EKG STRIPS

Understanding how to read heart rhythms.

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Summary of Heart Measurements

- P wave: Upright
- PR interval: Less than 0.20 sec (5 small boxes)
- QRS wave: Less than 0.12 sec (3 small boxes)
- ST segment: Even with isoelectric line
- QT interval : Less than 0.40 sec

Heart Rate Measurement

- Six second Method
  - Print a 6 second strip (about 30 large boxes)
  - Count the number of R waves and multiple by 10.
- Large box Method
  - Count the number of large squares between R waves.
  - 300/ # = HR.
- Small box Method
  - Count the number of small squares between R waves
  - 1500/# = HR.
- Normal HR: 60-80bpm, atrial and ventricular should be the same.

Regularity of Rhythm

- The duration between the R-R waves should be the same
- The duration between the P-P waves should be the same.
- RMBR: Normal ECG rhythms are regular in pattern. Also be one P wave for every QRS complex.
  - How do we measure?
    - Use calipers
    - Use paper and mark off each R-R or P-P and check consecutive waves to see if they match up.

Morphology of the P wave

- Make sure there are P waves.
- Normal:
  - Regular,
  - Symmetric shape being upright and rounded
  - Uniform P waves
  - One P wave for every QRS wave.

P-R interval

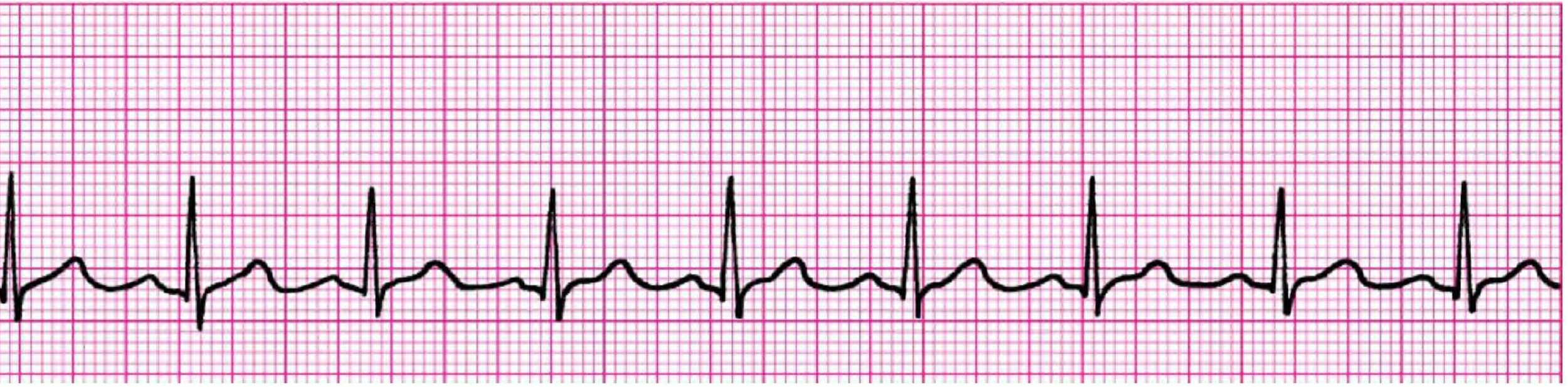
- RMBR: Measure the time an impulse travels from the Atrial to AV node.
- Normal Findings:
  - 0.12 to 0.20 seconds in length.
  - PR interval must be constant throughout the rhythm
- Abnormal Findings:
  - > 0.20 : delayed time from SA node to AV node.
  - Irregular PR interval: SA- AV conduction problem.

QRS complex

- RMBR: Represents ventricular depolarization
- Normal Findings:
  - Same size, shape and direction
  - Equal duration/width.
  - R - R interval is regular
  - Less than 0.12 sec
- Abnormal Findings:
  - Greater than 0.12: Irregular ventricular rhythm.

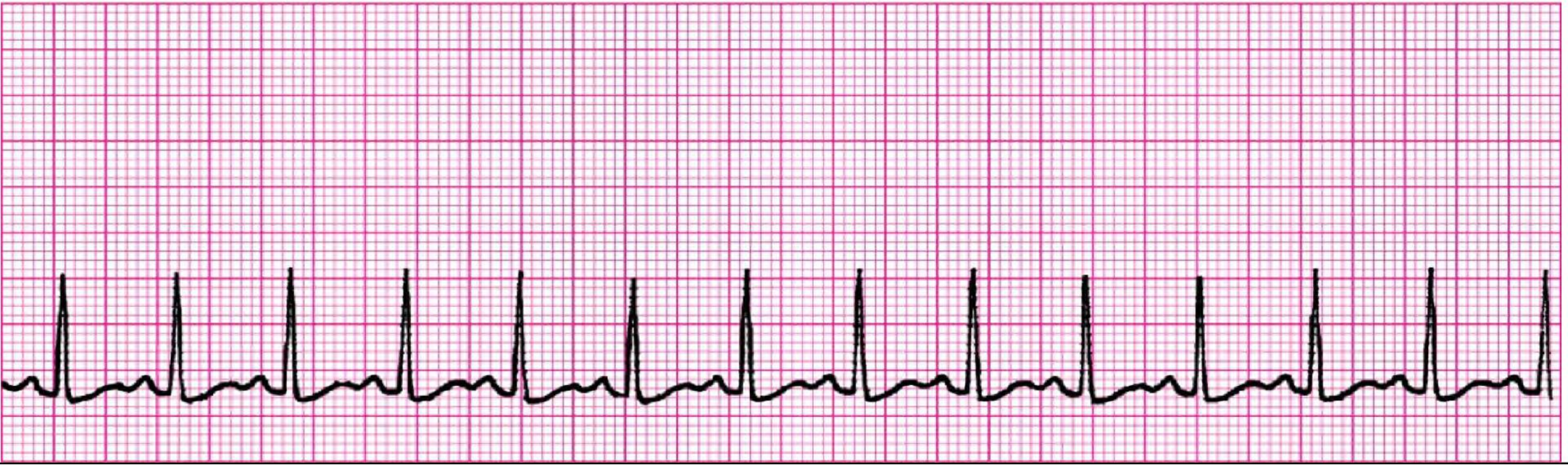
ST segment and T wave

- ST segment:
  - Isoelectric line, no greater than 1mm above the isoelectric line.
- T wave:
  - Upright when R wave is upright .
  - T wave deflects downward when R wave is downward.
- Abnormal Findings:
  - >1mm ST segment elevation or depression from the isoelectric line.
  - T wave opposite direction than the R wave.



