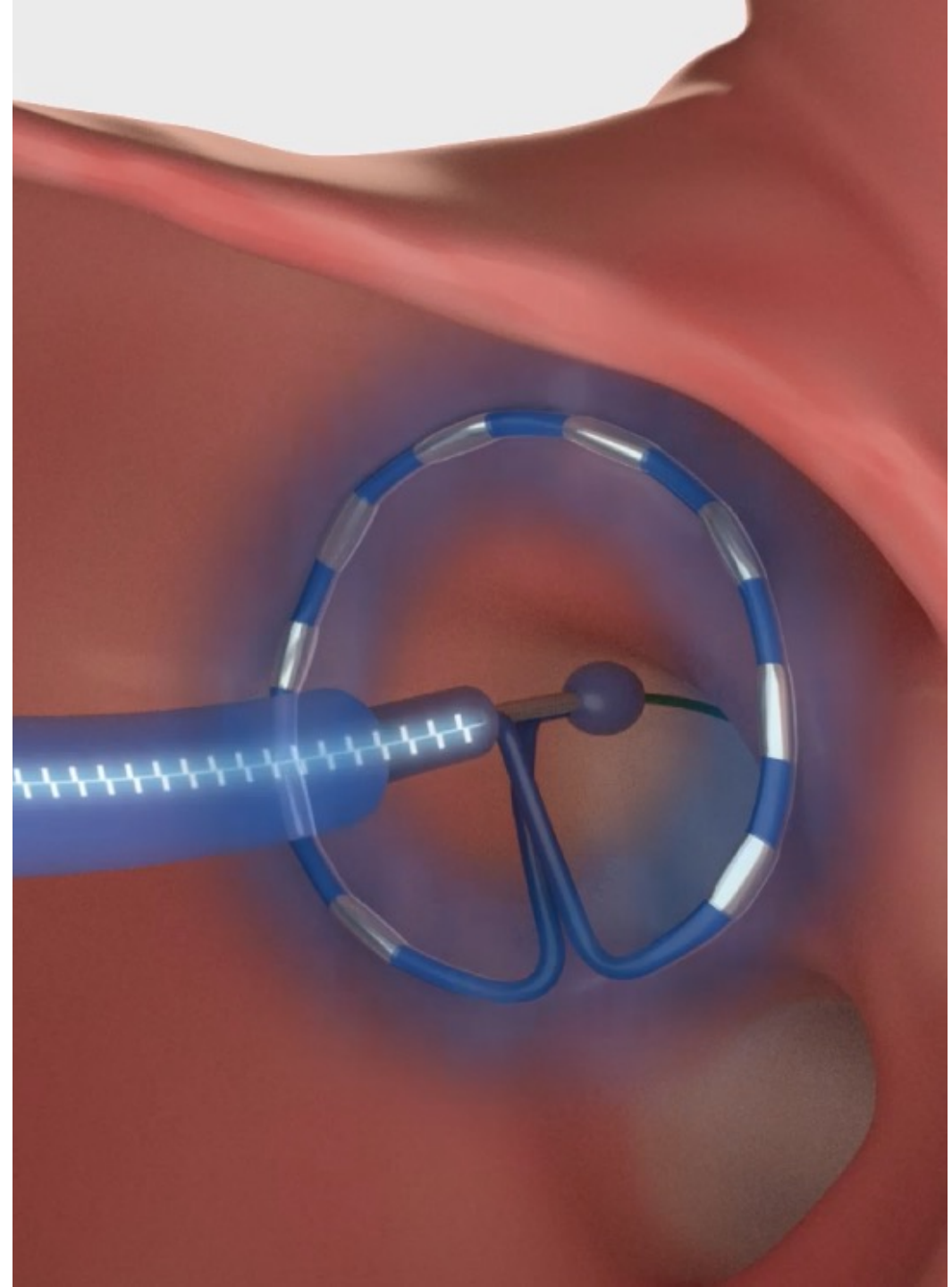


# Irreversible Electroporation for Cardiac Ablation

**ICD-10 Coordination and  
