



Exaggerated Atrial Repolarization Wave Amplitude In Sinus Tachycardia Mimicking Myocardial Ischemia

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Keywords

- Atrial repolarization
- Axis shift
- Modified Limb Lead
- Sinus Tachycardia
- Standard Limb Lead

Introduction

- Studies on atrial repolarization (Ta wave) are infrequent due to its low amplitude (μV) and majorly concealed by the ensuing QRS complex in standard ECG.
- Ta wave and its characteristic changes in different heart conditions are studied rarely and also its role as potential marker for determining atrial arrhythmias is undermined.
- A study [1] witnessed the Ta wave in PR segment in Sinus Rhythm (SR) volunteers using a novel Modified Limb Lead (MLL) system and referred as ‘observable Ta wave’.
- This study extends the use of MLL to determine the exaggerated Ta wave amplitude in Sinus Tachycardia (ST) condition compared to the SR volunteers.

Case Presentation

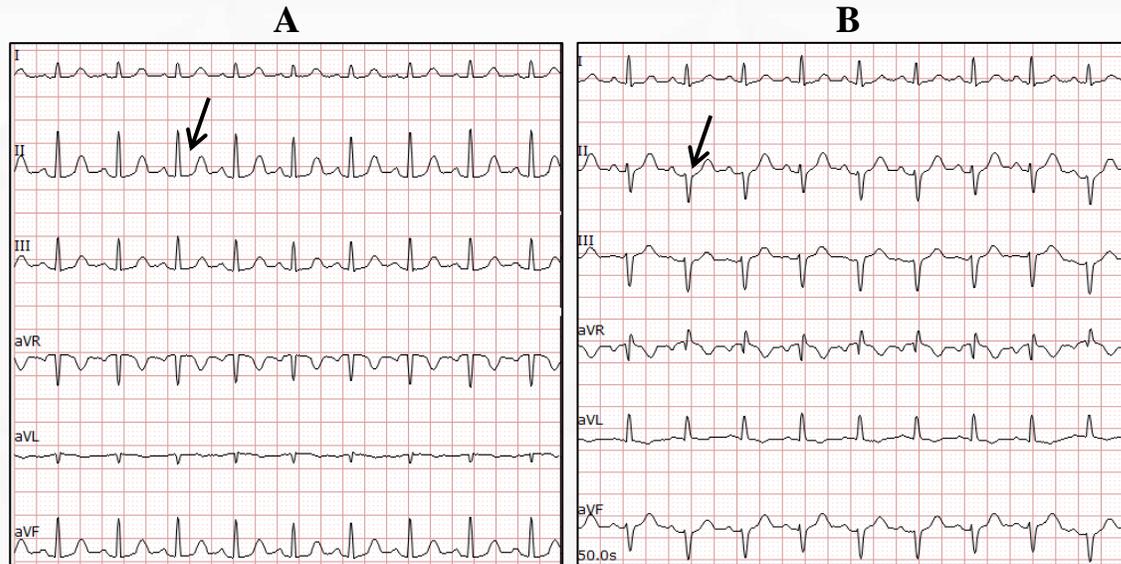


Fig. 1. ECG of (A) SLL (B) MLL in Sinus tachycardia condition.

- SLL and MLL ECG in frontal planes were recorded on 23 year old female in SR and ST conditions at standard paper speed as shown in **Fig. 1**.
- She did not have history of any cardiovascular diseases, hypertension, or chronic medications. SR ECG was recorded in resting supine position and ST ECG after excessive physical activity.
- Moreover the Ta wave amplitude found to be higher in MLL ST from SLL ST with difference of 25 μ V.

- **Fig. 2.** shows the single beat ECG waveform in both groups for SLL and MLL at paper speed 100 mm/s and 40 mm/mV.
- In SLL, Ta wave was witnessed only in ST recording in inferior leads (Fig. 2c); however in MLL, it was visible in both SR (Fig. 2b) and ST groups (Fig. 2d).
- Unlike the SR recording of SLL, Ta wave was observed in MLL with the amplitude of 75 μ V due to electrical mean vector of lead II being parallel to the atrial waves direction [2].
- SLL ST ECG noted a PR and ST segment saucer like depression indicating the presence of Ta wave [3].

