

# Understanding the Role of ECG in Tip Placement

ARROW<sup>®</sup> VPS G4<sup>™</sup> Device

# Objectives

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## Clinician will be able to:

- Describe the five waveforms of the heart's electrical activity
- Understand correlation between waveform activity and the ARROW® VPS G4™ Device

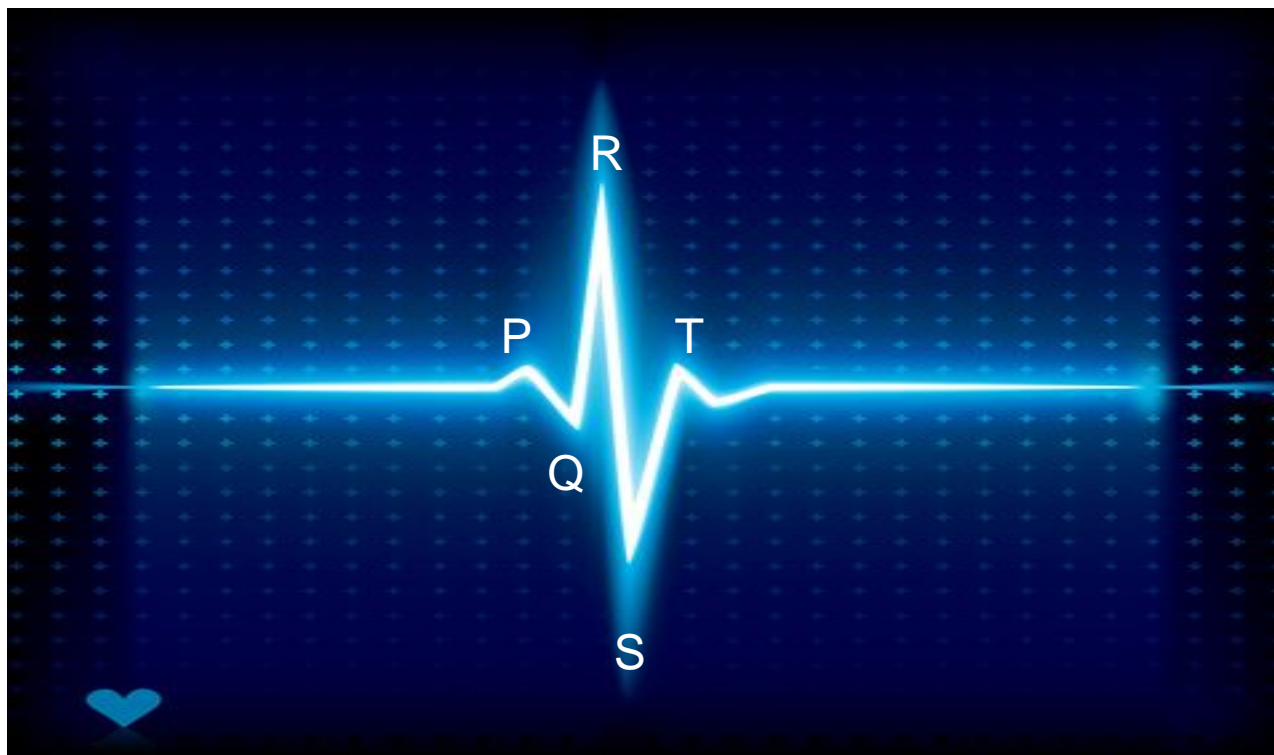
## Principles of ECG: Waveforms

- An electrocardiogram (ECG) is a diagnostic test that measures and records the electrical activity of the heart
- It translates the heart's electrical activity into line tracings on paper



