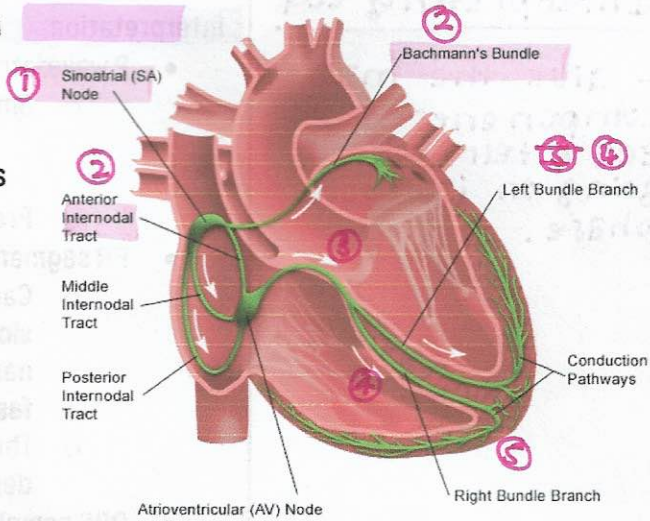
ECG Reading

CARDIAC CONDUCTION

- describe the cardiac conduction pathway

CARDIAC CONDUCTION SYSTEM



- Electrical pathway:
  1) SA node
  2) AV node and Backman's bundle
  3) Septum and bundles
  4) Right and left bundle branch
  5) Purkinje fibers – generate the **QRS complex** (ventricle depolarization)
- The heart is capable of **automaticity** = do not need electrical input from the brain to generate electrical potential
- **SA node** and **AV node**
  - **SA node** is the fastest rate of all the cardiac cells → they are the "pacemaker"
    - → The fastest **signal will take control of the heart**, thus if a group of cells outside the SA node is faster → those cells will become the pacemaker
    - → Normal SA node rhythm = between **60-100bpm**
      - ✓ A health person may not need treatment
    - → IF SA node doesn't work (known as **6 sinuses syndrome**) = **AV node** will become the pacemaker → then the intrinsic heart rate will be be**tween 40-60bpm**
      - ✓ If both nodes are compromised → complete or 3rd degree **heart block** → now the ventricles will have to pace themselves (rate will be **between 20-30bpm**) → rate is too slow to be compatible with life
  - **AV node** is the only way to send electrical impulses to the **ventricles**
    - → Under normal circumstances, the cartilages of the heart valves will not allow electrical impulses to flow through the ventricles unless AV node is present
- **Dysrhythmia:** electrical impulse does not follow the normal **conduction pathway** → CO is compromised

- what is the normal SA node rhythm? what about AV node?
- If a pt has HR of 26 bpm, what does that mean?
- describe the importance of AV node

ELECTROCARDIOGRAM

Components:

- Line/segment = **iso-electrical line**
- Positive wave = **moving upward from baseline**
- Negative wave = **moving downward from baseline**
- Interval = combination of **segment and wave**; measures how long certain parts are taking
  - Ex: PR interval tells us how long it takes electrical signals to move from **SA node to the ventricles**

Interpreting ECG

- Give the main components of ECG & tell what is going on in each phase.

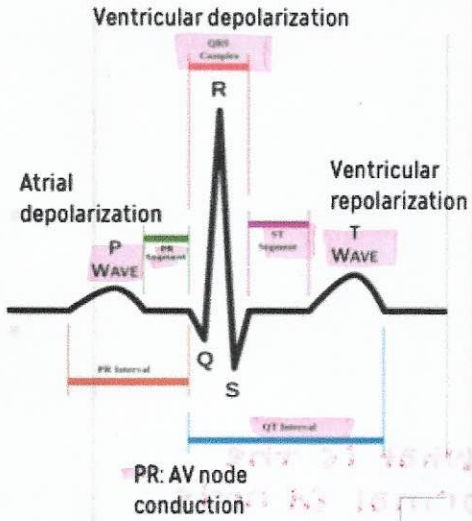
- A pt's ECG shows ST elevation, what does it mean? What if it was a ST depression?

- QT prolongation means _____

Leads
- Define "lead"?

