

Pacemaker Basics

Children's Medical Center EP Nurses

Objectives

1

Understand
pacemaker
basics

2

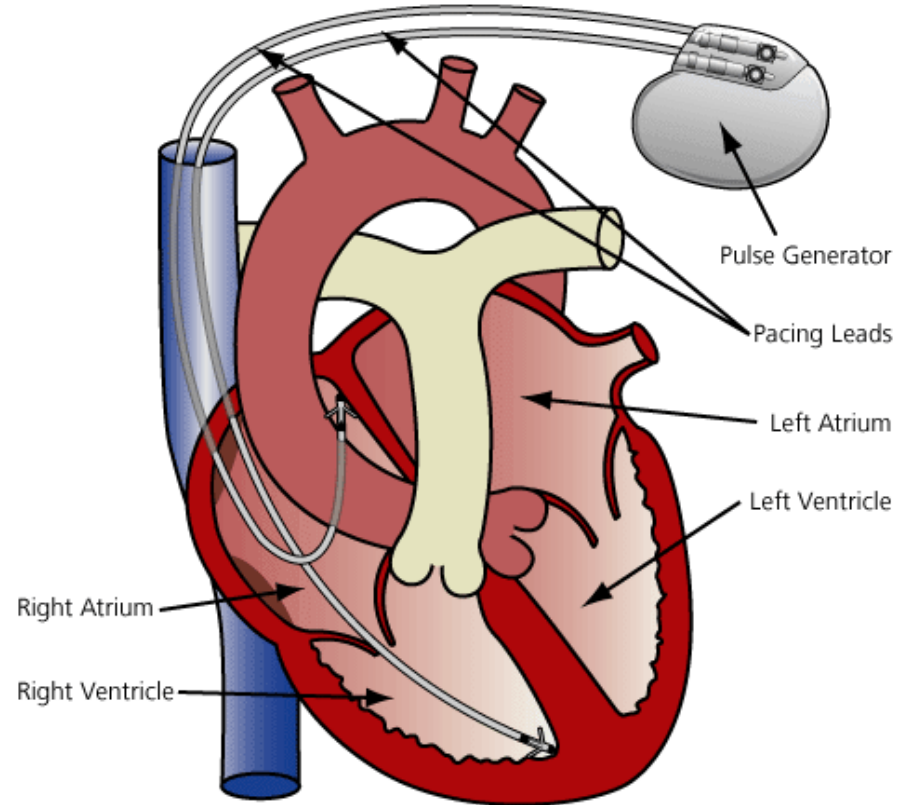
Understand
pacemaker
modes/settings

3

Identify and
confirm
appropriately
paced and
sensed rhythm

What is a pacemaker system?

- ▶ Pacemaker generator:
 - ▶ The “brain”
 - ▶ Implanted device that helps regulate the hearts rhythm by sending electrical impulses to the heart muscle to create a normal heart rhythm
- ▶ Pacing Leads:
 - ▶ Insulated wires that carry electrical impulses from pacemaker to heart muscle



Pacemaker Functions



Pace

Ability to send an electrical impulse to capture and contract the heart muscle tissue



Sense

Ability of device to “see” intrinsic cardiac activity

Understanding Pacemaker Modes

- ▶ The first letter of the mode tells you which chamber the lead **paces**
- ▶ The second letter of the mode tells you which chamber of the lead **senses**
- ▶ The third letter of the mode tells you the **response** to a sensed event

I	II	III
Chamber paced	Chamber sensed	Response to sensing
O = none A = atrium V = ventricle D = dual	O = none A = atrium V = ventricle D = dual (atrium & ventricle)	O = none T = triggered I = inhibited D = dual (trigger & inhibit)