Maintenance Committee**

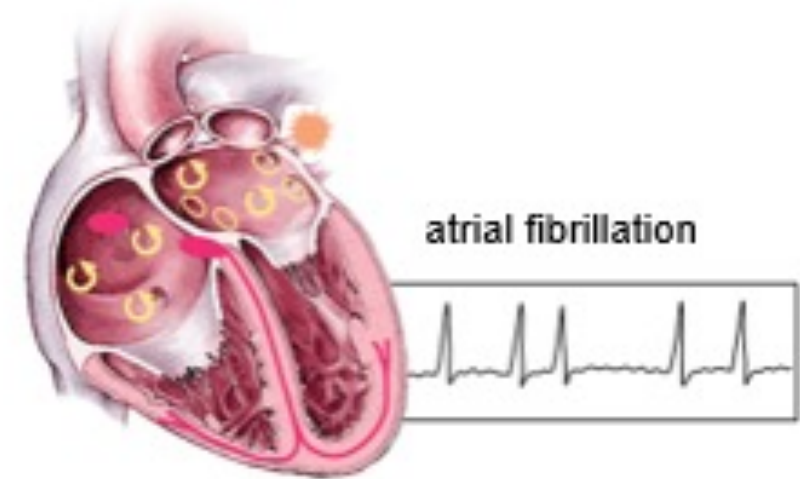
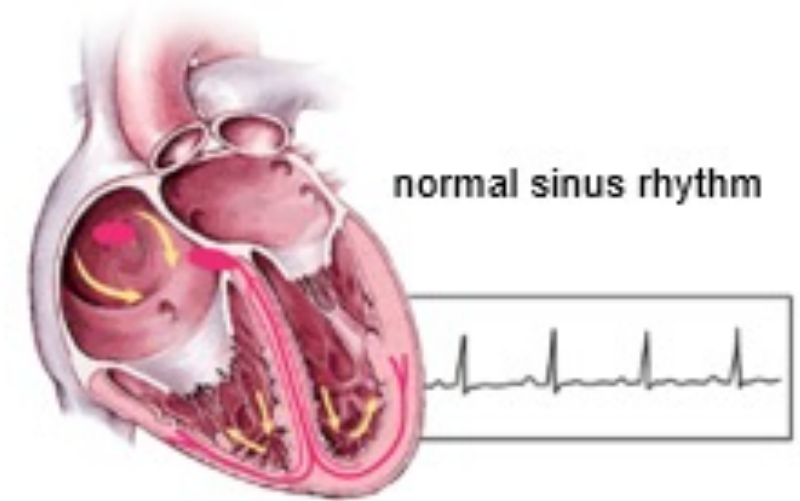
**September 12, 2023**