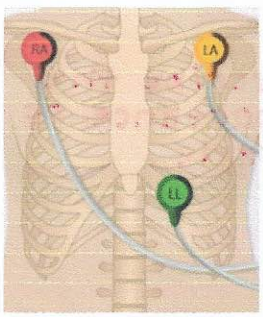
Interpretation

- P wave: atrial **depolarization**
  - Smaller than QRS since atria is very small compared to ventricles
    - → If P waves become larger = more electrical impulses generated in atria (can indicate enlargement of atria
  - Presence of P wave does not necessarily mean atrial contraction
- PR segment: AV node conduction
  - Can be longer if the heart is **slower** (esp. in athletes); can be narrower/short if the heart is **faster**
  - The **interventricular septum** is depolarizing
- QRS complex: ventricular depolarization
  - As the ventricles are depolarizing, the atria is also **repolarizing**, but we can't see it b/c the atria's electrical activity is smaller than that of ventricles
- ST segment
  - ST elevation = MI
  - ST depression = ischemia
- QT interval
  - Prolongation = increased relative **refractory period** (the state in which the heart is vulnerable)
- T wave: ventricular repolarization
  - Heart "re-sets"
  - Repolarizes from **apex to base**



Electrodes

- Connected to wires
  - Wires are connected to monitoring devices that **translates electrical signals** into visual fields
- Allow detection of electrical activity in heart

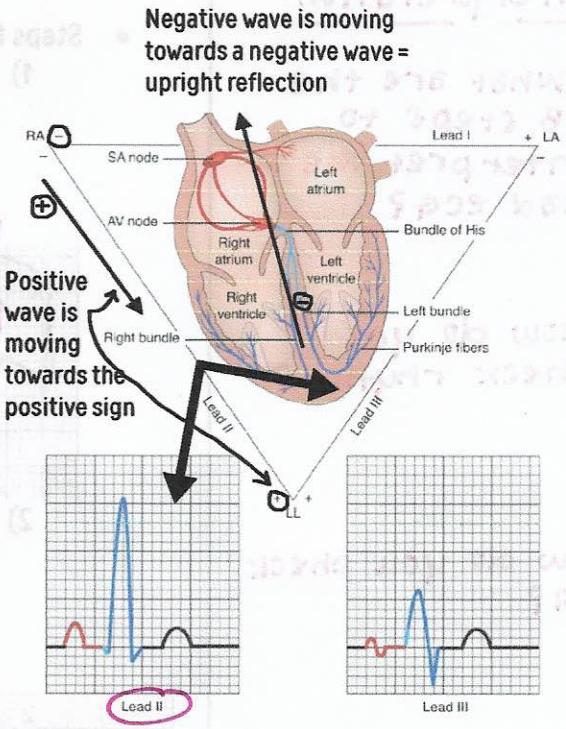


LEADS

- **Def:** imaginary lines formed between 2 electrodes
  - Sort of like a **camera angle** = looking at the heart towards a reference point; each lead gives a different view
    - → We will focus on **lead 2** (most typical one)
- They provide a "snapshot" of electrical activity in the heart
  - Appearance of lead differs depending on the placement of lead
    - → Ex: some leads will have QRS complex inverted while others will have it everted
- We need to know where to place the lead to get a **proper reading**

Lead 2

- Placement: **positive electrode is placed at the apex of heart and is looking at the base on the heart**
- Upright wave = positive wave
  - When positive wave of energy (**generation of electrical current**) moves towards positive lead → upward reflection
  - When negative wave of energy moves towards negative lead → upward reflection

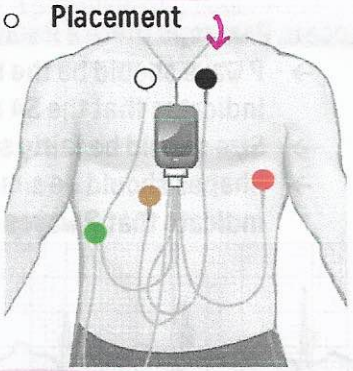


Methods of Obtaining an ECG - Which type is most accurate?

