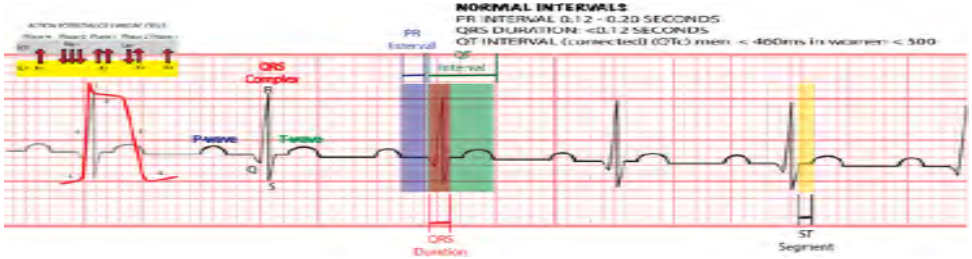


DETERMINE RHYTHM

- P wave for each QRS complex?
- QRS complex for each P wave
- Rate <100 >60 = Sinus Rhythm

DETERMINE INTERVALS

PR - normal 0.12 - 0.20 s
QRS Duration: <0.12 s

QT Interval	1-15 years.	Male.	Female
Normal	0.44	<0.43	<0.45
Prolonged.	>0.46.	>0.45.	>0.47

DETERMINE RATE

Count # of large boxes between the QRS complexes.

300 150 100 75 60 50 43

DETERMINE REGULARITY

Measure the space between QRS complexes. If equal distance = regular. If not equal distance evaluate if the irregularity recurs on a regular basis or is irregular irregular. (Atrial fibrillation, etc.)

DETERMINE AXIS

LEAD	II	AVF	ETIOLOGY
Normal	+	+	NORMAL
LAD	+	-	Obesity, Left ant fascicular block, Inf MI, ASD, WPW
RAD	-	+.	Cavitus pectorum, L post fascicular block, Lat MI, RVH, COPD
Indeterminate (No Mans Land)	-	-	Leads reversed, COPD,

DETERMINE WAVE MORPHOLOGY

HYPERTROPHY (Enlarged myocardium)

- LEFT VENTRICULAR HYPERTROPHY : Causes: aerobic exercise, systemic hypertension, cardiovascular disease, remodeling
  - Criteria: R wave in V5 or V6 > 25mm
  - S wave in V1 or V2 >25mm
  - Sum of R wave in V5 or V6 and S wave in V1 > 35mm
- RIGHT VENTRICULAR HYPERTROPHY: Causes - advanced Lung disease, pulmonary hypertension
  - Criteria: R wave >S wave in V1

Left Atrial Enlargement
(=**P** **M**itrale)

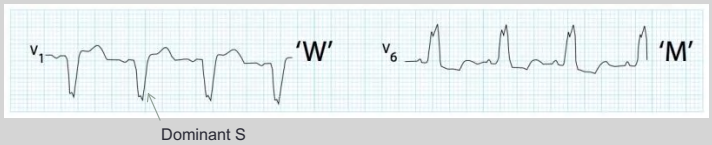
P Mitrale) P wave >0.12 s & bifed in II

Right atrial enlargement
(= **P** **P**ulmonale)

P Pulmonale) Peaked P wave >25 mm in II

BUNDLE BRANCH BLOCKS

LEFT BUNDLE BRANCH BLOCK

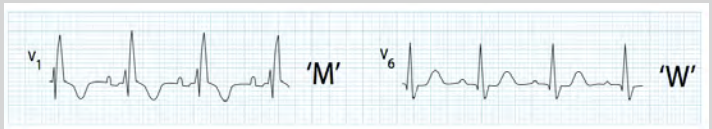


AORTIC STENOSIS, ISCHEMIA, HTN, ANT MI, ^K+, DIGOXIN

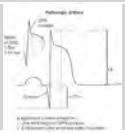
- QRS duration of > 120 ms
- Dominant S wave in V1
- Broad monophasic R wave In lateral leads (I, aVL, V5-V6)
- Absence of Q waves in lateral leads
- Prolonged R wave peak time > 60ms iN left precordial leads (V5-6)

RIGHT BUNDLE BRANCH BLOCK

- Broad QRS > 120 ms
- RSR' pattern in V1-3 ('M-shaped' QRS complex)
- Wide, slurred S wave in the lateral leads (I, aVL, V5-6)



PE, RVH, ISCHEMIA, CARDIOMYOPATHY,

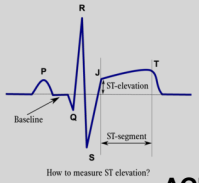


PATHOLOGIC Q WAVES (OLD MI)

