I ADVANCED VIRTUAL COURSE OF NORMAL & PATHOLOGICAL ELECTROCARDIOGRAM & VECTORCARDIOGRAM ON THE INTERNET

PROF. MAURICIO ROSENBAUM

CLASS 4: NORMAL VCG

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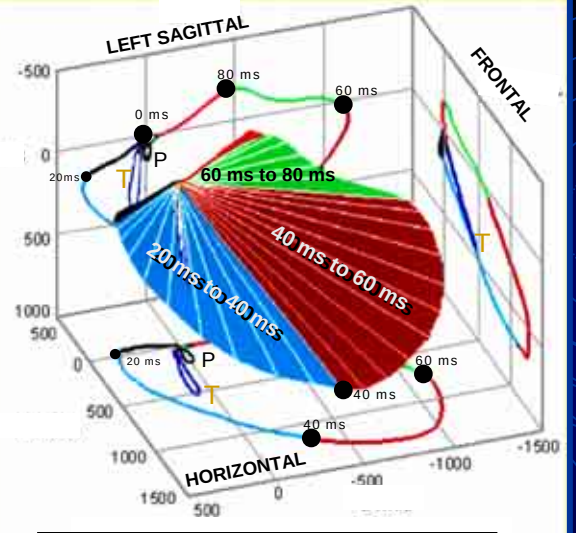
NORMAL VECTORCARDIOGRAM
X,Z & Y ORTHOGONAL LEADS
FRANK'S METHOD

The vectorcardiogram (VCG) is a method that records the electrical potentials that originate in the heart, in the three planes of space during the cardiac cycle. These planes are: *FRONTAL, HORIZONTAL* and *SAGITTAL* (left or right).

Chambers activation and repolarization originate the P loop (biatrial chamber depolarization), the QRS loop (depolarization of biventricular chamber) and the T loop (ventricular repolarization), which result from the union of final the portions of the so-called instantaneous manifest vectors that are the result of the algebraic addition of multiple instantaneous vectors of bioelectric potentials that originate in the heart during the cardiac cycle.



MAP COLORED ACCORDING TO TIME

0 ms to 20 ms	60 ms to 80 ms
20 ms to 40 ms	80 ms to 100 ms
40 ms to 60 ms	COLOR OF T LOOP

REPRESENTATION OF P, QRS & T LOOPS IN THE THREE PLANES OF SPACE (FRONTAL, HORIZONTAL & LEFT SAGITTAL) REPRESENTED IN COLORS ACCORDING TO TIME ELAPSED

FRANK'S METHOD FOR THE VECTORCARDIOGRAM

The system used today by all centers to perform vectorcardiograms (VCG) is the system created by the American engineer Ernest Frank [1-2]. This author proposed using 7 electrodes to minimize errors, 5 of them located in the 5th intercostal space (electrodes A, C, E, I, M), one in the left leg (F) and one in the nape (H).

1) Frank E. An accurate clinically practical system for spatial vetorcardiography. Circulation 1956;13:737.
2) Frank E, Seiden GE. Comparison of limb and precordial vetorcardiography systems. Circulation 1956; 14:83.

LOCATION OF ELECTRODES TO CONDUCT VECTORCARDIOGRAMS ACCORDING TO FRANK'S METHOD

Seven electrodes are placed in the body surface, and they are called H, F, I, A, C, E & M.

H: POSTERIOR AREA OF THE NECK.

F: LEFT LEG.

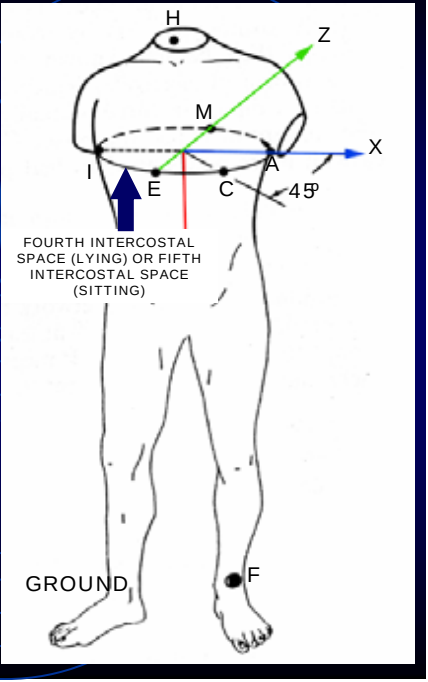
I: RIGHT MIDDLE AXILLARY LINE (5º LEFT INTERCOSTAL SPACE)

A: LEFT MIDDLE AXILLARY LINE (5º LEFT INTERCOSTAL SPACE)

C: MIDDLE CLAVICULAR LINE (5º LEFT INTERCOSTAL SPACE).

E: CENTER OF THE STERNUM (5º LEFT INTERCOSTAL SPACE).

M: SPINAL APOPHYSIS (5º LEFT INTERCOSTAL SPACE).



CHARACTERISTICS OF LEADS

The leads are called *ORTHOGONAL* because they are perpendicular to each other, and *CORRECTED* because they use technical devices of resistance and multiple connections that correct the lack of homogeneity of the electrical field of the heart.

CHARACTERISTICS OF LEADS

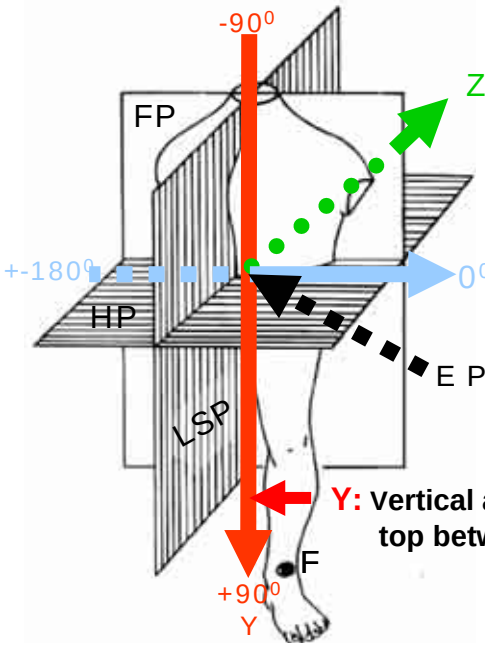
The method uses leads in the three planes of space:

FRONTAL, HORIZONTAL* and *SAGITTAL.

These leads and the three planes cross each other in a point called E, making a 90^0 angle. The three leads are called X, Y & Z.

- **X: axis of X from left to right – 0^0 to + 180^0;**
- **Y: vertical, bottom to top, between $+90^0$ and -90^0;**
- **Z: the one of the sagittal plane with the letter Z heading from the back (-90^0) to the front ($+90^0$).**

REPRESENTATION OF THE THREE ORTHOGONAL LEADS CORRECTED IN THE THREE PLANES OF SPACE



Z: The one of the sagittal plane with the letter Z heading from the back (-90⁰) to the front (+90⁰).

X: axis of X from left to right– 0⁰ to +- 180⁰;

This one constitutes the 0 point of VCG and it remains stationary before P loop onset.

Y: Vertical and heading from bottom to top between +90⁰ and -90⁰

MEANING ACCORDING TO THE LOCATION OF THE CONDUCTION DELAY

INITIAL = ***PRE-EXCITATION, WPW SYNDROME/ DELTA WAVE.***

END MIDDLE DELAY = ***CLBBB.***

END DELAY = ***CRBBB OR IRBBB.***

UNIFORM CONDUCTION DELAY = ***HYPERCALEMIA; QUINIDINE EFFECT; INTRA-INFARCTION, INTRAMURAL OR NON-SPECIFIC BLOCK.***

BASIC CONCEPTS ON VECTORCARDIOGRAPHY

Vector: a unit of measurement used in electro-vectorcardiography to represent a dipole of depolarization or repolarization.

It has: 1) Direction, 2) Orientation and 3) Module, magnitude or intensity.
All vectors have a beginning and an end called respectively *origin* and *end*.

BASIC CONCEPTS ON VECTORCARDIOGRAPHY

Direction: it is described as the trajectory of the vector in space, in other words, the line that joins the two poles of the dipole that represents its axis.

Orientation: represented by the two poles of the vector: origin and end. The latter indicates where the vector is heading.

Module, magnitude or intensity: represented by the length of the vector and expressed by the formula: $E = {}^{F}/_{q}$, where E is intensity of the vector, F force that acts on the load, and q the value of the load.

BASIC CONCEPTS ON VECTORCARDIOGRAPHY

Equivalent or instantaneous vector: it is the vectorial representation of a moment in the cardiac cycle.