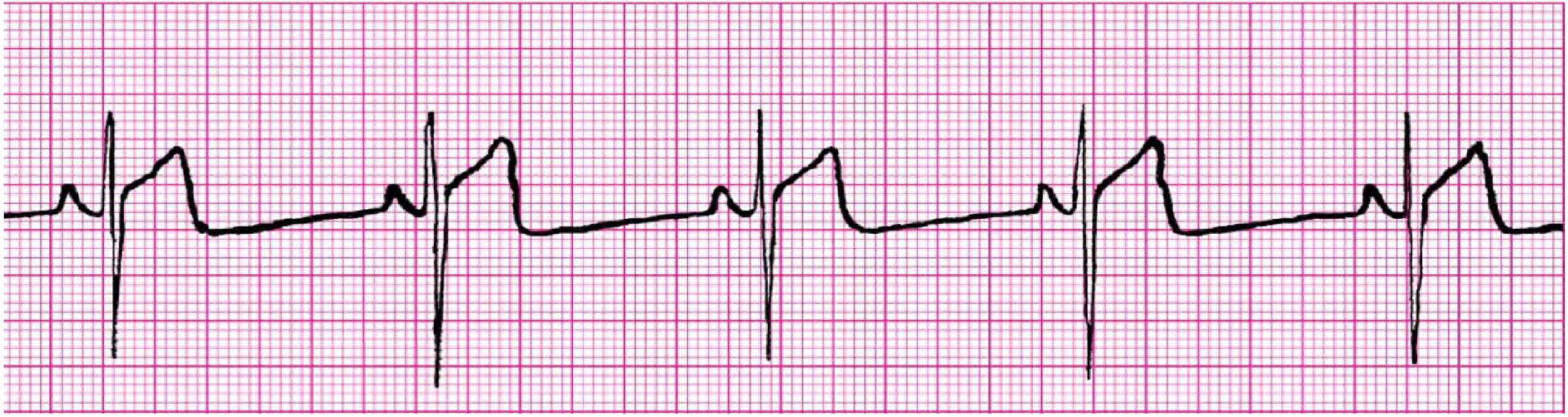
Normal Sinus Rhythm

- Rate: 60-100BPM
- Regularity: Regular
- P wave: Present and upright
- PR interval: 0.12-0.20 sec
- QRS: <0.12
- Causes: Normal healthy heart
- Treatment: None



Sinus Tachycardia

- Rate: 100-150BPM
- Regularity: Regular
- P wave: Present and upright
- PR interval: 0.12-0.20sec
- QRS: <0.12sec
- Causes: Stress, exercise, fever, dehydration, blood loss, anemia. Anxiety, heart failure, cocaine, cafferine, atropine, dopamine, norepinephrine, epinephrine etc.
- Treatment:
  - Asymptomatic: Observation
  - Symptomatic: Treat underlying cause, may give beta blockers, calcium channel blockers

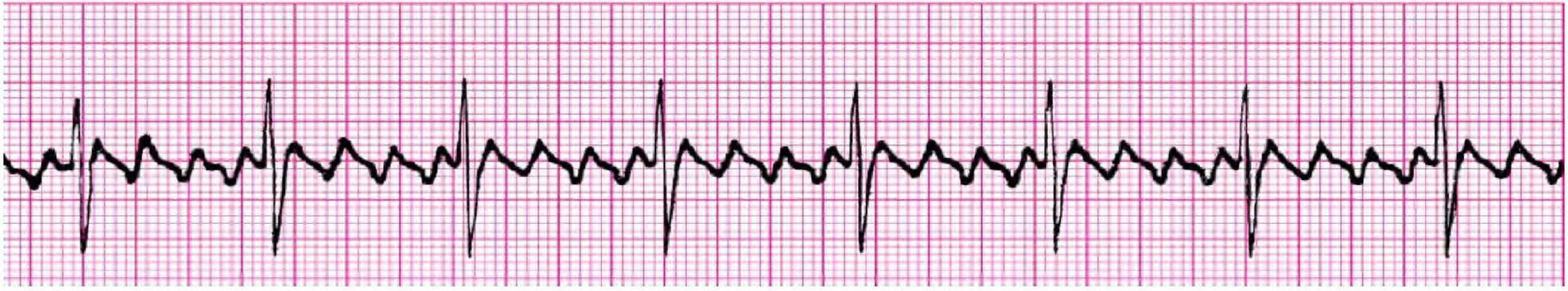


Sinus Bradycardia

- Rate: < 60BPM
- Regluarity: Regular
- P wave: Present and upright
- PR interval: 0.12-0.20 sec
- QRS: <0.12 sec
- Causes: Well-conditioned athletes, sleep, increased vagal tone due to vomiting, bearing down, digitalis, calcium channel blockers, beta blockers, inferior MI, increased ICP, organophosphate poisoning, hypothyroidism, electrolyte imbalance, hypothermia.
- Treatment:
  - Asymptomatic: Observation
  - Symptomatic: Atropine 0.5-1.0mg,max of 3mg, Transcutaneous Pacing.

