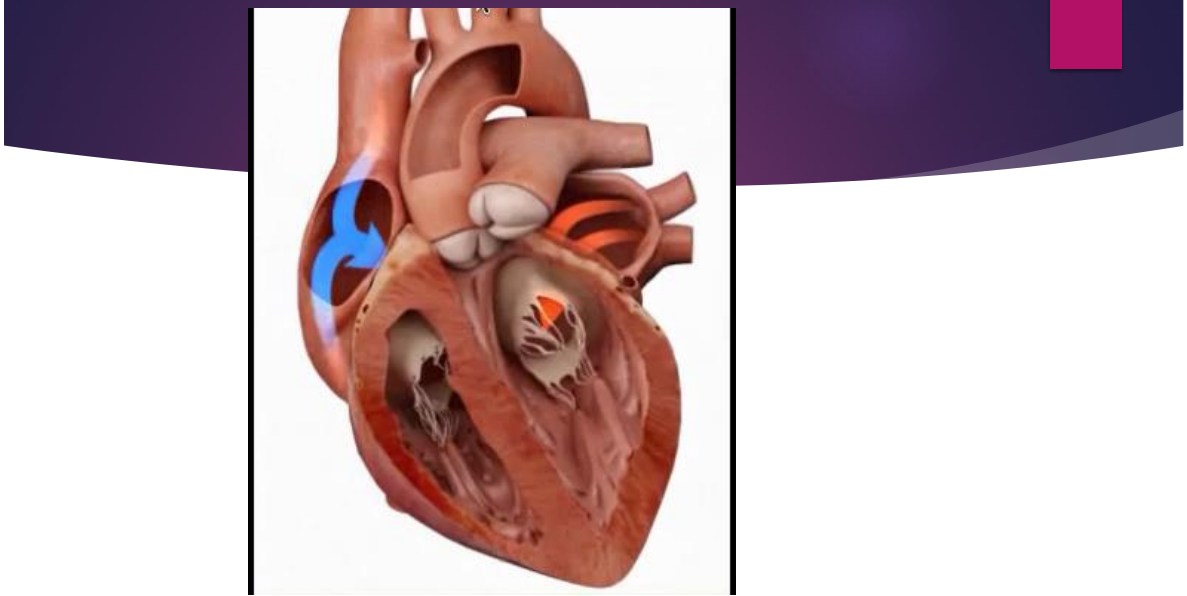
Etruscan shrew 1500 BPM



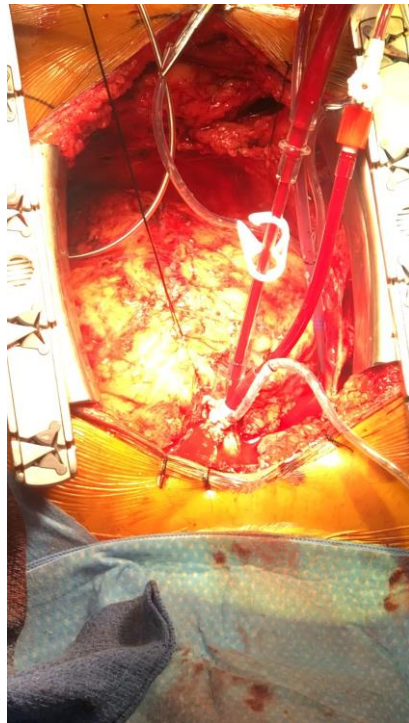
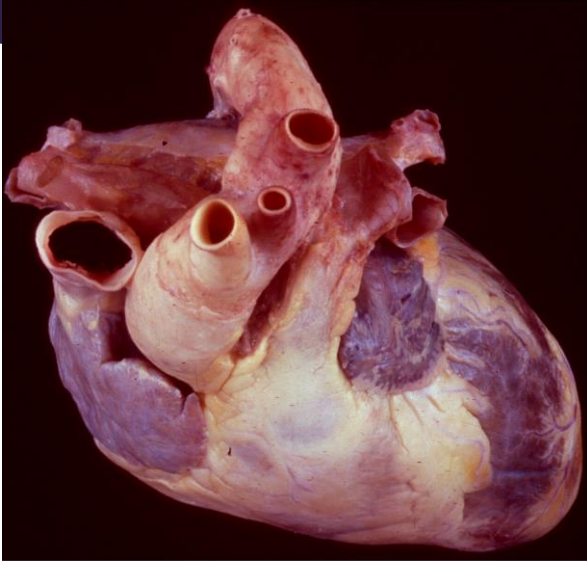
- This aquatic creature found in Hawaiian Waters Has Three Hearts