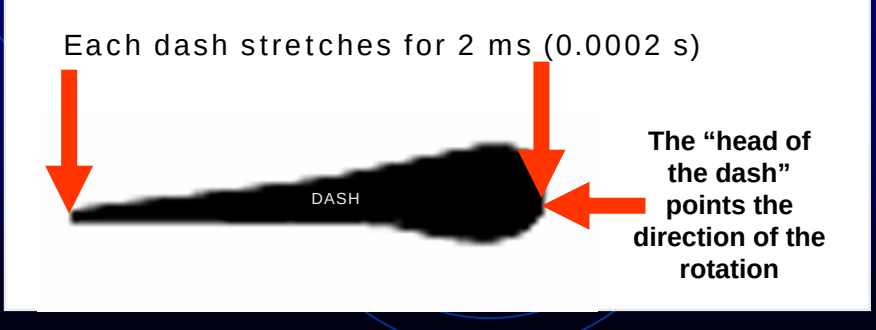
Manifest instantaneous vector: it is the vectorial projection in the three planes of space, of the electrical activity of the heart (atrial and ventricular depolarization, and ventricular repolarization) during a cardiac cycle. By joining the ends of the infinite vectors that make up a manifest instantaneous vector, we draw a line called vectorcardiographic loop, where the magnitude and direction of the instantaneous vectors change from moment to moment.

The loops are fragmented by the action of an oscillator – which cuts the current intermittently for a known period of time, usually each 2 ms (0.0002 s).

The goal of this intermittent cut is to know the total duration of the loop in study, which may be estimated by multiplying the number of fragments (in the form of dashes) for the time selected (in our case 2 ms). The morphology of the fragments in the form of dashes enables to determine the direction of the rotation, thus the "head" of the dash indicates the rotational direction.

MANIFEST INSTANTANEOUS VECTOR

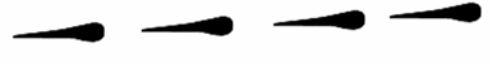
Each dash represents a time of 2 ms or 2.5 ms, depending on the calibration of the device.



DETERMINATION OF CONDUCTION VELOCITY OF STIMULUS

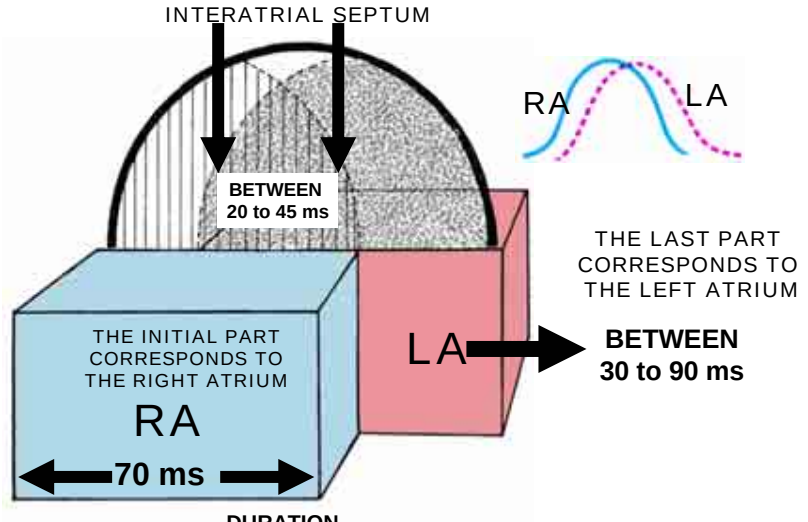
The greater or the lesser distance between dashes indicates the greater or the lesser conduction velocity in the area. Thus, when they are very close to each other, it indicates the presence of conduction delay. To consider the phenomenon as true, it is necessary for it to be evident in at least 2 planes.

SEPARATE DASHES = MORE DROMOTROPISM



VERY CLOSE DASHES = LESS DROMOTROPISM

ACTIVATION OF BIATRIAL CHAMBER



ACTIVATION OF BIATRIAL CHAMBER

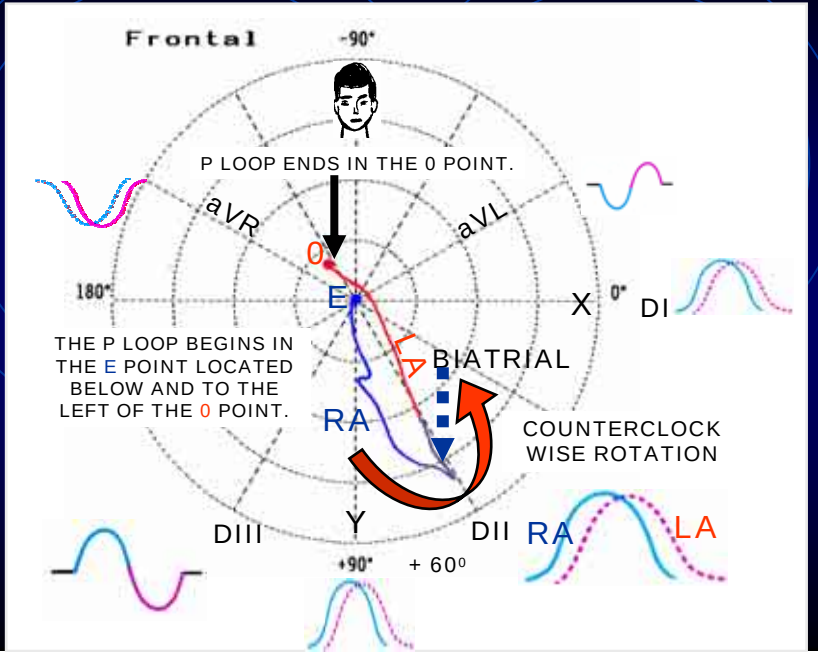
P LOOP: loop of small voltage corresponding to the depolarization of the biatrial chamber. The initial part corresponds to the right atrium (between 0 and 70 ms), next the interatrial septum (between 20 and 45 ms), and finally the left atrium (between 30 and 90 ms). To make an analysis possible, it is necessary to amplify: 1 mV = 30 cm. The P loop begins in the E point and ends in the so-called 0 point. The former has an anterior and inferior location in relation to the latter.
The P loop is open because atrial repolarization (Tp loop) is diametrically opposite to the P loop.

E POINT: it constitutes the zero point of VCG and it remains stationary before the onset of the P loop. It corresponds to the isoelectric line between the T wave and the P wave of ECG. The E letter corresponds to the cardiac dipole.

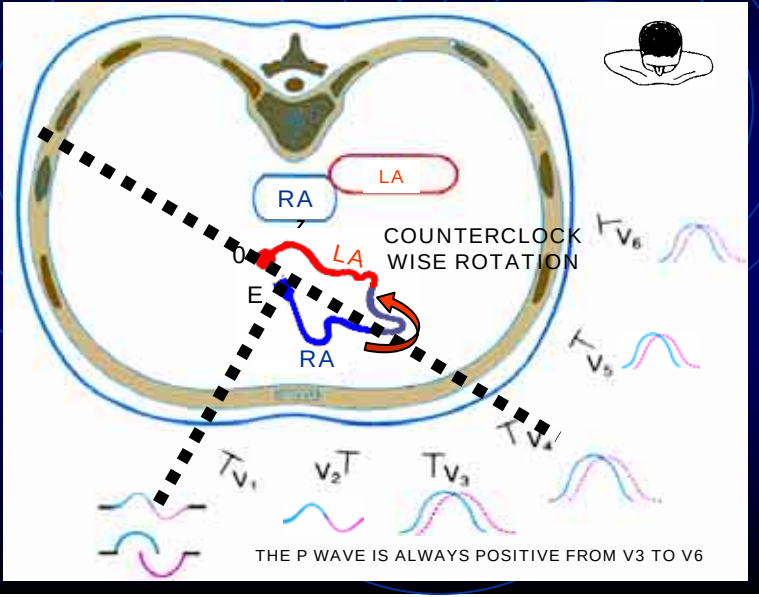
ITEMS TO BE STUDIED IN THE P LOOP

1) Magnitude and direction of maximal vector: P vector;
2) Location of the greatest part of the P loop;
3) Morphology;
4) Aspect: presence of notches;
5) Type of loop rotation: FP: counterclockwise; in the HP: counterclockwise or in eight; and RSP: clockwise.
6) Location of the E (initial) and 0 points (final).

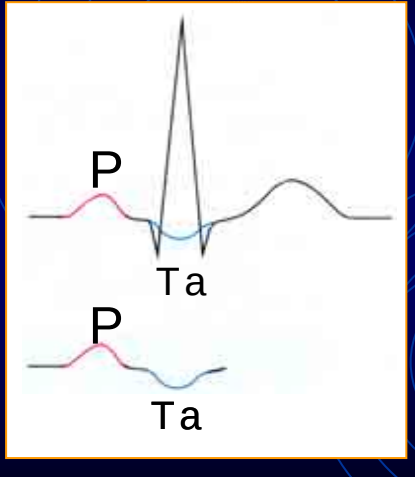
P LOOP OF BIATRIAL CHAMBER IN THE FRONTAL PLANE



P LOOP OF BIATRIAL CHAMBER IN THE HORIZONTAL PLANE



P LOOP IS OPEN BECAUSE ATRIAL REPOLARIZATION (TP OR TA LOOP) IS COMPLETELY OPPOSITE TO THE P LOOP



In ECG, Ta or Tp wave: wave generally not visible because it is hidden by QRS. It represents atrial repolarization. Ta polarity is opposite to the P wave and its magnitude is 100 to 200 mV.

