ECG TABLES

ABDULRAHMAN SALEH NASEEF

MPHIL, ST. GEORGE'S UNIVERSITY OF LONDON, UK
CARDIOVASCULAR TECHNOLOGY INSTRUCTOR
BSc. CLINICAL SCIENCE, CARDIOLOGY, NESCOT COLLEGE, UK
INVASIVE & NON-INVASIVE RCVT (USA), CCI/MBCVT (USA)
PRINCE SULTAN CARDIAC CENTER (PSCC)
RIYADH, SAUDI ARABIA

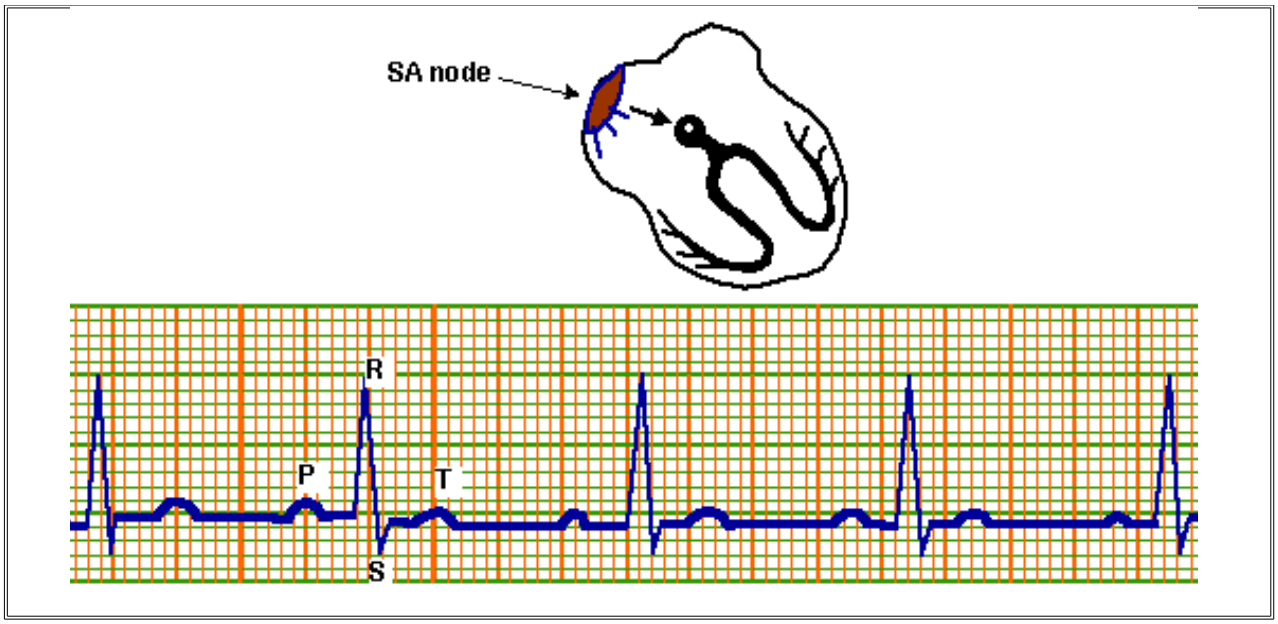
SUB DIVISION	MAIN ECG RHYTHM TYPES			
	SINUS RHYTHMS	ATRIAL RHYTHMS	JUNCTIONAL RHYTHMS	VENTRICULAR RHYTHMS
	NORMAL SINUS RHYTHM	WANDERING PACEMAKER	JUNCTIONAL RHYTHM	IDIOVENTRICULAR RHYTHM
	SINUS BRADYCARDIA	ATRIAL TACHYCARDIA	ACCELERATED JUNCTIONAL RHYTHM	ACCELERATED IDIOVENTRICULAR
	SINUS TACHYCARDIA	ATRIAL FLUTTER	NON-PAROXYSMAL JUNCTIONAL TACHYCARDIA	VENTRICULAR TACHYCARDIA
	SINUS ARRHYTHMIA	ATRIAL FIBRILLATION		VENTRICULAR FIBRILLATION
				ASYSTOLE

	SINUS BEAT	ATRIAL BEAT	JUNCTIONAL BEAT	AGONL RHYTHM
				VENTRICULAR BEAT

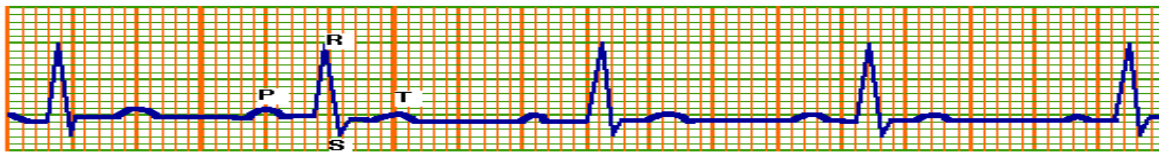
(1) SINUS RHYTHM:

RHYTHM						
(1) SINUS RHYTHMS						
TYPE	Origin	P Wave	PRI	QRS	Rate/ mints	REGULARITY
NORMAL SINUS RHYTHM	SA Node	Upright & rounded	0.12 – 0.20 secs, constant	Narrow (0.06-0.12 secs), precede by P wave	60 – 100 b/m	P-P , R-R, T-T are regular
SINUS BRADYCARDIA	SA Node	Upright & rounded	0.12 – 0.20 secs, constant	Narrow (0.06-0.12 secs), precede by P wave	Less than 60 b/m	P-P , R-R, T-T are regular
SINUS TACHYCARDIA	SA Node	Upright & rounded (sometimes hidden in T wave)	0.12 – 0.20 secs, constant	Narrow (0.06-0.12 secs), precede by P wave	Greater than 100 b/m	P-P , R-R, T-T are regular
SINUS ARRHYTHMIA	SA Node	Upright & rounded	0.12 – 0.20 secs, constant	Narrow (0.06-0.12 secs), precede by P wave	Varies: 60 - 100 b/m	P-P , R-R, T-T are irregular caused by respiration
SINUS BEAT	SA Node	Upright & rounded	0.12 – 0.20 secs, constant	Narrow (0.06-0.12 secs), precede by P wave		

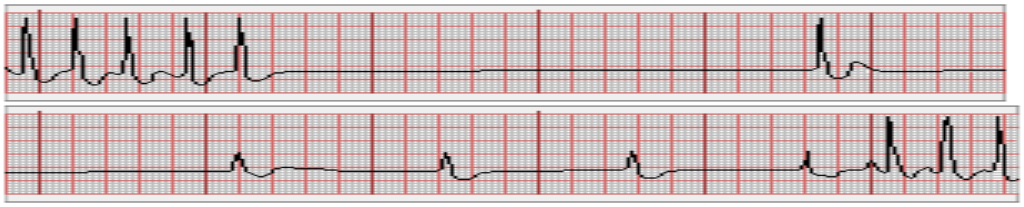
(1) SINUS RHYTHMS	
TYPE	(A) NORMAL SINUS RHYTHM
ORIGIN	SA Node.
P WAVE	All uniform and "all" of them look alike, upright & rounded.
PR INTERVAL	The normal PR Interval (PRI) is 0.12 to 0.20 sec (120 milliseconds to 200 milliseconds), constant.
QRS COMPLEX	Narrow (0.06-0.12 secs), precede by P wave.
HEART RATE (b/ mints)	60 – 100 b/min
REGULARITY	P-P , R-R, T-T are regular.
INTERPRETATION	NORMAL SINUS RHYTHM.
NOTES: there is no one normal heart rate, but this varies by age. It is normal for a newborn to have a heart rate up to 150 b/min, while a child of five years of age may have a heart rate of 100 b/min. The adult's heart rate is even slower at about 60-80 b/min.	



(1) SINUS RHYTHMS	
TYPE	(B) SINUS BRADYCARDIA:
ORIGIN	SA Node.
P WAVE	All uniform and "all" of them look alike, upright & rounded.
PR INTERVAL	The normal PR Interval (PRI) is 0.12 to 0.20 sec (120 milliseconds to 200 milliseconds), constant.
QRS COMPLEX	Narrow (0.06-0.12 secs), precede by P wave.
HEART RATE (b/ mints)	Less than 60 b/min.
REGULARITY	P-P , R-R, T-T are regular.
INTERPRETATION	SINUS BRADYCARDIA

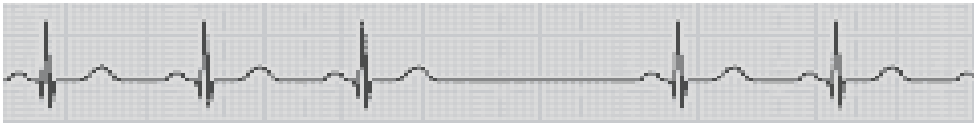


NOTES: the most common cause of symptomatic sinus bradycardia is THE SICK SINUS SYNDROME (SSS).

