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Pulsed field ablation (PFA) Marshall plan including Marshall vein ethanol infusion (MVEI) approach in primary intent for persistent atrial fibrillation treatment. A prospective single-center cohort study

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Introduction Different ablation strategies and energies have been developed for persistent atrial fibrillation (PeAF) treatment, but early management is still controversial. In the clinical setting of PeAF, the safety and efficacy of early Marshall plan combined with pulsed field ablation (PFA) and vein of Marshall ethanol infusion (VOMEI) have not yet been evaluated.
Objective Our prospective cohort study sought to: (1) assess the safety and feasibility of the non-thermal Marshall plan approach combined with VOMEI (Marshall plan VOMEI) as a first-line therapy in PeAF patients; (2) evaluate its mid-term efficacy.
Method Between April 2024 and February 2025, 55 PeAF patients were referred for Marshall plan VOEMI. The Marshall Plan sequences were implemented as follows: VOEMI first followed by left pulmonary vein isolation (PVI), then mitral plus roof lines, and then right PVI; lastly the roof line and the mitral line were once again checked. The Farapulse system was used for PFA ablation.
Results Marshall vein failure occurred in 4/55 patients (7.3%). Fifty-one pts (92.7%) who underwent Marshall plan VOEMI as first-line therapy were included. Their clinical and echocardiographic characteristics were as follows: mean age of 70 ± 7.6 years, 23.5% of women, mean CHA_2DS_2VA score of 2.9 ± 1.7, mean left ventricular ejection fraction of 57 ± 14%, and mean left atrial size of $26 \pm 4 cm^2$ and volume (52 ± 22 ml/m^2). Procedure steps duration (min) and X-ray exposure (min) were as follows: skin to skin procedure (47 ± 12 and 14.4 ± 4.7 min); VOMEI duration (10.4 ± 3.7 and 3.6 ± 2.4 min); transeptal puncture (4.9 ± 3 and 2.5 ± 2.1 min) and PFA (21.1 ± 6.5 and 7.5 ± 2 min). The total number of PFA applications was 60 ± 7.6, 38 ± 4 for PVI, 10 ± 3 for roof line and 14 ± 6 for the mitral line. The % of mitral line recurrence at the procedure end was 43% despite VOMEI. Accordingly, repeated new applications were required until the mitral line block was obtained. No complications occurred. At mid-term FU (6.5 ± 3 months), freedom from any atrial arrhythmia was 80.4%. Recurrences were as follows: PeAFib in 4, paroxysmal AFib in 4, left atrial flutter in 1 and right atrial flutter in 1.
Conclusion This real-life prospective cohort study showed that de novo PFA Marshall plan plus VOEMI in PeAF is feasible, safe, but associated with a high rate of acute mitral line block recovery. Mid-term freedom from any atrial arrhythmia recurrences is close to 80%.
Disclosure of interest The authors declare that they have no competing interest.

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Impact of diagnosis-to-ablation time on left atrial remodeling and voltage-guided ablation outcome in persistent atrial fibrillation patients