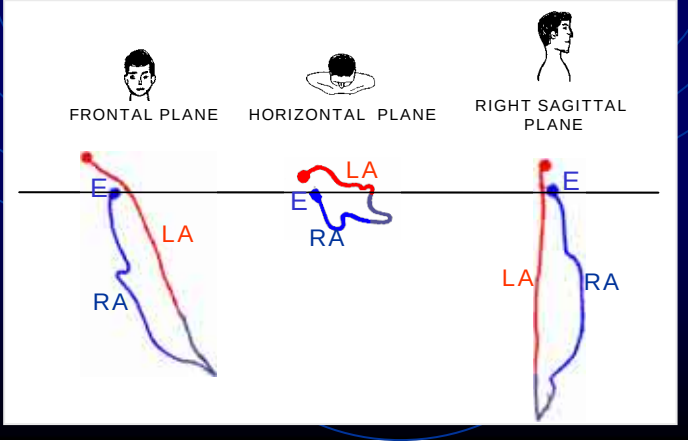
It may possibly reach the ST segment and the T wave, causing ST segment depression and resembling myocardial ischemia[1].

1) Kapin PM, et al. J Am Coll Cardiol. 1991; 18: 127-135.

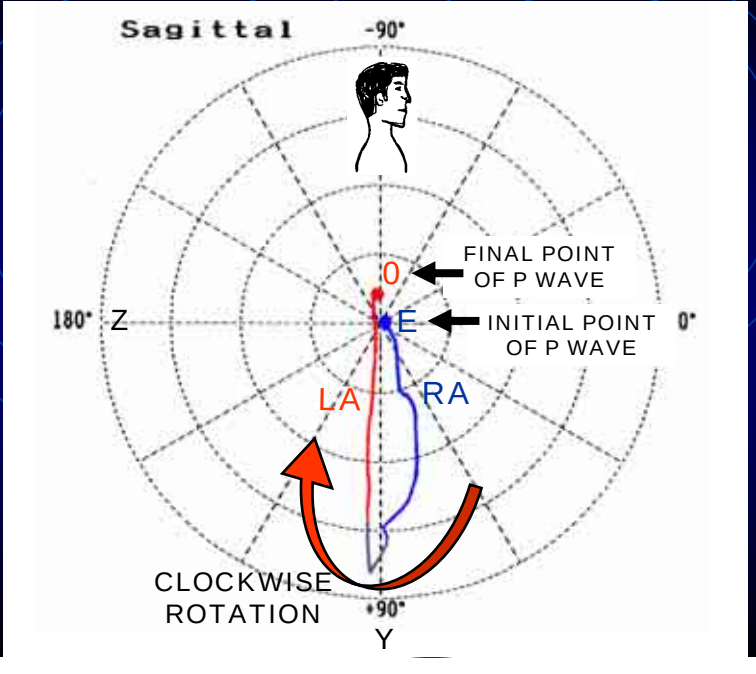
ATRIAL REPOLARIZATION

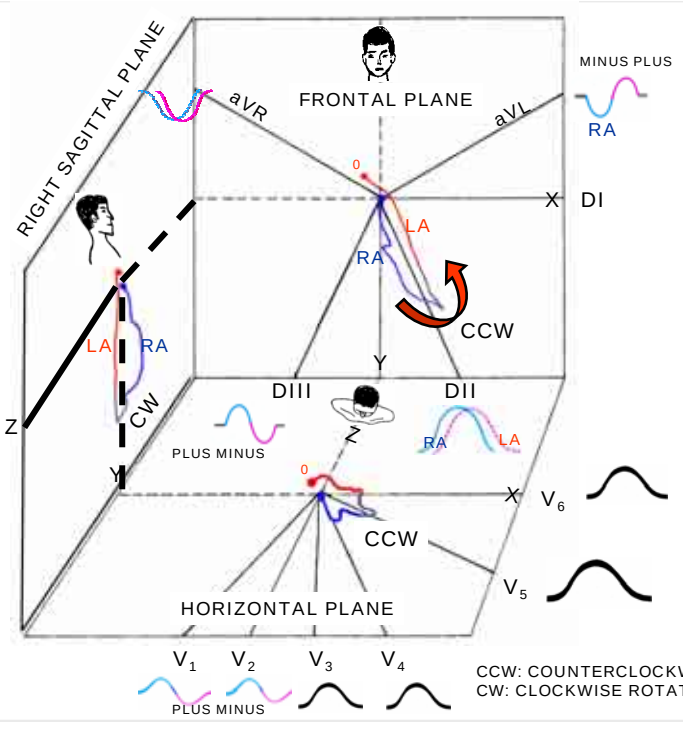
Ta OR Tp VECTOR

Atrial T vector (Ta vector): atrial repolarization (Ta vector) is responsible for the P loop being open and not closed (point 0 does not coincide with initial point E). A straight line from the onset of the P loop (E point) to the end of it (0 point) indicates the magnitude and direction of the Ta or Tp vector.

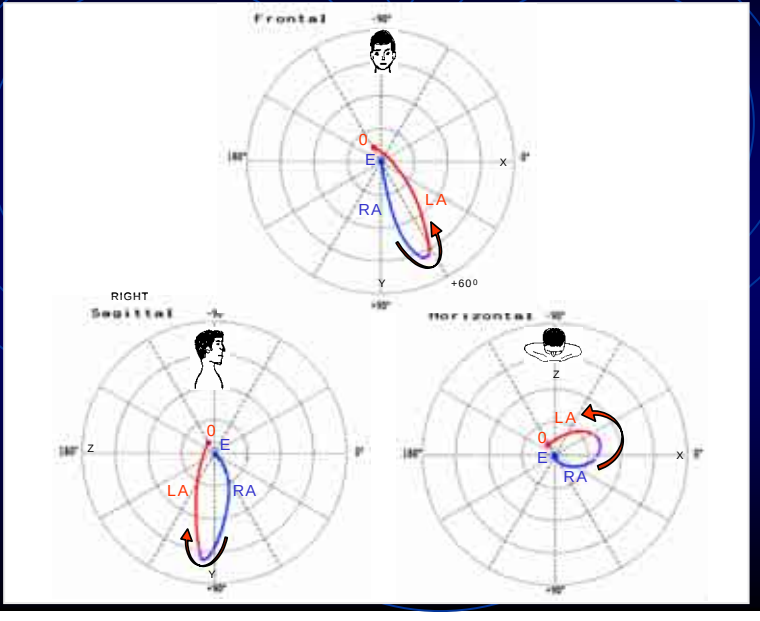


P LOOP IN BIATRIAL CHAMBER IN RIGHT SAGITTAL PLANE




RIGHT SAGITTAL PLANE
FRONTAL PLANE
HORIZONTAL PLANE
aVR
aVL
MINUS PLUS
RA
DI
LA
RA
CCW
Y
Z
LA
RA
CW
DIII
DII
PLUS MINUS
RA
LA
Z
0
X
V6
CCW
V5
V1
V2
V3
V4
PLUS MINUS
CCW: COUNTERCLOCKWISE ROTATION
CW: CLOCKWISE ROTATION

NORMAL P LOOP IN THE THREE PLANES



SUMMARY OF NORMAL CHARACTERISTICS OF THE P LOOP IN THE THREE PLANES

The P loop has a short slow conduction in the onset, in at least 2 planes.

Two small notches are usually observed: one in the efferent limb and another in the afferent limb.

SUMMARY OF NORMAL CHARACTERISTICS OF THE P LOOP IN THE THREE PLANES

	FP	HP	RSP
ROTATION	Counterclockwise	Counterclockwise or in eight	Clockwise
DIRECTION	Inferior and left	Anterior initial and posterior final part	Antero-inferior initial and posterior final part
MORPHOLOGY	Oval	Oval	Spear point or triangular
LOCATION	Left inferior quadrant.	$^{1}/_{3}$ in anterior quadrant and $^{2}/_{3}$ in posterior quadrant.	$^{1}/_{3}$ anterior and inferior and $^{2}/_{3}$ posterior and inferior.

SUMMARY OF NORMAL CHARACTERISTICS OF THE P LOOP IN THE THREE PLANES

	FP	HP	RSP
LOCATION OF MAXIMAL VECTOR:	$+65^0$ ($+20^0$ to $+20^0$)	$+50^0$ to -45^0	$+55^0$ to -120^0
VOLTAGE OF MAXIMAL VECTOR:	0.2 mV or less.	= or < 0.1 mV.	= or < 0.18 mV.
MAXIMAL ANTERIOR FORCES:		Adults up to 0.06 mV. Children up to 0.08 mV.	Adults up to 0.06 mV. Children up to 0.08 mV.
MAXIMAL POSTERIOR FORCES:		Up to 0.04 mV.	Up to 0.04 mV.
MAXIMAL LEFT FORCES:	Adults up to 0.09 mV Children up to 0.13 mV.	Adults up to 0.09 mV Children up to 0.13 mV.	