Understanding Pacemaker Modes

Single Chamber Modes

- **AAI and VVI**

Dual Chamber Mode

- **DDD**



Practice Questions

Pacing Code

chamber paced	chamber sensed	mode of pacing
A-Atrium	A-Atrium	I-Inhibit
V-Ventricle	V-Ventricle	T-Triggered
D-Atrium & Ventricle	D-Atrium & Ventricle	D-Inhibit & Triggered
O-Not applicable	O-Not applicable	O-Not applicable

AAI

Chamber Paced
Atrium

Chamber Sensed
Atrium

Action
Inhibit

VVI

Chamber Paced
Ventricle

Chamber Sensed
Ventricle

Action
Inhibit

DDD

Chamber Paced
Atrium and Ventricle

Chamber Sensed
Atrium and Ventricle

Action
Inhibit and Trigger

Are the following pacemaker modes single chamber or dual chamber?

- ▶ AAI Single
- ▶ VVI Single
- ▶ DDD Dual

What does the second
letter in the pacemaker
code represent?

Understanding Pacemaker Settings

Key Focuses:

Pacemaker Lower Rate (Single Chamber)

Pacemaker Lower Rate and Upper Rate (Dual Chamber)

Pacemaker Lead Output

Pacemaker Lead Sensitivity

Pacemaker Lead Impedance

Lower Rate and Upper Rate

- ▶ The lower rate indicates the rate at which the pacemaker will maintain for the patient.
 - ▶ It will not allow the heart rate to go below this rate.
- ▶ On a **dual** chamber pacemaker, there is a lower rate and an upper tracking rate.
 - ▶ The upper tracking rate is the maximum rate at which a dual-chamber device will pace the ventricle in response to atrial activity.

Pacemaker Lead Output

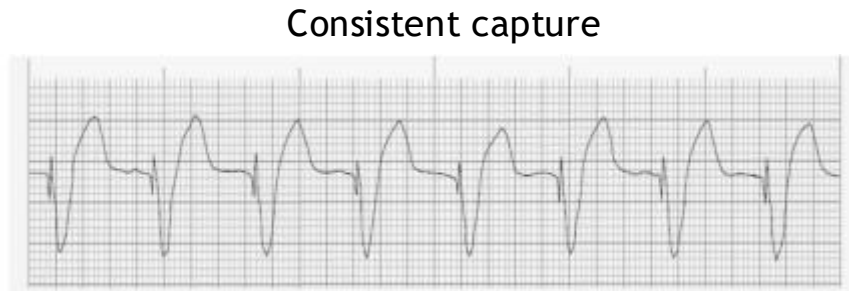
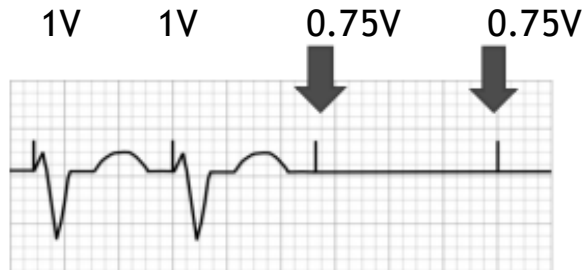
The programmed output on a pacemaker lead is the energy (volts) that is sent out every time a pace occurs.



The programmed output is based off the threshold for that lead.

Pacing Threshold Definition:

- ▶ A threshold is the minimum amount electrical energy (voltage) required to consistently cause the heart muscle to contract (capture).
- ▶ In the example below, you lose capture at 0.75V, therefore your threshold is 1V.



Pacemaker Impedance Definition

Impedance = Resistance of electrical flow through the pacemaker lead
Measured in ohms (Ω)

