The Postural Effects on Electrical Activities of Heart in Apparently Healthy Young Adults

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ABSTRACT

Background

The electrical activities of heart recorded as electrocardiogram (ECG) are mostly done in supine postures. The body postural changes have effects in these electrical activities in heart which needs to be properly recognized.

Objective

To find the variations in electrocardiogram during postural changes from supine to upright i.e. sitting and standing postures among apparently healthy young adults.

Method

A cross sectional study was carried out in Manipal College of Medical Sciences after the institutional ethical clearance. The apparently healthy 30 Nepalese male medical students between 18-25 years of age were enrolled. The electrocardiography was elicited in supine, sitting and standing postures in the participants after 5 minutes' interval between each procedure in each participant.

Result

The highest mean amplitudes of Q wave were seen in sitting postures (0.12±0.04 mm), R wave in standing postures (1.46±0.55 mm) and S wave also in standing postures (0.23±0.2 mm). The mean amplitudes of Q and S waves showed statistically significant difference when compared between supine and upright postures. The maximum QRS duration was found while sitting (0.08±0.01 ms)and maximum heart rate in standing posture (82.43±10.59/min). The mean comparison of heart rate was statistically highly significant when compared between supine and standing postures. The mean QRS frontal axis was comparatively increased while standing (64.30±39.29).

Conclusion

The electrical activities of heart vary during postural changes among apparently healthy young adults. These changes are most prominent when compared between supine and standing postures which urges for careful interpretation of electrocardiogram if it is done in upright postures.

KEY WORDS

Electrocardiogram, Heart, Postures

INTRODUCTION

The electrocardiograms (ECG) are the graphical representations of electrical activities of heartand the procedure is named electrocardiography. This procedure helps in monitoring and diagnosis of heart related problems. Itis mostly done in supine posture and interpretation is also based on physiological rangesbased on the calculations of supine ECG. However, certain conditions demand the ECG to be taken in upright postures like exercise stress test, evaluation of syncope, or in patients who can't assume the supine positions.[1] Hence, it is important to know the variations in ECG during postural changes.

The postural effects on the cardiovascular responses have been extensively studied.[2-7] The significant finding includes increase in heart rate in upright postures.[8-10] The electrical activities of heart including R wave amplitudes and QRS frontal axis are found tofluctuateduring postural changes in normal adults.[1] This study also aims to find the fluctuations in electrical activities of heart between supine and upright postures i.e. sitting and standing. This will help to form a basis for careful interpretation of upright ECG.

METHODS

This cross sectional study was conducted in Manipal College of Medical Sciences from June, 2018 to August, 2018 after getting the ethical approval. Thirty young Nepalese male students between 18-25 years of age were included by convenience sampling. The sample size was calculated taking consideration of mean and standard deviation (calculated QT interval) in supine and standing posture with sample size formula.[1]

$$N= (Z\alpha+Z\beta)^2/(\sigma/\delta)^2$$

The participants were non-smoker, non-alcoholic with no history of systemic diseases or allergies orcardiovascularsurgeries and were apparently healthy. The participants were enrolled, allowed them to rest in supine position for 5 minutes. With all precautions, the electrocardiography was first done in supine position with Schiller electrocardiograph with calibration of paper speed as 25 mm/s and sensitivity of 10 mm=1 mV. Then, in 5 minutes' interval, another ECG was recorded in the same participant with sitting position with back held erect. It was followed by electrocardiography in standing posture in next 5 minutes' interval.

The ECG interpretations were done taking Lead II into consideration. The amplitudes of Q,R,S waves, QRS duration, QRS frontal axis, Heart rate were taken in considerations in all three body postures. The data was entered and analyzed with SPSS-16 version. The distributive analysis and mean comparison (Paired T test) were done and $P < 0.05$ was considered significant and < 0.001 was considered highly significant taking confidence interval of 95%.

RESULTS

The mean amplitude of Q wave was comparatively more in sitting posture which was statistically significant ($P < 0.05$) in comparison to supine postures. The mean amplitude of R wave was comparatively more in standing posture but had no significant statistical difference when compared to supine posture. The mean amplitude of S wave was comparatively more in standing posture which was statistically significant when compared to supine ($P = 0.01$). The mean QRS complex duration was highest in sitting posture however it had no statistically significant difference when compared to supine posture (Table 1 and 2).