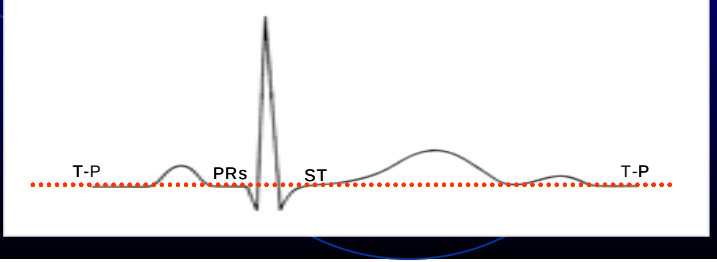
ATRIAL T VECTOR

Atrial repolarization (Ta vector) is responsible for the P loop being open and not closed (0 point does not coincide with initial E point).

A straight line from the onset of the P loop to the end of it, shows the magnitude and direction of the Ta vector.

EXTERIORIZATION OF SEGMENTS IN VECTORCARIOGRAPHY

In vectorcardiography, isoelectric lines corresponding to PR (PRs), ST and T-P segments are not recorded if they do not show depression or elevation. Thus, the segments manifest as stationary points. This non-manifestation is the reason why the ECG is superior to VCG in the analysis of segments and intervals.



QRS LOOP IN THE THREE PLANES

It is the electrical event that occurs after the P loop and begins in the 0 point and ends in the J point.
It represents biventricular chamber depolarization.

In it we should study:

1) **Morphology in the three planes:** FP; HP and RSP or LSP;
2) **Location:** in adults the main body of the QRS loop in the left inferior and posterior quadrants is normal;
3) **Magnitude of maximal vector;**
4) **Rotation:** clockwise, counterclockwise or in eight;
5) **Aspect.**

FRONTAL PLANE

I) **LOCATION:** the body of the QRS loop is located in the left inferior quadrant for adults and older children. In newborn babies, the predominant location is in the right inferior quadrant: SAQRS to the right. In average around $+125^0$ but it may reach 180^0.

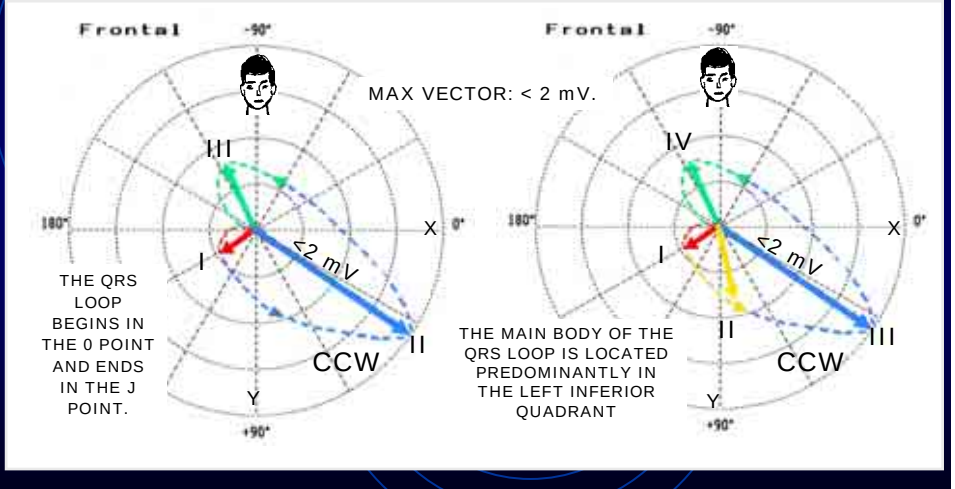
II) **ROTATION:** usually it could be:

1) **Clockwise:** observed in hearts in vertical position.
2) **Counterclockwise:** observed in hearts in horizontal position.
3) **In eight:** it could be normal.

III) **MAGNITUDE OF MAXIMAL VECTOR:** < 2 mV.

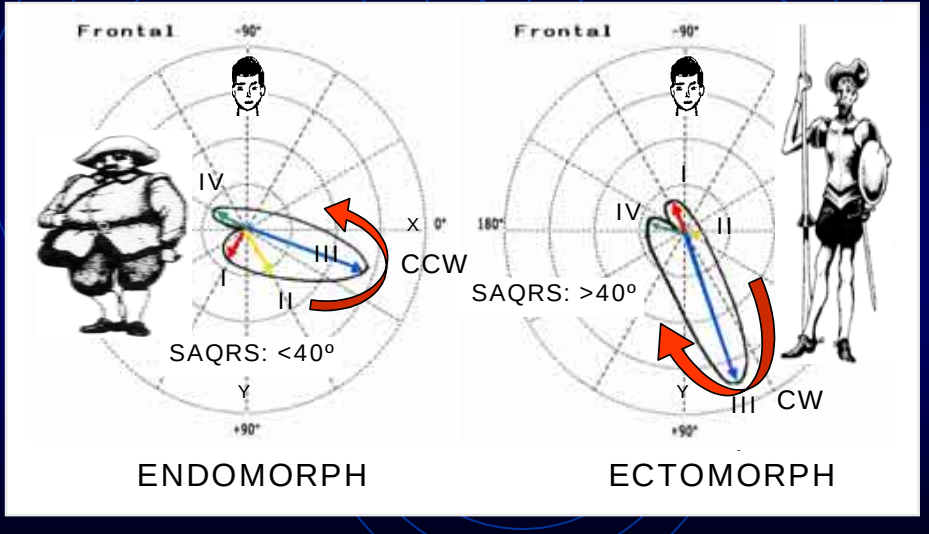
REPRESENTATION OF QRS LOOP IN FRONTAL PLANE WITH 3 OR 4 VECTORS

QRS loop represents biventricular chamber depolarization.



Normal rotation of QRS loop in the frontal plane could be CW, CCW or in eight.