Birce Onal, PhD  
Principal Clinical Research Specialist  
Medtronic



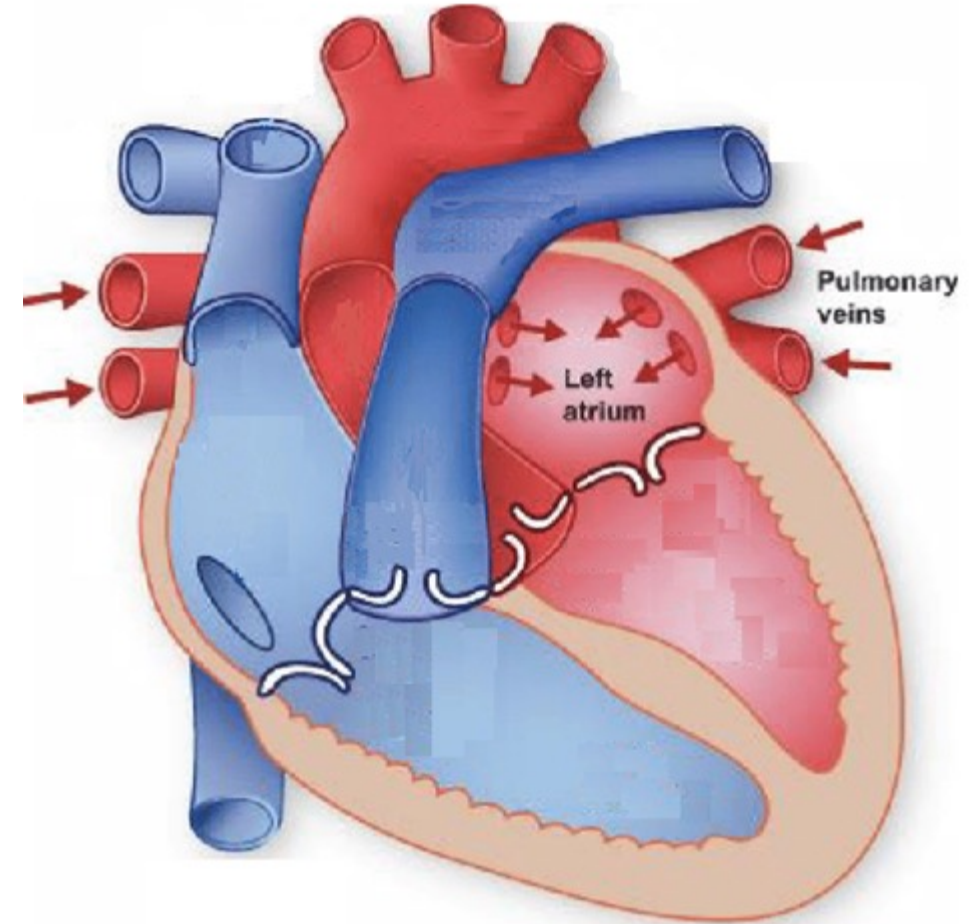
# Atrial Fibrillation

- ❖ In normal heartbeats, the sinoatrial node in the right atrium generates a single electrical impulse.
  - ❖ The atria contract and push blood into the ventricles, which contract in response to the normal propagation of the single impulse through the atrioventricular node. Ventricular contraction pushes blood out to the lungs and the rest of the body.
- 
- ❖ In atrial fibrillation, electrical impulses generate from multiple sites in both atria.
  - ❖ The atria contract irregularly and much faster, becoming out of sync with the ventricles.
  - ❖ Blood is retained in the atria and may form clots, leading to increased risk of stroke.



# Role of Pulmonary Veins

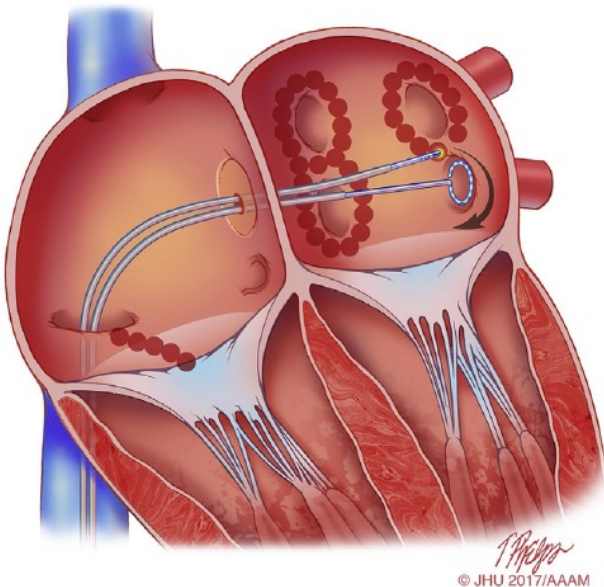
- ❖ The function of the pulmonary veins is to return newly reoxygenated blood from the lungs to the heart.
- ❖ Anatomically, all four pulmonary veins empty into the left atrium of the heart.
- ❖ The pulmonary veins may generate aberrant impulses that contribute to atrial fibrillation.