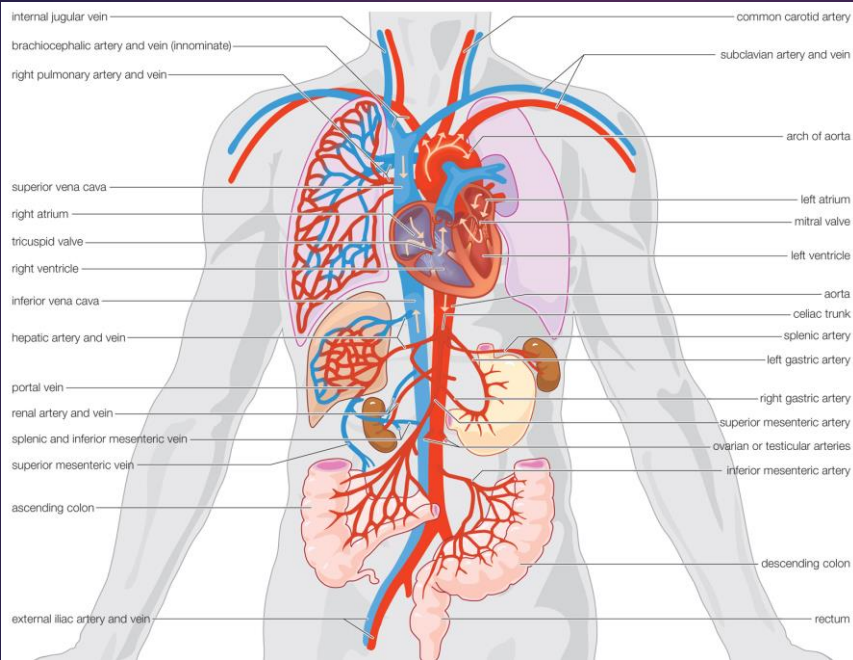
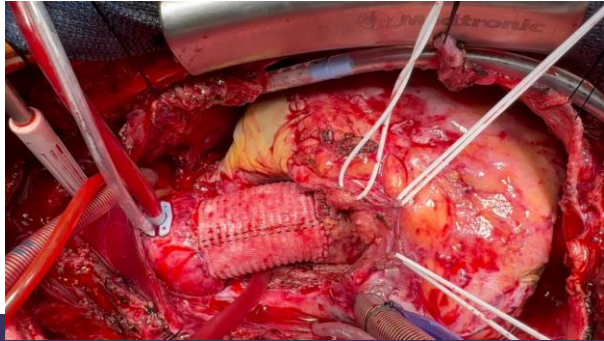
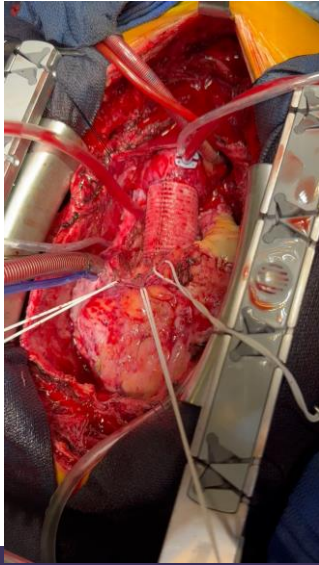
- Octopus