Premature Atrial Contractions

- Rate: 60-100BPM
- Regularity: Regular
- P wave: Present; upright and some normal and some are notched, peaked or buried.
- PR interval: Normal, shorter, longer PR interval depending at the origin of the PAC.
- QRS: < 0.12 sec
- Why: A premature atrial contraction results from an ectopic stimulus that comes from either the left or the right atrium, but not the sinus node. The atria are depolarized from the ectopic stimulus, but the remainder of the conduction is normal through the AV Node and downward.
- Causes: Common and occur in normal hearts, ischemic, use of sympathomimeticagents, caffeine intake, stress, myocardial abnormal
- Treatment:
  - Asymptomatic: Observe
  - Symptomatic: Observe and treat symptoms, pt will complain of palpations and skipped HR.



Atrial Flutter

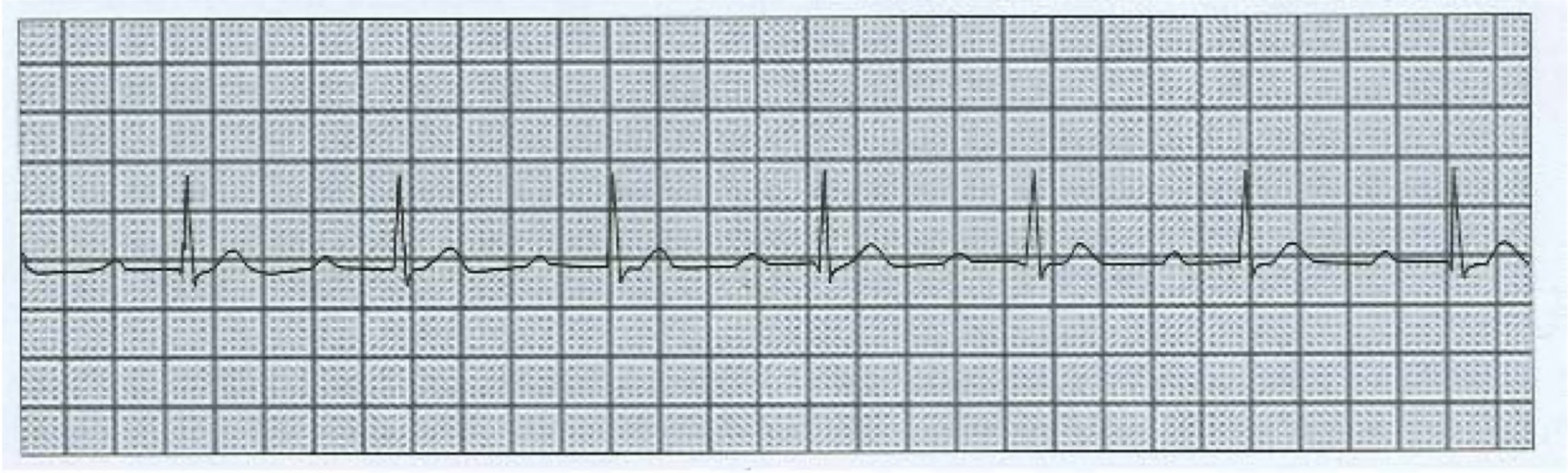
- Rate: Atrial rate: 250-350bpm, ventricular<100(controlled), >100(uncontrolled)
- Reguarity: Atrial regular, ventricular depends on AV conduction
- P wave: Absent; saw tooth/flutter waves
- PR interval: n/a
- QRS: <0.12sec
- Why: Caused by a flawed reentry circuit within the atria. AV node protects the ventricles by allowing some of the atrial depolarizations to conduct through the rest of the conducting pathways. RMBR, loss of coordinated contraction of the atria.
- Cause: Bad reentry within atria, acute or chronic cardiac issue, mitral/tricuspid valve disorder, cor pulmonale, pericarditis, Post MI complication, hyperthyroidism, alcoholism, post cardiac surgery
- Treatments
  - Asymptomatic: Observation and HR control using beta and calcium channel blockers to reduce ventricular rate.
  - Symptomatic: Synchronized cardioversion: 100J, 200J, 300, 360j

Atrial Fibrillation

- Rate: Ranges
- Regularity: Irregularly, regular
- P wave: None
- PR interval: None
- QRS: <0.12sec
- Why: Caused by chaotic reentry/ectopic activity = atria quivering not contracting. This causes low cardiac output and increased ventricular response which increases instability of patient.
- Causes: Ectopic/reentry, MI, CAD, CHF, COPD, ischemia chest trauma
- Treatment :
  - Stable: Treat symptoms and observe.
  - Unstable: Beta and calcium channel blockers, digoxin, amiodarone, synchronized cardioversion at 120-200J

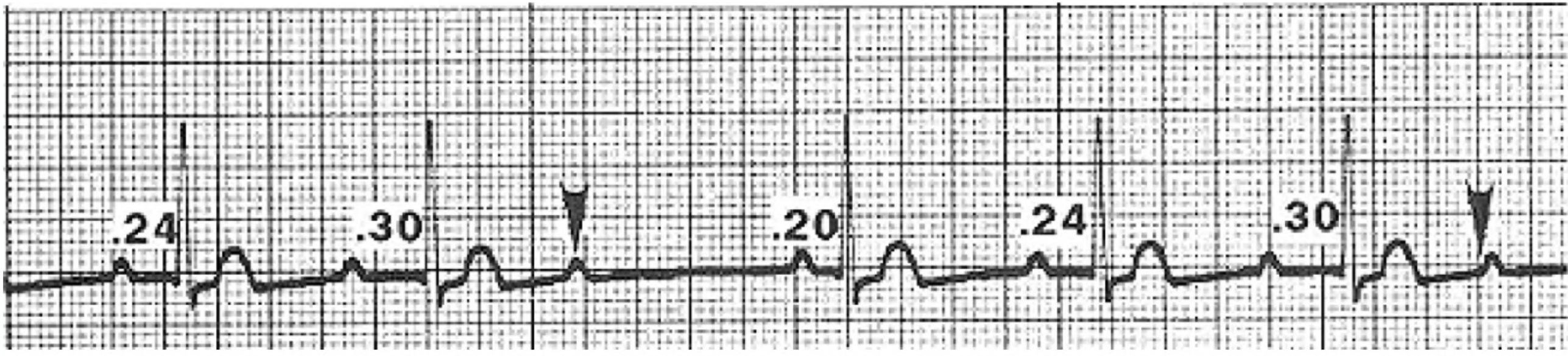
Supraventricular Tachycardia (SVT)