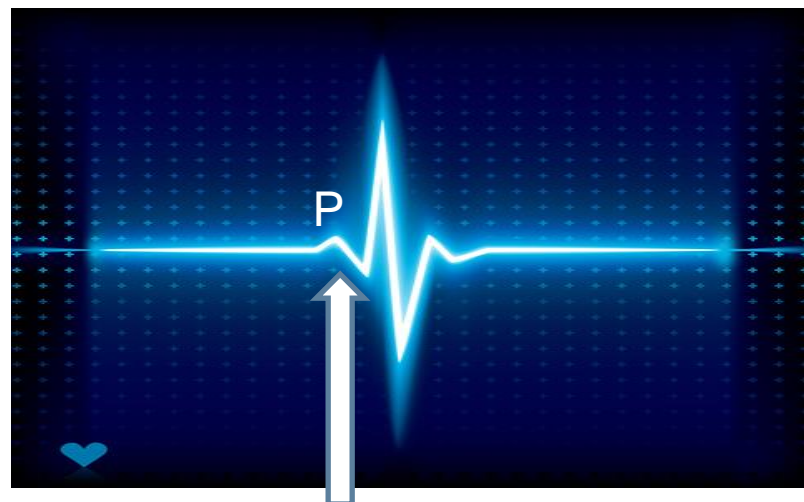
## Principles of ECG: Waveforms

- A complete cardiac cycle has five identifiable waveforms
- These electrical impulse patterns are labeled P, Q, R, S, and T waves
- Each of these five waveform segments represents electrical activity within a specific area of the heart



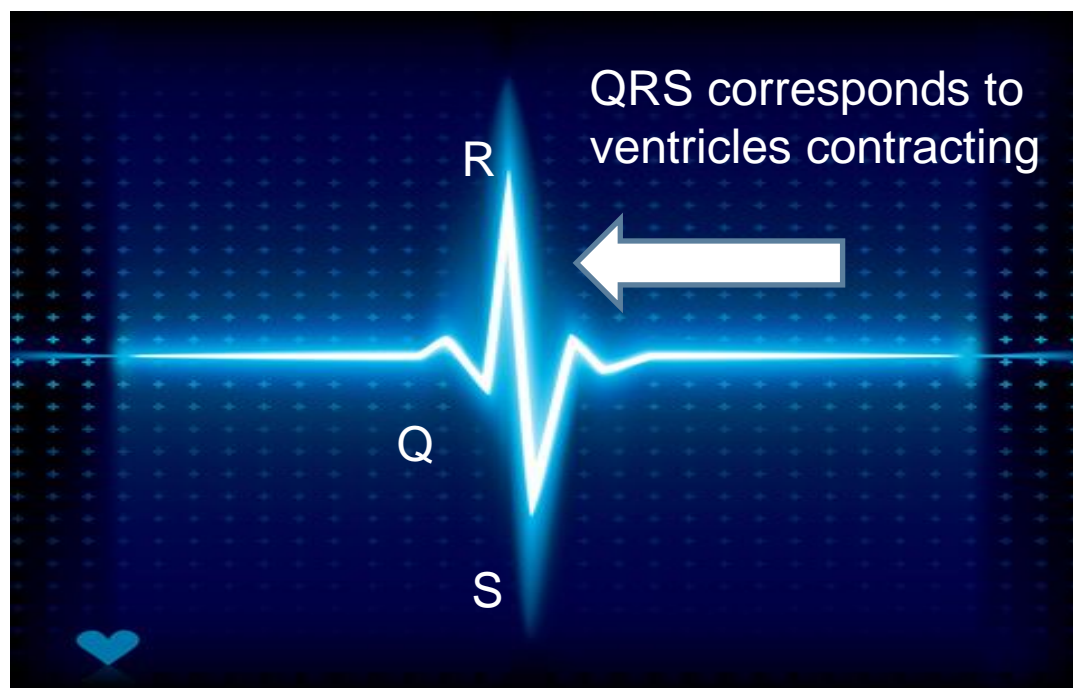
## Principles of ECG: Waveforms

- The first half of the P-wave appears when the SA node activates the right atrium and reaches the AV node
- When the P-wave is complete, the left atrium and the AV node are completely activated
- The line after the P-wave indicates the activation of the AV junction
- A normal P-wave indicates both atrial chambers have contracted and begun to empty blood into the ventricles
- In a normal heart rhythm, the P-wave is rounded and positive or above the baseline



