The Postural Effects on Electrical Activities of Heart in Apparently Healthy Young Adults
Chaudhary S, Ranamagar R, Shrestha L, Pun DB, Karmacharya P, Mahotra NB

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 heart and the procedure is named electrocardiography. This procedure helps in monitoring and diagnosis of heart related problems. Its mostly done in supine posture and interpretation is also based on physiological ranges based 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 to fluctuate during 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

\[ N = \frac{(Z_{\alpha/2}+Z_{\beta})^2}{(\sigma/\delta)^2} \]

The participants were non-smoker, non-alcoholic with no history of systemic diseases or allergies or cardiovascular surgeries 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>
<thead>
<tr>
<th>Postures</th>
<th>Amplitudes</th>
<th>Duration</th>
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<tr>
<td></td>
<td>Q wave (mm)</td>
<td>R wave (mm)</td>
</tr>
<tr>
<td>Supine</td>
<td>Mean±SD</td>
<td>Mean±SD</td>
</tr>
<tr>
<td>Sitting</td>
<td>0.10±0.00</td>
<td>1.38±0.36</td>
</tr>
<tr>
<td>Standing</td>
<td>0.11±0.03</td>
<td>1.46±0.55</td>
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The mean QRS frontal axis was maximum in standing posture which was statistically not significant when 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>
<thead>
<tr>
<th>Postures</th>
<th>QRS frontal axis (degree)</th>
<th>Comparison of mean of QRS frontal axis</th>
</tr>
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<tbody>
<tr>
<td>Supine</td>
<td>59.5±10.21</td>
<td>Supine with sitting (P value)</td>
</tr>
<tr>
<td>Sitting</td>
<td>56.8±39.33</td>
<td>Supine with standing (P value)</td>
</tr>
<tr>
<td>Standing</td>
<td>64.3±39.29</td>
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</table>

The significant finding includes increase in heart rate in upright postures.8-10
### 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. 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. The study carried out in China has showed the decrease in R wave amplitude with postural changes from lying to sitting and standing position. 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.

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. This study in contrast has found the increased mean QRS frontal axis with standing posture but the difference was statistically insignificant.

### 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.

### ACKNOWLEDGEMENT

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### REFERENCES


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

<table>
<thead>
<tr>
<th>Postures</th>
<th>Heart Rate [Mean ±D]</th>
<th>Comparison of mean of RR Interval</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Supine with sitting (P value)</td>
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<tr>
<td></td>
<td></td>
<td>Supine with standing (P value)</td>
</tr>
<tr>
<td>Supine</td>
<td>73.73±7.24</td>
<td>0.048</td>
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<tr>
<td>Sitting</td>
<td>76.80±8.79</td>
<td>0.000</td>
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<tr>
<td>Standing</td>
<td>82.43±10.59</td>
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