- **Normal resistance** – friction caused by the hose and nozzle



- **Low resistance** – leaks in the hose reduce the resistance



- **High resistance** – a knot results in low total current flow



Pacemaker Lead Sensing

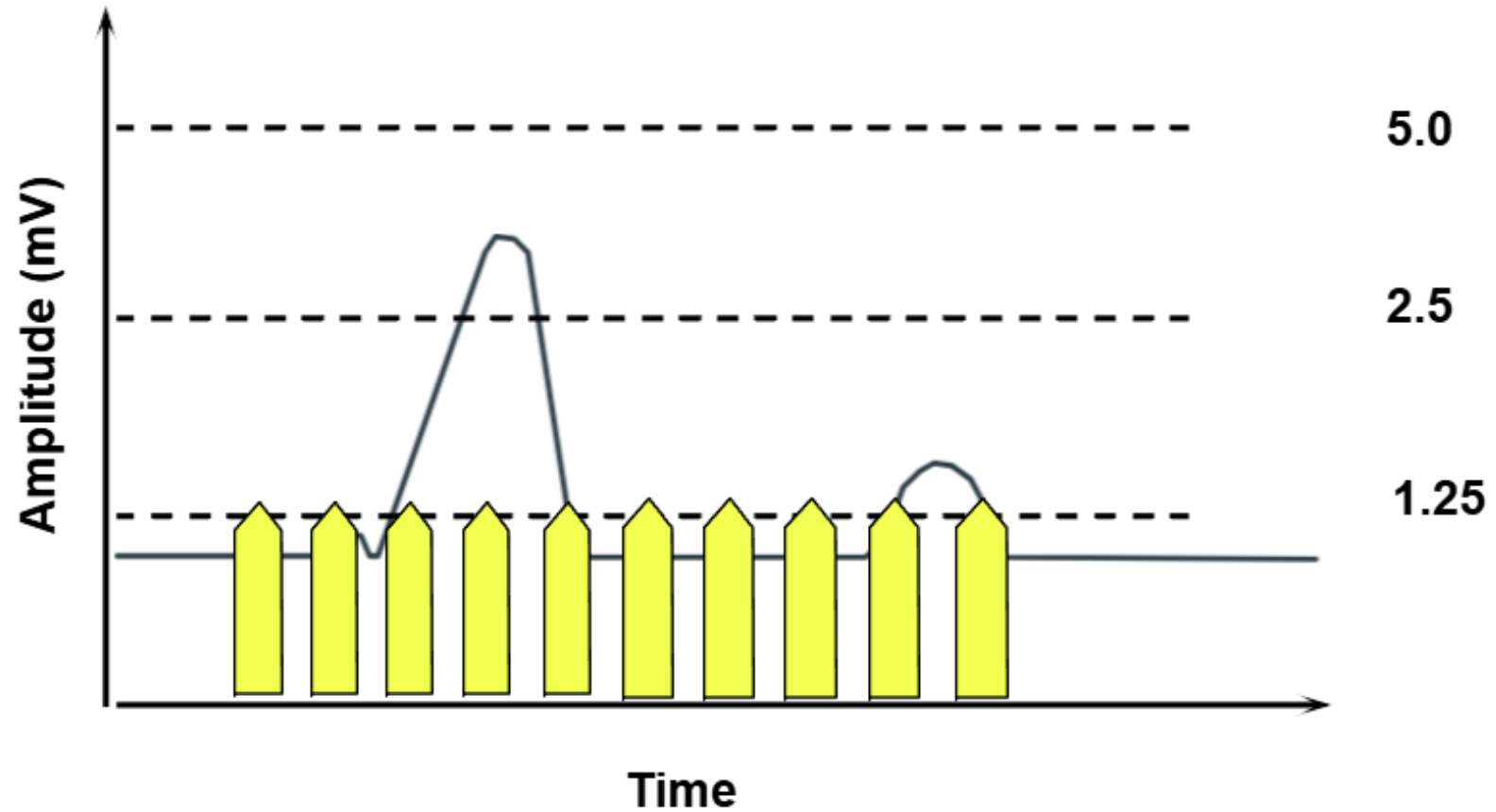
Goal: To sense “see”
any intrinsic P-wave or
R-wave appropriately

