Vectorcardiography

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Outline

- Display and terminology
 Depolarization basics
- Sequence of activation of the heart
- Correlation of ECG and VCG
- Normal
- Common abnormalities

Depolarization Basics



Friedman HH. Diagnostic electrocardiography and vectorcardiography 1971

Depolarization Basics



Friedman HH. Diagnostic electrocardiography and vectorcardiography 1971

The Vector Concept



- rional Fian
- Magnitude
- Direction

The direction of the arrow is the direction of depolarization

Chou TC et al. Clinical Vectorcardiography, 2nd ed, 1974







Friedman, 1971 and Chou, 1974



Right Sagittal plane

Frontal plane















Sequence of Activation

Netter







Netter



L. VENTRICULAR DEPOLARIZATION

APICAL DEPOLARIZATION







LATE L. VENTRICULAR DEPOLARIZATION

VENTRICLES DEPOLARIZED

Netter



VENTRICLES REPOLARIZED

×

×

×

×

×

×





Sequence of Depolarization



Sequence of Depolarization



Chou TC et al. <u>Clinical Vectorcardiography</u>, 2nd ed, 1974





Sequence of Ventricular Activation

SEQUENCE OF VENTRICULAR ACTIVATION











PHASE I INITIAL SEPTAL ACTIVATION. (0.01 SEC)

- PHASE 2 CONTINUED ACTIVATION OF SEPTUM AND ACTIVATION OF APICO-ANTERIOR PORTIONS OF RIGHT AND LEFT VENTRICLES. (0.02 SEC)
- PHASE 3 COMPLETION OF SEPTAL ACTIVATION AND ACTIVATION OF MOST, IF NOT ALL, OF RIGHT VENTRICLE AND MOST OF LEFT VENTRICLE. (0.04-0.06 SEC) PHASE 4 ACTIVATION OF POSTEROBASAL REGION OF LEFT VENTRICLE, BASE OF SEPTUM AND BASE OF RIGHT
 - VENTRICLE. (0.06-0.08 SEC)

Friedman HH, 1971

Sequence of Ventricular Activation





Friedman HH, 1971



Sequence of Ventricular Activation



Friedman

Sequence of Activation





Deriving the Vector from the Scalar

From Grant RP. <u>Clinical</u> <u>Electrocardiography</u>. McGraw-Hill. 1957



Deriving the Vector from the Scalar



From Grant RP. Clinical Electrocardiography. McGraw-Hill. 1957

Deriving the Vector from the Scalar



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Normal Frontal Plane QRS Loop



Mean maximal vector

Chou TC et al. <u>Clinical Vectorcardiography</u>, 2nd ed, 1974

Standard Limb Lead Projection





Chou TC et al. <u>Clinical Vectorcardiography</u>, 2nd ed, 1974

Limb Lead ECG and VCG



Vectorcardiographic Measurements



Chou TC et al. <u>Clinical Vectorcardiography</u>, 2nd ed, 1974

Vector Terminology



Chou TC et al. <u>Clinical Vectorcardiography</u>, 2nd ed, 1974



erse Plane

- E point is the beginning of the P wave, the end of the T-P segment
- O point is the end of the PR segment, the beginning of the QRS



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Transverse Plane



• The end of the QRS is not precisely at the same point as the beginning, so there is a normal ST segment, especially in the transverse plane.

Transverse Plane



 The end of the T loop is back to the E point



Normal Frontal Plane



Normal Transverse Plane



Normal Sagittal Plane











Deriving Scalar From Vector



Scalar Y Lead From Vector





Scalar X Lead From Vector

(A) Derivation of the Orthogonal lead X from the Transverse Plane QRS loop



Scalar Z Lead From Vector

(B) Derivation of the Orthogonal lead Z from the Transverse Plane QRS loop



Correlation of Chest Leads and VCG Transverse Plane





Abnormalities

- Hypertrophy
- Conduction abnormalities
- Infarction

Left Ventricular Hypertrophy



Left Ventricular Hypertrophy



Left Ventricular Hypertrophy



Right Ventricular Hypertrophy



Right Ventricular Hypertrophy



Right Ventricular Hypertrophy Type A















TYPE B RIGHT VENTRICULAR HYPERTROPHY

Right Ventricular Hypertrophy Type B



Right Ventricular Hypertrophy Type C



Left Bundle Branch Block

COMPLETE LEFT BUNDLE-BRANCH BLOCK



Left Bundle Branch Block



Right Bundle Branch Block

COMPLETE RIGHT BUNDLE-BRANCH BLOCK











T'

Right Bundle Branch Block



в

Α

Right Bundle Branch Block



Left Anterior Fascicular Block



Wolff-Parkinson-White





Initial forces are posterior

Anterior Infarction

Initial forces are anterior, but 0.02 sec vector is posterior



Anterolateral Infarction

Ρ -90° Transverse R<u>±180</u>° Plane 0° |90° A S -90 P± 180° <u>°</u>A **Right Sagittal** Plane 90° S 1-90° a۷L R<u>±180</u>°, °L **Frontal Plane** 5 90° aVF ш

Initial forces are clockwise in transverse plane

Inferior Infarction

Initial forces are superior for too long, over 0.025 sec, and superior displacement is excessive.

Transverse Plane









Frontal Plane









Inferolateral Infarction

Combination of inferior MI and lateral MI criteria



Inferior Infarction and LAFB

Left Anterior Hemiblock

Left Anterior Hemiblock and Inferior Myocardial Infarction



Posterior Infarction

Initial forces are anterior too long and too far in transverse plane Transverse Plane

Right Sagittal

Plane





LA T





Frontal Plane



RAE


RIGHT ATRIAL ENLARGEMENT









RAE vs LAE



RIGHT ATRIAL ENLARGEMENT



LAE







LEFT ATRIAL ENLARGEMENT







References

- Friedman HH. Diagnostic electrocardiography and vectorcardiography. McGraw-Hill, 1971
- Chou TC, Helm RA, and Kaplan S. Clinical vectorcardiography, 2nd ed. Grune and Stratton, 1974.
- Netter FH. Ciba collection of medical illustrations, Vol 5. Heart. 1978.