- Rate: >150BPM
- Regularity: Regular
- P wave: May not be visible due to fast heart rate
- PR interval: <0.12 sec
- QRS: Narrow, <0.12 sec
- Causes: Sudden due to a premature atrial beat and atrial re-entry current
- Treatment:
  - Asymptomatic: Observation
  - Symptomatic and stable: Valsalva maneuver, Place face in ice bath, IV adenosine (6mg, 12mg, 12mg),
  - Symptomatic and unstable: Synchronized cardioversion at 100J, 200j, 300J, 360J,



1st degree AV heart block

- Rate: 40-90BPM
- Regularity: Regular
- P wave: Present and upright
- PR interval: >0.20 sec
- QRS: < 0.12 sec
- Why: Conduction delay occurs at the level of the AV node.
- Causes: Acute inferior and right ventricular MI, increased vagal tone, beta and calcium channel blockers, electrolyte imbalances
- Treatment
  - Asymptomatic: Observe
  - Symptomatic: Treat underlying causes and symptoms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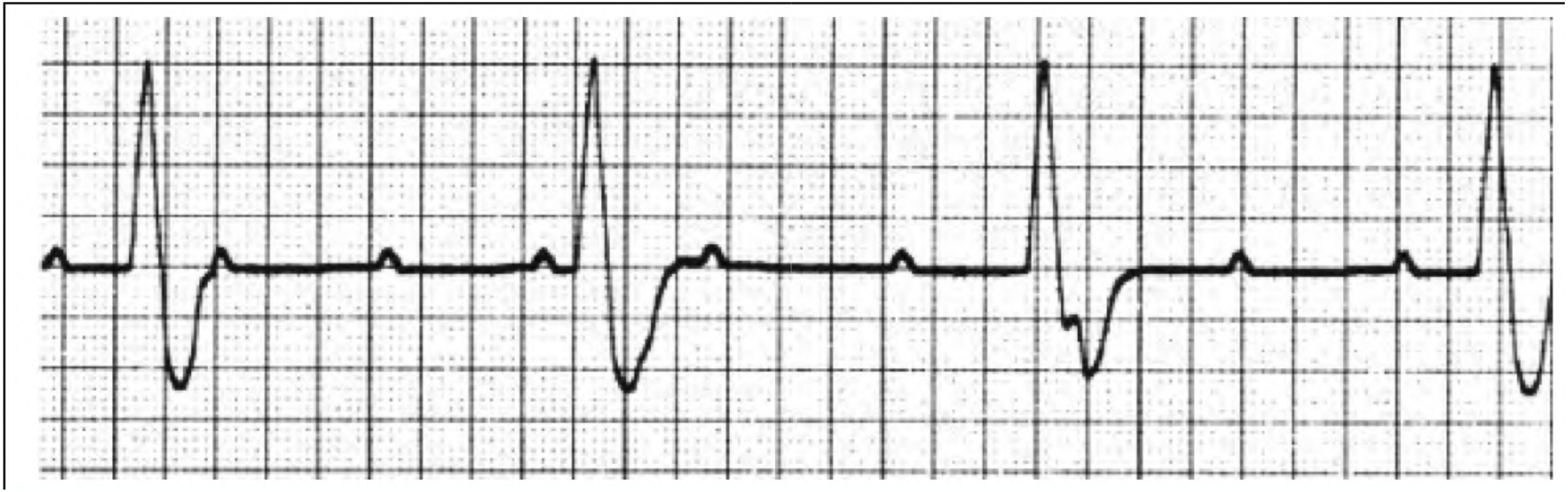
2nd Degree AV block Mobitz/Type I, Wenckebach

- Rate: 60-90 BPM
- Regularity: Atrial regular, Ventricular irregular due to dropped P waves
- P wave: Present and upright; P's are not followed by a QRS.
- PR interval: Progessively longer until one P wave isn't followed by a QRS complex. Blocked beat, cycle starts again.
- QRS: < 0.12 seconds
- Why: SA node is working fine, but impulses through the AV node take long, longer and longer to conduct until an impulse is blocked. Block occurs ar the AV node.
- Cause: Inferior and right ventricular MI, increased vagal tone, beta and calcium channel blockers, electrolyte imbalances, ischemic heart disease.
- Treatment:
  - Asymptomatic: Observe
  - Symptomatic: Atropine 0.5mg, max of 3mg.

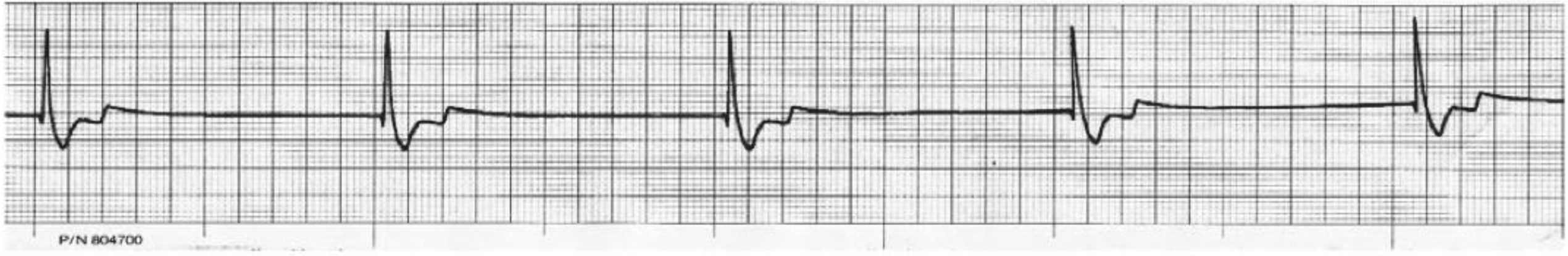
2nd degree AV block Type II/ Mobitz II

- Rate: 40-60BPM
- Regularity: Atrial regular, ventricular irregular
- P wave: Present and upright, more P’s than QRS.
- PR interval: conducted beats will be constant
- QRS: < 0.12 sec for conducted beats
- Why: Block occurs below AV node at bundle of His or bundle branches . Shown with successful P waves having a constant PR interval and followed by one/more non- conducted P waves. SA node is fine, therefore P-P is regular but irregular ventricles. RMBR if block is at the bundle of His then the QRS is narrow, if block is at bundle branches then QRS is wider.
- Caused: Anterior MI, damage to the bundle branch system, severe CAD
- Treatments
  - Asymptomatic: Observe
  - Symptomatic: Transcutaneous Pacing