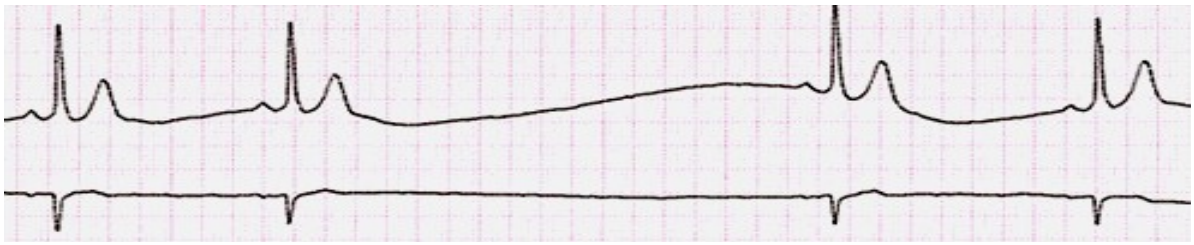


THE TYPES OF SSS:

a. **SINO-ATRIAL (SA) BLOCK:** is a type of **SSS** in which the electrical signals **move too slowly through the sinus node. SA Block unclear whether** the **sinus node pacer cells generate impulses** which **fail to be conducted out of the sinus node** (SA exit block) or **whether the pacer cells fail to generate impulses** (SA arrest). **SA BLOCK** may be associated with abnormal intrinsic nodal function, a failure of the SA junction, or a failure of propagation in the surrounding tissue.



b. **SINUS ARREST:** is when the signal from the SA node has a **pause** in its normal pacemaker activity. **Sinus arrest** upsets the timing of the sinus node discharge and the **underlying rhythm will not resume on time following the pause.**



(1) SINUS RHYTHMS	
TYPE	(C) SINUS TACHYCARDIA
ORIGIN	SA Node.
P WAVE	All uniform and "all" of them look alike, upright & rounded.
PR INTERVAL	The normal PR Interval (PRI) is 0.12 to 0.20 sec (120 milliseconds to 200 milliseconds), constant.
QRS COMPLEX	Narrow (0.06-0.12 secs), precede by P wave.
HEART RATE (b/ mints)	**Greater than 100 b/min.**
REGULARITY	**P-P , R-R, T-T are regular.**
INTERPRETATION	SINUS TACHYCARDIA
NOTES: the **sinus node can initiate impulses up to a rate of approximately 200**	

b/min (in healthy young people during vigorous exercise). Maximum sinus rate is slower in older individuals. In infants reactive sinus tachycardia may occur at rates as fast as 240 b/min, (a rate which would suggest another mechanism in adults). The **rhythm is similar to NORMAL sinus rhythm with the EXCEPTION that the RR INTERVAL IS SHORTER, less than 0.6 seconds. P waves are present and regular** and **each P wave is followed by a QRS complex** in a ratio of 1:1. As rate increases, P wave may be superimposed on the preceding T wave and it then becomes difficult to identify. **ST-T abnormalities are common with tachycardia**. From **tracing alone it is not always possible to DIFFERENTIATE BETWEEN SINUS TACHYCARDIA AND ATRIAL TACHYCARDIA** or **supraventricular tachycardias** (SVT).

(1) SINUS RHYTHMS	
TYPE	(D) SINUS ARRHYTHMIA
ORIGIN	SA Node.
P WAVE	All uniform and "all" of them look alike, upright & rounded.
PR INTERVAL	The normal PR Interval (PRI) is 0.12 to 0.20 sec (120 milliseconds to 200 milliseconds), constant.
QRS COMPLEX	Narrow (0.06-0.12 secs), precede by P wave.
HEART RATE (b/ mints)	**Varies, between 60 - 100 b/min or slow, 40 – 60 b/min.**
REGULARITY	**P-P , R-R, T-T are irregular caused by respiration.**
INTERPRETATION	SINUS ARRHYTHMIA
NOTES: sinus arrhythmia can be confused with SA BLOCK and **with ATRIAL EXTRASYSTOLES**. However, the **rhythm change in sinus arrhythmia is GRADUAL whereas in SA block the rhythm change is ABRUPT**, and **atrial extrasystoles** are **characterized by SUDDEN, PREMATURE P waves. Alterations in vagal tone MEDIATED BY STRESS RECEPTORS IN THE LUNGS, which are irregular, result in phasic changes of the discharge rate**	

and usually has no clinical significance. Since the **impulses arise in the SA node, all the ECG complexes have a normal configuration**. Sinus arrhythmia is a **normal finding in children and young adults in those who are athletic**, or **patients with respiration problems**, and tends to reduce or disappear with age.

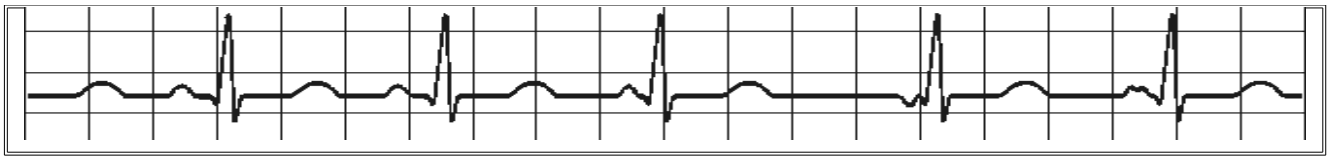
(1) SINUS RHYTHMS	
TYPE	**(E) SINUS BEAT**
ORIGIN	SA Node.
P WAVE	All uniform and "all" of them look alike, upright & rounded.
PR INTERVAL	The normal PR Interval (PRI) is 0.12 to 0.20 sec (120 milliseconds to 200 milliseconds), constant.
QRS COMPLEX	Narrow (0.06-0.12 secs), precede by P wave.
HEART RATE (b/ mints)	**Underlying ECG rhythm.**
REGULARITY	**Underlying ECG rhythm.**
INTERPRETATION	**UNDERLYING ECG RHYTHM.**
NOTES: read the ECG rhythm first.	

(2) ATRIAL RHYTHMS:

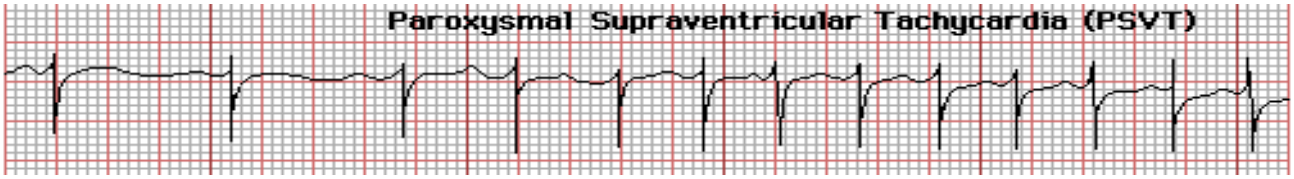
RHYTHM						
(2) ATRIAL RHYTHMS						
TYPE	**Origin**	**P Wave**	**PRI**	**QRS**	**Rate/ mints**	**REGULARITY**
WANDERING PACEMAKER	An atrial ectopic focus	Changes from beat to beat.	Changing	Narrow (0.06-0.12) secs	60 – 100 b/m	P-P , R-R, T-T regular or slightly irregular
ATRIAL TACHYCARDIA	An atrial ectopic focus	Differs from sinus P wave & may be lost in or precedes T	0.12 – 0.20 secs, Constant	Narrow (0.06-0.12) secs	150 – 250 b/m	P-P , R-R, T-T usually regular

		wave.				
ATRIAL FLUTTER	An atrial ectopic focus	No P wave, Flutter wave	**No PRI**	Narrow (0.06-0.12) secs	**Atrial:** 250-350 b/m. **Ventricular:** 60-150 b/m.	**Atrial:** P-P, R-R, T-T are regular. **Ventricular:** P-P , R-R, T-T, varies or regular.
ATRIAL FIBRILLATION	An atrial ectopic focus	No P wave, F waves low amplitude	**No PRI**	Narrow (0.06-0.12) secs	**Atrial:** 350-800 b/m. **Ventricular:** • Less than 100 = controlled. • Greater than 100 = Uncontrolled ventricular response.	P-P , R-R, T-T are irregularly irregular
ATRIAL BEAT	An atrial ectopic focus	Differs from Sinus P wave	May be same or longer than Sinus P wave	Narrow. Looks like a Sinus conducted beat.		

(2) ATRIAL RHYTHMS	
TYPE	**(A) WANDERING PACEMAKER**
THE CRITERIA OF WANDERING ATRIAL PACEMAKER:	
ORIGIN	An atrial ectopic focus.
P WAVE	Changes from beat to beat.
PR INTERVAL	Changing.
QRS COMPLEX	Narrow (0.06-0.12) secs.
HEART RATE (b/ mints)	**60 – 100 b/m.**
REGULARITY	**P-P , R-R, T-T regular or slightly irregular.**
INTERPRETATION	**WANDERING ATRIAL PACEMAKER**
NOTES: Impulses originate from varying points in atria, Variation in **P** wave contour, **P-R** and **P-P** interval and therefore in **R-R** intervals.	



