Normal limits of ECG measurements related to atrial activity using a modified limb lead system

Atrial repolarization is rarely seen clearly on a standard 12-lead electrocardiogram on account of the fact that it is largely obscured by the QRS complex. In the main, during sinus rhythm at a relatively normal heart rate, only 50 ms of an atrial repolarization wave might be seen at the terminal potion of the PR segment. In the vast majority of ECGs, this part of the PR interval is at the same potential as the P wave onset. On the other hand, depression or reciprocal elevation of the terminal part of the PR interval relative to P wave onset is often regarded as being due to pericarditis (1) or atrial infarction (2).

Notwithstanding, anything that can enhance an apparent depression or elevation of the PR segment at the end of this interval would be of potential clinical interest. For this reason, the paper of Sivaraman et al. (3), published in this issue of the Anatolian Journal of Cardiology, is of interest. They have introduced a new so-called modified limb lead (MLL) system, which they indicate was designed to enhance P wave amplitudes and assist with the study of atrial repolarization (Ta) waves. To do this, they have repositioned the standard limb lead (SLL) system electrodes R, L, and F onto the front of the chest, where positioning of the electrodes effectively forms an inverted Einthoven triangle but with the right arm electrode at the apex and the left arm and left leg electrodes at the base (Fig. 1 of the article). If conventional circuitry is used to record the leads, then what will be recorded in the lead I position on the 12-lead ECG printout will be almost identical to what is recorded in the lead II position. Since the left arm and left leg electrodes are extremely close together in this system, then lead III of the MLL system can be expected to have an extremely low signal recorded. Figure 3 in the article shows that this is indeed the case in a healthy individual. The same situation should be obtained, even in the presence of an abnormal ECG.

The theoretical considerations above are reflected in the measurements shown in the paper, which sets out normal limits of the limb lead amplitudes in the new lead system. The mean P wave amplitudes in leads I and II are 0.111 mV and 0.118 mV, respectively-i.e., the mean values are virtually identical as predicted from theoretical considerations. Also, as could be predicted, the mean P wave amplitude in lead III was found to be “0” mV. However, the mean P wave amplitudes in the MLL system are significantly greater than in the SLL system, which meets the aim of the designers of the MLL system. The increase in the mean P wave amplitude of lead I of the MLL was 73.4% and 18% in lead II compared to the corresponding measures in the SLL system. This suggests that any measurements of Ta amplitude may be enhanced through the use of the new MLL system.

As the authors (3) themselves point out, the measurement of axes in this lead system is to some extent meaningless. It also is to be expected that measurements of PR interval, QRS duration, and QT interval in the modified limb lead system should essentially be identical to those obtained with the standard limb leads. Any minor differences are simply due to measurement error. These findings are indeed what is shown in Table 3 of the paper.

There are no measurements of Ta (i.e., the atrial repolarization wave) in this paper on normal limits. Paradoxically, data on normal limits of the Ta wave might only be derived from patients with varying degrees of heart block, where it would have to be assumed that atrial activation was normal in character. It therefore remains to be seen whether the new MLL system will be of value in the assessment of patients where atrial repolarization with depression or elevation of the terminal PR segment might be visible for one reason or another.

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