ROTATION OF QRS LOOP IN FRONTAL PLANE AND INFLUENCE OF BIOTYPE

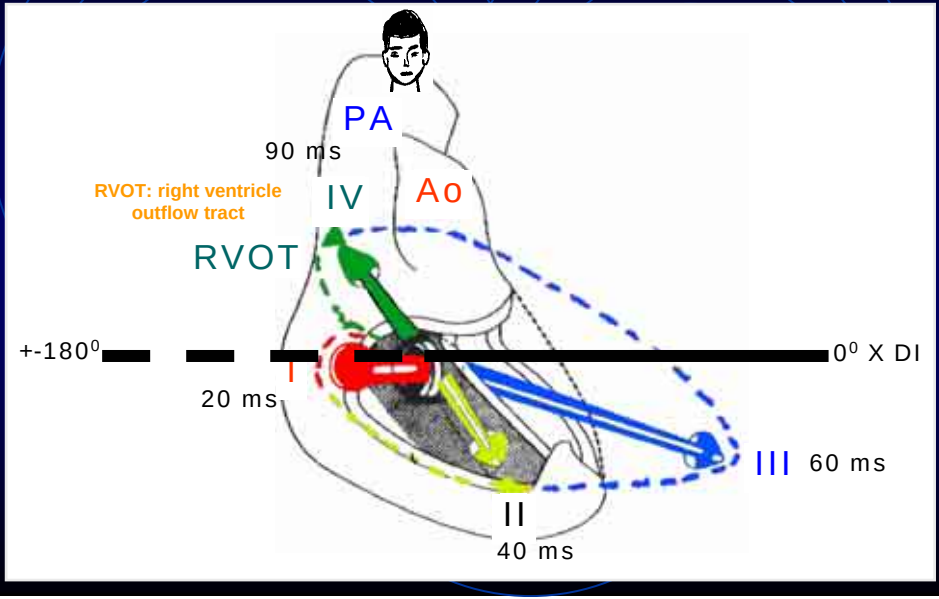


CCW: 15%

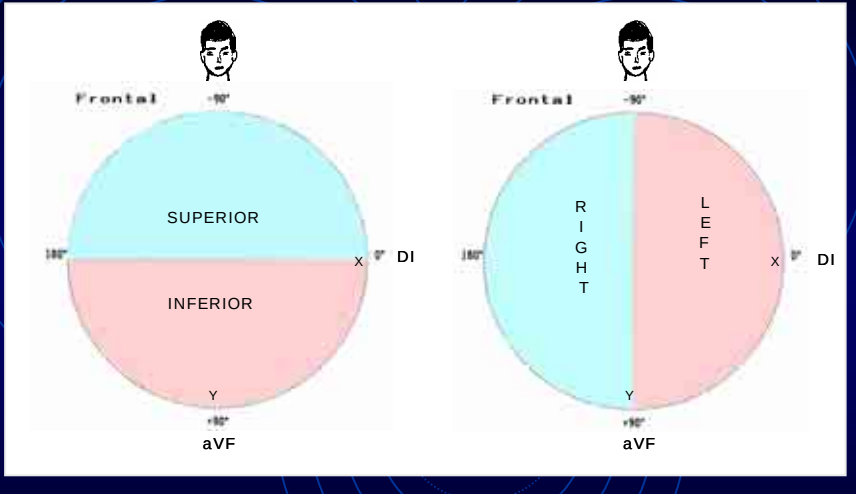
ROTATION IN EIGHT 35%

CW: 50%

QRS LOOP IN FRONTAL PLANE REPRESENTED BY FOUR VECTORS

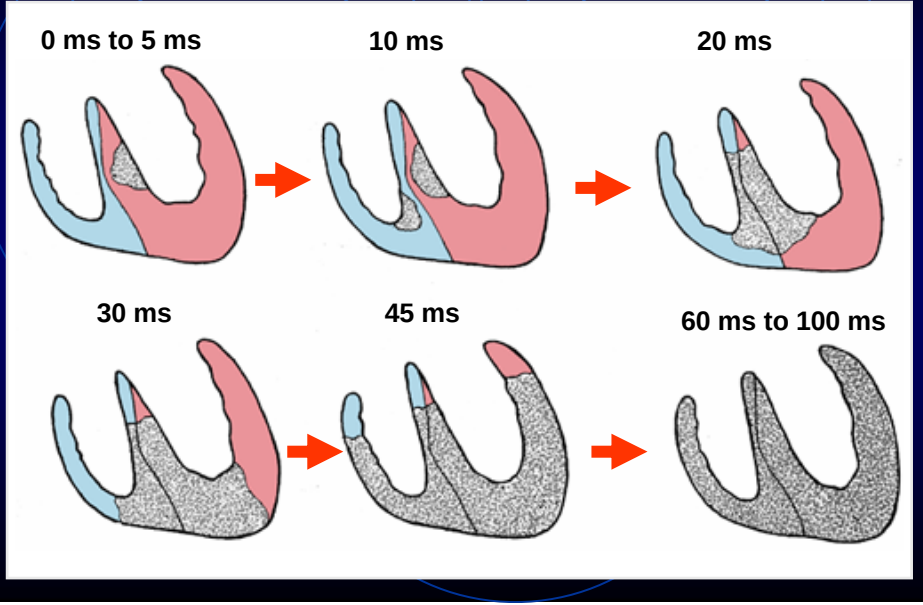


FRONTAL PLANE



The frontal plane (FP) is formed by the intersection of the X and Y leads. This plane enables to determine if the vector in study heads upwards, downwards, to the left or right.

NORMAL SEQUENCE OF ACTIVATION OF VENTRICLES



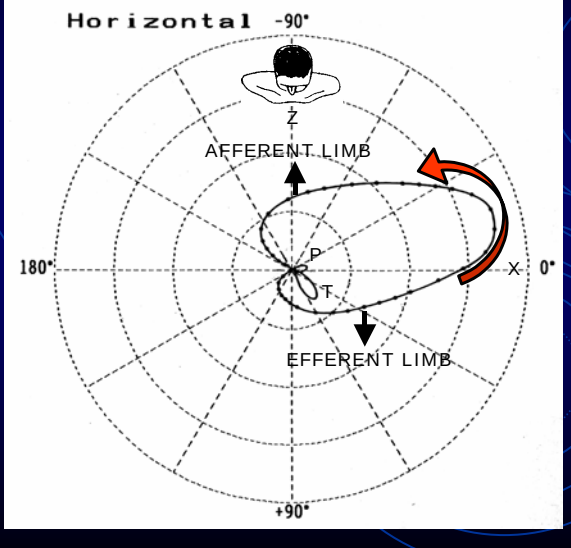
HORIZONTAL PLANE

I) **LOCATION:** the vector of the initial 20 ms, recorded slightly slower, is always located in anterior quadrants and usually in the right. This vector represents septal and paraseptal activation; the main body of the QRS loop is located predominantly in the left posterior quadrant in this plane.

II) **ROTATION:** always counterclockwise in adults.

III) **MAGNITUDE OF MAXIMAL VECTOR:** < 2.2 mV.

HORIZONTAL PLANE



Note: in newborn babies QRS loop is located in the right anterior quadrant.

HORIZONTAL PLANE

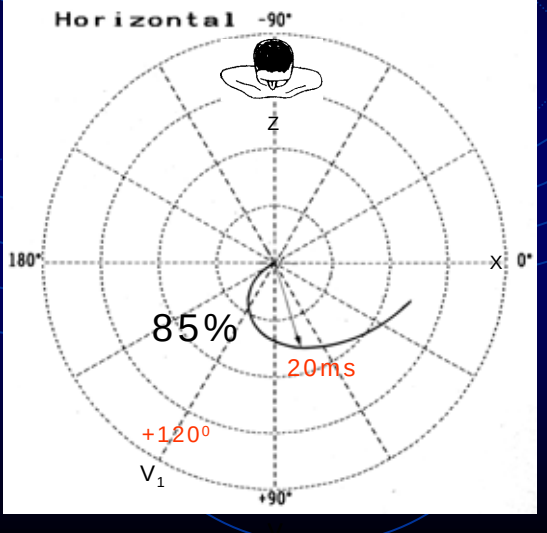
I) VECTOR OF INITIAL 20 ms, INITIAL DEFLECTION OR Q LOOP:

It represents the activation of the middle third of the left septal surface (vector 1e) and of the inferior part of the right inferior septum (vector 1d).

In most cases it is heading to the front and usually to the right (85%). In average, it is located in +120º (between +60º and +157º) originating a convexity to the right in the HP (A).

HORIZONTAL PLANE

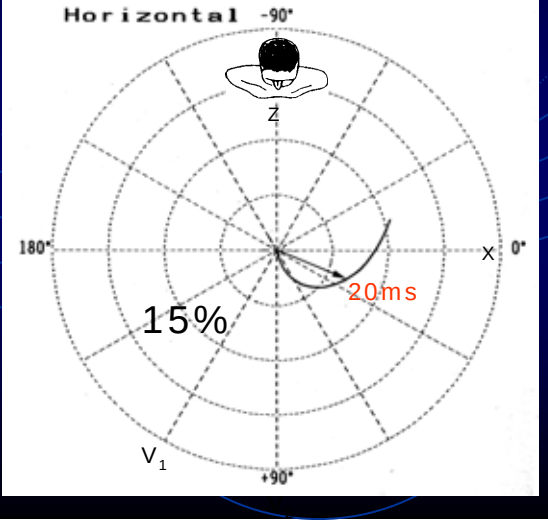
VECTOR OF INITIAL 20 ms, INITIAL DEFLECTION OR Q LOOP:



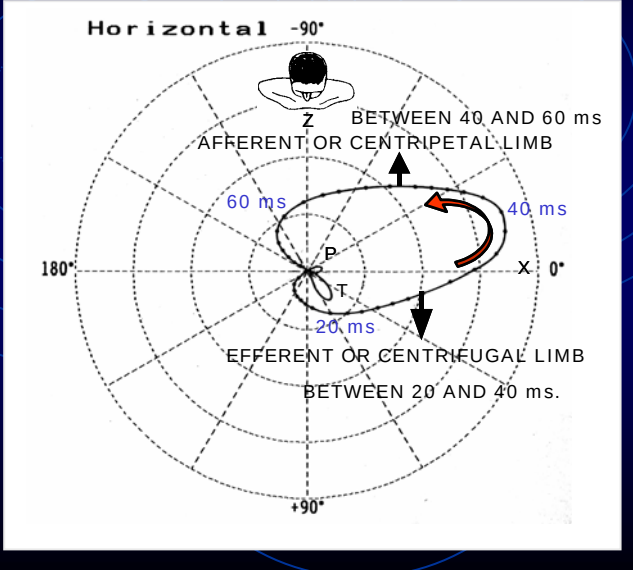
HORIZONTAL PLANE

VECTOR OF INITIAL 20 ms, INITIAL DEFLECTION OR Q LOOP:

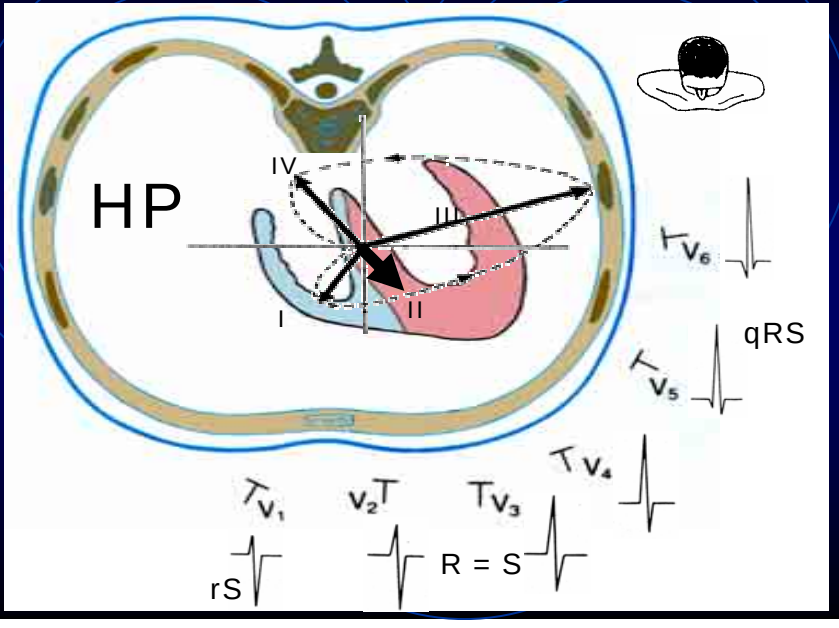
Only 15% heads to the left.