Methods of Obtaining an ECG

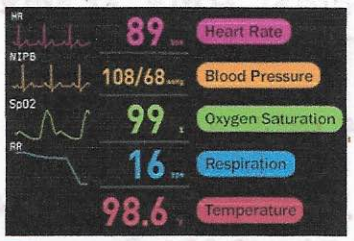
- 12 lead ECG
  - Used to **diagnose dysrhythmias**
  - Focused on the **left ventricles** since that's where most problems occur
- Cardiac telemetry
  - Most common at the bedside
  - 5 lead ECG
  - Placement

- How do you place the electrodes for 5-lead ECG?



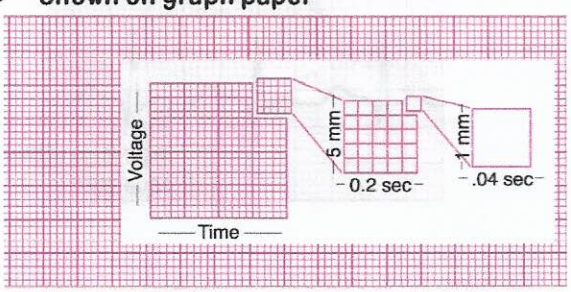
White
Black
Brown
Green
Red

- Holter monitor
  - Portable monitor that is used for pts who have palpitations at home, but they are gone when pt comes to ER
  - Records 24/7
- Bedside cardiac monitor
  - Usually seen in ICU, ER, post-op, and pre-op
  - Gives at least 2 lead along with other v/s



12 LEAD ECG INTERPRETATION

- Shown on graph paper



Time tells you how long electrical signals take to travel

Voltage tells you how much electrical potential there is

12-Lead ECG Interpretation

- What are the 8 steps to interpret the 12 lead ecg?

- How do you check rhythm?

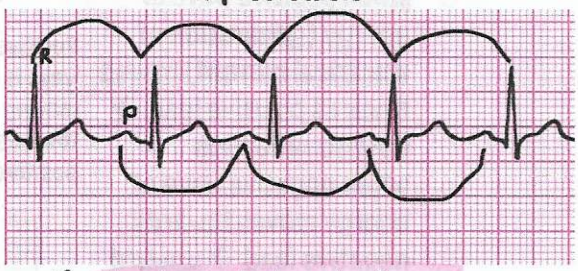
- How do you check HR?

- No "p-waves" means _____

- What is the normal time frame for PR interval?

- A pt's ECG has a PR-interval is 0.4 secs, what does that mean?

- Steps for interpretation
  1) Rhythm: is it regular or irregular?
     a. Check **R-R intervals**
     b. Check **P-P intervals**
     → If irregularity is found, determine if the irregular heart rhythm is **predictable**

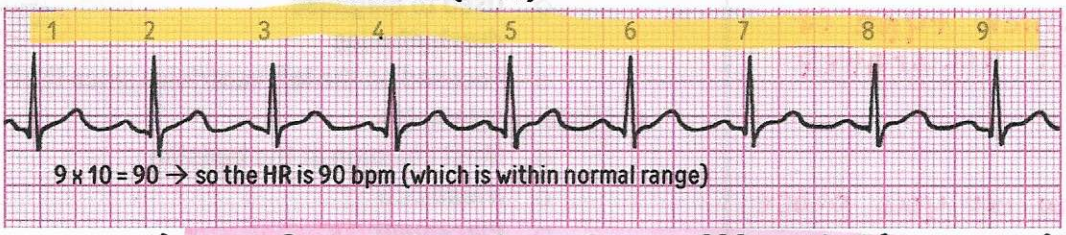


R-R intervals are spread out **evenly** = reg heart rhythm

P-P intervals are spread out evenly = reg atrial rhythm

This lead has reg atria and vent. Rhythms

  2) Heart rate: fast or slow?
     a. Count the number of **R waves** in a **6 sec strip** and multiply by 10; you do **(R * 10)**
     b. Count the number of **P waves** in a 6 sec strip and multiply by 10 for atria rate (P * 10)