# Pulmonary Vein Isolation

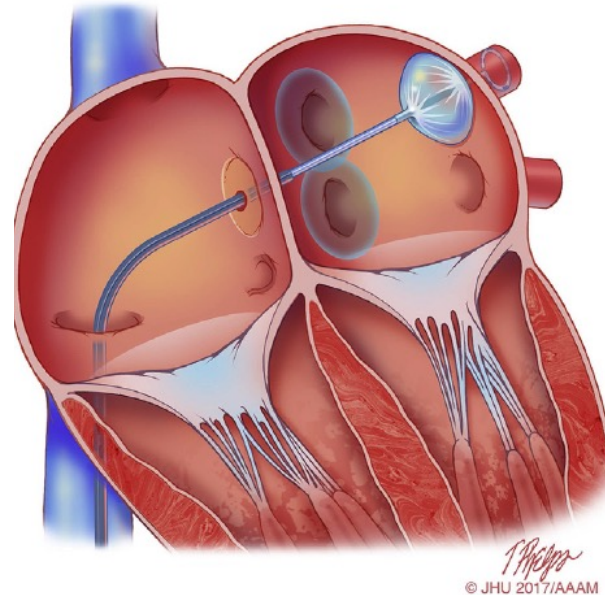
- ❖ Pulmonary vein isolation disrupts the aberrant signals and is an established treatment for atrial fibrillation.
- ❖ The procedure is currently performed using thermal energy sources, either radiofrequency or cryoablation.

## ① Radiofrequency PVI



Radiofrequency pulmonary vein isolation is typically performed by creating multiple lesions using point ablation.

## ② Cryoablation PVI

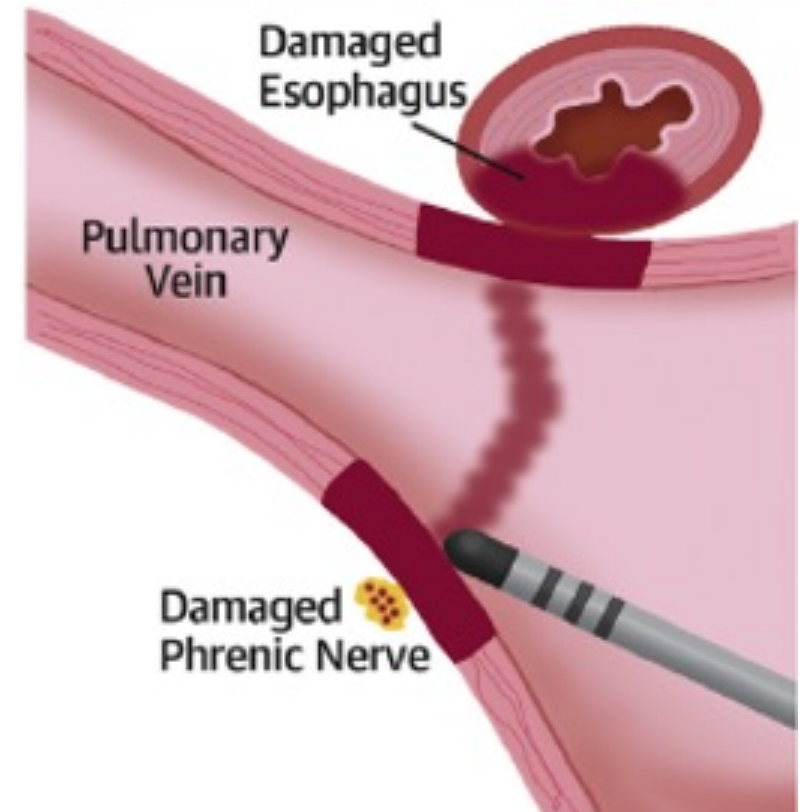


Cryoablation typically involves deploying a balloon at the opening of each pulmonary vein.