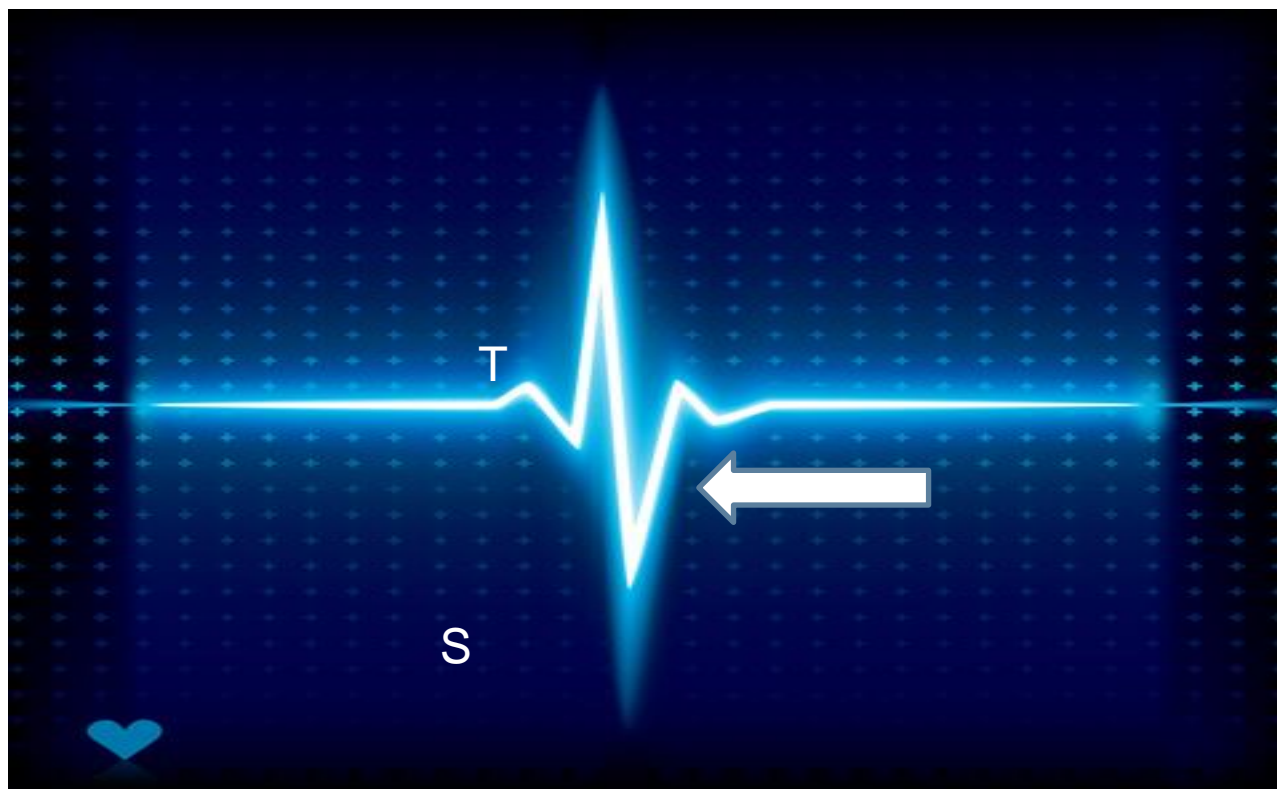
## Principles of ECG: Waveforms

- The negative Q-wave indicates the ventricular septum has been activated
- The QRS complex indicates the ventricles have been activated from the inside to the outside of the surface. Depolarization has begun
- QRS Complex = ventricle contraction