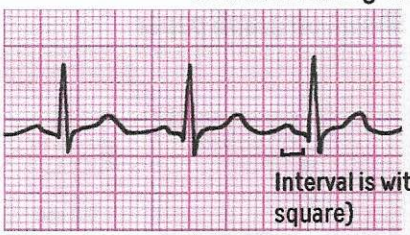


9 x 10 = 90 → so the HR is 90 bpm (which is within normal range)

  3) Locate **P wave**; is there a P wave for every **QRS complex**? (normally yes)
     → P wave should be the beginning of every **cardiac cycle** → indicates that the SA node is acting as **pacemaker**
     → Size should be fairly **small**
     → Shapes should be similar for all P waves; different shapes may indicate that **P waves are not generated for SA node**

All the P waves look fairly similar

  4) Determine the **PR interval**; normal time is **0.12-0.2 secs**
     → Interval should **not be above 1 big square** (since 1 big square = 0.2secs)
     ✓ If longer = **first degree AV block**
     → Make sure every QRS complex has a **P wave before**
     ✓ **If no QRS is seen** = electrical impulses were not sent to the ventricles
     ✓ **If no P wave before** = SA node is not pacing the heart and something else is



Each QRS is preceded by a P wave

Interval is within 0.12-0.2 secs (less than 1 big square)

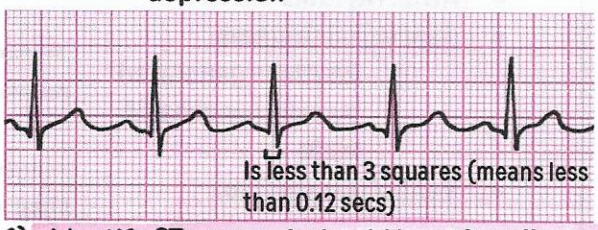
- What is the normal time frame for QRx complex?

- What would a hypokalemic pt's ecg look like? What about hyperkalemia?

- A pt's ecg shows high T wave, what does that mean?

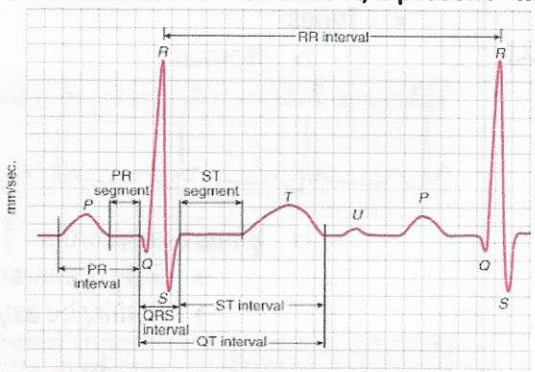
- What are some s/s of dysrhythmias?

5) Identify **QRS complex**; (normal time should be **less than 0.12 secs**)
   - → You want nice, skinny QRS complex (for maximum CO)
   - → No longer than **3 small squares**
   - → **Hyperkalemia** causes wide and prolonged QRS while **hypokalemia** causes QT interval prolongation, U wave, and ST depression



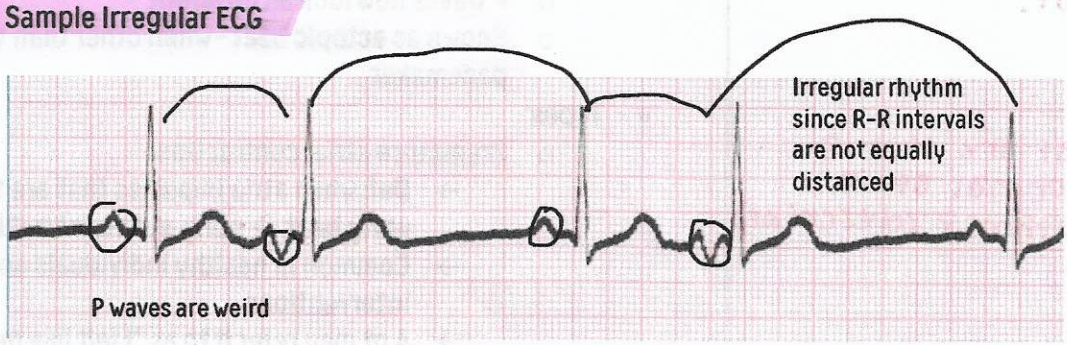
QRS are all tall, skinny, and similar

6) Identify **ST segment**; should be at **baseline**
7) Identify **T wave** and check if there's **U wave**; should be upright and flattened for T wave
   - → Peaked **T wave** may mean **hypokalemia** or
   - → **U waves** should be absent; if present = **hypokalemia**