3rd Degree AV Block or Complete Heart Block

- Rate: 40-60 BPM
- Regularity: P-P is irregular, R-R is regular
- P wave: Present and upright, extra P waves
- PR interval: No relationship between P waves and QRS complex.
- QRS: Can be > 0.12 seconds or < 01.2 seconds.
- Why: Block occurs at AV node/bundle of His/bundle branches. The SA node controls the atria and since no communication between SA and AV node, the backup pacemaker take over for the ventricles. Two separate pacemakers in upper and lower chambers of the heart = AV dissociation.
- Causes: Acute inferior or right ventricle MI, ischemic heart disease, increased vagal tone, digitalis toxicity, beta and calcium channel blockers, electrolyte imbalances
- Treatment:
  - Asymptomatic: Observe
  - Symptomatic: Transcutaneous Pacing.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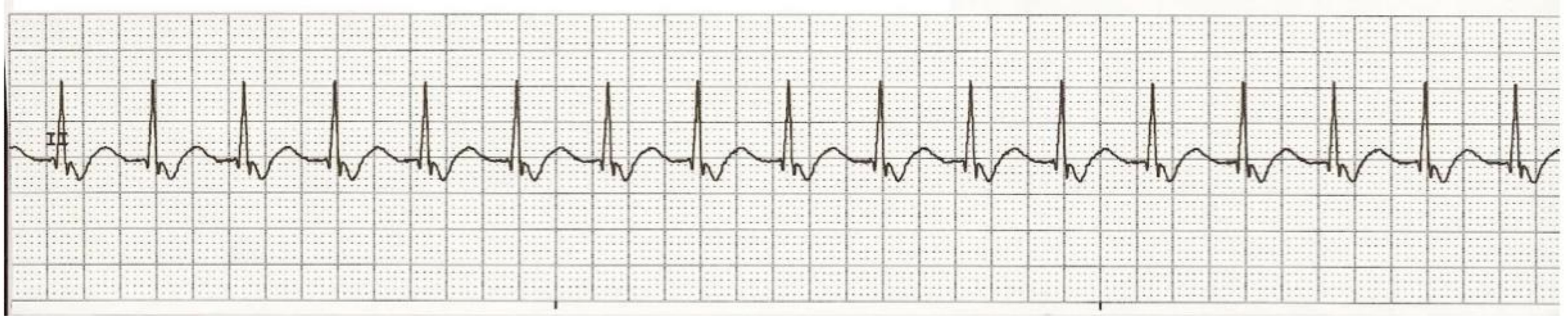
Junctional Rhythm

- Rate: 40-60 BPM
- Regularity: Regular
- P wave: Absent
- PR interval: Absent
- QRS: <0.12 sec and may be wider
- Why: Area around Bundle of His is called AV junction, lies a back up pacemaker called Junctional pacemaker. If the AV node is not depolarized by sinus impulse in 1-1.5 secs it will initiate its own impulse = junctional escape rhythm. This rhythm has absent P waves or unusual p waves such as inverted or p wave after QRS wave showing retrograde (impulse has to travel backward to activate the atria). RMBR has an intrinsic rate of 40-60bpm.
- Causes: Electrolyte imbalance, sick sinus syndrome, digitalis toxicity, inferior wall MI , hypoxemia,
- Treatment :
  - Stable: Observation
  - Unstable: Treat reversible causes, Atropine 0.5mg may be considered.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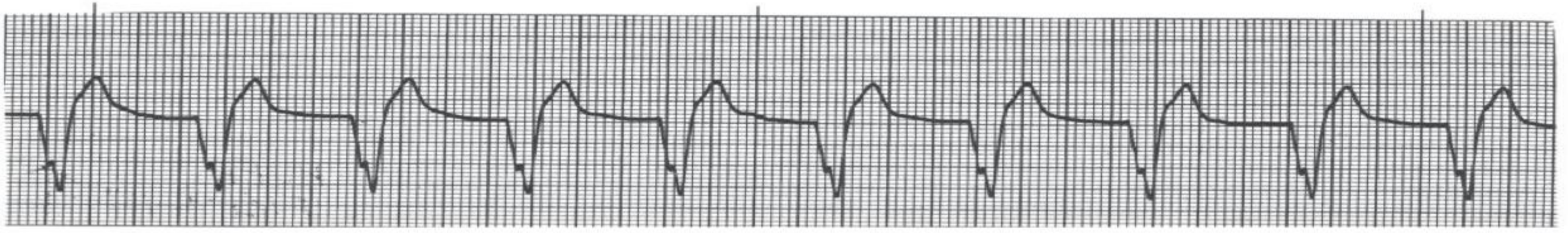
Accelerated Junctional Rhythm/ Junctional Tachycardia

- Rate: 60-100 bpm, if >100 bpm it is junctional tachycardia.
- Regularity: Ventricular rhythm is regular
- P wave: Absent
- PR interval: N/a
- QRS: <0.12 seconds
- Why: Similar to junctional rhythm but pacemaker is now sped up past intrinsic rate of 40-60bpm.
- Cause: Digoxin toxicity, hypoxia, cardiomyopathy, MI, valve replacement surgery
- Treatment:
  - Asymptomatic: Observation
  - Symptomatic: Beta blockers, calcium channel blockers, amiodarone, discontinue digoxin.