A pathologic Q wave = 2 small squares deep (2mm), 1 small square wide and >25% of subsequent R wave in 2 contiguous leads

ST SEGMENTCHANGES

ELEVATION



CAUSES

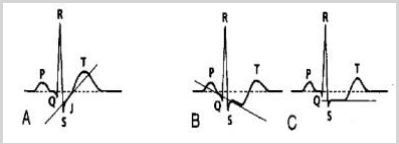
Acute MI, LVH, early depolarization

ACUTE MI

2 mm elevation in 2 contiguous leads

- **ANT = V3 V4. INF = II, III, AVF**
- **LAT = V5 V6. SEP = V1 V2**
- **POSTERIOR - ST Depression in V1 - V4**

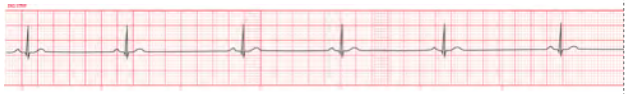
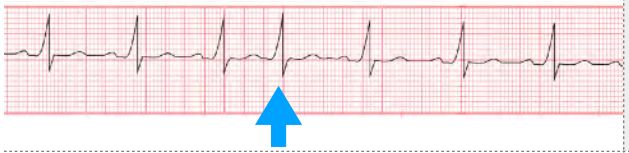
DEPRESSION



Upscoping downscoping. Horizontal

CAUSES

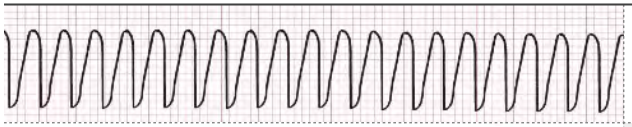
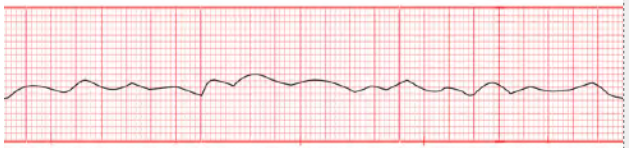
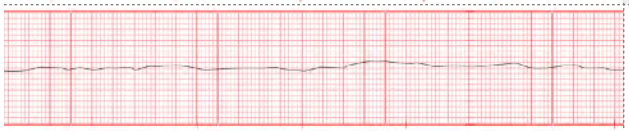
Ischmia, subendocardial injury, reciprocal changes, electrolyte imbalance, LVH or RVH

EKG STRIP	RHYTHM	RATE	REGULARITY	PR INTERVAL	QRS DURATION	INFORMATION	NOTES
	SINUS RHYTHM	60-100	REGULAR	0.12-0.20 ms	<0.12 ms	n/a	Normal EKG is not diagnostic and does not exclude disease
	SINUS TACHYCARDIA	>100	REGULAR	0.12-0.20 ms	<0.12 ms	Treat the underlying cause	May be caused by exercise, anxiety, fever, hypoxemia, hypovolemia, stimulants
	SINUS BRADYCARDIA	<60	REGULAR	0.12-0.20 ms	<0.12 ms	If symptomatic Atropine IV push or epinephrine	Normal in athletes and during rest. Medications may cause it including betablockers, benzodiazepines, calcium channel blockers
	SINUS ARRYTHMIA	Variable	Irregular, varies with respirations	0.12-0.20 ms	<0.12 ms	None unless bradycardia or tachycardia with symptoms	SA rate variable based on respirations. Common in children and elderly
	PREMATURE ATRIAL CONTRACTION	Variable	Irregular with PAC	0.12-0.20 ms	<0.12 ms	Premature beat preceded by a P-wave. (P wave may look different, different focus in Atria)	May be normal, often patient is aware of these ectopic beats. No treatment unless symptomatic
	PREMATURE JUNCTIONAL CONTRACTION	Variable	Irregular with PJC	0.12-0.20 ms	<0.12 ms	Premature narrow QRS without or retrograde P wave. Originates from AV Junction	May be normal.
	PREMATURE VENTRICULAR CONTRACTION	Variable	Irregular with PVC	0.12-0.20 ms	<0.12 ms	Premature wide bizarre QRS complex. Originates in the ventricle.	May be normal. Occurs in cardiac irritation, hypoxia, ischemia. Lidocaine for frequent or symptomatic. 2 PVC = couplet 3 PVC = Triplet

