

T-Wave Morphology Changes as Surrogate for Blood Potassium Concentration in Hemodialysis Patients

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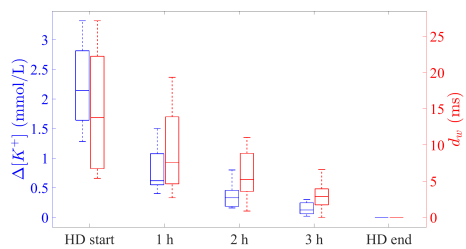
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Introduction. Patients at end-stage renal disease (ESRD) undergoing hemodialysis (HD) are at high cardiovascular mortality risk due to potassium concentration ($[K^+]$) changes out of normal ranges. The assessment of $[K^+]$ levels is limited as it can only be performed through blood tests in a hospital environment. Since $[K^+]$ levels are reflected on the T-wave in the electrocardiogram (ECG) signal, we hypothesized the T-wave morphology could be used to monitor $[K^+]$ changes in ESRD patients during HD. The aim of this study was to investigate whether d_w , a time-warping-based ECG marker of T-wave morphology changes, with known association with ventricular repolarization dispersion, can monitor changes in $[K^+]$ levels.

Methods. We used 48-h long ECG recordings and $[K^+]$ measurements from a set of blood samples collected from 12 ESRD patients undergoing HD. An average T-wave (ATW) was obtained every hour of the ECG recordings and a reference T-wave was taken at the end of the HD session. The morphological changes between each ATW and the reference one were quantified with d_w . The relative variations ($\Delta[K^+]$) in $[K^+]$ with respect to the reference values (end of treatment), during the HD session were computed. Spearman's correlation was computed between d_w and $\Delta[K^+]$.

Results. The Figure shows the evolution of the distribution of $\Delta[K^+]$ and d_w during the HD session across all patients. The values of d_w were significantly correlated with $\Delta[K^+]$ (median [interquartile range] correlation coefficient of 0.95[0.15]).

Conclusions. T-wave morphology changes, quantified by d_w , exhibit high correlation with $[K^+]$ changes. The results of this study support the use of d_w to track changes in $[K^+]$ in ESRD patients undergoing HD.



Box-plots of $\Delta[K^+]$ (blue) and d_w (red) during HD.