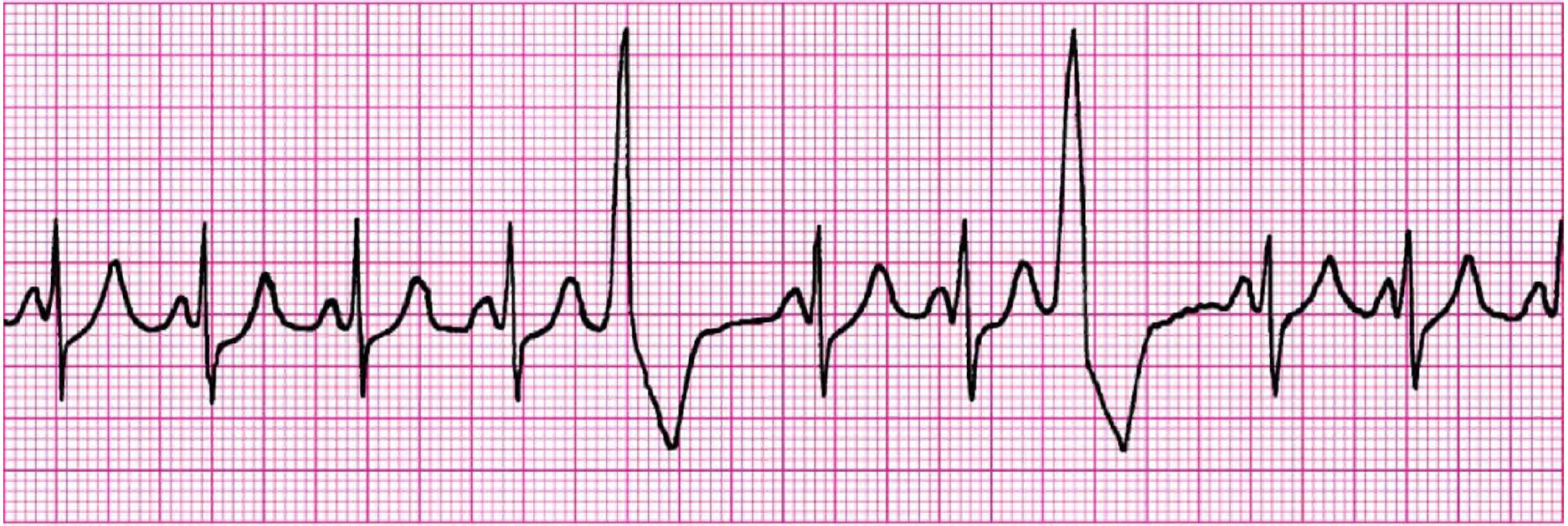
Idioventricular Rhythm (IVR)

- Rate: 20-40 BPM
- Regularity: regular (wide and slow)
- P wave: n/a
- PR interval: n/a
- QRS: > 0.12 seconds
- Why: Ventricles don’t receive signals at proper rate, ventricular pacemaker begins to create its own impulses. RMBR: ventricular signals are not spread through conducting pathways but cell to cell = wide QRS. Ventricular pacemaker has an intrinsic rate of 20-40BPM.
- Causes: MI, Pacemaker Failure, Electrolyte imbalance
- Treatments: Consider atropine, use of lidocaine and amiodarone and maybe pacing.



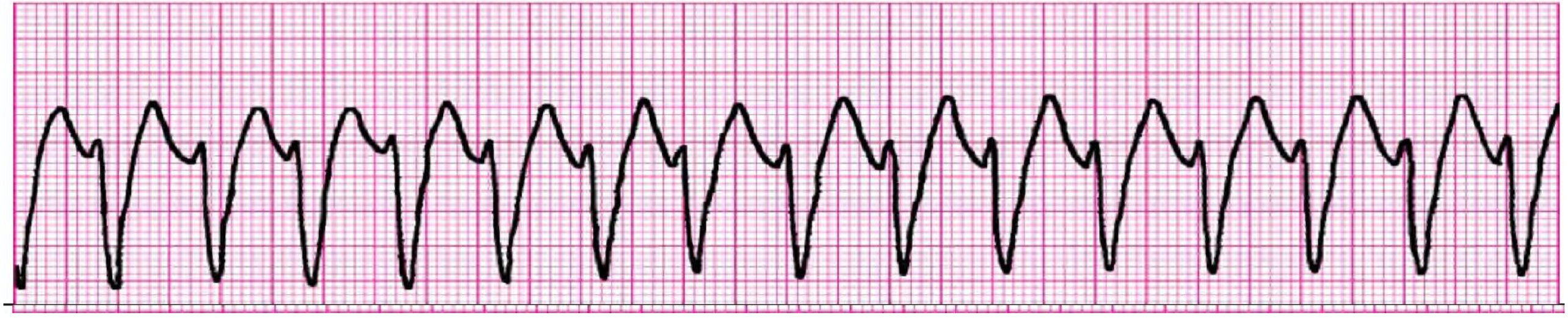
Accelerated Idioventricular Rhythm (AIVR)

- Rate: 40-100bpm
- Regularity: Regular
- P wave: n/a or retrograde conduction
- PR interval: n/a
- QRS: wide; > 0.12 seconds
- Why: Similar to Idioventricular rhythm, but ventricular pacemaker is sending signals faster than intrinsic rate.
- Causes: MI, Pacemaker Failure, Electrolyte Imbalance
- Treatments: Consider atropine, use of lidocaine and amiodarone and maybe pacing.