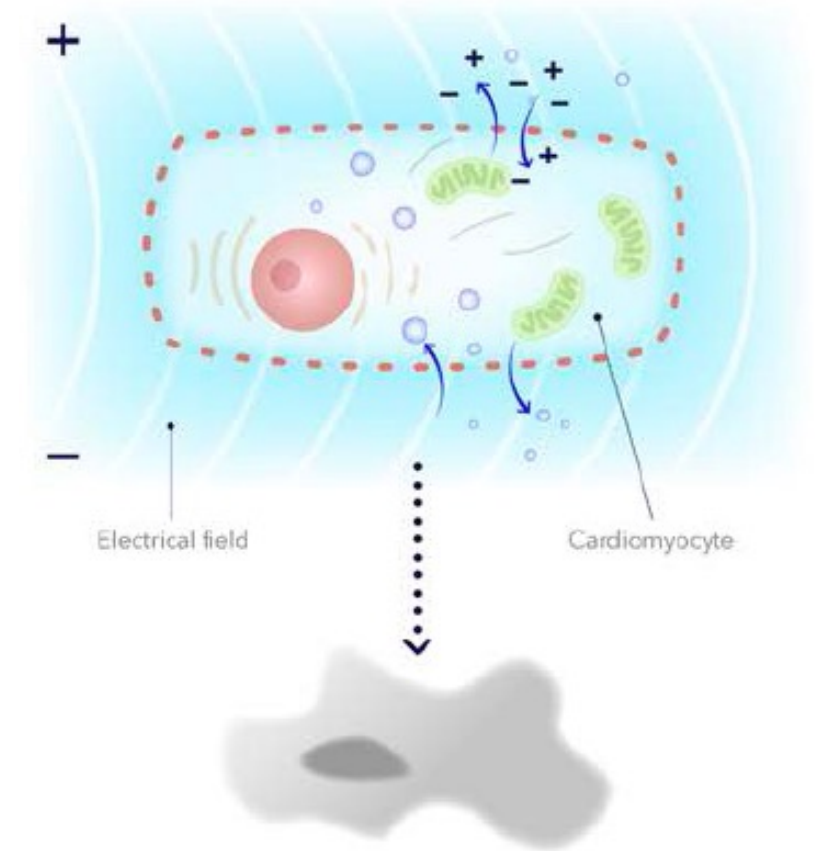
# Current Risks of Pulmonary Vein Isolation

- ❖ Thermal energy is effective but both radiofrequency and cryoablation have several known risks.
- ❖ The risks are associated with the anatomic proximity of major structures as well as the indiscriminate nature of thermal energy in destroying cells.
- ❖ Significant complications include:
  - Esophageal injury
  - Phrenic nerve damage
  - Pulmonary vein stenosis



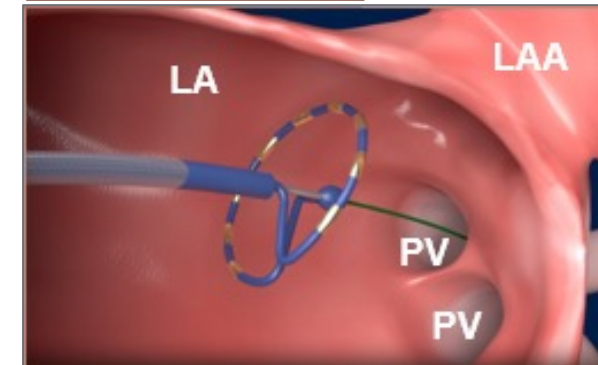
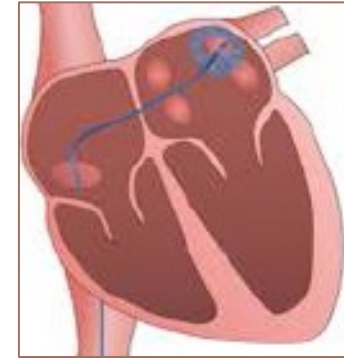
# Irreversible Electroporation Technology

- ❖ Irreversible electroporation is currently used to treat cancer in other body systems, but its use in the heart to treat atrial fibrillation is more recent.
- ❖ Irreversible electroporation is non-thermal and can avoid the risks of thermal ablation.
- ❖ It delivers electrical pulses which increase the permeability of cell membranes, leading to cell death.
- ❖ Cardiomyocytes are susceptible to this effect but other tissues, including the esophagus and phrenic nerve, are more resistant.
- ❖ Irreversible electroporation for cardiac ablation is rapid and delivers applications in milliseconds.