8) Interpret the rhythm
   - → Anytime you see an abnormal strip, do a **physical assessment** and ask the pt how he/she is feeling
     - ✓ Check for SOB, capillary refill, dyspnea, etc.
   - → Look for classic s/s:
     - ✓ Cool, clammy, sweaty
     - ✓ Dizzy
     - ✓ Decreased **LOC**
     - ✓ Decreased **BP**
   - → **You want to treat the pt and not the monitor!**
   - → All dysrhythmias can lead to **decreased CO** –what we want to prevent

Sample Irregular ECG



Cardiac Rhythms

- What is a "junctional rhythm?

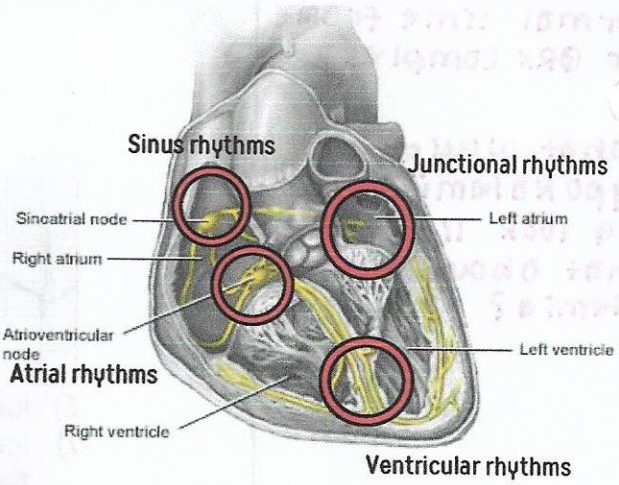
- sinus rhythms are shown by ____
- What are the 2 abnormal sinus rhythms? (describe)

- Define "ectopic" beat.

- What are the 3 abnormal atrial rhythms? (describe)

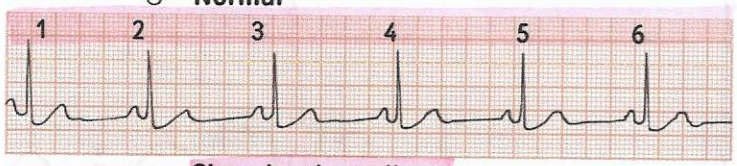
CARDIAC RHYTHMS CLASSIFICATIONS

- Sinus rhythms
  - Rhythms generated by the **SA node**
- Atrial rhythms
- Junctional rhythms
  - Rhythms generated by cells **near the SA node**
- Ventricular rhythms



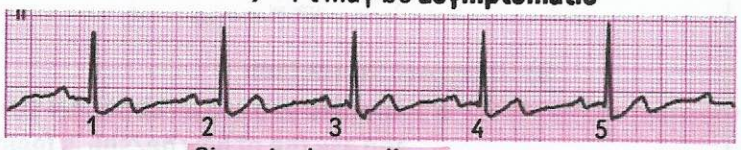
Sinus Rhythms

- Shown via **P wave**
- Vary according to **rate**
- Types:
  - Normal



- Rate: 60 bpm
- Rhythm: regular
- P waves: uniform and upright
- P to QRS ratio = one to one
- PR interval: between 0.12-0.2 secs
- QRS complex: less than 0.12 secs

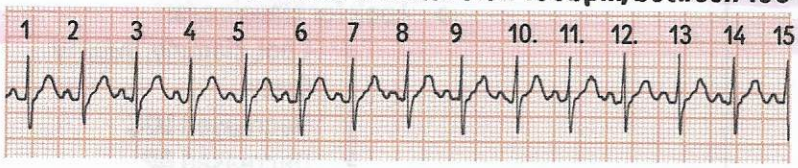
  - Sinus bradycardia
    - → Rate is slower than 60bpm
    - → Pt may be **asymptomatic**