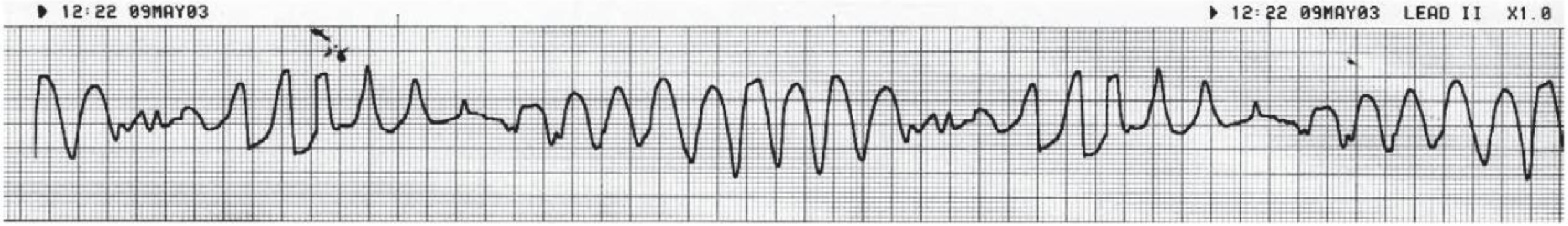
Premature Ventricular Contractions

- Rate: Depends on underlying rhythm,
- Regularity: Depends on underlying rhythm,
- P wave: Usually no p waves associated with QRS.
- PR interval: None
- QRS: >0,12; wide and bizarre in appearance.
- Why: Depolarization that happens in either ventricle before next expected sinus beat causing a premature ventricular beat.
- Types:
  - Unifocal PVCs: PVC look the same; originate from the same focus
  - Multifocal PVCs: Represent myocardial irritability because different foci are initiating PVCs. Can be couplet, ventricular bigeminy, trigeminy, quadrigeminy and any more is called runs of v-tach.
  - RMBR: R on T phenomena where R waves develop on or near a T wave.
- Causes: caffeine, tobacco, alcohol, digoxin toxicity, exercise, hypocalcemia, hypokalemia, new MI
- Treatment
  - Asymptomatic: Observe; rule out hypoxemia, hypokalemia
  - Symptomatic: Treat underlying cause



Monomorphic Ventricular Tachycardia

- Rate: 100-250 bpm
- Regularity: Ventricular rhythm is regular
- P wave: Unlikely to appear since rate is fast, buried in the QRS
- PR interval: N/A
- QRS: Wide > 0.12 sec
- Why: 3/more PVCs in a row, caused by a single foci in either ventricle that fires at a rate to override the SA node and control the heart rhythm. RMBR has wide QRS due to the time takes to conduct action potential cell to cell.
- Causes: R on T phenomenon, hypoxia, ischemia, acidosis, cardiomyopathy, electrolyte imbalances, increased ICP, CAD.
- Treatment:
  - Stable: 12 lead, consider lidocaine 1mg/kg
  - Unstable w/pulse: 12 lead, synchronized cardioversion 100J, 200J, 300J, 360J
  - Unstable pulseless: Defibrillation at 200J, 300J, 360J and CPR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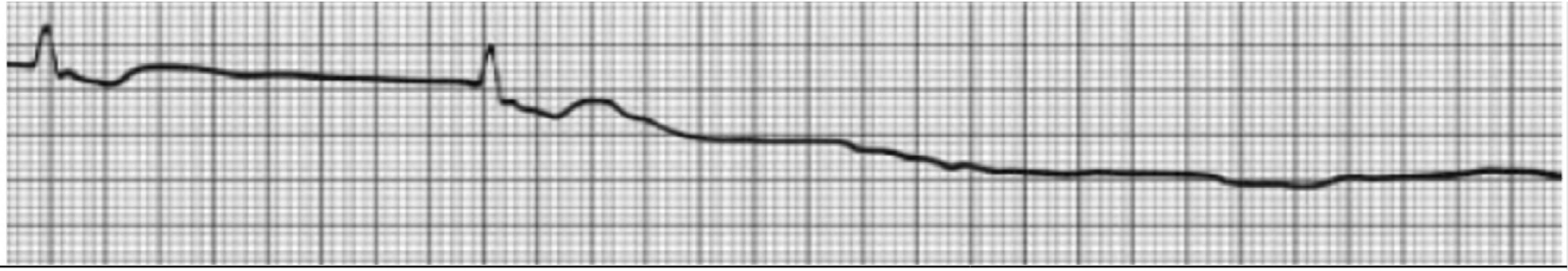
Polymorphic Ventricular Tachycardia/ Torsades de Pointes

- Rate: 100-250bpm
- Regularity: Oscillation, regular
- P wave: P waves buried in QRS
- PR interval: n/a
- QRS: Wide; > 0.12 sec
- Why: Mutifoci in the ventricles override the SA mode , causing QRS completes of varying amplitude axis and duration.
- Cause: QT lengthening drugs eg quinidine, procainamide and stalol, MI, hypokalemia, hypomagnesemia, hypercalcemia
- Treatment:
  - Magnesium sulfate: 2gm diluted in 10ml NS
  - Defibrillation at 200J, 300j, 360J
  - https://www.youtube.com/watch?v=ExmDJ7OfZaI

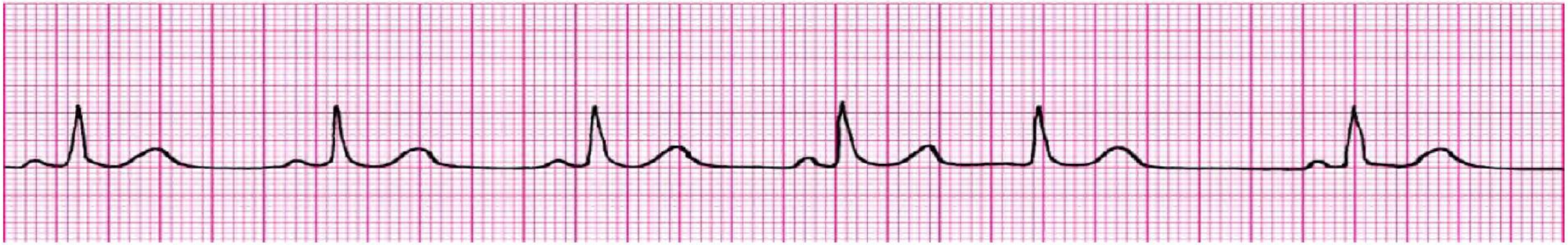
Ventricular Fibrillation

- Rate: Unable to measure
- Regularity: No visible rhythm
- P wave: n/a
- PR interval: n/a
- QRS: n/a
- Why: irritable ventricles send out rapid and disorganized stimulus= no organized ventricular depolarization. Therefore ventricles do not contract but instead fibrillate = no cardiac output, no pulse and no bp.
- Cause: CAD, MI, trauma, hypoxia, acidosis, antiarrhythmics, electrolyte imbalances, cardioversion, hypothermia, electrocution
- Types:
  - Coarse V-Fib: waves are seen, indicates recent onset and can be converted by quick defibrillation.
  - Fine V-fib: Waves are shorter, begins to resemble systole indicates delay since collapse.
- Treatment: Prompt defibrillation, 200J, 300J, 360J and follow CPR protocol.