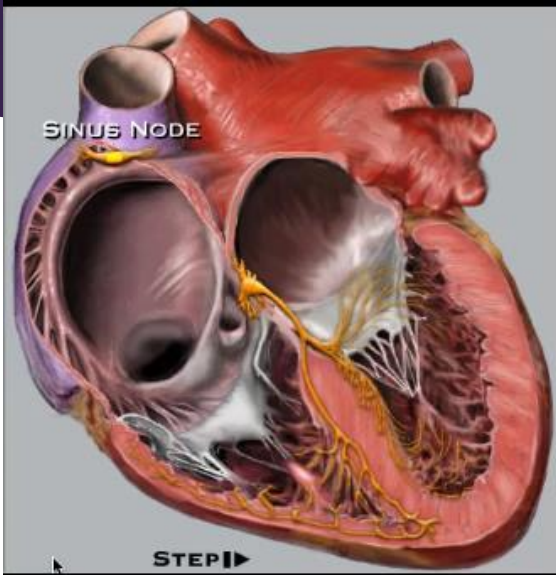
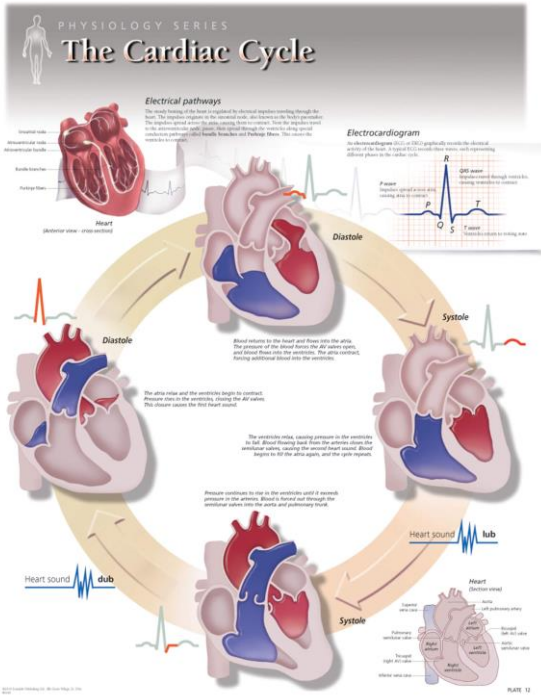




## Normal Heart External Topography



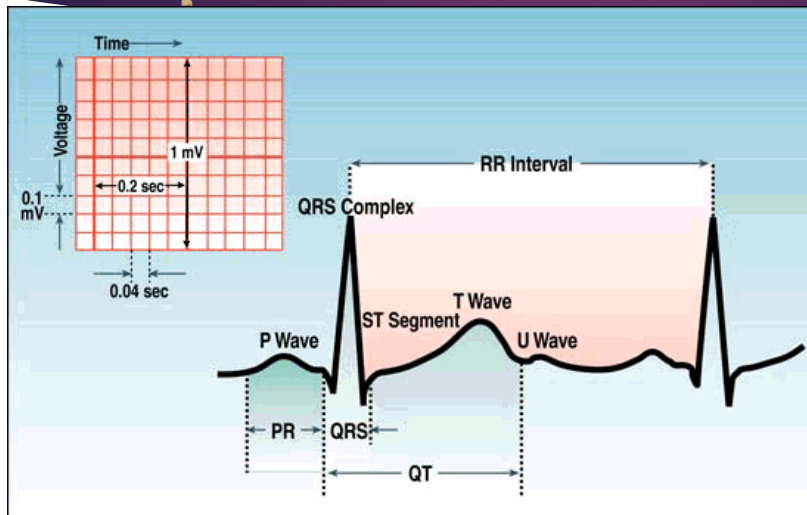
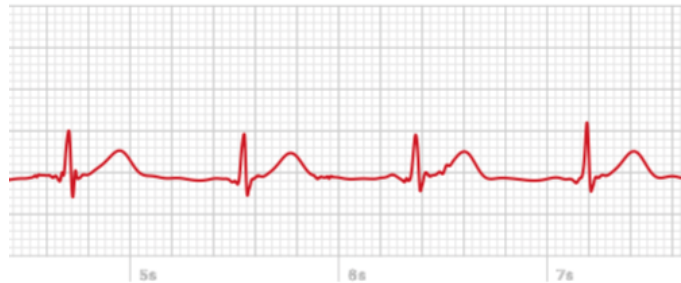