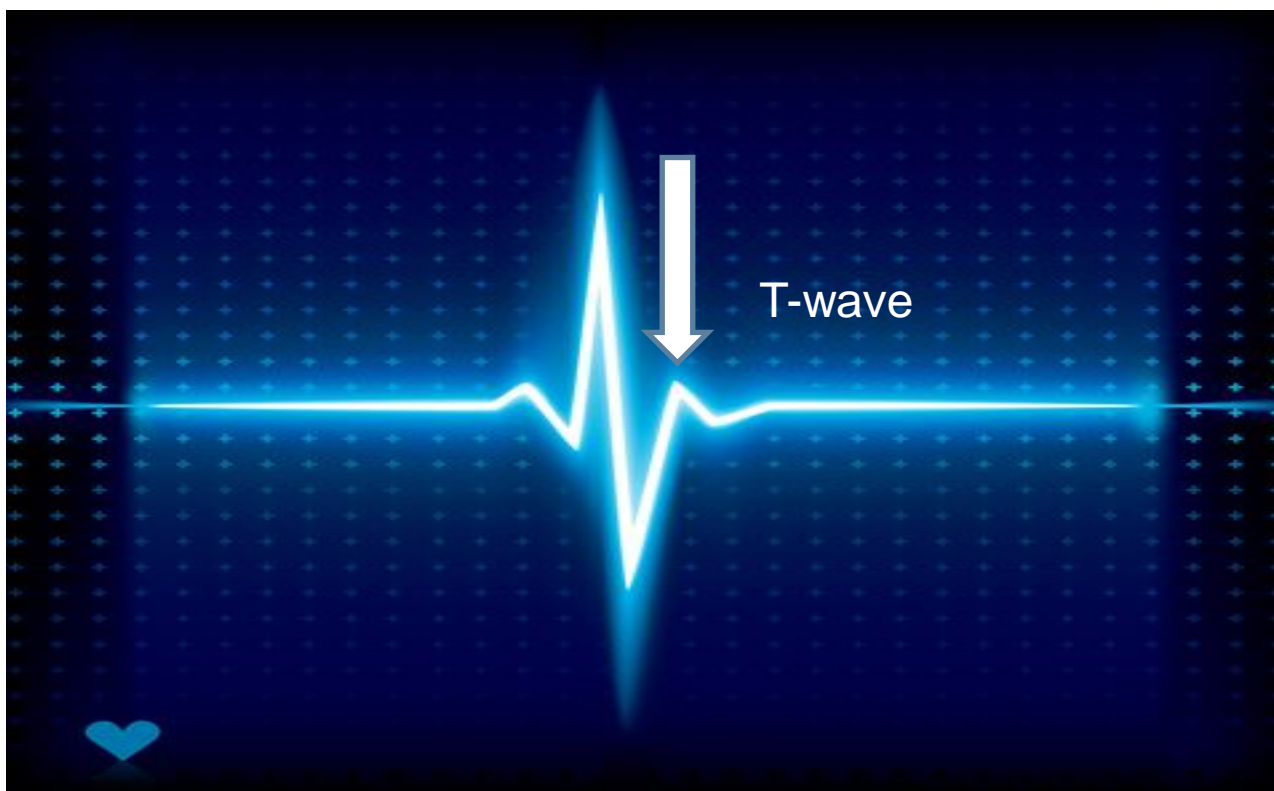
## Principles of ECG: Waveforms

- The ST segment indicates the end of depolarization and the beginning of ventricular repolarization
- The ventricles are returning to an electrically ready state to receive next impulse