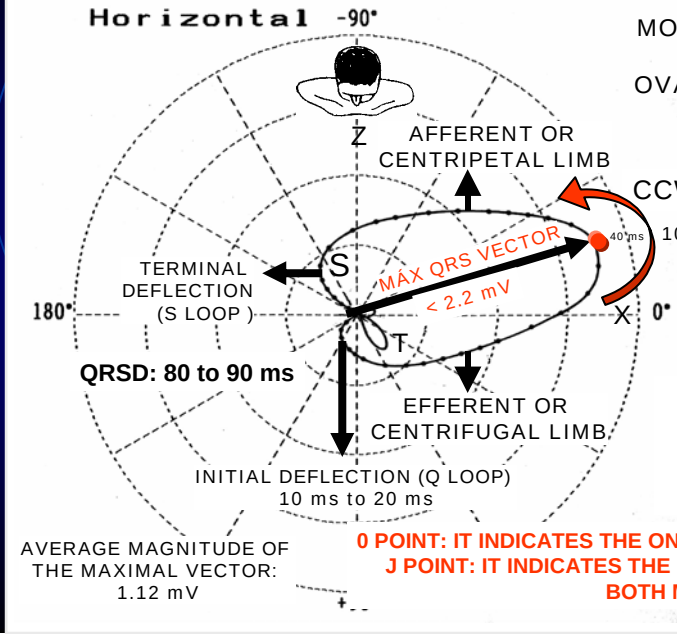
HORIZONTAL PLANE



ECG/VCG CORRELATION IN HORIZONTAL PLANE OF VENTRICULAR DEPOLARIZATION



CHARACTERISTICS OF NORMAL QRS LOOP IN HORIZONTAL PLANE



MORPHOLOGY OF QRS LOOP: OVAL OR ELLIPTIC

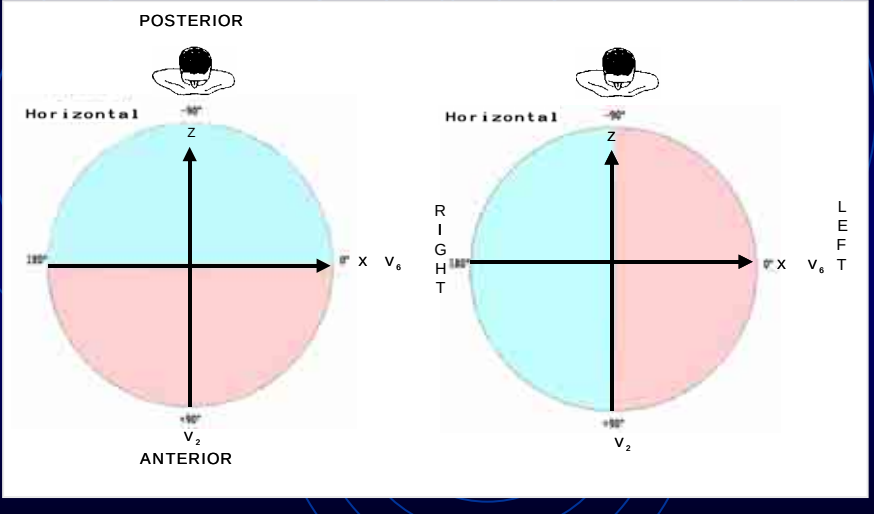
THE MAIN BODY OF THE QRS LOOP IS LOCATED PREDOMINANTLY IN THE LEFT POSTERIOR QUADRANT

(R LOOP)
40 ms to 60 ms

THE MAJOR AXIS OF THE QRS LOOP IS APPROXIMATELY TWICE THE SIZE OF THE MINOR AXIS.

0 POINT: IT INDICATES THE ONSET OF THE QRS LOOP
J POINT: IT INDICATES THE END OF THE QRS LOOP
BOTH MAY COINCIDE OR NOT.

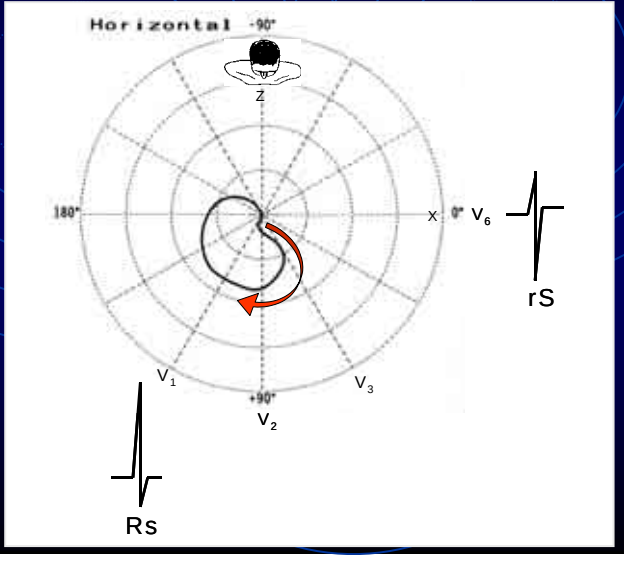
HORIZONTAL PLANE



The horizontal plane (HP) is formed by the intersection of the Z and X leads. It points whether the vector heads to the front, the back, left or right.

EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

NEWBORN BABIES IN THE FIRST 24 HOURS



EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

NEWBORN BABIES IN THE FIRST 24 HOURS

LOCATION OF QRS LOOP: right anterior quadrant.

ROTATION OF QRS LOOP: clockwise.
V_1 V_2: Rs. Rarely pure R. If R wave voltage was the same as or more than 10 mm, it strongly suggests right ventricular enlargement (RVE). qR pattern suggests RVE.

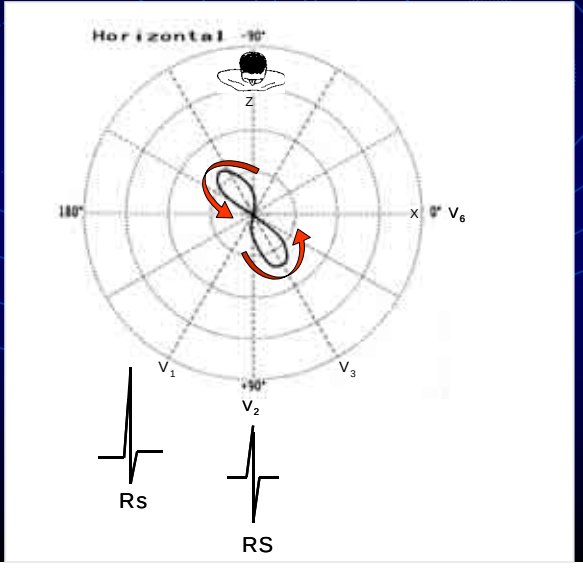
R/S RATIO: greater than 1 in V_1 and V_2 .
Inversion of adult progression of R/S in precordial leads. Adult R/S progression in precordial leads is rare in the first month of life, and when present it suggests left ventricular enlargement (LVE).
V_5 V_6: qRS, rS or RS. S waves always deep in these leads.

T WAVE: it may be of positive polarity in V_1 in the first day of life, remaining negative since the third day. Positive T beyond this time suggests RVE.

ORIGIN: predominance of right ventricle.

EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

BETWEEN 1 AND 2 MONTHS



EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

BETWEEN 1 AND 2 MONTHS

LOCATION OF QRS LOOP: right anterior and posterior quadrant.

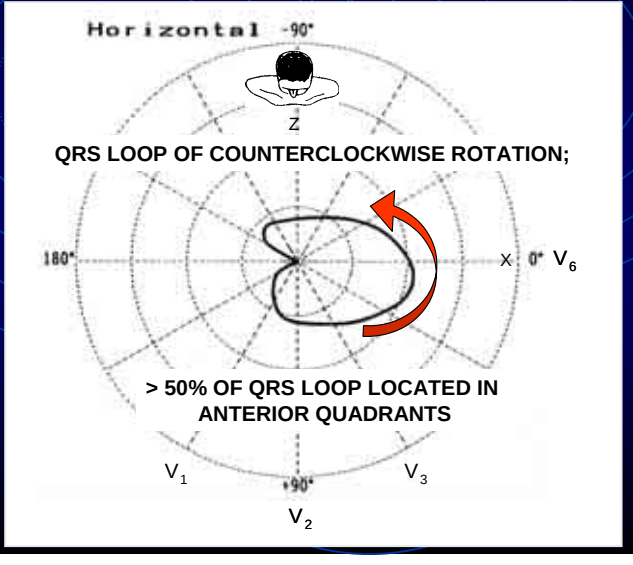
ROTATION OF QRS LOOP: in eight or counterclockwise.