(2) ATRIAL RHYTHMS	
TYPE	(B) ATRIAL TACHYCARDIA (SUPRAVENTRICULAR TACHYCARDIA)
1. PAROXYSMAL ATRIAL TACHYCARDIA:	
ORIGIN	An atrial ectopic focus.
P WAVE	May not always be discernible due to fast rate, frequently obscured in the preceding T wave.
PR INTERVAL	Not measurable.
QRS COMPLEX	Usually normal, less than 0.10 sec.
HEART RATE (b/ mints)	150 – 250 b/min.
REGULARITY	Usually regular.
INTERPRETATION	PAROXYSMAL ATRIAL TACHYCARDIA

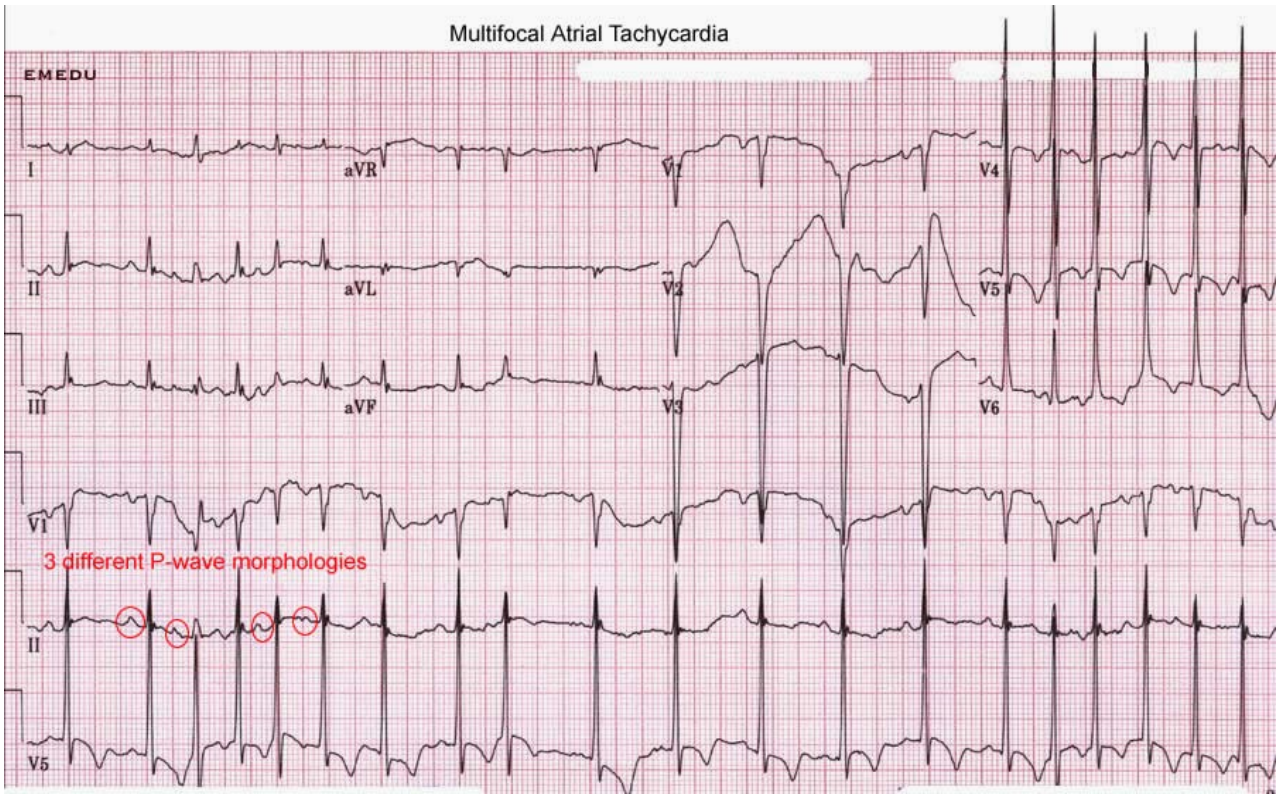


NOTES: the **old name was paroxysmal atrial tachycardia (PAT)**; no longer called PAT unless P waves are clearly seen. PSVT rhythms start and stop suddenly in comparison to sinus tachycardia, which begins and ends gradually. PSVT is also **differentiated from sinus tachycardia by altered configuration of the P waves**. PSVT is supported by either an AV nodal reentry circuit (AV nodal reentry tachycardia; AVNRT) or an AV reentry circuit using the AV node and an accessory pathway (circus movement tachycardia; CMT):

i. Occurs from an **ectopic atrial pacemaker** or **rapid reentry in the atria and AV node.**
ii. Results in **decreased cardiac output due to loss of atrial kick** and shortened diastole.
iii. Characterized by a **rapid heart rate with P waves difficult to distinguish.**

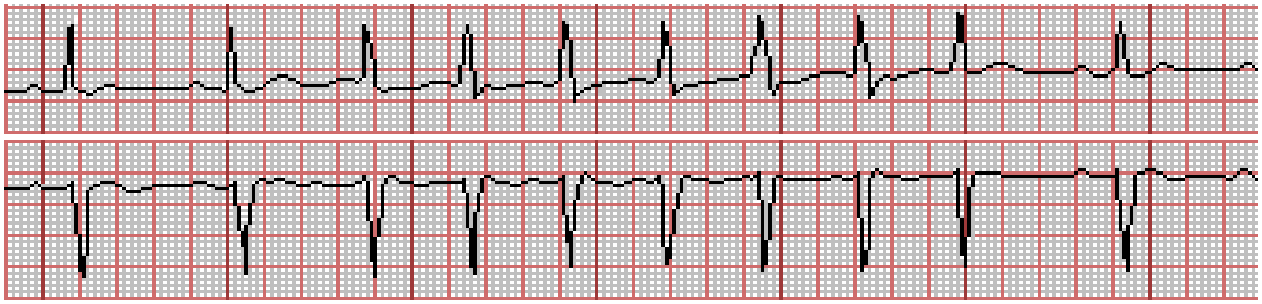
(2) ATRIAL RHYTHMS	
TYPE	(B) ATRIAL TACHYCARDIA (SUPRAVENTRICULAR TACHYCARDIA)
2. MULTIFOCAL ATRIAL TACHYCARDIA (MFAT)	
ORIGIN	An atrial ectopic focus.
P WAVE	THREE OR MORE P WAVE MORPHOLOGIES
PR INTERVAL	VARYING PR INTERVALS (should see at least 3 different P wave morphologies in a given lead) due to several atrial locations are competing for control of the rhythm, resulting in P waves of differing shape and/or PR interval.

QRS COMPLEX	Usually normal, less than 0.10 sec.
HEART RATE (b/ mints)	i. **A rate greater than or equal to 100 b/min (100-250 b/min).** ii. **If atrial rate is <100 b/min**, call it **MULTIFOCAL ATRIAL RHYTHM.**
REGULARITY	i. **Ventricular response is irregularly irregular** (i.e., often confused with A-fib). ii. **May be intermittent, alternating with periods of normal sinus rhythm.** iii. Because the **P waves occur at differing times**, the **rhythm tends to be irregular.**
INTERPRETATION	**MULTIFOCAL ATRIAL TACHYCARDIA (MFAT)**



NOTES: It is **seen most frequently in patients with severe pulmonary disease.** The rapid ventricular rate can be symptomatic (hypotension, angina, congestive heart failure).

(2) ATRIAL RHYTHMS	
TYPE	(B) ATRIAL TACHYCARDIA (SUPRAVENTRICULAR TACHYCARDIA)
3. ATRIOVENTRICULAR NODAL REENTRANT TACHYCARDIA (AVNRT)	
ORIGIN	Use a concealed accessory pathway for retrograde conduction.
P WAVE	May or may not be seen; follow closely after the QRS if they are seen; retrograde P is usually lost in the QRS. Subsequent P waves are buried in the QRS (retrograde activation).
PR INTERVAL	At the onset of the tachycardia is long as the impulse uses the slower pathway.
QRS COMPLEX	Usually normal in contour and duration (narrow complex).
HEART RATE (b/ mints)	150-250 b/min (rarely above 250).
REGULARITY	Usually regular.
INTERPRETATION	ATRIOVENTRICULAR NODAL REENTRANT TACHYCARDIA (AVNRT)



NOTES: a reentrant supraventricular rhythm whose circuit is located in the region of the AV node. **Two functionally separate pathways down to the AV node;** a **slow** (posterior) **pathway** and a **fast** (anterior) **pathway.** Slow pathway has the shortest refractory period.

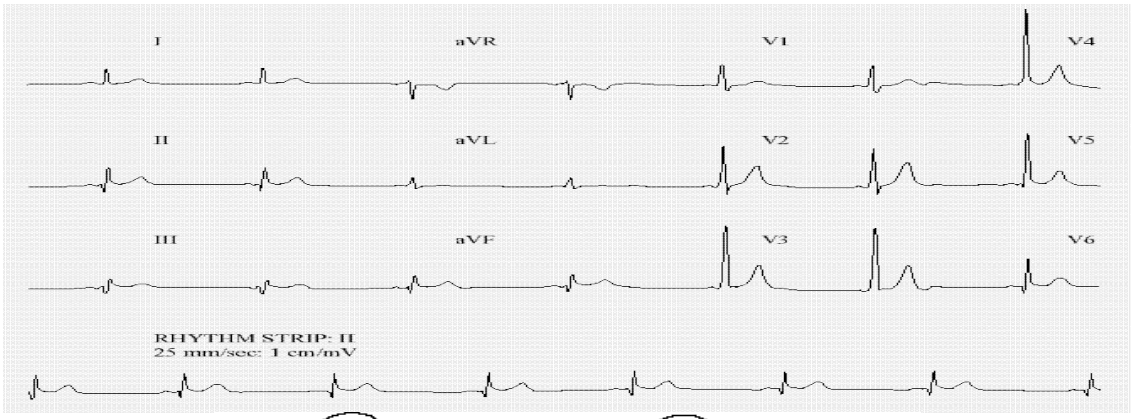
(2) ATRIAL RHYTHMS	
TYPE	(B) ATRIAL TACHYCARDIA (SUPRAVENTRICULAR TACHYCARDIA)