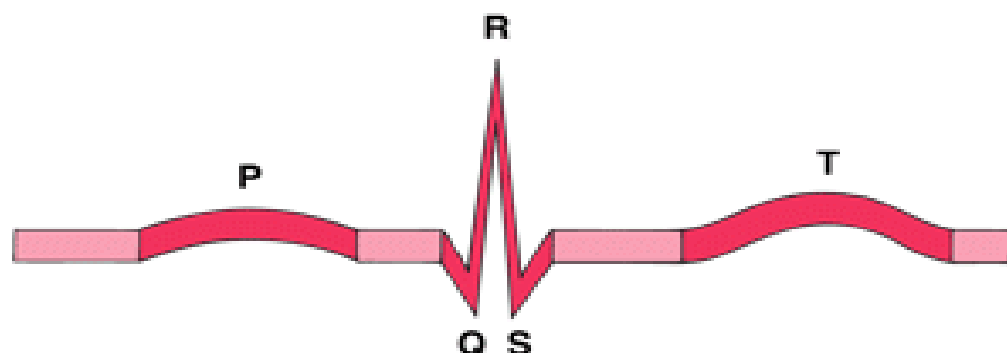
## Principles of ECG: Waveforms

- The T-wave represents ventricular repolarization
- The ventricles are preparing to receive the next electrical impulse
- A normal T-wave is rounded