To prevent:
Undersensing and
Oversensing

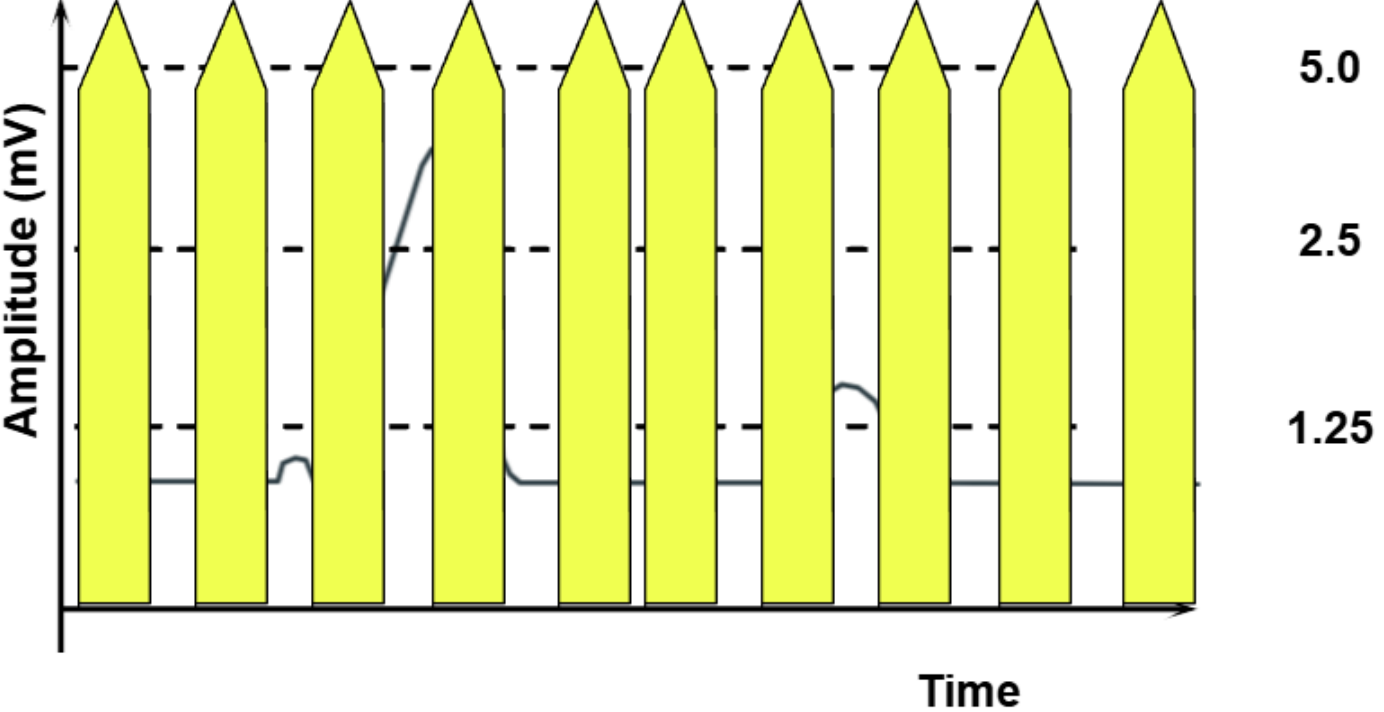
Sensing Threshold Definition:

- ▶ A pacemaker's sensing threshold is the lowest sensitivity setting (highest mV value) that allows the device to accurately detect the heart's intrinsic electrical signals (P-waves or R-waves)
- ▶ Example:
 - ▶ On a scale of 0.9 mV- 5 mV
 - ▶ 0.9 mV is the most sensitive (seeing everything)
 - ▶ 5 mV is the least sensitive (seeing less)