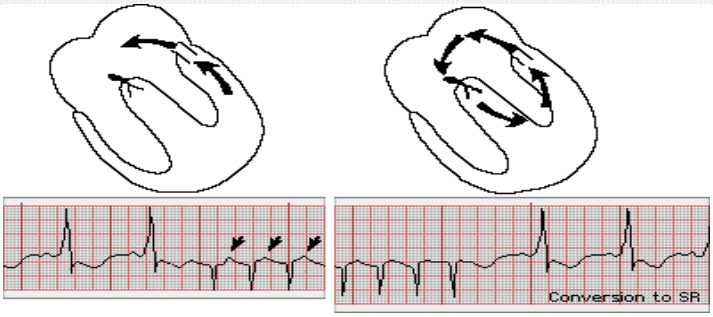
4. AV NODAL REENTRY TACHYCARDIA (AVRT)

ORIGIN	Impulse enters ventricles via the AV node and His bundle and returns to the atria via a rapidly conducting accessory pathway placing the P' wave close to the preceding QRS.
P WAVE	Retrograde P waves are seen on the following ST segment and the QRS configuration is as in normal sinus rhythm.
PR INTERVAL	Initial PR interval not prolonged.
QRS COMPLEX	Usually normal in contour and duration (narrow complex).
HEART RATE (b/ mints)	250 – 300 b/min.
REGULARITY	Usually regular.
INTERPRETATION	AV NODAL REENTRY TACHYCARDIA (AVRT) [ORTHODROMIC RECIPROCATING TACHYCARDIA]

NOTES:TWO MAIN CATEGORIES:

1. ORTHODROMIC RECIPROCATING TACHYCARDIA (ORT), where the CIRCUIT is ANTEROGRADE VIA THE AV NODE AND HIS BUNDLE AND RETROGRADE VIA AN ACCESSORY PATHWAY.
2. ANTIDROMIC RECIPROCATING TACHYCARDIA (ART), where the CIRCUIT is ANTEROGRADE VIA THE ACCESSORY PATHWAY AND RETROGRADES VIA THE HIS PURKINJE SYSTEM AND AV NODE.





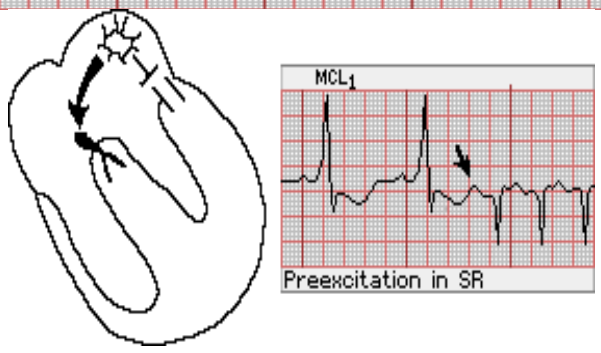
NOTES (1): Also a common arrhythmia in WOLFF-PARKINSON-WHITE (WPW) SYNDROME. Usually initiated by a PAC (but may be initiated by a PVC.

(2) ATRIAL RHYTHMS

TYPE	(B) ATRIAL TACHYCARDIA (SUPRAVENTRICULAR TACHYCARDIA)
4. AV NODAL REENTRY TACHYCARDIA (AVRT)	
ORIGIN	Where the **CIRCUIT is ANTEROGRADE VIA THE ACCESSORY PATHWAY AND RETROGRADES VIA THE HIS PURKINJE SYSTEM AND AV NODE.**
P WAVE	If atrial fibrillation (no P wave seen).
PR INTERVAL	**Short PR interval and a delta wave as seen in WPW syndrome.**
QRS COMPLEX	The **QRS is deformed by delta waves** e.g. rapid atrial fibrillation via an accessory pathway and may resemble VT.
HEART RATE (b/ mints)	**250 – 300 b/min.**
REGULARITY	**Irregularly irregular.**
INTERPRETATION	**AV NODAL REENTRY TACHYCARDIA (AVRT) [ANTIDROMIC RECIPROCATING TACHYCARDIA]**

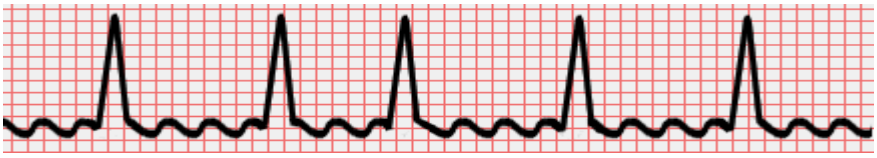
NOTES:TWO MAIN CATEGORIES:

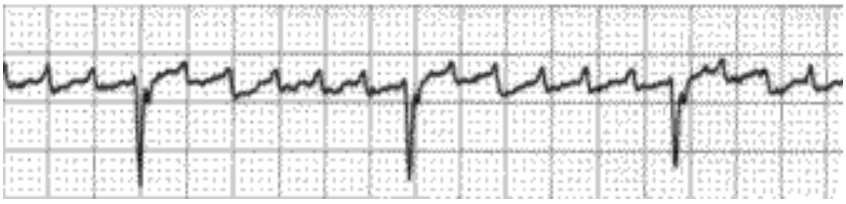
1. **ORTHODROMIC RECIPROCATING TACHYCARDIA** (ORT), where the **CIRCUIT is ANTEROGRADE VIA THE AV NODE AND HIS BUNDLE AND RETROGRADE VIA AN ACCESSORY PATHWAY.**
2. **ANTIDROMIC RECIPROCATING TACHYCARDIA** (ART), where the **CIRCUIT is ANTEROGRADE VIA THE ACCESSORY PATHWAY AND RETROGRADES VIA THE HIS PURKINJE SYSTEM AND AV NODE.**

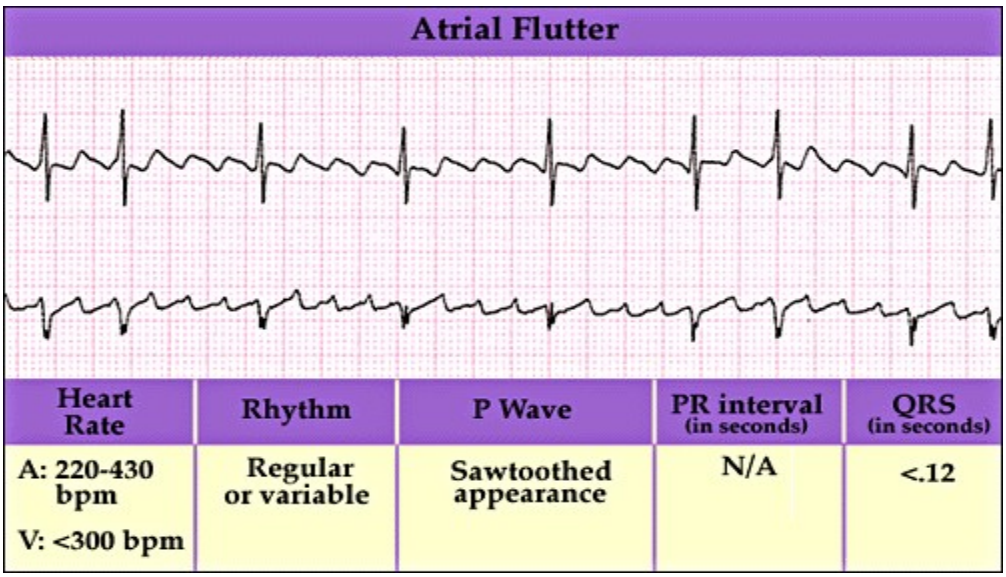


NOTES (2): When impulses travel down the accessory pathway in an anterograde manner, ventricular preexcitation results.

(2) ATRIAL RHYTHMS	
TYPE	**(C) ATRIAL FLUTTER**
ORIGIN	An atrial ectopic focus.
P WAVE	No P wave, Flutter wave or sawtooth looking, more P (F wave) waves than QRS complex.
PR INTERVAL	Not measurable (no P waves).
QRS COMPLEX	Less than 0.10 sec, but not 1:1 with the F (P) waves.
HEART RATE (b/ mints)	**Atrial (250 – 400 b/min), Ventricular (varies depending on conduction but will be less than atrial rate).**
REGULARITY	**Atrial:** P-P, R-R, T-T are **regular.** **Ventricular:** P-P , R-R, T-T, **varies or regular** (if conduction is regular).
INTERPRETATION	**ATRIAL FLUTTER**







Heart Rate	Rhythm	P Wave	PR interval (in seconds)	QRS (in seconds)
A: 220-430 bpm V: <300 bpm	Regular or variable	Sawtoothed appearance	N/A	<.12

NOTES: the atrial impulses travel in a circular course, setting up regular, rapid (220-300 b/min) **FLUTTER WAVES without any isoelectric baseline.** The atrial muscles respond to the rapid stimulation producing wave deflections **called flutter waves** (resemble a sawtooth pattern) or **called F waves.** The ventricular rate (QRS) is regular or irregular and slower depending upon the

degree of block.