Rate: 50 bpm (**lower than normal rate**)

Everything else is the same

  - Sinus tachycardia
    - → Rate is **faster than 100bpm; between 100-200bpm**



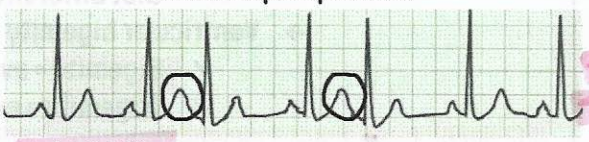
Rate: 150bpm (**faster than normal rate**)

Atrial Rhythms

- Happens when **atria take over as pacemaker**
  - P waves now look all **different**
  - Known as **ectopic beat** –when other than the SA node is acting as pacemaker
- Types:
  - Premature atrial contraction
    - → **Def:** when atria impulses that are faster than SA node's cause **early beat → early atria contractions**
    - → Common in healthy individuals and usually don't need interventions
    - → A pt may refer it to as "I felt like my heart skipped a beat"

- How can you check premature ventricular impiex?

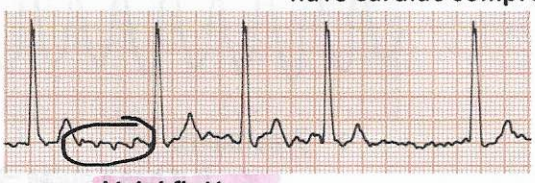
→ Frequent or symptomatic PAC need treatment and can lead to serious dysrhythmias



Blending of P wave and T wave

- Atrial fib.
  - → **Def:** disorganized and random cells in atria are firing → atria **cannot contract in synchrony and are rather squirming**
  - → Atrial rate is **between 350-600bpm** (very fast)
    - ✓ **AV nodes** can block the abnormally fast electrical impulses from atria → allows ventricles to keep their rhythms for a while, but the AV node cannot block all impulses → can lead to vent. dysrhythmias as well
  - → Most common sustained cardiac arrythmia
  - → Usually associated with **aging** (15% of ppl above 85 yrs) and often happens in heart that is **chronically ill** (like hypoxia, COPD, sleep apnea, etc.)
  - → Can be asymptomatic
  - → Causes **loss of atrial "kick"** → decreased CO by 20-30%
    - ✓ May not impact healthy ppl but for ppl who already have cardiac compromise, it can cause serious issues

- How can you check a.fib?

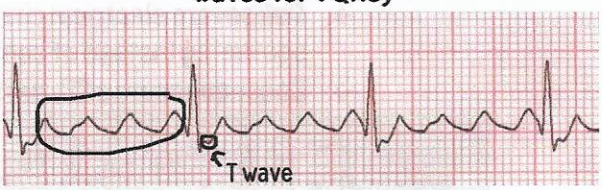


Unable to see P waves; we only see squirmy lines instead of a proper wave

T waves are also pretty invisible

- Atrial flutter
  - → Has a fairly regular ventricular rate
  - → Similar to **A. fib** but the P waves are countable
  - → Atrial rhythms is between **250-350 bpm**
  - → "Sawtooth pattern" on P waves
  - → Greater number of P waves than QRS complex (usually 3-4 P waves for 1 QRS)

- How can you check a.flutter?



You can count the P waves in a row

Ventricular Rhythms

- Ventricles become the pacemaker
- Types:
  - Premature ventricular complexes
    - → Can't see P wave or PR interval
    - → QRS is longer than 0.12 secs and look bizarre
    - → T waves are opposite QRS direction
    - → More than 2 PVCs in a row = **vent. Tachycardia**
    - → Unifocal vs multifocal
      - ✓ Unifocal = premature beats look alike, means that one part of the ventricle has an issue

- Ventricular rhythms are shown by ——
- What are the 3 abnormal ventricular rhythms?
- Differentiate "unifocal" vs "multi focal" PVC.

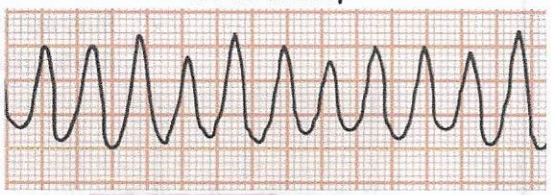
- How can you check for PVC?