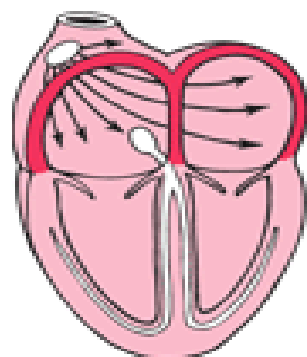




# Principles of ECG: Waveforms

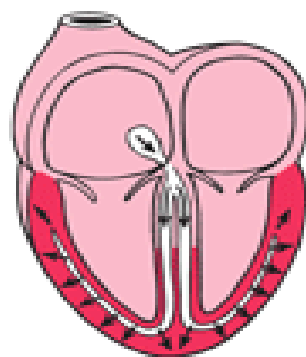


**P Wave**



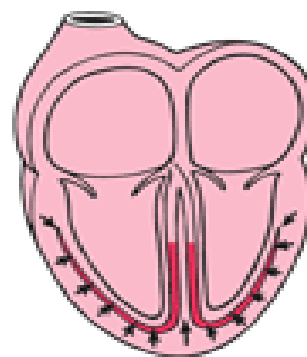
Activation of the  
atria

**QRS Complex**



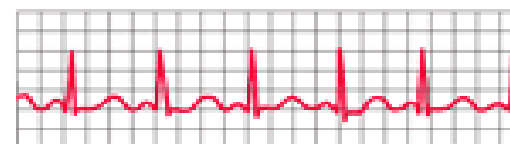
Activation of the  
ventricles

**T Wave**

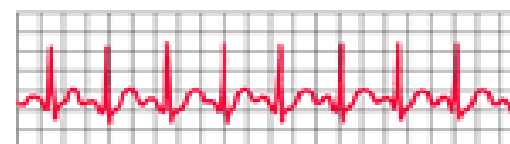


Recovery wave

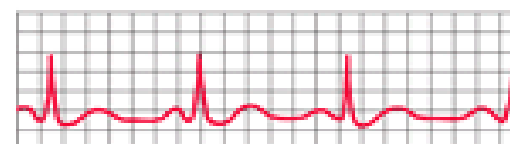
**Normal Heartbeat**



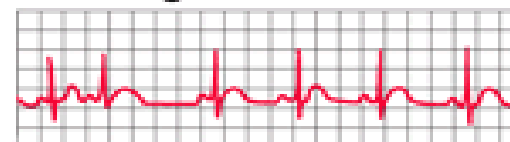
**Fast Heartbeat**



**Slow Heartbeat**



**Irregular Heartbeat**



## Conduction

### Normal Sinus Rhythm

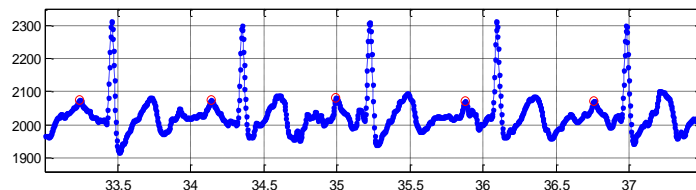