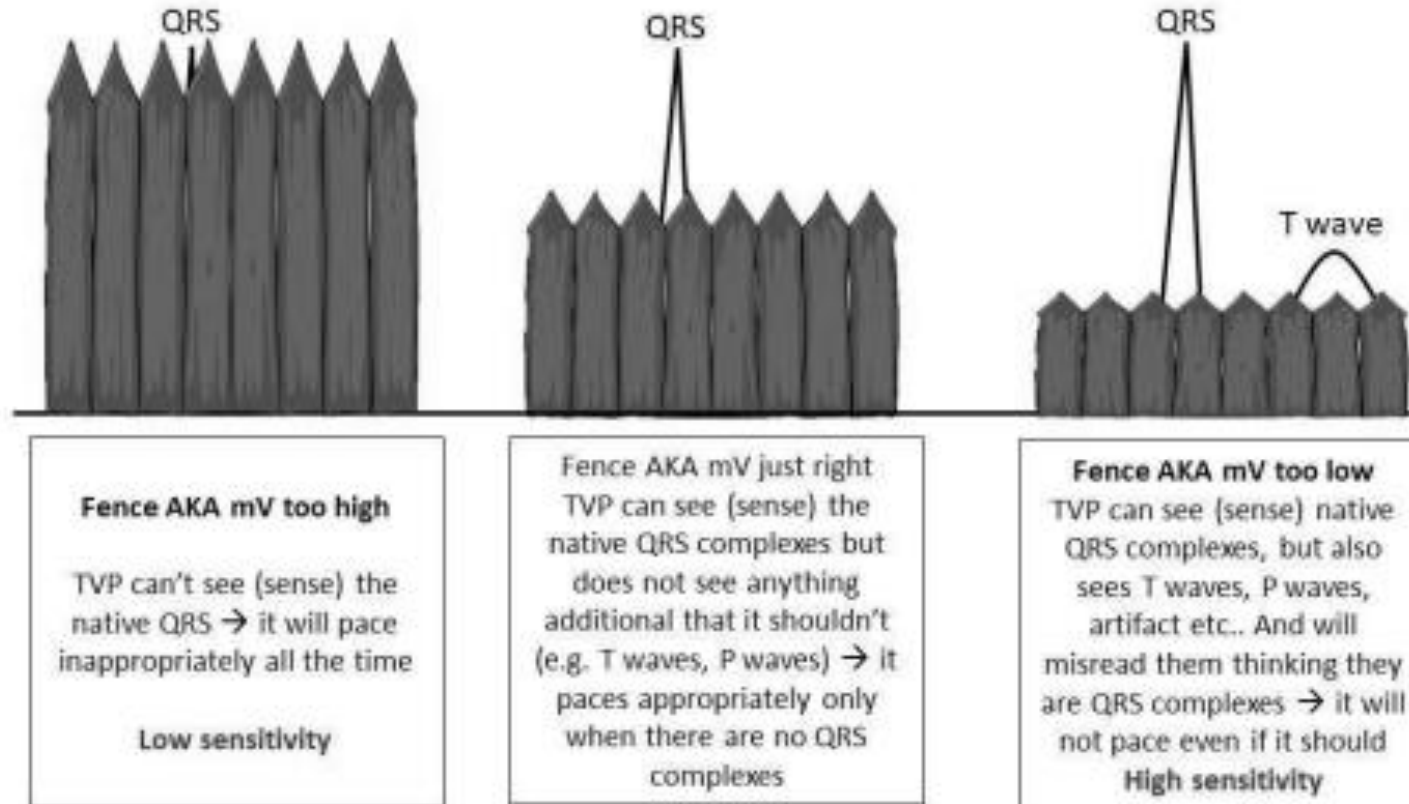
More Sensitive = Low Sensitivity Number



Less Sensitive = Higher Sensitivity Number



Sensing Fence Analogy



@RawanAAmir

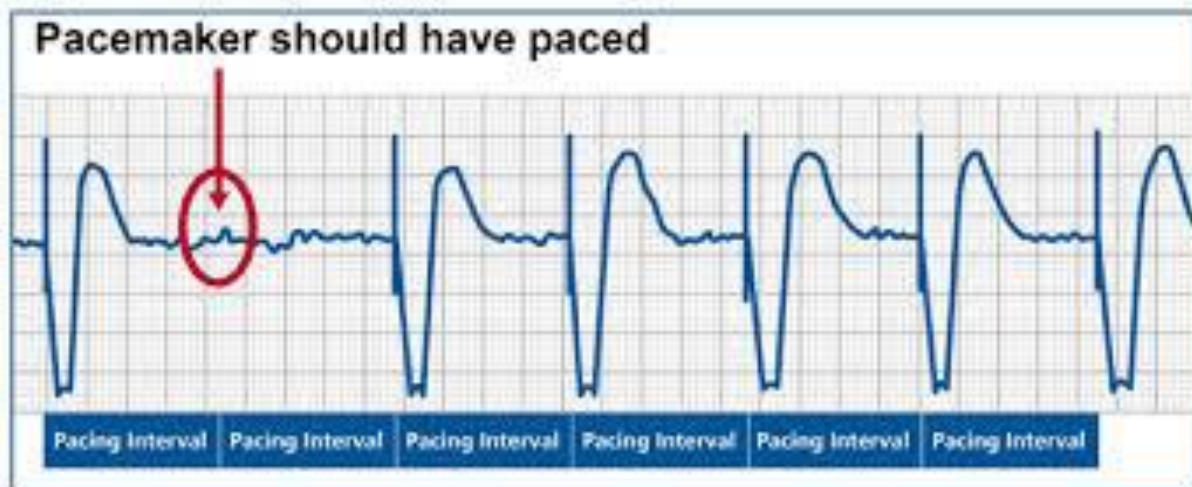
Under Sensing

- ▶ Under sensing occurs when the pacemaker does not sense an intrinsic event at the appropriate timing even though there is one there. Therefore, it sends out a pace.
- ▶ Under sensing = Over pacing
- ▶ The device is pacing when it does not need to be.
- ▶ Example:



Over Sensing

- ▶ Over sensing occurs when the pacemaker senses an event that is either inappropriate or does not exist. Therefore, it does not send out a pace when needed.
- ▶ Over sensing = Under pacing
- ▶ The device is not pacing when it needs to be.
- ▶ Example:

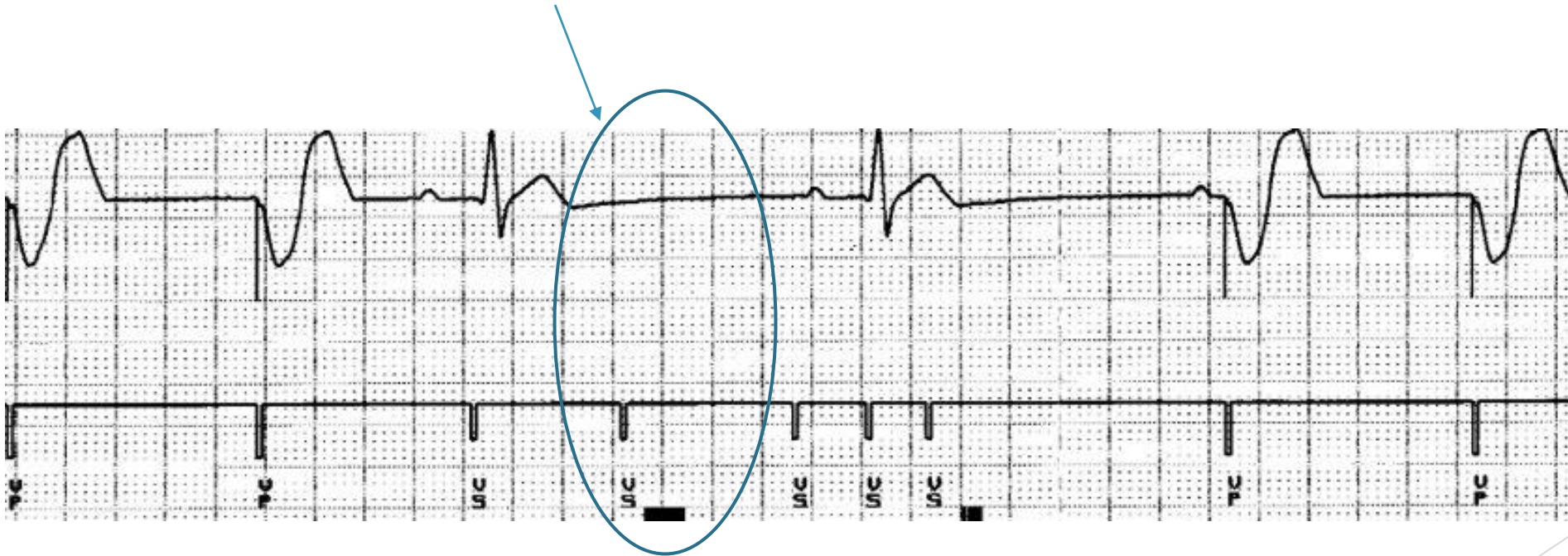




Practice Questions

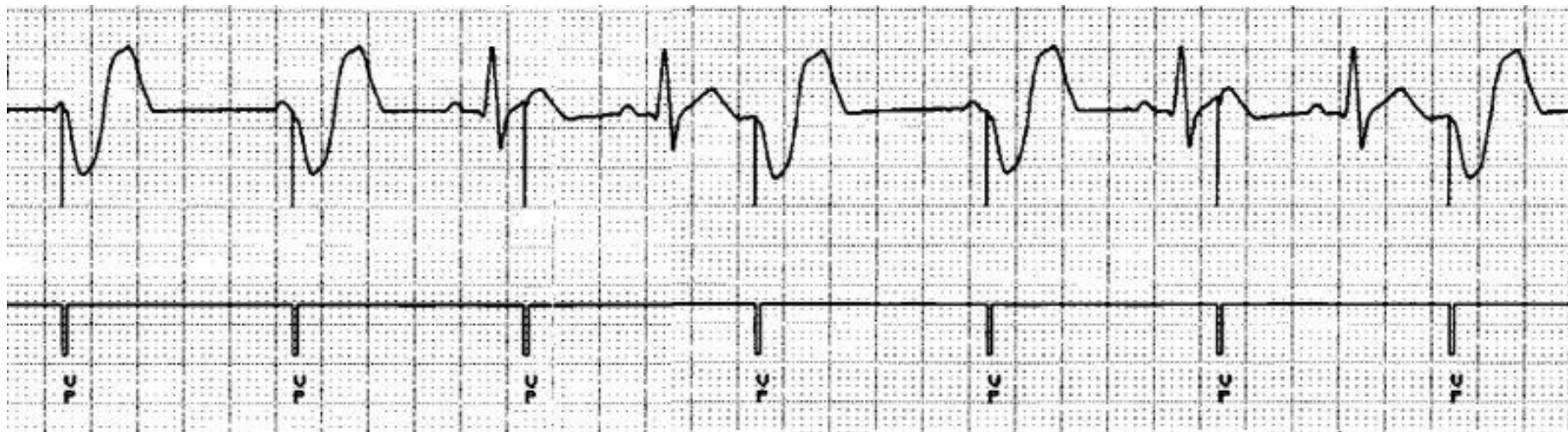
Question 1

- ▶ What is happening in this strip?



Question 2

- ▶ What is happening in this strip?



Question 3

- ▶ What is happening in this strip?



Failure to capture

Sensitivity Questions

Which of the values in each pair would be more sensitive?

- 0.8 mV or 3 mV
- 1 mV or 4.5 mV
- 0.4 mV or 2.8 mV

Does being more sensitive mean the device is seeing less or more?

More sensitive= the device is seeing more

▶ Questions?