V_1: Rs. R is still dominant in V_1 V_4R. RSR' may be recorded.

V_2: R/S. Ratio close to 1. Frequent wide voltage in precordial leads that may resemble biventricular enlargement.

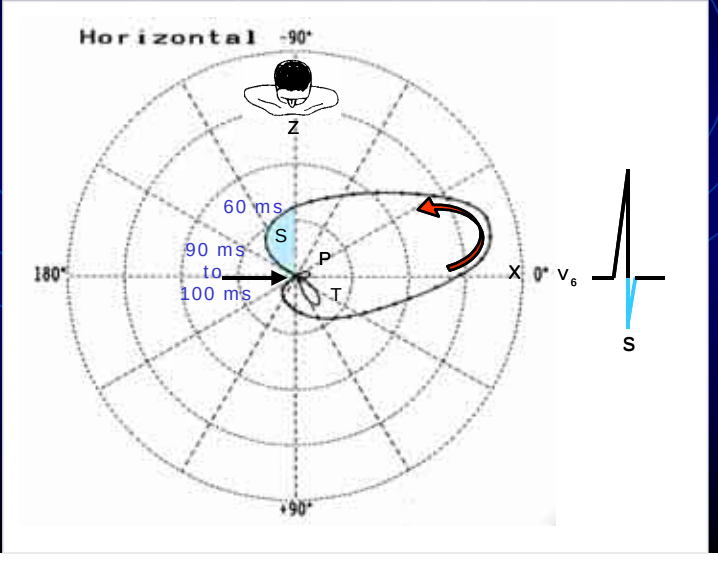
EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

BETWEEN 2 AND 6 YEARS OLD



EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

IN ADULTS



EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

CHARACTERISTICS OF THE LOOP IN ADULTS

1) **DURATION OF QRS (QRSD)** from 80 to 90ms (it may be up to 100 ms);
2) **OBLIGATORY COUNTERCLOCKWISE ROTATION IN THE HP;**
3) **ELLIPTIC OR OVAL MORPHOLOGY;**
4) **LOCATION:** main body of QRS loop, located predominantly in the left posterior quadrant; major axis, approximately twice the size of the minor axis.
5) **VECTOR FROM 20 TO 40 ms:** it represents depolarization of paraseptal region. It is part of the centrifugal or efferent limb of QRS loop.

EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

CHARACTERISTICS OF THE LOOP IN ADULTS

Intermediary vectors, between 40 ms and 60 ms, represent depolarization of free walls of both ventricles. The 40 ms moment has a posterior location (behind the X line); however, in young people and pregnant women, up to 44 ms may be anterior.

Some authors accept the 50 ms moment as the normal borderline.

Note: the body of the R loop stretches from 20 ms to 60 ms, and it is formed by an efferent or centrifugal limb from 20 ms to 40 ms, and another afferent or centripetal limb from 40 to 60 ms.

EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

CHARACTERISTICS OF THE LOOP IN ADULTS

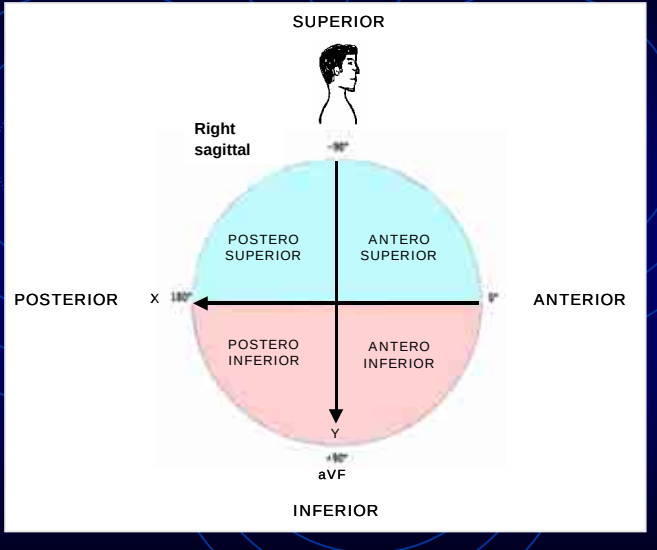
TERMINAL DEFLECTION: it stretches from 60 to 90 or 100 ms. It is known as the S loop or terminal end, located back and to the left or right of the orthogonal Z lead, ending in the J point (it usually coincides with the initial 0 point, however, not in all cases although still normal). In the S loop there may be –as a normal variant- End Conduction Delay (ECD), which should not exceed 25 ms. If this happens, it should be considered dromotropic disorder by one of the divisions of the right branch of the His bundle, in most instances corresponding to a normal variant.

EVOLUTION OF QRS LOOP LOCATION AND ROTATION IN THE HORIZONTAL PLANE WITH AGE

CHARACTERISTICS OF THE LOOP IN ADULTS

In the cases in which the terminal deflection or S loop is to the right of the Z line, the QRS loop area located to the right must be < than 20 % of the total area of the QRS loop. When this occurs, we may be facing a type C RVE, left posterior fascicular block (LPFB), end conduction delay (ECD), complete or advanced right bundle branch block (CRBBB) or lateral electrically inactive area.

RIGHT SAGITTAL PLANE



The sagittal plane (SP) is formed by the intersection of the Z and Y axes, and it indicates if the vector heads upwards, downwards, to the front or back.

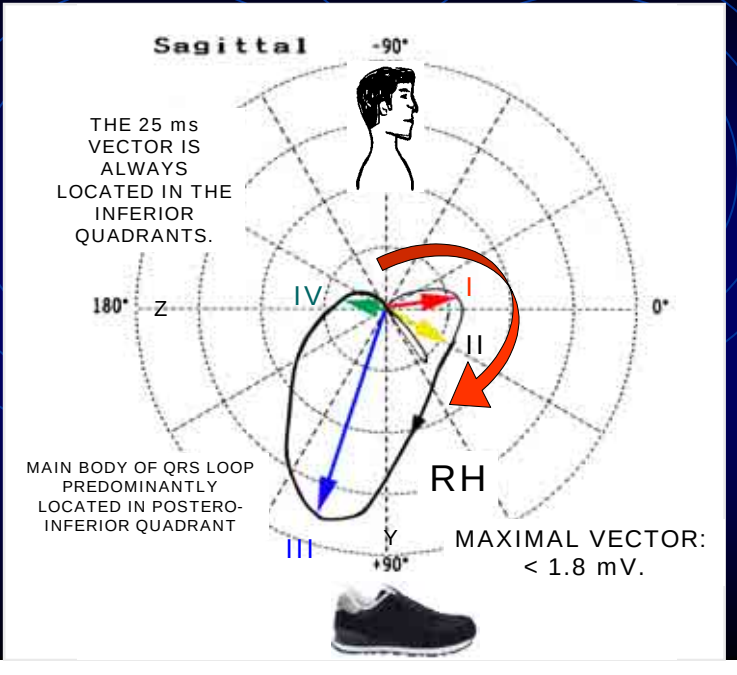
RIGHT SAGITTAL PLANE

I) **LOCATION:** the 25 ms vector is always located in the inferior quadrants. The main body of the QRS loop in adults is located predominantly in the postero inferior quadrant. In newborn babies in the antero- inferior quadrant.

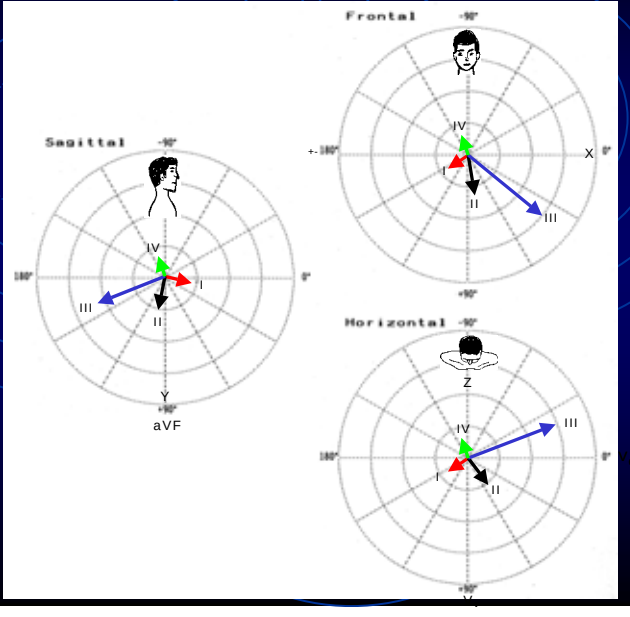
II) **ROTATION:** clockwise (RSP) or counterclockwise (LSP).

III) **MAGNITUDE OF MAXIMAL VECTOR:** < 1.8 mV.

NORMAL QRS LOOP IN THE RIGHT SAGITTAL PLANE



THE THREE PLANES USED IN VECTORCARDIOGRAPHY (FP, HP AND RSP OR LSP) AND THE PROJECTION OF FOUR VECTORS OF VENTRICULAR DEPOLARIZATION.