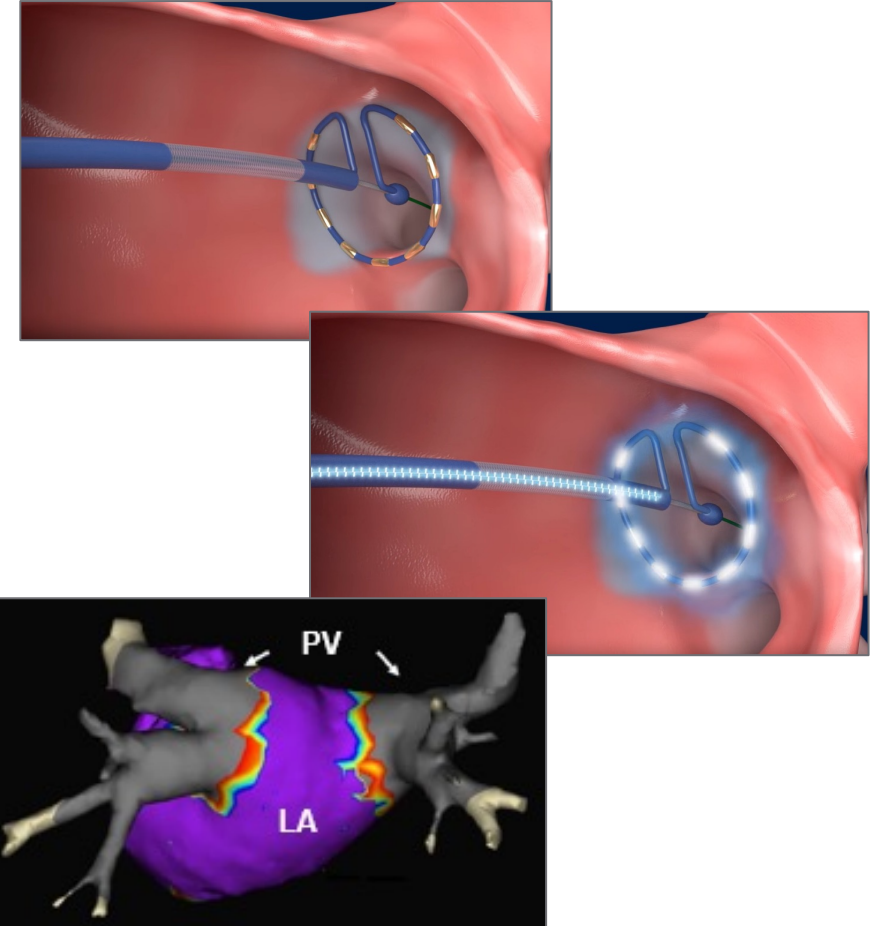
# Pulmonary Vein Isolation by Irreversible Electroporation

- ❖ This is a transvenous procedure performed percutaneously under imaging guidance.
  - ❖ Pulmonary vein isolation is typically a stand-alone procedure, although it may be performed with EPS and ablation of other arrhythmias in complex scenarios.
- Following peripheral venous access, the ablation catheter is advanced into the right atrium of the heart.
  - Transeptal puncture is performed and the catheter is then advanced into the left atrium.
  - The ablation catheter is placed at the opening of the first pulmonary vein.



# Pulmonary Vein Isolation by Irreversible Electroporation

- Irreversible electroporation is delivered via the catheter to the opening of the first pulmonary vein.
- After each application, the catheter is rotated to a new position to achieve full circumferential ablation.
- The same process is repeated at each of the remaining pulmonary veins, using the same catheter.
- The catheter is removed after successful pulmonary vein isolation is verified.





# Procedure Documentation

- ❖ The procedure is typically performed by electrophysiologists and interventional cardiologists.
- ❖ Documentation can be found in the cardiac catheterization lab procedure report and procedure log.
  - Irreversible electroporation may be abbreviated as “IRE.”
  - Irreversible electroporation for cardiac ablation is alternately referred to as “pulsed field ablation.”
  - Pulsed field ablation may be abbreviated as “PFA.”
  - The model of IRE ablation catheter shown is the PulseSelect™.

*Clinical Questions?*