(2) ATRIAL RHYTHMS	
TYPE	**(D) ATRIAL FIBRILLATION**
ORIGIN	An atrial ectopic focus.
P WAVE	No P wave, F waves low amplitude.
PR INTERVAL	**No PRI.**
QRS COMPLEX	Narrow (0.06-0.12) secs.
HEART RATE (b/ mints)	**1. ATRIAL** (350 - 600 or 400 b/min as an average). **2. VENTRICULAR** (160 – 180 b/min) or depending on conduction: i. If **ventricular rate is >100** b/min, **called UNCONTROLLED A-fib.** ii. If **ventricular rate is < 100** b/min, **called CONTROLLED A-fib.**
REGULARITY	**Atrial and ventricular irregular. P-P , R-R, T-T are irregularly irregular.**
INTERPRETATION	**ATRIAL FIBRILLATION**

NOTES: A Fib or **AF**, is an **example of a supraventricular tachycardia** that is **not considered to be PSVT**. It is **a condition in which** the **electrical activity of the atrium becomes very rapid and disorganized** (usually due to reentrant excitation within the atria with multiple reentry circuits, this causes a loss of atrial kick due to the ineffective quiver of the myocardium). The **atrial rate can exceed 400 b/min!** AF **can occur intermittently**, which is **known as PAROXYSMAL ATRIAL FIBRILLATION**, or it **can be PERSISTENT**. When atrial fibrillation has been present for more than 6 months and there's little hope of restoring a normal rhythm, it is

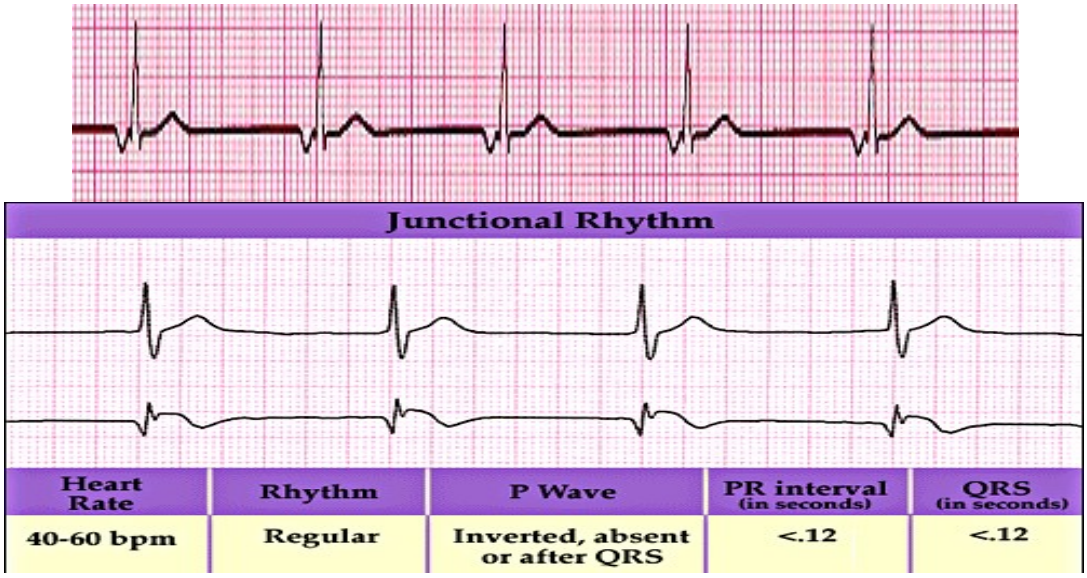
known as Permanent AF (previously known as Chronic AF). Occasionally, **it occurs in the absence of other cardiac conditions** and is then called **LONE ATRIAL FIBRILLATION.**

(2) ATRIAL RHYTHMS	
TYPE	**(E) ATRIAL BEAT**
ORIGIN	An atrial ectopic focus
P WAVE	Differs from Sinus P wave.
PR INTERVAL	May be same or longer than Sinus P wave.
QRS COMPLEX	Narrow. Looks like a Sinus conducted beat.
HEART RATE (b/ mints)	**Underlying ECG rhythm.**
REGULARITY	**Underlying ECG rhythm**
INTERPRETATION	**UNDERLYING ECG RHYTHM.**
NOTES: read the ECG rhythm first.	

(3) JUNCTIONAL (NODAL) RHYTHMS: when we speak of junctional rhythms **we are referring to AV NODAL RHYTHMS** which include the following rhythms:

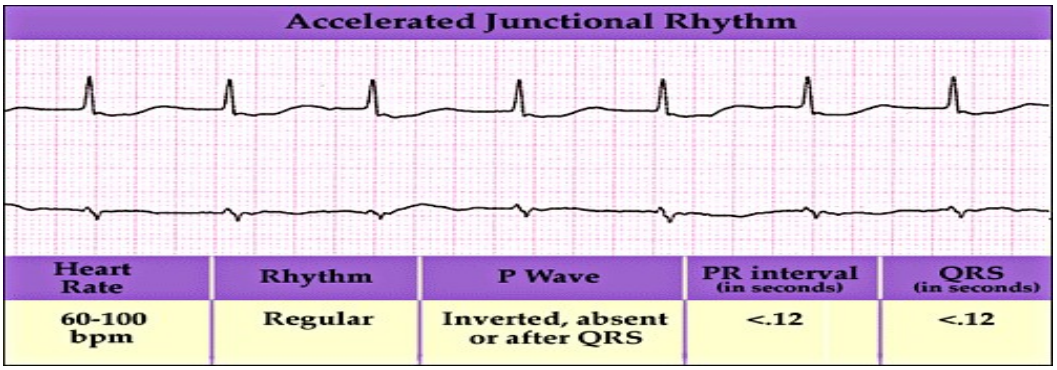
RHYTHM						
(3) NODAL (JUNCTIONAL) RHYTHMS						
TYPE	**Origin**	**P Wave**	**PRI**	**QRS**	**Rate/ mints**	**Regularity**
NODAL ESCAPE RHYTHM	AV Node	Can come: before, after, or during QRS. If seen, usually inverted. May be absent.	If present: shorter than 0.12 sec	Narrow. Looks like sinus beat, may be narrower than a sinus conducted beat.	40 – 60 b/m	P-P , R-R, T-T are regular
ACCELERATED NODAL RHYTHM	AV Node	Can come: before, after, or during QRS. If seen, usually inverted. May be absent.	If present: shorter than 0.12 sec	Narrow. Looks like sinus beat. May be narrower than a Sinus conducted beat.	60 – 100 b/m	P-P , R-R, T-T are regular
NON-PAROXYSMAL NODAL TACHYCARDIA	AV Node	Can come: before, after, or during QRS. If seen, usually inverted. May be absent.	If present: shorter than 0.12 sec	Narrow. Looks like sinus beat. May be narrower than a Sinus conducted beat.	100 –180 b/m	P-P , R-R, T-T are regular
NODAL BEAT	AV Node	Can come: before, after, or during QRS. If seen, usually inverted. May be absent.	If present: shorter than 0.12 sec	Narrow. Looks like sinus beat. May be narrower than a Sinus conducted beat.		

(3) JUNCTIONAL (NODAL) RHYTHMS	
TYPE	(A) JUNCTIONAL ESCAPE RHYTHM:
ORIGIN	AV Node.
P WAVE	Can come: before, after, or during QRS. If seen, usually inverted. May be absent. Depends on speed of conduction : - Negative P waves before the QRS. - P wave after the QRS. - P wave hidden in the QRS.
PR INTERVAL	If present: shorter than 0.12 sec
QRS COMPLEX	Width is normal (<0.10 sec).
HEART RATE (b/ mints)	40 – 60 b/m.
REGULARITY	P-P , R-R, T-T are regular.
INTERPRETATION	JUNCTIONAL ESCAPE RHYTHM



NOTES: If a wandering pacemaker is present in the atria, inverted P waves can precede the QRS complex.

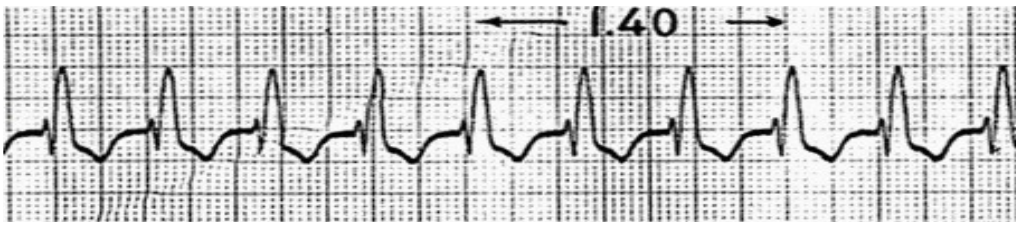
(3) JUNCTIONAL (NODAL) RHYTHMS	
TYPE	(B) ACCELERATED NODAL RHYTHM:
ORIGIN	AV Node.
P WAVE	Can come: before, after, or during QRS. If seen, usually inverted. May be absent. Depends on speed of conduction : - Negative P waves before the QRS. - P wave after the QRS. - P wave hidden in the QRS.
PR INTERVAL	If present: shorter than 0.12 sec.
QRS COMPLEX	Width is normal (<0.10 sec). Looks like sinus beat. May be narrower than a Sinus conducted beat.
HEART RATE (b/ mints)	60 - 100 b/min.
REGULARITY	P-P , R-R, T-T are regular.
INTERPRETATION	ACCELERATED JUNCTIONAL RHYTHM.