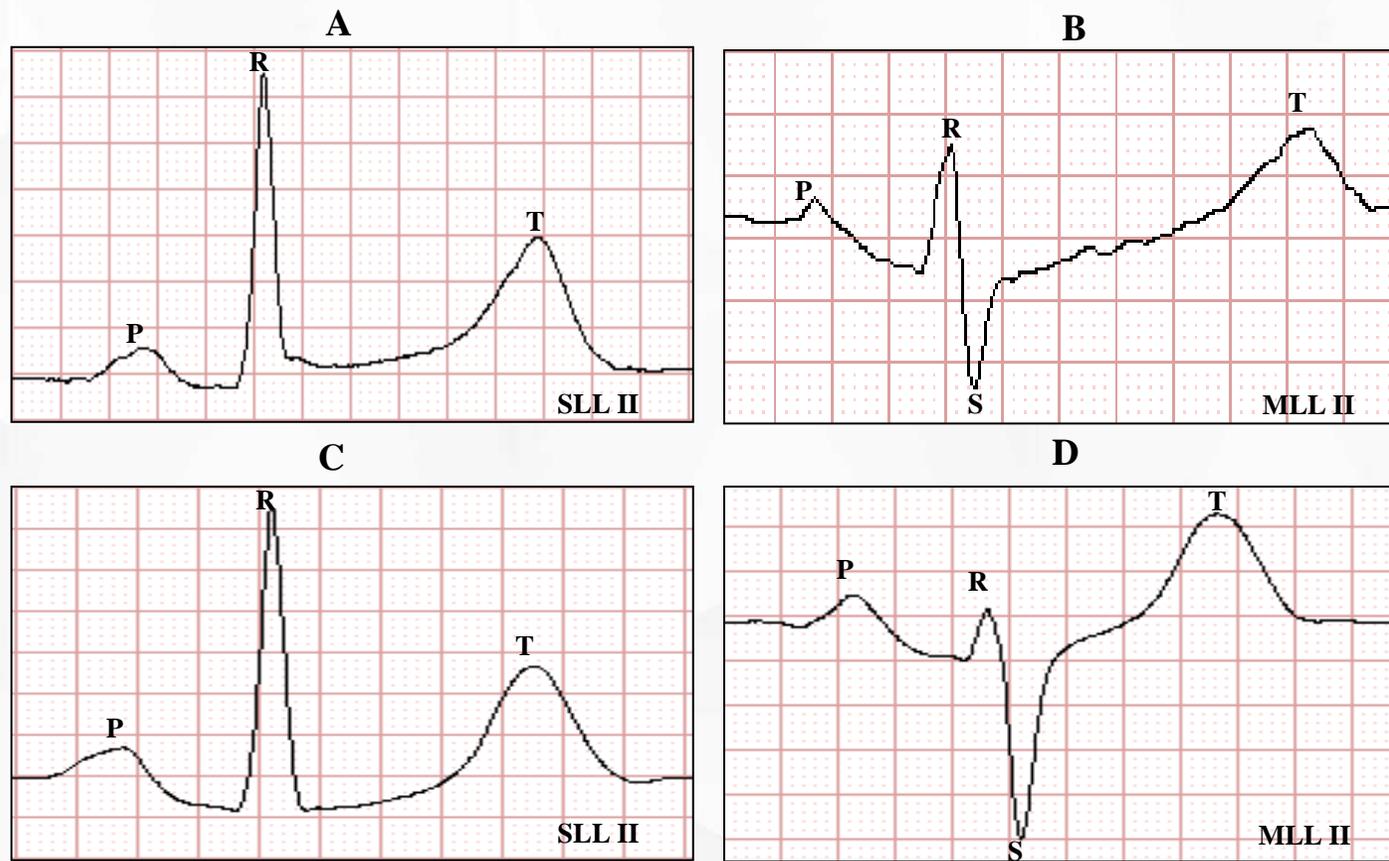


Fig. 2. Single beat ECG waveform in sinus rhythm for (A) SLL (B) MLL and sinus tachycardia for (C) SLL (D) MLL.

Discussion

- The increased heart rate has an impact on ECG wave amplitude [4] due to change in axis. Ventricular hypertrophy conditions leads to changes in ventricular repolarization (T wave) axis.
- T wave has proven to be indicators for many ventricular related disorders [5, 6]. Similarly, results of this study signify that higher heart rate tends to shift Ta wave axis leading to increased amplitude of observable Ta wave in ST.
- Higher P wave amplitude in ST condition was also noted with the shift in axis. A similar result was noted in [3] stating rapid heart rate induces the increase in voltage of Ta wave.
- Moreover, in ST condition with short PR interval, the impact of Ta wave extends to S-T segment with depression by >0.1 mm as noted in this study, may lead to misinterpretation of myocardial ischemia.

Conclusion

- Proper understanding of Ta wave manifestation on ECG signal in normal and abnormal heart conditions, provides the scope for accurate diagnosis in clinical ECG.
- Hence, the study of Ta wave and its visible morphology changes can be a prospective indicator for atrial arrhythmias and can also reduce the false positive detection of myocardial infarction during the retrograde conduction in atria.