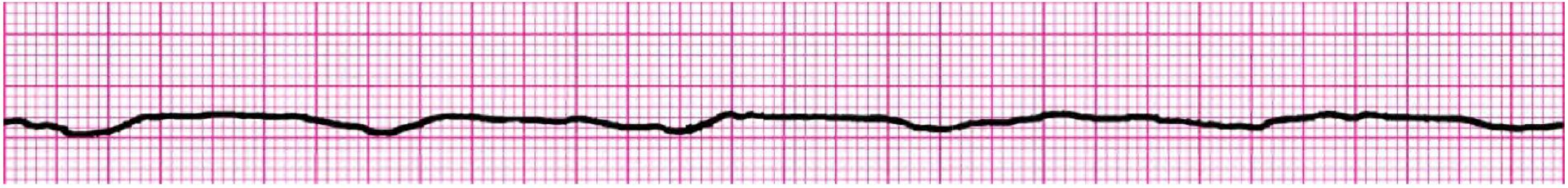
Agonal

- Rate: None
- Regularity: none
- P wave: none
- PR interval: none
- QRS: none
- Why: Due to medications might see some electrical activity, agonal breathing.
- Causes: Cardiac disease, Ischemia, MI, acidosis, hypoxia, electrolyte imbalances
- Treatment: CPR and advanced airway, epinephrine 0.01mg/kg 1:10,000



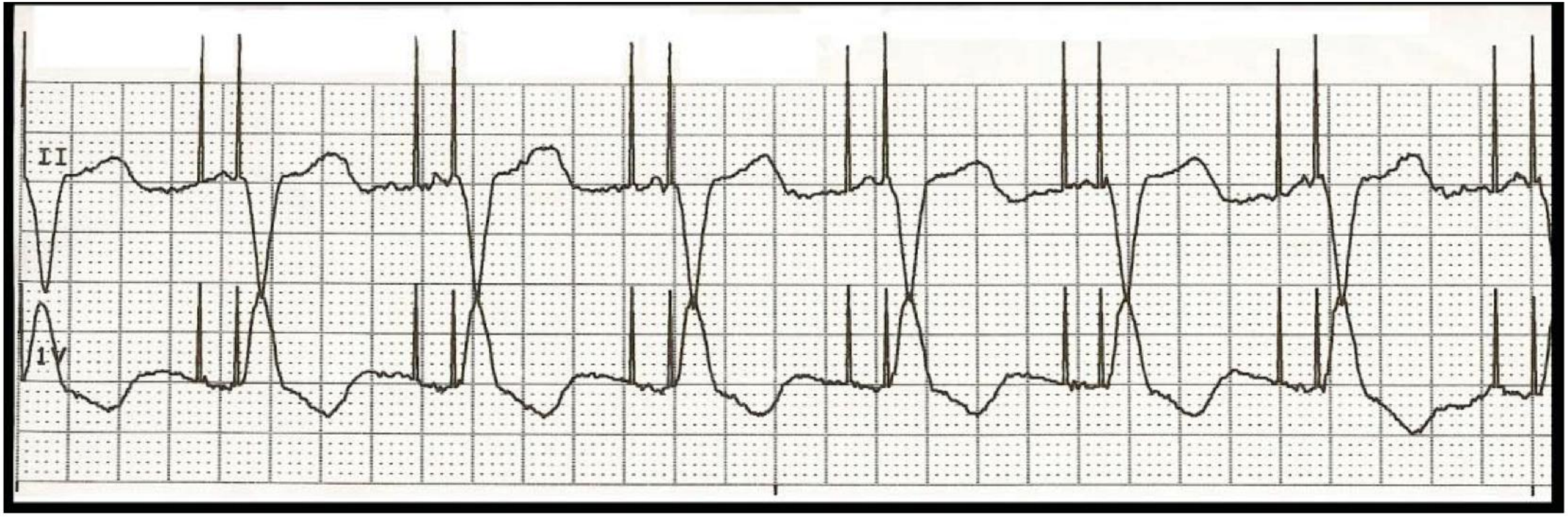
Pulseless Electrical Activity (PEA)

- Rate: Depends on rhythm
- Regularity: Depends on rhythm
- P wave: Depends on rhythm
- PR interval Depends on rhythm
- QRS: Depends on rhythm
- Why: Presence of electrical activity but inadequate mechanical activity.
- Causes: Hypovolemia, Hypoxia
- Treatment: CPR and advanced airway, epinephrine 0.01mg/kg 1:10,000



Asystole

- Rate: None
- Regularity: none
- P wave: none
- PR interval: none
- QRS:none
- Why: Absence of electrical activity, no depolarization=no contraction. Always double check by assessing pulse and can confirm in leads I and III.
- Causes: Cardiac disease, Ischemia, MI, acidosis, hypoxia, electrolyte imbalances
- Treatment: CPR and advanced airway, epinephrine 0.01mg/kg 1:10,000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Paced Rhythm

- Rate: Determined by pacemaker
- Regularity: Regular
- P wave: Can be present and upright
- PR interval:< 0.20 sec
- QRS: Variable based on pacemaker.
- Causes: Implantation of a pacemaker in the chest.
- Treatment: Check vitals, emergent pacing and possibly CPR.