NOTES: Supraventricular rhythm resulting from a focus in or near the AV junction,

note the absence of P waves, the atria are contracting, but in a retrograde fashion. The P waves are not seen here because they are buried in the QRS complex.

(3) JUNCTIONAL (NODAL) RHYTHMS	
TYPE	(C) NONPAROXYSMAL NODAL TACHYCARDIA
ORIGIN	AV Node.
P WAVE	Can come: before, after, or during QRS. If seen, usually inverted. May be absent. Depends on speed of conduction : - Negative P waves before the QRS. - P wave after the QRS. - P wave hidden in the QRS.
PR INTERVAL	If present: shorter than 0.12 sec.
QRS COMPLEX	Width is normal (<0.10 sec). Looks like sinus beat. May be narrower than a Sinus conducted beat.
HEART RATE (b/ mints)	100 - 180 b/min.
REGULARITY	P-P , R-R, T-T are regular.
INTERPRETATION	NONPAROXYSMAL NODAL TACHYCARDIA



NOTES: NONPAROXYSMAL NODAL TACHYCARDIA CHARACTERIZED BY RAPID RATE, NARROW COMPLEXES, AND ABSENT OR ABNORMAL P WAVES. Mechanism responsible could be increased automaticity of the junctional tissue or conduction of the ectopic impulse though a reentry circuit. This **usually begins as an accelerated junctional rhythm but the heart rate gradually increases to >100 b/min**. There may be AV dissociation (will be discussed later), or retrograde atrial capture may occur. Ischemia (usually from right coronary artery occlusion) and digitalis intoxication are the two most common causes.

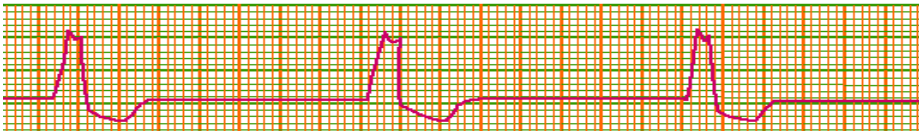
(3) JUNCTIONAL (NODAL) RHYTHMS	
TYPE	(D) NODAL L BEAT
ORIGIN	AV Node.
P WAVE	Can come: before, after, or during QRS. If seen, usually inverted. May be absent.
PR INTERVAL	If present: shorter than 0.12 sec.
QRS COMPLEX	Narrow. Looks like sinus beat. May be narrower than a Sinus conducted beat.
HEART RATE (b/ mints)	Underlying ECG rhythm.
REGULARITY	Underlying ECG rhythm.
INTERPRETATION	UNDERLYING ECG RHYTHM.
NOTES: read the ECG rhythm first.	

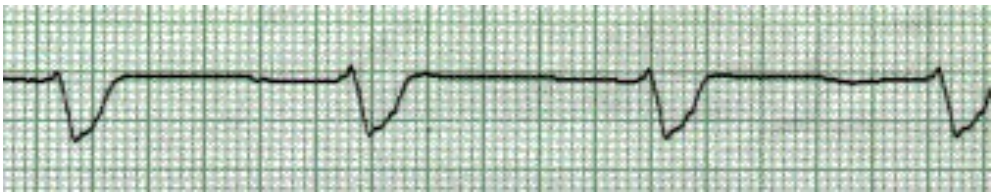
(4) VENTRICULAR RHYTHM:

RHYTHM						
(4) VENTRICULAR RHYTHMS						
TYPE	**Origin**	**P Wave**	**PRI**	**QRS**	**Rate/ m**	**Regularity**
IDIO-VENTRICULAR RHYTHM	Ectopic ventricular focus	No P wave, or No relationship to QRS.	None (absent)	Wide & bizarre, greater than 0.12 secs. Inverted T wave.	20 – 40 b/min	P-P, R-R, T-T are regular
ACCELERATED IDIO-VENTRICULAR	Ectopic ventricular focus	No P wave, or No relationship to QRS.	None (absent)	Wide & bizarre, greater than 0.12 secs. Inverted T wave.	40 – 100 b/min	P-P, R-R, T-T are regular
VENTRICULAR TACHYCARDIA	Ectopic ventricular focus	No P wave, or No relationship to QRS.	None (absent)	Wide & bizarre, greater than 0.12 secs. Inverted T wave.	150 - 250 b/min	P-P, R-R, T-T are regular or slightly irregular.
VENTRICULAR FIBRILLATION	Ectopic ventricular focus	No P wave, or No relationship to QRS.	None (absent)	Unidentifiable	150 - 500 b/min	P-P , R-R,T-T are regular or slightly irregular.
ASYSTOLE	Ectopic ventricular focus	NO ELECTRICAL ACTIVITY (STRAIGHT LINE?)				
AGONL RHYTHM	Ectopic ventricular focus	WIDE QRS UNTIL THE PATIENT DIE?				

VENTRICULAR BEAT	Ectopic ventricular focus	Absent	Absent	Wide & bizarre, greater than 0.12 secs. Inverted T wave.		

(4) VENTRICULAR RHYTHM	
TYPE	**(A) IDIOVENTRICULAR RHYTHM (VENTRICULAR ESCAPE RHYTHM)**
ORIGIN	Ectopic ventricular focus.
P WAVE	No P wave, or No relationship to QRS.
PR INTERVAL	None (absent).
QRS COMPLEX	Wide & bizarre, greater than 0.12 secs. Inverted T wave.
HEART RATE (b/ mints)	**20 - 40 b/min, sometimes slower** (i.e., **slower than a junctional escape rhythm**).
REGULARITY	**Usually regular. P-P, R-R, T-T are regular.**
INTERPRETATION	**IDIOVENTRICULAR RHYTHM**



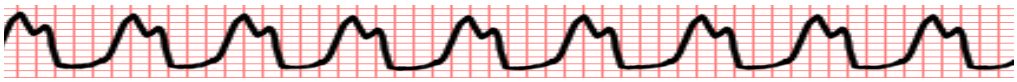


NOTES: ventricular escape rhythm (idioventricular rhythm) is a **PROTECTIVE ESCAPE MECHANISM when higher centers in the conducting system fail to conduct to the ventricle. Idioventricular rhythm may be transient** (as with vagal effect) **or continuous** (as seen with advanced heart disease), usually a terminal event occurring just before ventricular standstill.

(4) VENTRICULAR RHYTHM	
TYPE	(B) ACCELERATED IDIOVENTRICULAR
ORIGIN	Ectopic ventricular focus or an escape pacemaker site in the ventricles.
P WAVE	No P wave, or No relationship to QRS.
PR INTERVAL	None (absent).
QRS COMPLEX	Wide & bizarre, greater than 0.12 secs. Inverted T wave.
HEART RATE (b/ mints)	40 – 100 b/min.
REGULARITY	Usually regular. P-P, R-R, T-T are regular.
INTERPRETATION	ACCELERATED IDIOVENTRICULAR

NOTES: sometimes called ISOCHRONIC VENTRICULAR RHYTHM because the ventricular rate is close to underlying sinus rate. Accelerated idioventricular rhythm is common following acute MI, and is frequently a reperfusion rhythm

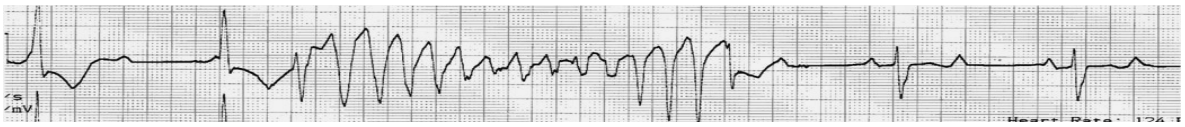
(4) VENTRICULAR RHYTHM	
TYPE	**(C) VENTRICULAR TACHYCARDIA**
ORIGIN	Ectopic ventricular focus.
P WAVE	No P wave, or No relationship to QRS. None associated, the SA node does continue to fire independently, so P waves may be seen at random, but are usually hidden in the QRS complexes.
PR INTERVAL	None (absent) or not measurable.
QRS COMPLEX	Wide & bizarre, greater than 0.12 secs. Inverted T wave.
HEART RATE (b/ mints)	**150 - 250 b/min.**
REGULARITY	**Usually regular, may be somewhat irregular (P-P, R-R, T-T are regular or slightly irregular).**
INTERPRETATION	**VENTRICULAR TACHYCARDIA**



NOTES: VT CAN BE CLASSIFIED BY ECG MANIFESTATION INTO:

a. **MONOMORPHIC VT:** the QRS complexes in an episode of tachycardia are identical, **sometimes called unifocal**. Monomorphic VT may occur in patients with structural heart disease such as coronary artery disease or may occur in patients without obvious heart disease (idiopathic).

b. **POLYMORPHIC VT** (TORSADES DE POINTES): the QRS complexes are changing from beat to beat and the rhythm appears more chaotic. The QT or repolarization syndromes are typically associated with polymorphic VT often called torsades de pointes due to original French description of the QRS complexes as "twisting" about its axis. QT syndromes are not associated with monomorphic VT.