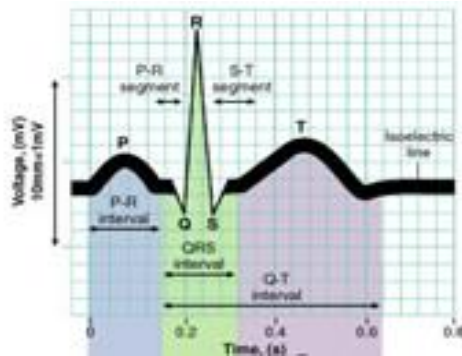




## Electrical events in the heart result in mechanical events

- ▶ The heart can sometimes beat too fast
- ▶ The heart can sometimes beat too slowly
- ▶ Both of these can lead to pathology





Normal P wave has amplitude of  $\leq 0.25$  mV

Q wave is first downward deflection after P wave; signals start of ventricular depolarization

R wave is positive deflection after Q wave

S wave is negative deflection preceded by Q or R waves

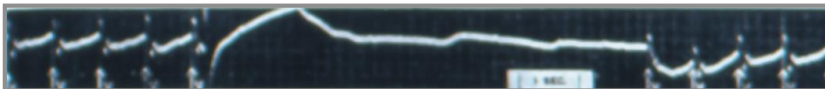
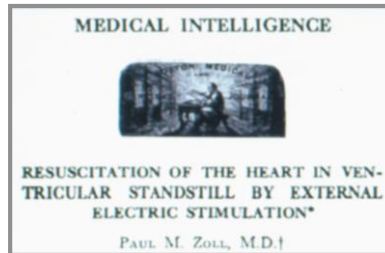
T wave follows QRS

## Heart Block can be bad



OREGON  
HEALTH & SCIENCE  
UNIVERSITY

Paul Zoll – “Father of  
Modern Pacing”



Pacing ON

Pacing OFF

Pacing ON

Zoll, New Engl J Med 1952; 247: 768-771.

## Seymour Furman

- ▶ Developed the temporary transvenous ventricular lead as a surgical resident (1958).
- ▶ The temporary pacemaker that he used was line-powered and needed to be wheeled on a cart.
- ▶ The patient could walk as far as the electrical power cord would allow.
- ▶ Made innumerable contributions to the art and science of pacing.
- ▶ He felt strongly about sharing his ideas in the public domain (publishing) and was opposed to patents.



