

Improved recording of P-wave amplitude by reduced leads for mHealth applications.

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Abstract:

Introduction: Improving P-Wave Amplitude (PWA) enhances the diagnosis of atrial arrhythmias and supports better treatment. In this study, an Atrial Lead System (ALS) is proposed to enhance the PWA. The study was performed by comparing the PWA in the ALS with the lead-II of Standard Limb Lead (SLL) system, Modified Limb Lead (MLL) system, and P-lead.

Methods: This observational study includes fifty healthy male subjects (mean age 25 ± 2.81 years). The SLL, MLL, P-Lead, and ALS were recorded using Mindray Beneheart R12 ECG machine. In ALS, electrode 1 is placed on manubrium sterni, and electrodes 2 and 3 are placed on the right and left seventh clavicular junction near the costal margin. Leads L_{A1} is obtained from electrodes 1 and 2, L_{A2} from electrodes 1 and 3, and L_{A3} from electrodes 2 and 3. L_{A3} is not considered in the study. The right leg electrode is made as a reference and positioned over the right ankle. Only lead-II of the SLL and MLL were considered.

Results: The mean PWA in the SLL, MLL, and P-lead are $129 \pm 46.61 \mu\text{V}$, $105 \pm 40.62 \mu\text{V}$, and $177 \pm 65.13 \mu\text{V}$, respectively. L_{A1} and L_{A2} of the ALS have mean PWA of $169 \pm 67.70 \mu\text{V}$ and $181 \pm 67.64 \mu\text{V}$. This study result shows that PWA in the ALS leads L_{A1} and L_{A2} has significantly greater amplitude values than in lead-II of the SLL and MLL system ($p < 0.05$). L_{A1} is the third-best lead after P-lead also has a significant improvement in PWA.

Conclusion: The ALS allows better visualization of PWA than in SLL, MLL, and P-lead. More accurate P-wave detection and greater information of atrial activity are made possible and will support mHealth applications.

Keywords: Atrial Lead System, Atrial arrhythmias, Electrocardiogram, Improved P-wave amplitude, mHealth applications.

Table 1. Amplitude and temporal changes in different leads and its significance

Measurements	SLL-II	MLL-II	P-Lead	L_{A1}	L_{A2}	P-value*
P-wave amplitude (μV)	129 ± 46.61	105 ± 40.62	177 ± 65.13	169 ± 67.70	181 ± 67.64	<0.05 #SLL-II & MLL-II are NS
R-wave amplitude (μV)	1205 ± 498.26	616 ± 373.01	1999 ± 645.96	1285 ± 584.80	2010 ± 672.51	<0.05 #SLL-II & L_{A1} are NS
Heart Rate (bpm)	81 ± 13.56	76 ± 10.88	76 ± 13.32	73 ± 9.95	73 ± 9.95	NA
P-wave Duration (ms)	96 ± 10.31	89 ± 12.91	92 ± 16.19	96 ± 11.70	97 ± 11.22	>0.05
PR-Interval (ms)	139 ± 16.08	139 ± 21.61	129 ± 21.19	136 ± 19.74	136 ± 20.23	>0.05

Values represented in mean \pm SD; NS – not significant; NA – not applicable; *P-value between SLL and other optimal leads.