- ✓ Multifocal = premature beats look different, means that different parts of the ventricles are irritated
  - → Ventricular bigemity vs ventricular trigemity
    - ✓ Bigemity = every other QRS complex is a PVC
    - ✓ Trigemity = every 3rd QRS complex is a PVC

This is a **multifocal** since the 2 QRS look different

- How can you check for v. tach?

- Ventricular tachycardia
  - → **Def:** tachycardia coming in ventricles
  - → Looks like a bunch of PVCs lined up; "shark tooth" appearance
  - → No P waves
  - → Almost invisible T waves
  - → You can count the R waves
  - → **Very serious; cannot live for long**
    - ✓ Some pts may have "bursts" of v-tach and that may not be as deadly

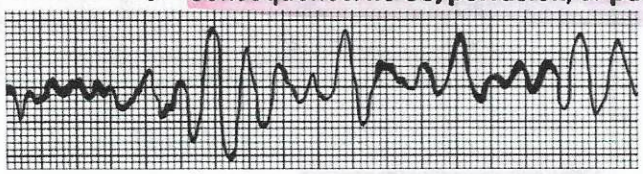


Looks weird bur organized (has a pattern)

- ____ can have a pulse or no pulse
- How do you treat v. tach?

  - → Treatment:
    - ✓ If it has a **pulse** → sedate pt (if possible) and do **synchronized cardioversion** (shocking in coordination to "R wave" to prevent delivering is at QT interval which can cause **v. fib**)
    - ✓ If no pulse → **defibrillation** and ACLS protocol; treat it like a v. fib
- Ventricular fibrillation
  - → **Def:** severe electrical chaos in the ventricles → ventricles are squirming instead of contracting
  - → Consequence: **no CO, perfusion**, or **pulse**

- How can you check for v.tach?



Looks very weird and disorganized unlike v. tach

- How do you treat v.tach?

  - → Treatment:
    1) Defibrillate
    2) CPR (only buys time)

DEFIBRILLATION

- 2 types:
  - **Monophasic**: sends energy in one direction (need higher level of joules)

Defibrillation

- What is the main goal of defibrillation?

- which dys can we try defibrillation?

  - **Biphasic** (more common): 2 passes of energy in heart → allows to reduce the number of joules needed for each pass → less pain and complications like burns
- Goal: allow **SA node** to resume control
- MOA: electrical current is delivered through the chest wall and heart to depolarize myocardial cells so that the SA node can pick back up rhythm
- Used for:
  - **Ventricular fibrillation**
  - **Pulseless ventricular tachycardia**

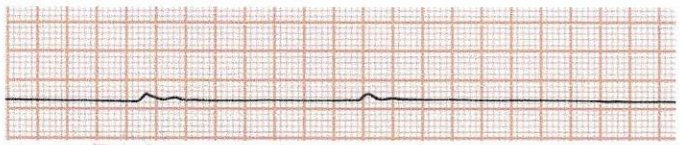
Defibrillating Steps

1) Self-adhesive pads are applied to pt's chest (remove hair as needed)
2) Protect the pt from burns by making sure that environment is fire safe (like not near O2)
3) Charge defibrillator and make sure all team members are "all clear"
4) Deliver shock
5) Begin CPR
6) Check for normal rhythm by checking **pulse;** is yes → yay
7) If no pulse → resume CPR

Asystole

- How do you treat a-systole?

ASYSTOLE



- Def: no electrical activity; ventricular **standstill**
- "flat line"
- May see tiny P wave
- Cannot be treated with shock; the best you can do is CPR and call code

Artifact

- Define "artifact"

- How do you treat artifact?

ARTIFACT

- "Garbage"
- Mechanical issue like pt's electrodes are misplaced or pt is moving, malfunctioning electrodes, etc.

Electrical Interference

- Define electrical interference.

ELECTRICAL INTERFERENCE

- Not pathological but a disturbance of electrical impulse
- Can be due to pt shivering and his/her muscle generating impulses