

DIRECTIONS OF CARDIAC VECTORS IN MALE STUDENTS

By

S. R. KAPOOR AND I. K. YAGNIK

Department of Physiology, G.S.V.M. Medical College, Kanpur

The heart and the body form a three dimensional spatial system. The electrical events are therefore also three dimensional. A single electrocardiographic tracing is unidimensional electrically. The record of vector forces in three dimensions provides a more comprehensive formation than the scalar technique.

The correct interpretation of E.C.G. depends on differentiation between "normal" and "abnormal" patterns. The present study of vector analysis in young students was undertaken to delineate normal pattern.

MATERIALS AND METHODS

The present study was made on 225 normal healthy male students of G.S.V.M. Medical College, Kanpur. After recording their age, height and weight, a twelve lead (lead I, II, III, aVR, aVL, aVF and V_1-V_6) conventional electrocardiogram by a direct writing instrument was taken in all cases. Most of the cases were in basal conditions i.e. they were asked to sleep in the recording room on previous night and E.C.G. was recorded early in the morning after 8-9 hours' normal sleep and before allowing them to leave the bed for toilet.

In the present work we have used Grant's (1) concept of cylindrical model for plotting mean vector. Although this simpler method does not give the magnitude of the vectors, it gives their directions as accurately as more painstaking method of plotting areas enclosed by various deflections. Also the direction of the vector is far more important than its magnitude in clinical electrocardiography.

The frontal plane directions of mean spatial P, QRS and T vectors were determined by Grant's (1) method. The same procedure was used to plot the frontal plane directions of the instantaneous QRS vector of initial 0.01-0.02 sec., initial 0.03-0.04 sec. and terminal 0.03-0.04 sec.

The precordial leads were used to determine how far anteriorly or posteriorly from this frontal plane projection, the spatial vector was directed. This was done in accordance with Grant's(1) method by identifying the precordial leads with the null or transitional deflection for that vector. To allot the degree to vector direction, Zao's(4, 5) concept of "polarity" circles was used.

QRS-T Angle

The angle between mean spatial QRS and mean spatial T vector is known as the QRS-T angle. We have used Grant's(1) method to measure it in frontal plane.

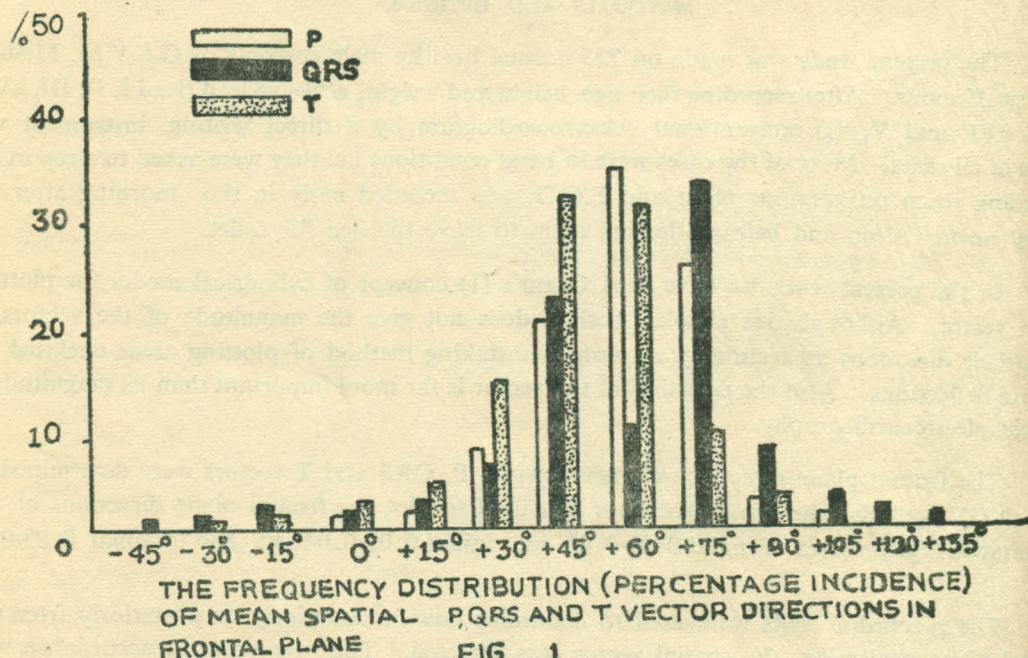
OBSERVATIONS AND RESULTS

In our series we had a very narrow age range. Average age was 20.22 years with 97% of the subject population falling within the range of 18-23 years. Average heart rate was 79/min. Out of 225 cases studied, 104, 113 and 8 were respectively under, average and overweight.