### Atrial Fibrillation

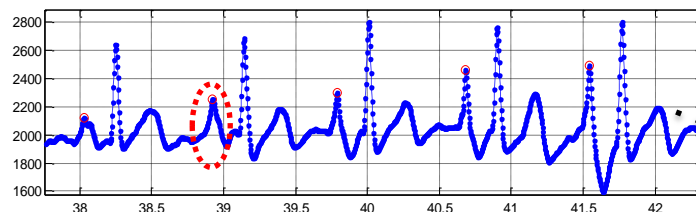


# P-wave Changes on Intravascular ECG Lead

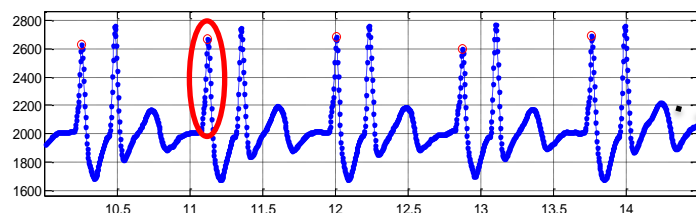
External ECG



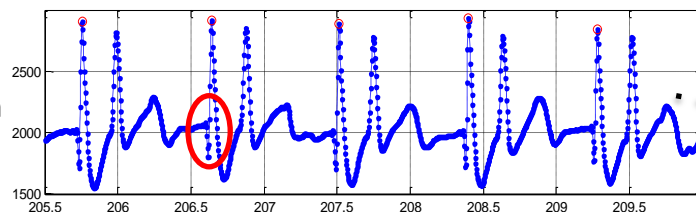
Same patient  
intravascular  
lead II



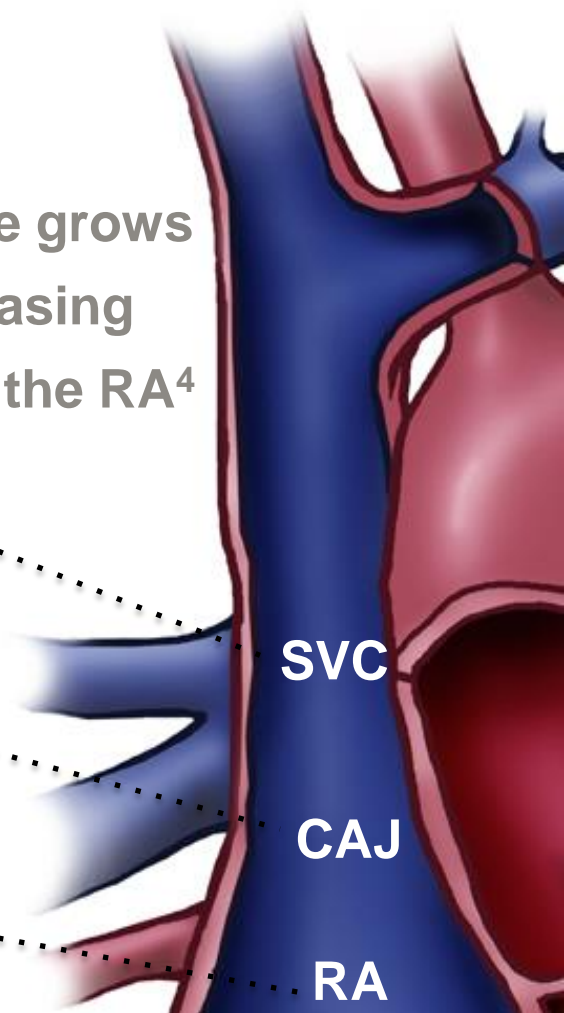
In CAJ



In right atrium

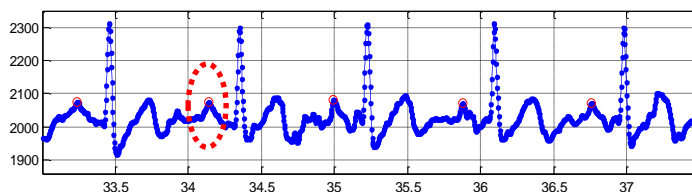


Atrial P-wave grows  
with increasing  
proximity to the RA<sup>4</sup>

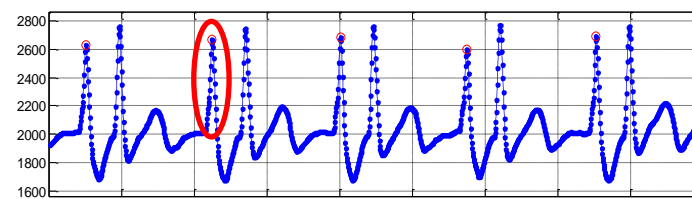


# P-wave Accuracy Range Greater Than Optimal

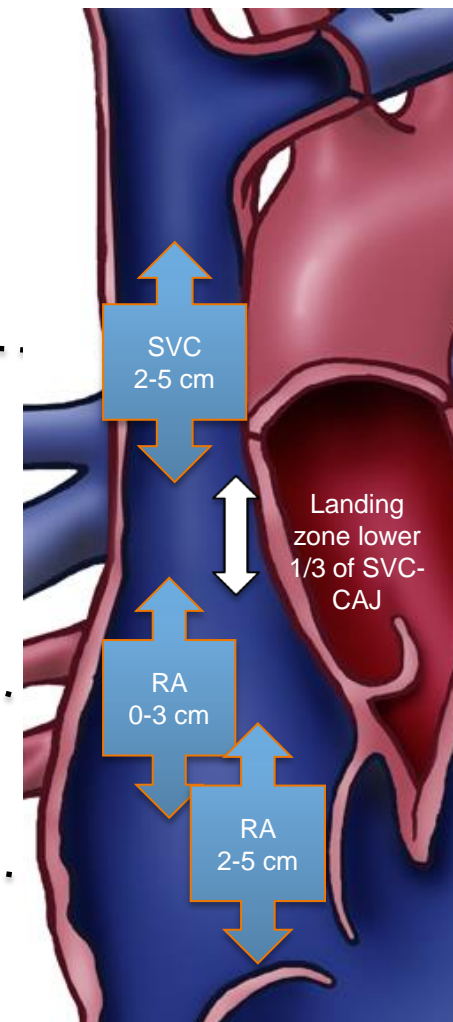
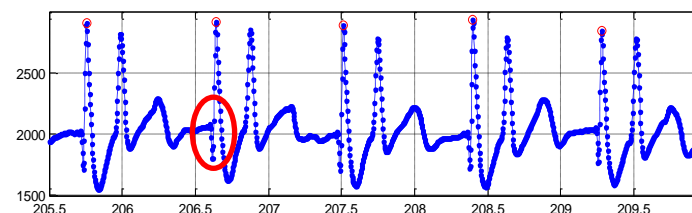
**Normal  
P-wave  
range**