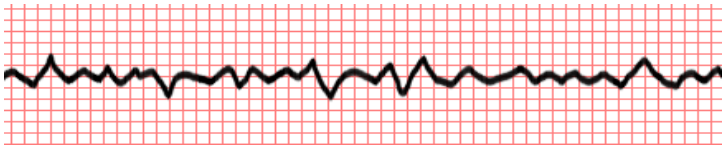


c. **THERE ARE VARIANT FORMS OF VENTRICULAR TACHYCARDIA, THESE INCLUDES:**

1. **TORSADES DE POINTES** (polymorphic VT).

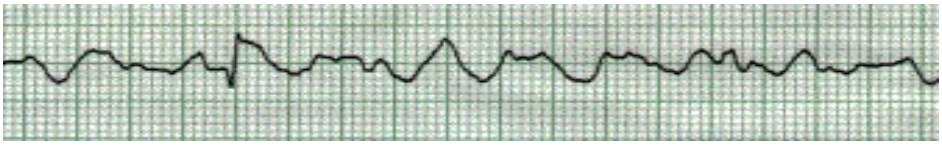
2. **Torsades de pointes** are a **unique variant form of VT, <u>associated with the long QT syndromes.</u>**
3. **Torsades de pointes** may be **caused by hypomagnesaemia.**
4. **PRESENCE OF FUSION QRS COMPLEXES (DRESSLER BEATS).**
5. **ATRIOVENTRICULAR (AV) DISSOCIATION.**

(4) VENTRICULAR RHYTHM	
TYPE	**(D) VENTRICULAR FIBRILLATION**
ORIGIN	Ectopic ventricular focus.
P WAVE	No P wave.
PR INTERVAL	None (absent).
QRS COMPLEX	Unidentifiable, no complexes are present.
HEART RATE (b/ mints)	**150 - 500 b/min.**
REGULARITY	**Chaotic.**
INTERPRETATION	**VENTRICULAR FIBRILLATION**

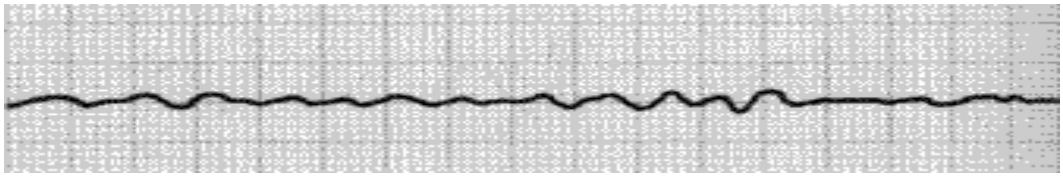


NOTES: known as VF or "V Fib. THERE ARE TWO TYPES OF VF:

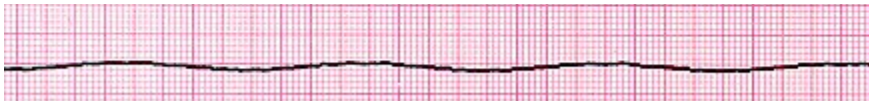
a. **COARSE:** waves are large, usually indicates a more recent onset and is more likely to be reversed by defibrillation (immediate unsynchronized defibrillation at 200J, 300J, 360J; for adult, pediatrics according to their weight).



b. **FINE:** waves are small, must be differentiated from asystole, prolonged delay without defibrillation results in fine VF and eventually asystole.



(4) VENTRICULAR RHYTHM	
TYPE	(E) ASYSTOLE (VENTRICULAR STANDSTILL)
ORIGIN	Ectopic ventricular focus.
P WAVE	Occasional P waves or erratic ventricular beats may be seen.
PR INTERVAL	None.
QRS COMPLEX	None.
HEART RATE (b/ mints)	None.
REGULARITY	None.
INTERPRETATION	VENTRICULAR STANDSTILL (VENTRICULAR ASYSTOLE)



NOTES: ventricular asystole represents the TOTAL ABSENCE OF VENTRICULAR ELECTRICAL ACTIVITY.

i. Complete absence of ventricular electrical activity.
ii. Occasional P waves or erratic ventricular beats may be seen.
iii. These patients will be pulseless. Treatment must be immediate if the patient is to have any chance at resuscitation.

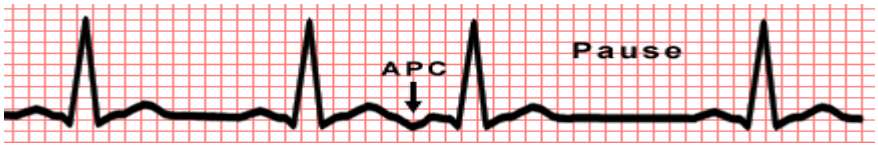
Ventricular asystole can occur also in patients with complete heart block in whom there is no escape pacemaker. VF may masquerade as asystole; it is best always to check two leads perpendicular to each other to make sure that asystole is not VF. Treatment for each arrhythmia is very different.

(4) VENTRICULAR RHYTHM	
TYPE	(F) AGONL RHYTHM
ORIGIN	Ectopic ventricular focus.
P WAVE	

PR INTERVAL	WIDE QRS UNTIL THE PATIENT DIE?
QRS COMPLEX	
HEART RATE (b/ mints)	
REGULARITY	
INTERPRETATION	AGONL RHYTHM
NOTES: PATIENT DIE?	

(5) THE BEATS OF (SINUS, ATRIAL, NODAL, & VENTRICULAR):

A) ATRIAL RHYTHM	
TYPE	1. PREMATURE ATRIAL BEAT (CONTRACTION) or PAC
1. P.A.C CRITERIA OF CONDUCTED NORMALLY:	
P WAVE	Abnormal in size, shape, deflection, or may be hidden in the preceding T wave distorting the T wave contour.
PR INTERVAL	Normal but may be shortened.
QRS COMPLEX	Less than 0.10 sec.
HEART RATE (b/ mints)	That of underlying rhythm.
REGULARITY	Underlying rhythm regular, irregular with PAC.
INTERPRETATION	UNDERLYING ECG RHYTHM WITH PAC.



NOTES: P.A.C WILL HAVE 1 OF 3 FATES: IT WILL BE NON-CONDUCTED, CONDUCTED NORMALLY, OR CONDUCTED ABERRANTLY.

A) ATRIAL RHYTHM	
TYPE	1. PREMATURE ATRIAL BEAT (CONTRACTION) or PAC
2. NONCONDUCTED PAC CRITERIA:	
P WAVE	Abnormal in size, shape, deflection, or may be hidden in the preceding T wave distorting the T wave contour.
PR INTERVAL	Absent.
QRS COMPLEX	Absent.
HEART RATE (b/ mints)	That of underlying rhythm.
REGULARITY	Underlying rhythm regular, irregular with nonconducted PAC.
INTERPRETATION	UNDERLYING ECG RHYTHM WITH PAC.

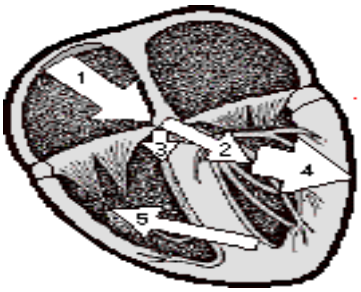
NOTES: P.A.C WILL HAVE 1 OF 3 FATES: IT WILL BE NON-CONDUCTED, CONDUCTED NORMALLY, OR CONDUCTED ABERRANTLY.

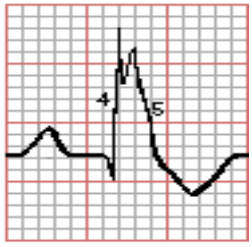
A) ATRIAL RHYTHM	
TYPE	1. PREMATURE ATRIAL BEAT (CONTRACTION) or PAC

3. PAC CONDUCTED ABERRANTLY CRITERIA:

ABERRANT PACs LOOK A LOT LIKE PVCs. DIFFERENTIAL DIAGNOSIS SHOULD FOCUS ON WHETHER A PREMATURE P WAVE PRECEDES THE WIDE QRS AND WHETHER A RBBB PATTERN OCCURS IN V_1 or V_6. Best criteria to support the diagnosis of aberrant supraventricular contraction are the **presence of a premature P wave**. Unfortunately the **P wave of PAC may be buried** so you may not see it; if a P wave precedes a PVC, it is usually sinus and not premature.

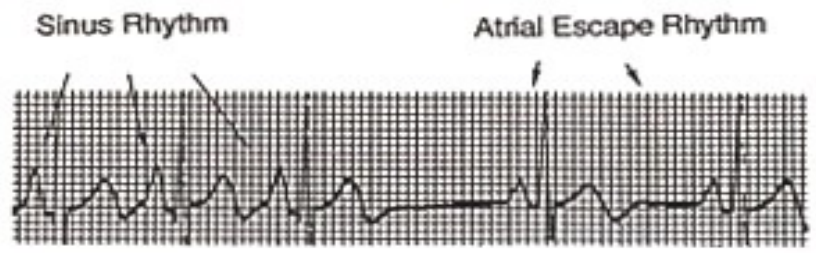
i. **Normal supraventricular conduction.**
ii. **Normal conduction in the left bundle branch.**
iii. Blocked conduction at the right bundle branch which is still refractory.
iv. **Normal conduction in the left ventricle.**
v. Abnormal, delayed conduction in the right ventricle by aberrant pathways.