To calculate the mean spatial P, QRS and T vector directions, we have used the observed E.C.G. readings without making any corrections. Degrees were allotted to the vector directions by using the hexa-axial reference frame-Grant (1).

Frontal Plane Vector Directions

The frequency distribution (percentage incidence) of mean spatial P, QRS and T vector directions on frontal plane is given in Fig. 1.



The averages and ranges of frontal plane vectors and QRS-T angle are summarised in Table 1.

Fig. 2 shows the percentage incidence of frontal plane QRS vector in relation to body weight. The overweight subjects being too small in number were excluded.

TABLE I

	Average	Range
P-Vector	+58°	0° to +105° (93% of subject population between +30° to +75°)
QRS Vector	+58°	-45° to +135° (90% between 0° to +90°)
T-Vector	+46°	-30° to +90° (94% between +15° to +75°)
QRS-T Angle	21°	0° to 90° (93% between 0° to 45°)

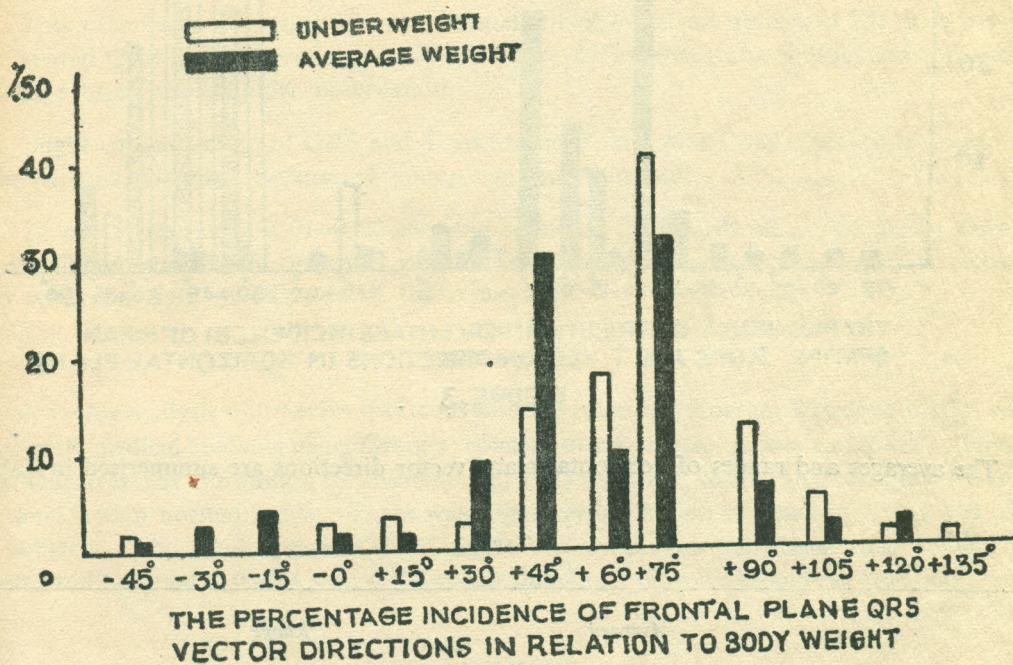


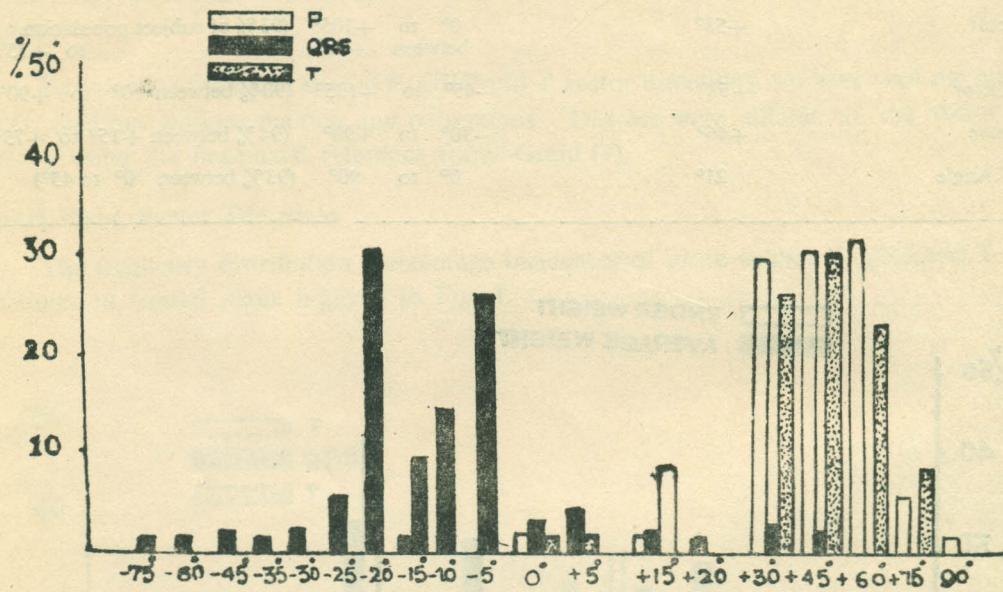
FIGURE .2

Initial 0.01—0.02 sec. and terminal 0.03—0.04 sec. QRS vector directions had a wide range of variation throughout the 360° of the circle. Initial 0.03—0.04 sec. QRS vector direction usually ran parallel with the mean QRS vector (electrical axis) and in 95% of the subjects, it did not fluctuate by more than 15° on either right or left side.

In four cases, electrical axis in frontal plane was directed slightly posteriorly (-30° to -45°). P axis and QRS-T angle had no correlation with body weight. QRS and T axes showed a trend for verticalisation within normal limits.

Horizontal Plane Vector Directions

The frequency distribution (percentage incidence) of mean spatial P, QRS and T vector directions in horizontal plane is given in Fig. 3.



THE FREQUENCY DISTRIBUTION (PERCENTAGE INCIDENCE) OF MEAN SPATIAL P, QRS AND T VECTOR DIRECTIONS IN HORIZONTAL PLANE

FIGURE 3

The averages and ranges of horizontal plane vector directions are summarised in Table 2.

TABLE 2

	Average	Range
P—Vector	+43°	-15° to +90°
QRS	-13°	-75° to +45°
T—Vector	+43°	0° to +75°