Pacing was maintained for 96  
days

## 1960 - 1980



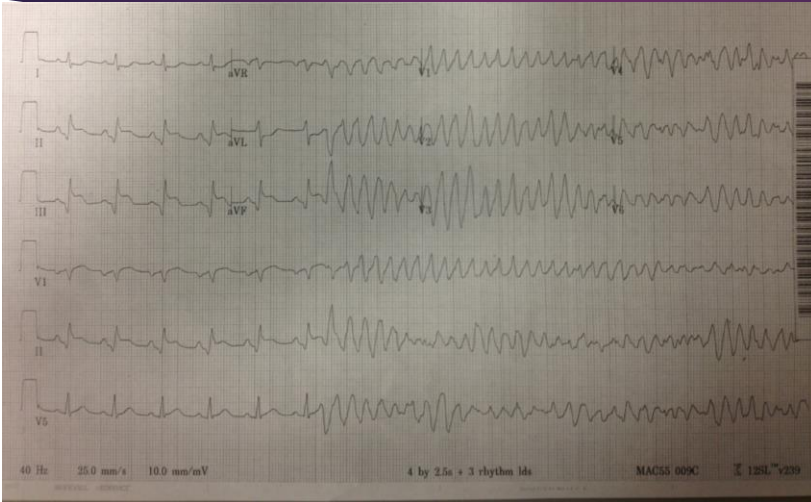
- Introduction of defibrillator for termination of atrial fibrillation, ventricular tachycardia or ventricular fibrillation - 1962
- Prolonged ambulatory (Holter) monitoring – 1961 coronary care units
- Totally implanted pacemaker - 1960 (Greatbach)



Pacemakers from the past and today



## Fast Heart Rhythms Can Kill

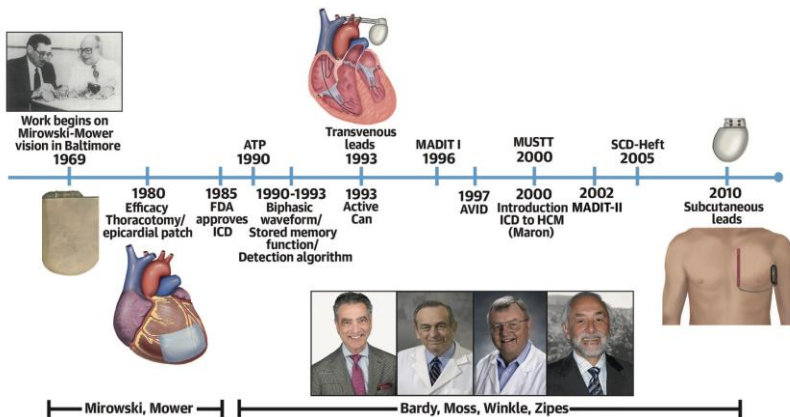


## Rarely Sudden Death Can Strike Younger People





# The implantable defibrillator



Maron BJ, et al. J Am Coll Cardiol. 2023;82(4):353-373.



Pioneers Michel Mirowski (right) and Morton Mower (left) began with a vision but with little in terms of resources, support from their colleagues, or personal academic visibility. Their research association occurred largely by chance after Mirowski emigrated from Israel to Baltimore.

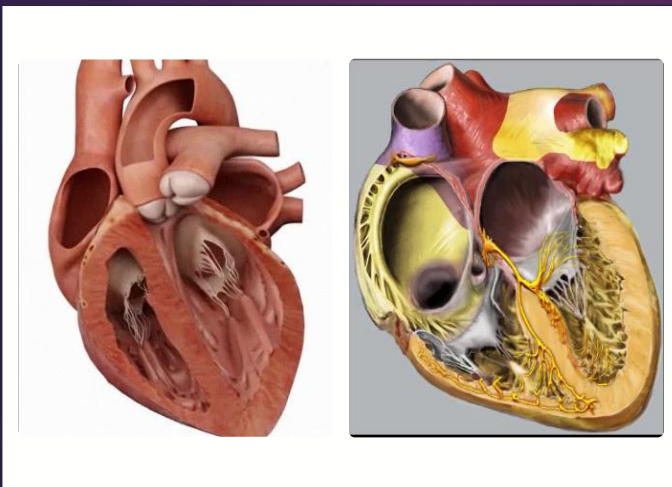
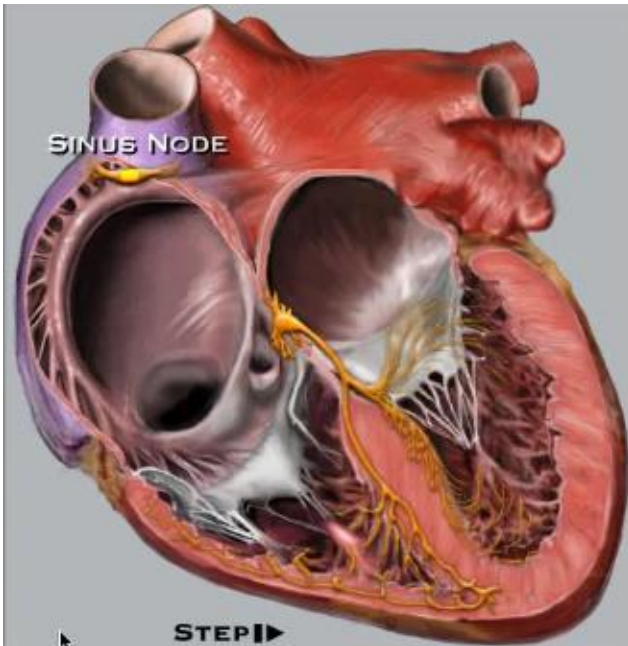
## ICD's Save Lives