THE THREE BASIC POINTS OF VCG

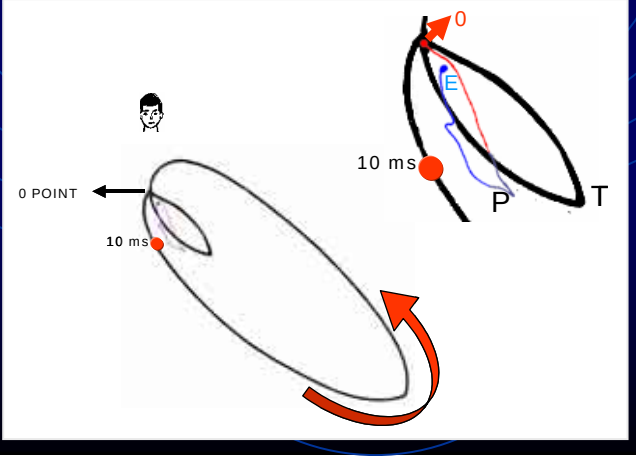
In vectorcardiography there are 3 basic points:

1) **E point;**
2) **0 point;**
3) **J point.**

E point: it indicates the onset of heart activation in the right atrium. In this point, the intersection of three orthogonal leads occurs (X, Z and Y).

THE THREE BASIC POINTS OF VCG

0 point: it corresponds to the end of biatrial chamber activation, QRS loop onset (because PR segment does not exist, it is only a point) and the end of ventricular repolarization (T loop).



THE THREE BASIC POINTS OF VCG

J point: in vectorcardiography, it corresponds to 3 elements: end of ventricular depolarization (QRS complex); beginning of repolarization (ST segment) when it does not present depression or elevation, and T wave onset.

In situations where there is depression or elevation of ST segment, the J point does not coincide with the 0 point, and the greater or lesser distance between both points indicate the greater or lesser ST segment elevation or depression.

The phenomenon is observed in early repolarization, acute phase of infarction, variant angina, pericarditis, Brugada syndrome, arrhythmogenic right ventricular dysplasia, etc.

T LOOP

1) **MORPHOLOGY:** it tends to be elliptic;
2) **MAGNITUDE OF MAXIMAL T VECTOR:** this is obtained from the 0 point up to the farthest point of the T loop. The maximal normal magnitudes in the three planes are:

   FP: 0.75 mV.

   HP: 0.75 mV.

   RSP: 0.70 mV.

3) **ROTATION:**

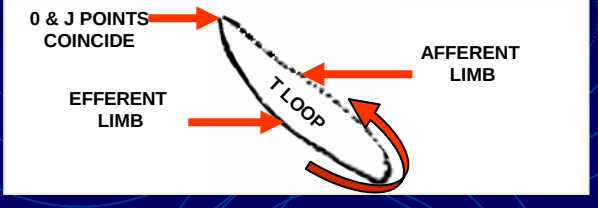
   FP: variable: clockwise or counterclockwise.

   HP: counterclockwise exclusively. Clockwise rotation in this plane indicates heart disease.

   RSP: clockwise. **LSP:** counterclockwise.

T LOOP

4) **VELOCITY OF RECORDING OF ITS EFFERENT AND AFFERENT LIMBS:**
the efferent limb is always recorded more slowly than the afferent one;



5) **LOCATION:** usually, left and inferior, and to the front in adults.

FP: in left inferior quadrant.

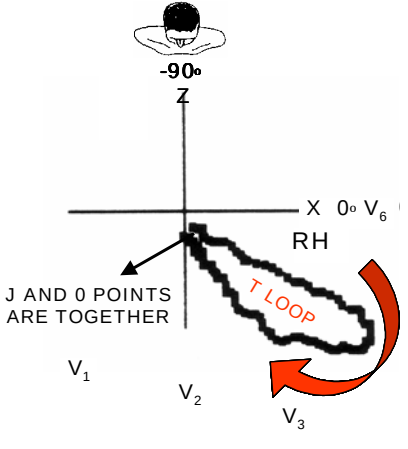
HP: in left anterior quadrant.

RSP: in antero-inferior quadrant.

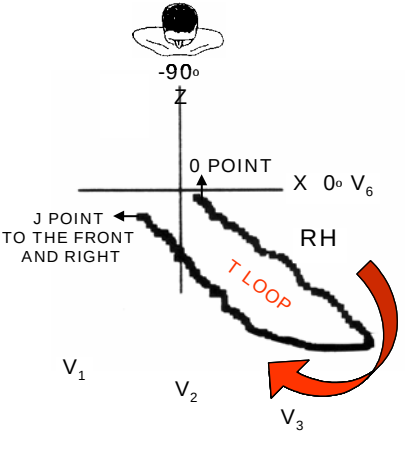
6) **QRS/T ANGLE:** < 75^0. Usually smaller in the FP than in the HP.

T LOOP

WHEN ST IS NOT ELEVATED
OR DEPRESSED

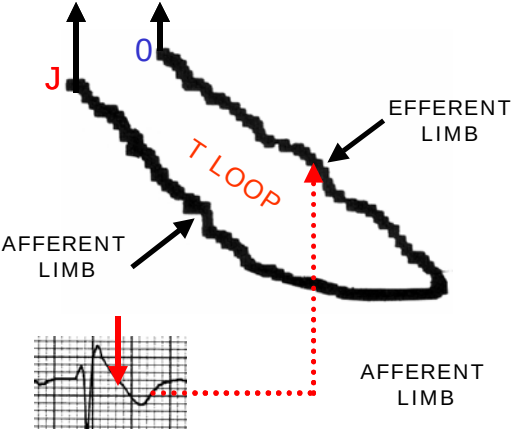


WHEN ST IS ELEVATED, THE J AND 0 POINTS
DO NOT COINCIDE



T LOOP

THE DISTANCE BETWEEN THE 0 AND J POINTS IS PROPORTIONAL TO THE DEGREE OF ST SEGMENT ELEVATION



CONCLUSION: the greater the distance between the two points, the greater the elevation or depression of the ST segment.

COMPARISON BETWEEN ECG AND VCG

	VCG	ECG
TYPE OF RECORDING:	Vectorial loops.	Scalar deflection.
TRIDIMENSIONAL INFORMATION:	Yes.	No.
MAIN QUALITY:	Better idea of magnitude and direction of forces at every moment[1].	Provides information about time and voltage.

1) Benchimol A, et al. Chest 1972; 61:74-76.

COMPARISON BETWEEN ECG AND VCG

	VCG	ECG
USEFULNESS:	Huge to understand the direction and magnitude of forces. More accurate diagnosis of chamber enlargement, fascicular blocks, association of inactive areas and fascicular blocks[1-2]. Ideal to teach and research.	Highly practical, reproducible, low cost. Considered as the "gold standard" for: a) Atrial and ventricular dromotropic disorders. Ventricular pre-excitation[3]. b) Most arrhythmias. c) Acute phase of infarction (sequential)

1) Lee GB, et al. Circulation. 1968;38:189-200.
2) Giorgi C, et al. Am Heart J 1987; 113:1539.
3) Chou TC. Am J Coll Cardiol 1986; 8:791-799.

COMPARISON BETWEEN ECG AND VCG

	VCG	ECG
SPECIFICITY AND SENSITIVITY FOR DIAGNOSIS OF CHAMBER ENLARGEMENT, FASCICULAR BLOCKS, VENTRICULAR PRE-EXCITATION, ASSOCIATION OF INACTIVE AREAS TO FASCICULAR BLOCKS:	Greater[1].	Smaller[2-3].
DIAGNOSIS OF ARRHYTHMIAS:	It could be superior only in certain dromotropic disorders: branch blocks, fascicular blocks, pre-excitation.	Superior in the rest: fibrillation, flutter, extrasystoles, escapes, tachycardias of any origin, AV blocks.

1) Khair GZ, et al. J Electrocardiol 1980; 13:93-98.
2) Hurd HP 2nd, et al. Circulation 1981;63:1025-1029.
3) Edenbrandt L, et al. Clin Physiol 1990; 10:551-559.

COMPARISON BETWEEN ECG AND VCG

	VCG	ECG
ANALYSIS OF U WAVE:	No.	Yes.
SEGMENTS AND INTERVALS:	Not appropriate.	Yes. Ideal.
DORSAL INFARCTION:	More diagnostic accuracy.	Less diagnostic accuracy.
INFERIOR INFARCTION ASSOCIATED TO FASCICULAR BLOCK:	More accuracy[1].	Less accuracy.

1) Hurd HP 2nd, et al. Circulation 1981;63:1025-1029.

COMPARISON BETWEEN ECG AND VCG

	VCG	ECG
SENSITIVITY AND SPECIFICITY FOR DIAGNOSIS OF INFARCTION:	More sensitivity and equal specificity.	Less sensitivity and equal specificity.
GENERAL DIAGNOSTIC ACCURACY:	15% greater than ECG.	15% lower than VCG.