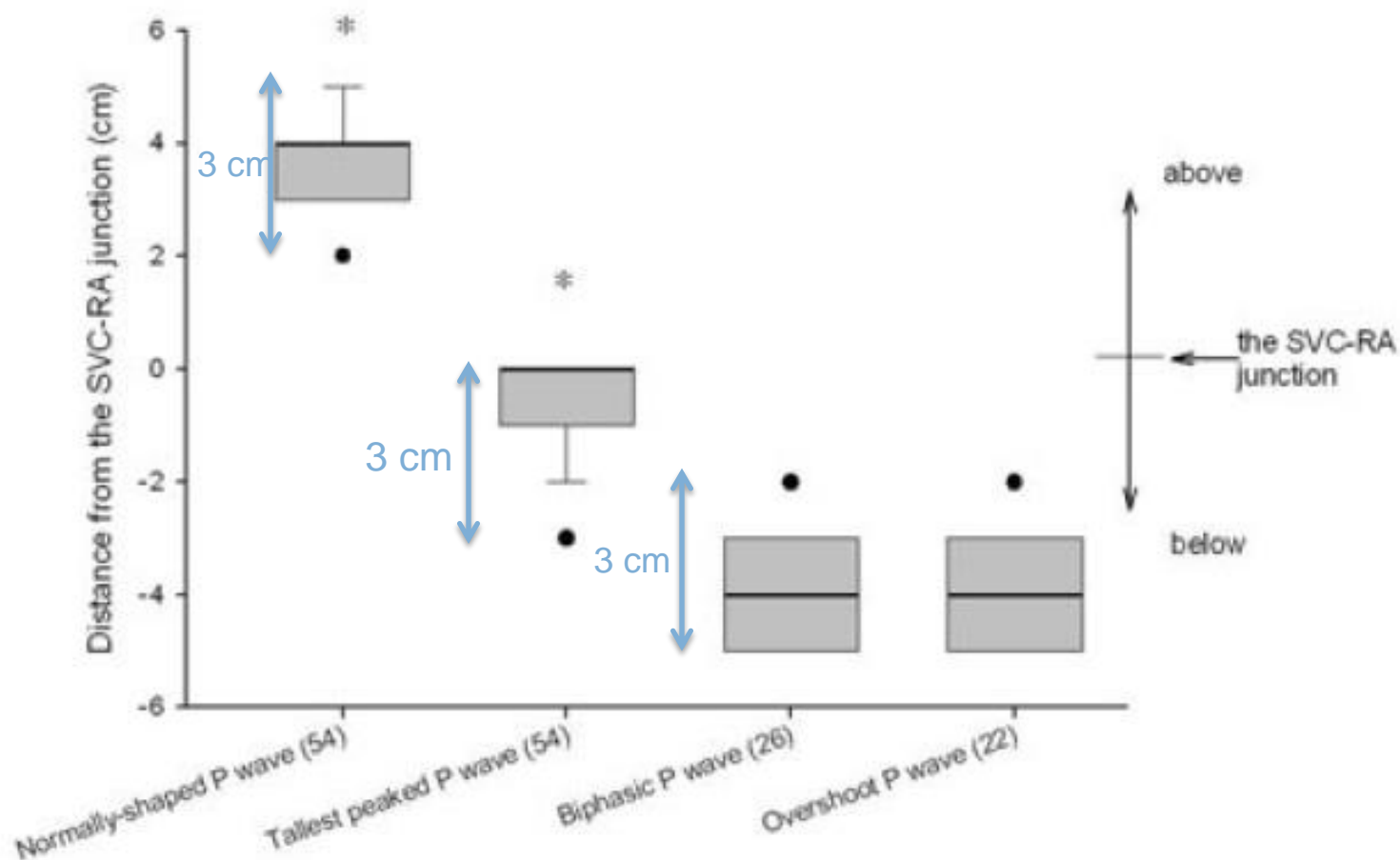
**Maximal  
P-wave  
range**



**Biphasic  
P-wave  
range**



# P-wave Inconsistency



Jeon et al, CAN J ANESTH 2006 / 53: 10 / pp 978-983

## ECG Principles

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- Identification of P-waves is essential to understanding CVC placement using the ECG method
- Insertion must be able to recognize P-wave changes on the ECG monitor
- When inserting a central venous catheter, as the tip enters the SVC and heads toward the right atrium, the height of the P-wave changes
- Identifying changes in the P-wave, as the catheter is inserted, allows accurate identification of tip position when entering the SVC or Right Atrium