EKG RHYTHM STRIPS

EKG STRIP	RHYTHM	RATE	REGULARITY	PR INTERVAL	QRS DURATION	DRUGS	NOTES
	ATRIAL FIBRILLATION	Variable If > 100 referred to as rapid ventricular response (RVR)	Irregularly irregular	Indeterminate	<0.12 ms	Anticoagulation if persistent, digoxin, betablockers, calcium channel	Determine if new onset or sustained. Treat underlying causes if new onset (Electrolytes, valvular defects, etc.)
	ATRIAL FLUTTER	Variable	Atria - regular Ventricles - regular or irregular	Sawtooth pattern variable rate	<0.12 ms	Treat the underlying causes. Symptoms usually related to Ventricular rate	May be early indication of underlying cardiac disease.
	FIRST DEGREE ATRIO-VENTRICULAR BLOCK	Variable	Regular	>0.20 sec (one large box)	<0.12 ms	n/a	Conduction through AV Node is slowed. Typically benign finding
	SECOND DEGREE AV BLOCK MOBITZ 1	Variable	Regularly irregular	Increasing PR interval until QRS dropped	<0.12 ms	Treat underlying cause	Causes: b-blockers, CCB, Digoxin, amiodarone, Inferior MI, Myocarditis
	SECOND DEGREE AV BLOCK MOBITZ 2	Variable	Regular	Variable Intermittent non-conducted p waves 2:1; 3:1	<0.12 ms	If bradycardia consider atropine, epinephrine	Failure of conduction at HIS-Purkinje. Ant. MI, cardiac surgery, amyloidosis, hyperkalemia, b-blockers, CCB, Digoxin, amiodarone
	COMPLETE HEART BLOCK	Variable Typically very brady-cardic	Irregular	Variable	Junctional or ventricular escape beats	Atropine Isuprel Pacemaker !	No supraventricular impulses are conducted. Causes: INF MI; b-blockers, CCB, digoxin
	SUPRA-VENTRICULAR TACHYCARDIA	>160	Regular	0.12-0.20 ms. Narrow QRS	<0.12 ms	adenosine, carotid massage, valsalva treat underlying cause	Rapid rhythm originating above the ventricles.

EKG RHYTHM STRIPS

EKG STRIP	RHYTHM	RATE	REGULARITY	PR INTERVAL	QRS DURATION	DRUGS	NOTES
	VENTRICULAR TACHYCARDIA	>120	REGULAR	n/a	Wide	lidocaine, procainimide, defib or cardiovert	Rapid wide EKG rhythm. Treatment defined by patient condition.
	VENTRICULAR FIBRILLATION	Not identifiable	Not identifiable	Not identifiable	None	Cardiac Arrest/ ACLS. Epinephrine, defibrillate, CPR	Life Threatening
	ASYSTOLE	Not identifiable	Not identifiable	Not identifiable	None	Epinephrine, CPR	NO identifiable atrial or ventricular rhythm. Follow ACLS guidelines

DIFFERENTIAL DIAGNOSIS

SHORT PR INTERVAL
- AV junctional rhythm
- Wolf Parkinson White Syndrome
- LGL Syndrome

LONG PR INTERVAL
- 1st degree AV Block
- Hyperkalemia
- Medications (Digoxin, BB, Ca Blockers)
- Ischemic Heart Disease

TALL P WAVE
- Right Atrial Enlargement
  - RV failure, pulmonary hypertension, tricuspid regurg, tricuspid stenosis, atrial septal defect

WIDE P WAVE
- Left Atrial Enlargement
  - Obesity, Obstructive Sleep Apnea

PATHOLOGIC Q-WAVES
- STEMI
- LVH
- WPW
- BBB
- PE

PROLONGED QT INTERVAL
- Electrolyte imbalance (Ca++)
- Medications (quinidine, procainimide, amiodaraone, sotolol, flecanide, antipsychotics, TCAs, macrolides, quinolones

TALL T WAVES
- ACUTE MI
- HyperKalemia
- Hypothermia

SMALL T WAVES
- Hypokalemia
- Pericardial Effusion
- Hypothyroidism

INVERTED T-WAVE
- Myocardial Ischemia
- Myocardial Infarction
- Ventricular Hypertrophy
- Digoxin Toxicity

PROMINENT U WAVES
- Hypokalemia
- Hypercalcemia

CRITERIA

1ST DEGREE AV BLOCK
- PR interval > or = 0.20 seconds

2ND DEGREE AV BLOCK MOBITZ 1
- Progressive Prolongation of PR until P wave is blocked

2ND DEGREE AV BLOCK MOBITZ II
- Constant PR Interval
- Intermittent non-conducted P waves

3RD DEGREE BLOCK (COMPLETE HEART BLOCK)
- Constant P - P and R - R intervals
- Complete failure of the atrial impulses to be stimulate ventricular activity
- Atrial rate typically faster then ventricular rate
- No association between atrial beats and ventricular beats

INTRAVENTRICULAR CONDUCTION DELAY
- Mean QRS Duration >110 ms in adults, >90 ms in children
- Criteria for RBBB or LBBB not met