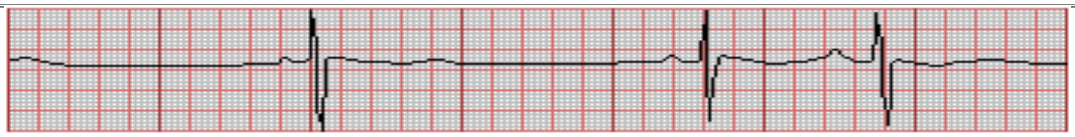




NOTES: P.A.C WILL HAVE 1 OF 3 FATES: IT WILL BE NON-CONDUCTED, CONDUCTED NORMALLY, OR CONDUCTED ABERRANTLY.

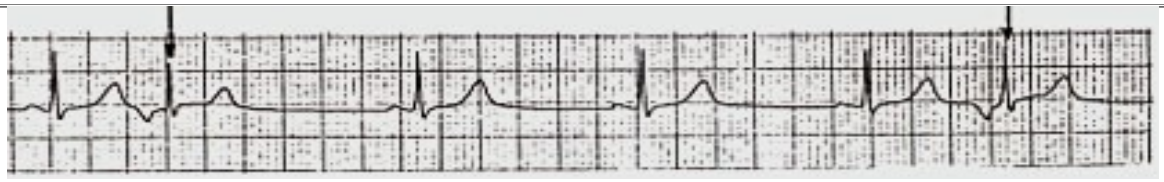
A) ATRIAL RHYTHM	
TYPE	**(2) ATRIAL ESCAPE BEAT**
P WAVE	- There is **different appearing and late P wave**. P wave that occurs later than would be expected from the sinus rate. - Note differing appearance of the P waves for Sinus Rhythm *vs*. Atrial Escape Complex (Rhythm). Like all escape complexes, it can occur only when the normal cardiac pacemaker does not function, as in sinus arrest.
QRS COMPLEX	If the **SA node slows down** and a **focus in the atrium takes over control of the heart**, the rhythm is described as an **atrial escape**. If the **focus is away from the SA node then the P wave will be abnormal**. It will be followed with a normal ventricular depolarization/repolarization cycle giving sinus morphology to the QRS complex and T wave.
HEART RATE (b/ mints)	**Underlying ECG rhythm.**
REGULARITY	**Underlying ECG rhythm.**
INTERPRETATION	**UNDERLYING ECG RHYTHM WITH ATRIAL ESCAPE BEAT.**





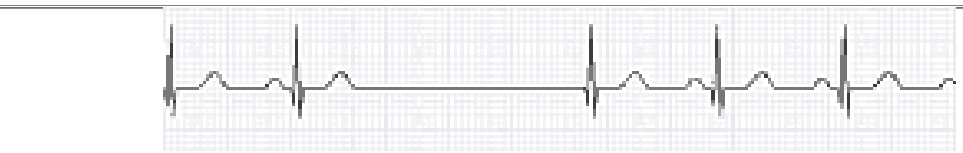
NOTES: **alternative names** are (atrial skipped beat).

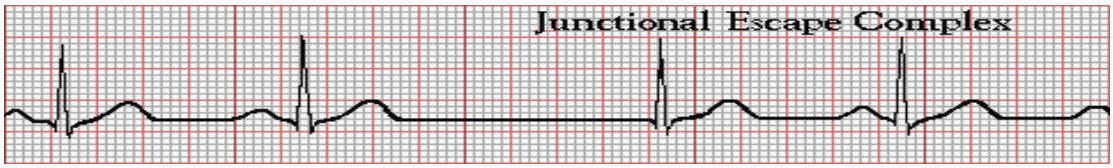
B) JUNCTIONAL (NODAL) RHYTHM:	
TYPE	**(1) PREMATURE JUNCTIONAL BEAT (CONTRACTION) or PJC**
P WAVE	Can come: before, after, or during QRS. If seen, usually inverted. May be absent. Depends on speed of conduction : - Negative P waves before the QRS. - P wave after the QRS. - P wave hidden in the QRS.
PR INTERVAL	If present: shorter than 0.12 sec
QRS COMPLEX	Normal (<0.10 sec) unless prolonged by aberrant conduction.
HEART RATE (b/ mints)	**Underlying ECG rhythm.**
REGULARITY	**Underlying rhythm is regular, irregular with extra beat (PJC's).**
INTERPRETATION	**UNDERLYING ECG RHYTHM WITH PREMATURE JUNCTIONAL CONTRACTION.**

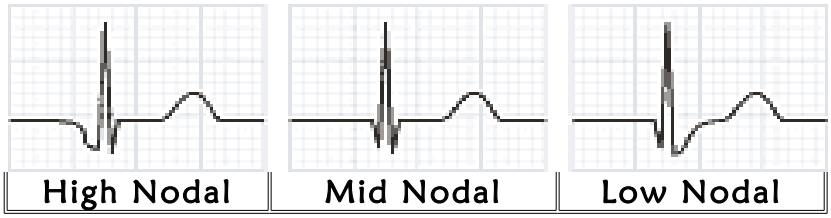


NOTES: alternative names are (junctional extrasystoles beat, junctional ectopic beat).

B) JUNCTIONAL (NODAL) RHYTHM:	
TYPE	(2) JUNCTIONAL ESCAPE BEAT:
P WAVE	Can come: before, after, or during QRS. If seen, usually inverted. May be absent. Depends on speed of conduction : - Negative P waves before the QRS. - P wave after the QRS. - P wave hidden in the QRS.
PR INTERVAL	If present: shorter than 0.12 sec.
QRS COMPLEX	Normal (<0.10 sec).
HEART RATE (b/ mints)	Underlying ECG rhythm.
REGULARITY	Underlying rhythm is regular, irregular with escape beat.
INTERPRETATION	UNDERLYING ECG RHYTHM WITH JUNCTIONAL ESCAPE.

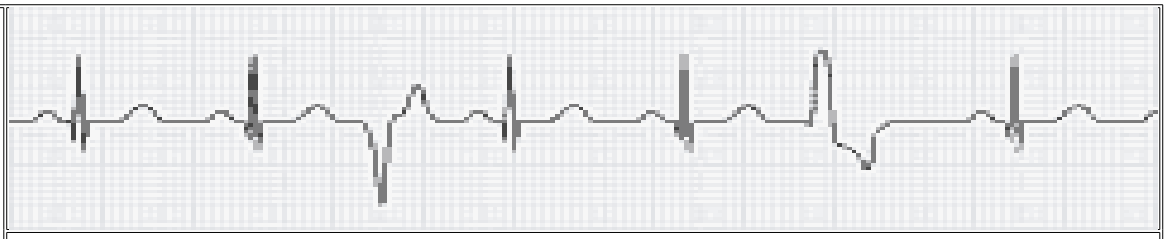






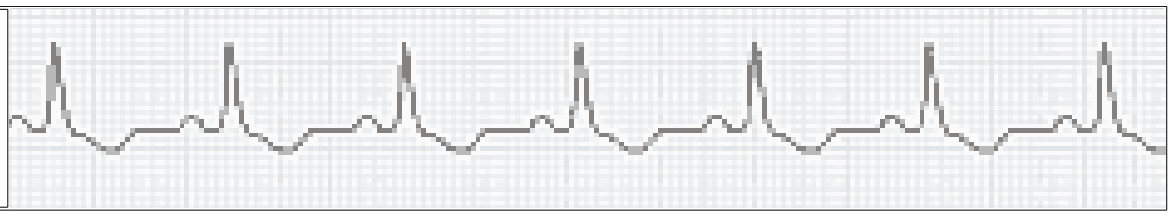
NOTES: alternative names are (junctional skipped beat). If the **region around the AV node takes over**, the rhythm is **called a Junctional escape complex** (escape beat).

PVCs as ISOLATED single (UNIFOCAL) beat	 Every fourth beat is PVC (beginning with the second beat). No P, wide bizarre QRS.
PVCs as ISOLATED single (UNIFOCAL) beat	 UNIFOCAL PVC'S: identical shapes, note a single PVC is labeled

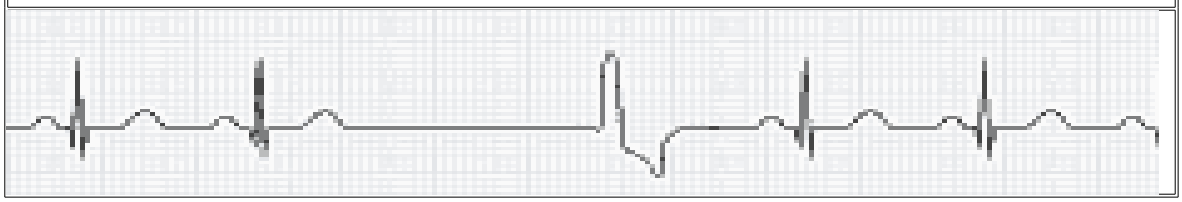
	isolated
PVCs as ISOLATED single (MULTIFOCAL) beat	 **MULTIFOCAL PVC'S:** if more than one potential focus exists then the patient will exhibit more than one morphology at different times.
PVCs as couplets (<u>BIGEMINY</u>) beats	 COUPLED PVC'S: occur in pairs.
PVCs as every third beat (<u>TRIGENEMINY</u>)	 TRIPLET PVC'S: occur in group of three.
R on T wave PHENOMENON	

	R ON T: occur on the peak of the T wave of the preceding beat.

THE R ON T PHENOMENA

FUSION BEATS	

VENTRICULAR ESCAPE BEAT



ABDULRAHMAN SALEH NASEEF