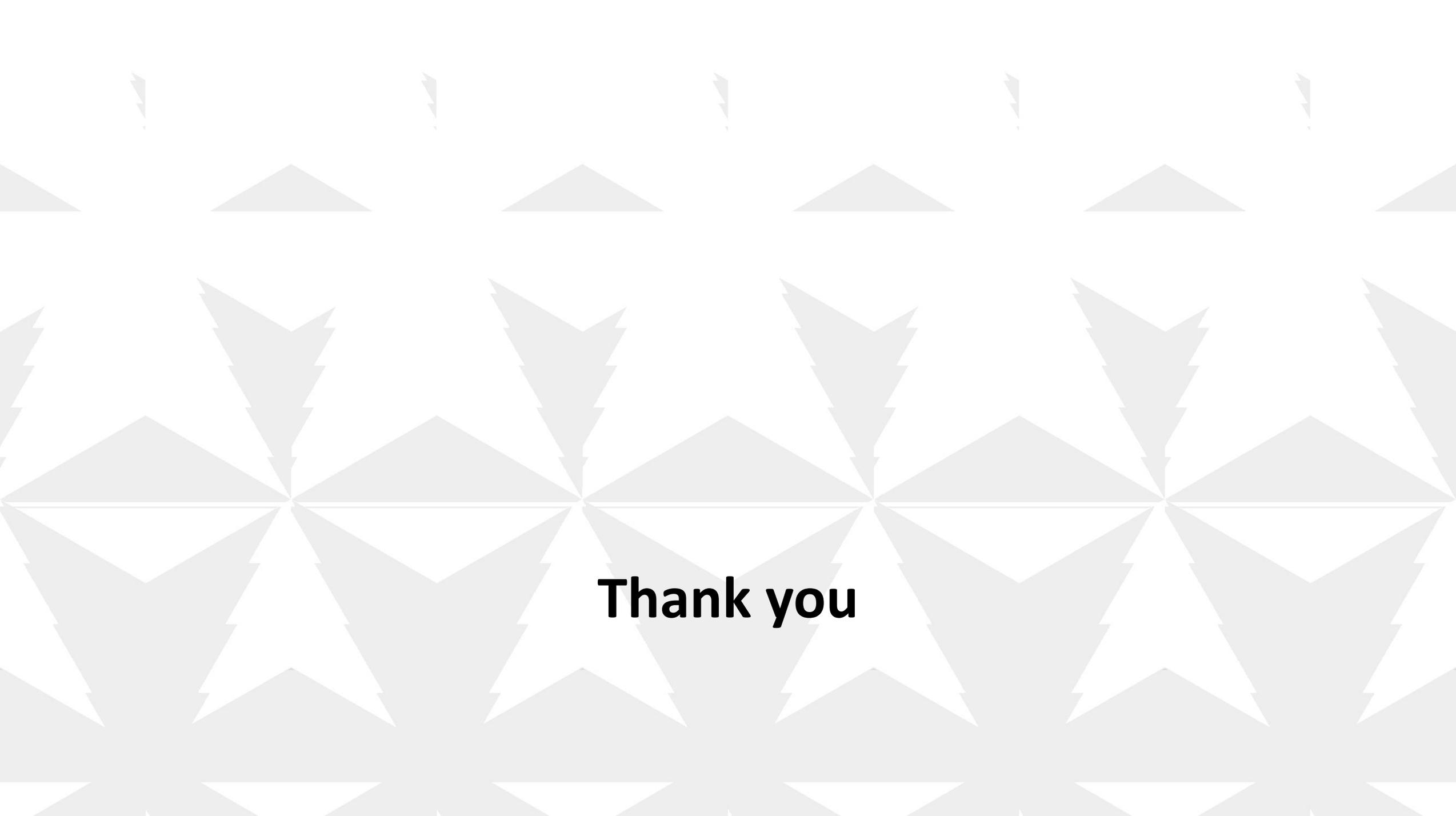
Acknowledgment

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References

1. Sivaraman J, Uma G, Venkatesan S, Umapathy M, Dhandapani VE. A novel approach to determine atrial repolarization in electrocardiograms. *J Electrocardiol* 2013;46:e1. 10.1016/j.jelectrocard.2013.05.009
2. Sivaraman J, Uma G, Venkatesan S, Umapathy M, Dhandapani VE. Normal limits of ECG measurements related to atrial activity using a modified limb lead system. *Anatol J Cardiol* 2015;15:2–6. 10.5152/akd.2014.5155
3. Childers R. Atrial repolarization: its impact on electrocardiography. *J Electrocardiol* 2011;44:635–40. 10.1016/j.jelectrocard.2011.07.031
4. Swerdlow CD, Zhou X, Voroshilovsky O, Abeyratne A, Gillberg J. High amplitude T-wave alternans precedes spontaneous ventricular tachycardia or fibrillation in ICD electrograms. *Heart Rhythm* 2008;5:670–76. 10.1016/j.hrthm.2008.02.018
5. Subramanian M, Ahamed H, Prabhu M, Mathew N, Harikrishnan MS, Pai PG, et al. The prognostic value of dispersion of repolarization in stress cardiomyopathy. *J Electrocardiol* 2020;62:79–85. 10.1016/j.jelectrocard.2020.03.006
6. Güner A, Kalçık M, Çelik M, Uzun F, Çizgici AY, Ağuş HZ, et al. Impaired repolarization parameters may predict fatal ventricular arrhythmias in patients with hypertrophic cardiomyopathy (from the CILICIA Registry). *J Electrocardiol* 2020;63:83–90. 10.1016/j.jelectrocard.2020.10.009



Thank you