In horizontal plane, the axes of mean spatial vectors of P and T were directed anteriorly in almost all cases while QRS vector was directed posteriorly in 94% of the subjects. There was no correlation between vector direction and body weight.

DISCUSSION

In spatial vector electrocardiography the human thorax may be assumed to be a homogenous sphere with the heart as vector point source, situated at its geometric centre. Any heart vector in the space may be obtained from its projection in two planes, such as the transversely vertical and horizontal planes.

The present method of vector analysis is simply a spatial counter-part of Einthoven assumptions. The use of 12 lead E.C.G. tracing for vector analysis requires no assumptions regarding the internal electrical properties of the body.

The observed averages and ranges for frontal and horizontal plane directions of P, QRS and T vectors and frontal plane QRS-T angle are within normal limits and are consistent with the findings of other workers e.g. Lipmen and Massie (3) and Zao *et. al.* (4, 5).

It is of interest that four of these normal subjects had an abnormal left axis deviation (mean spatial QRS vector direction was from -30° to -45°) without any obvious heart pathology. They have been placed under observation.

Slight verticalization of QRS and T vectors in frontal plane was observed in some under weight persons possibly because of young age and thin built.

In our series initial 0.01--0.02 sec. and terminal 0.03--0.04 sec., QRS vector directions were throughout the 360° of the circle and there was no significant pre-ponderance of vector direction either on right or left side of the circle.

SUMMARY

A vector analysis of a twelve lead conventional electrocardiogram was done in 225 young, normal male medical students using Grant's concept of cylindrical model and Zao's "Polarity" circles. Our averages and ranges for mean spatial P, QRS and T vectors in frontal and horizontal plane were within normal limits. There was slight verticalization of heart in young and thinly built subjects. The frontal plane QRS-T angle was within normal limits. The initial 0.01-0.02 sec. and terminal 0.03-0.4 sec. QRS vector directions ranged throughout the 360° of the circle.

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