Table 1. Mean distribution of electrocardiographic waves during ventricular depolarization in different postures (n=30)

Postures	Amplitudes			Duration
	Q wave (mm)	R wave (mm)	S wave (mm)	QRS complex (ms)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Supine	0.10±0.00	1.38±0.36	0.18±0.14	0.07±0.02
Sitting	0.12±0.04	1.45±0.50	0.20±0.17	0.08±0.01
Standing	0.11±0.03	1.46±0.55	0.23±0.20	0.07±0.02

Table 2. Mean comparison of electrocardiographic waves during ventricular depolarization in between different postures

Mean comparison	Supine with sitting (P value)	Supine with standing (P value)
Q wave amplitude	0.004	0.020
R wave amplitude	0.204	0.191
S wave amplitude	0.378	0.010
QRS duration	0.459	0.403

The mean QRS frontal axis was maximum in standing posture which was statistically notsignificantwhen compared to supine posture (Table 3). The mean heart rate was highest in standing posture which was statistically highly significant when compared to supine position (Table 4).

Table 3. Mean distribution and comparison of QRS frontal axis in different postures

Postures	QRS frontal axis (degree) [Mean ±S.D]	Comparison of mean of QRS frontal axis	
		Supine with sitting (P value)	Supine with standing (P value)
Supine	59.53±40.21	0.722	0.653
Sitting	56.83±39.33		
Standing	64.30±39.29		

Table 4. Mean distribution and comparison of Heart Rate in different postures

Postures	Heart Rate [Mean ±S.D]	Comparison of mean of RR Interval	
		Supine with sitting (P value)	Supine with standing (P value)
Supine	73.73±7.24	0.048	0.000
Sitting	76.80±8.79		
Standing	82.43±10.59		

DISCUSSION

The result of this study showed the electrical activities of heart vary during body postural changes among apparently healthy young adults. The heart rate was found to be increased from supine to upright posture which was similar to the several other studies.[3,8-14] This has been explained with venous pooling of blood in upright posture with resultant decrease venous return and the cardiac output which increases the sympathetic activity in the body resulting into increased heart rate.[4-7] The study carried out in China has showed the decrease in R wave amplitude with postural changes from lying to sitting and standing position.[15] However, this study has found the mean amplitudes of Q, R, S waves were increased when body postures was kept in upright postures. The mean amplitudes of Q and S waves also showed statistically significant difference when compared between supine and upright postures. The finding was also in contrast with the other study which reported no such significant changes in wave amplitudes from supine to standing posture.[1]

The standing posture is expected to cause rightward shift of QRS axis due to descent of diaphragm and change in the anatomical position of the heart. However, several studies have found the mean QRS axis shifting may not be demonstrated during posture change from supine to standing.[16,17] This study in contrast has found the increased mean QRS frontal axis with standing posture but the difference was statistically insignificant.

These alterations in electrical activities of heart during body posture changes are attributed to the change in anatomical orientation of heart in chest cavity, changes in lung volumes and change of electrode contact with skin.[1] The postural change which alter the gravitational gradient initially shift position of the heart and it's contact with neighboring tissue in upright position. The further upright posture can increase sympathetic activity caused by decrease venous return resulting into changes in ECG.[2] Thus, it is necessary for careful interpretation of standing ECG with references to the variations that is likely to occur in postural changes. Certain conditions which require the ECG to be taken in upright postures like exercise stress test, evaluation of syncope, or in patients who can't assume the supine positions has to be interpreted accordingly for avoiding the misdiagnosis.

The present study has some limitations. Firstly, the study has considered only male adult participants. The results can be different in female and other age groups. Also, the study could be elaborated taking interpretations from other limb and chest leads. The ECG changes among the diseased individuals could also be due to the pathological factors instead of postural changes if upright electrocardiography is conducted on them.

CONCLUSION

The body postural changes cause variations in electrical activities of heart seen in ECG among apparently healthy young adults. These changes are most prominent when compared between supine and standing postures. Hence, certain conditions associated with electrocardiography in upright postures like syncope or exercise stress test needs careful ECG interpretation to avoid the misdiagnosis.

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