## Tachy Arrhythmias

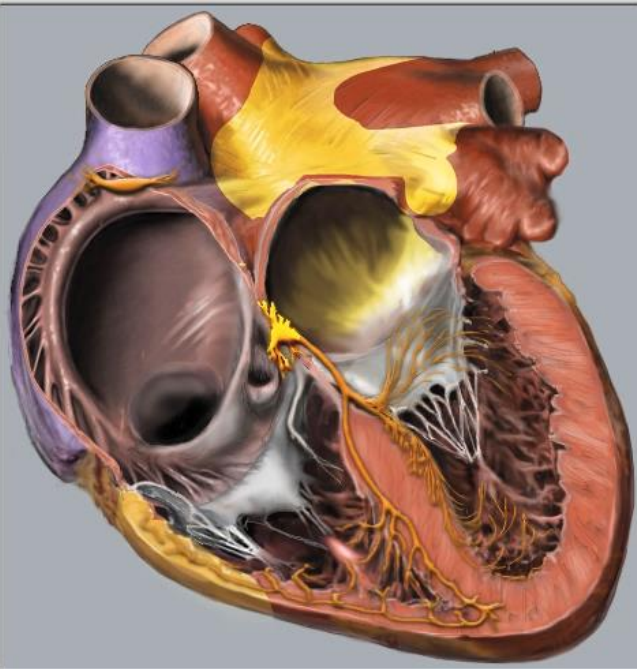
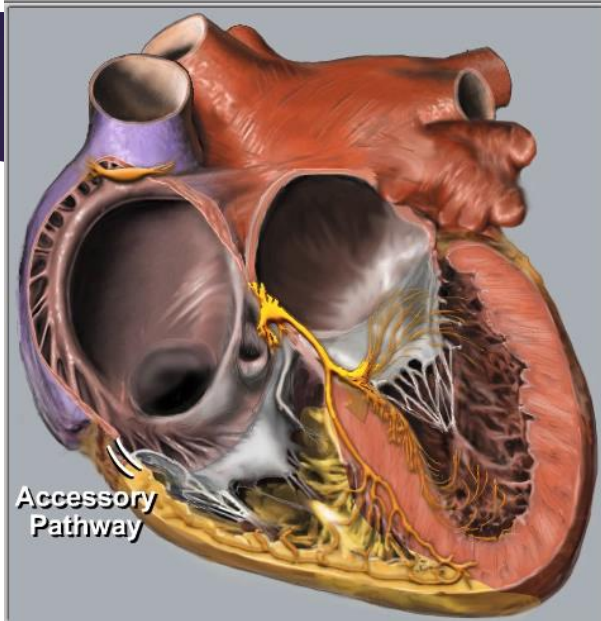
Sometimes the heart can go too fast because the top chambers are beating too fast – atrial tachyarrhythmia

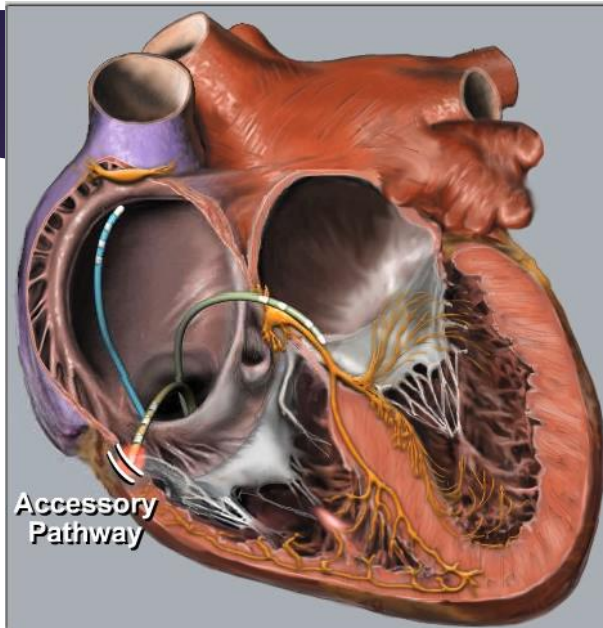
Sometimes the heart can go too fast because the bottom chambers are beating too fast – ventricular tachyarrhythmia



## Atrial Fibrillation





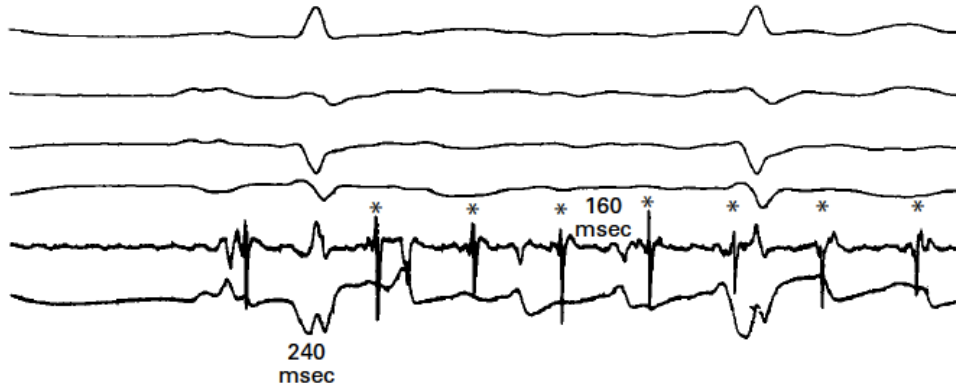


## What is cardiac ablation?

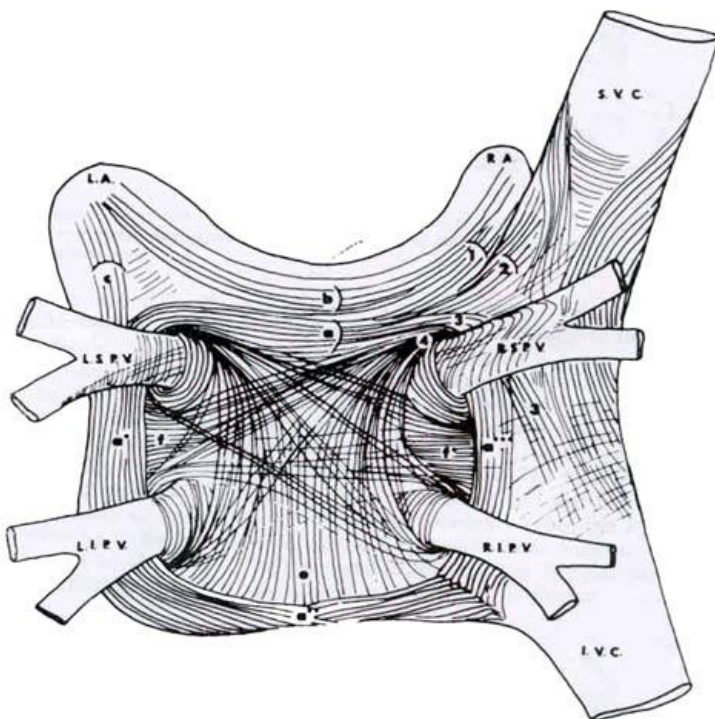
- ▶ The use of thermal energy to inactivate (kill) cardiac muscle
- ▶ The first person to perform Catheter Ablation in a human being was Melvin Scherinman
- ▶ 'you could hear a small explosion occurring in the patient's heart'

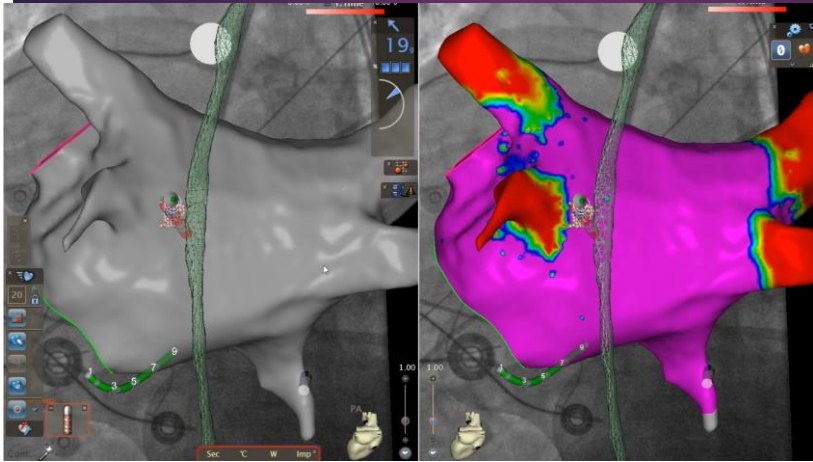


## Ablation for Atrial Fibrillation



1998





## Melvin Scheinman Educational Rhythm Foundation



## Mission Statement

- ▶ *To provide education and support for the development electrophysiology infrastructure in low and middle-income countries. Our goal is to empower local healthcare professionals with the knowledge and resources necessary to deliver high-quality electrophysiology care and improve the lives of individuals with cardiac rhythm disorders around the globe.*

## Doctors During the Khmer Rouge

- ▶ It is estimated that only 45 doctors survived during the reign of the Khmer Rouge; 20 of these left the country
- ▶ Approximately 10 MDs in Cambodia in 1989 – 8.5 million people

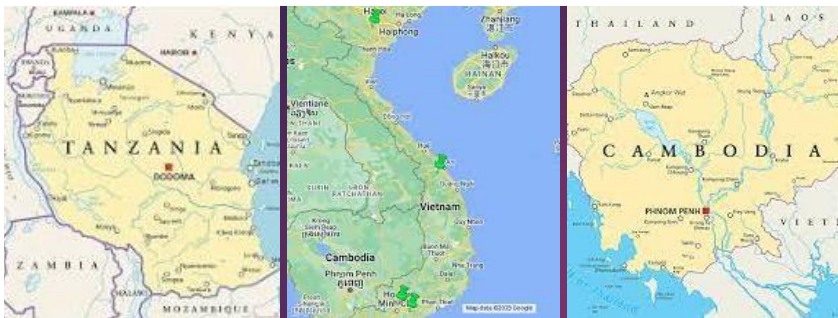


*"To keep you is no gain; to lose you is no loss."  
—Khmer Rouge warning*



Mam Chandara MD

## Hong's Bedroom and Bathroom



Melvin Scheinman  
Educational Rhythm  
Foundation

- ▶ Cambodia
- ▶ Tanzania
- ▶ Vietnam