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Introduction A delayed timing of ablation has been associated with a higher recurrence rate of atrial fibrillation (AF). Low-voltage zones (LVZs) are well-established predictors of AF recurrence following catheter ablation (CA). Data on LVZ assessment in relation to the diagnosis-to ablation time (DAT) remain limited.
Objective This study aimed to evaluate the extent of left atrial (LA) LVZs, bipolar voltage and the outcome of LA voltage-guided ablation in a cohort of patients with persistent AF according to DAT.
Method A total of 350 persistent AF patients undergoing a first voltage-guided CA were consecutively enrolled. In all, 131 patients with DAT ≤ 1 year and 219 patients with DAT >1 year were included. LA voltage maps were obtained in sinus rhythm. LVZ was defined as <0.5 mV.
Results In the DAT >1 year group, LA bipolar voltage was lower ($P<0.01$) and LA and LA indexed volume were higher ($P<0.01$). LVZ were more frequent (43% vs 28%), $P=0.01$), especially moderate LVZ ($P=0.04$). AF recurrence was observed more often in patients with DAT >1 year after one procedure (log rank test, $P=0.05$). Female sex ($P<0.001$), LA indexed volume ≥ 48 mL/m^2 ($P=0.008$), age ≥ 60 years ($P<0.05$) and P-wave duration ≥ 150 ms ($P<0.001$) were predictors of LVZ. No predictor of AF recurrence could be identified.
Conclusion Persistent AF patients with longer DAT displayed more extensive LA substrate remodeling. Despite a tailored ablation targeting LVZs, a longer DAT remained associated with a higher rate of AF recurrence. An early intervention strategy within the first year after AF diagnosis could optimize AF CA outcome.
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Ultra-short-term heart rate variability vs. short-term heart rate variability for AF onset prediction in the era of wearables

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Introduction The autonomic nervous system plays a key role in the onset of atrial fibrillation (AF). Its activity can be inferred from heart rate variability (HRV). In remote monitoring and wearable devices, HRV is typically measured using ECG or photoplethysmography (PPG), over recording periods shorter than five minutes. While the standard HRV measurement duration is five minutes, the increasing adoption of wearable technologies raises the ques-

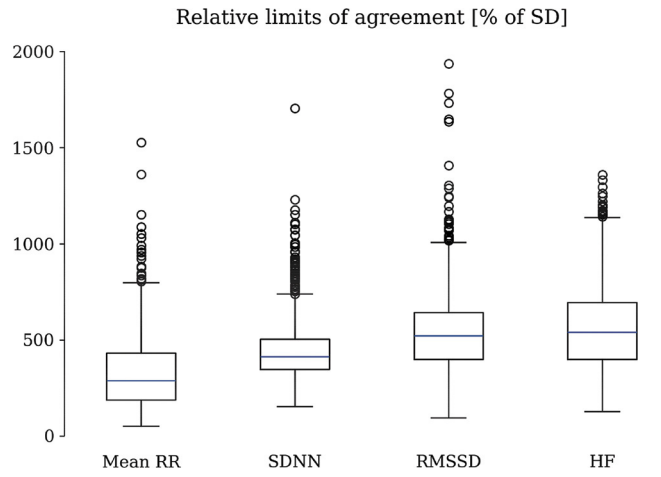

Fig. 1 All the limits of agreement (LoA) are substantially higher than the average variation for each HRV parameter.

tion of whether one-minute recordings can provide reliable HRV estimates.

Objective This study evaluates whether ultra-short-term HRV features extracted from one-minute ECG can effectively replace the HRV features computed over a standard five-minute measurement, in the context of short-term AF onset prediction.

Method We analysed a dataset of two-lead ECG Holter recordings from 927 patients, encompassing 987 individual recordings. Among these, we selected 520 patients (569 recordings) that developed an AF episode of more than 5 minutes preceded by at least 35 minutes of normal sinus rhythm. We computed time- and frequency-domain HRV parameters using sliding windows of 5- and 1-minute durations, progressing minute by minute to capture HRV dynamics over the 30 minutes directly preceding AF onset. We excluded AF episodes for which at least one HRV computation window contained more than 50% of ectopic beats, using the remaining 807 episodes (538 recordings, 495 patients) for our analysis. To assess the reliability of ultra-short-term HRV, we evaluated the equivalence between the measurements obtained on the different window durations using the Pearson correlation coefficient and Bland-Altman's limits of agreement (LoA).

Results The average Pearson correlation coefficient was below 0.65 for all HRV parameters except the mean RR intervals, denoting the lack of a strong correlation between estimates computed using the two window durations. Furthermore, all the LoAs were substantially higher than the average variation for each parameter (Fig. 1), indicating poor agreement between ultra-short-term and standard HRV measurements in the 30 minutes directly preceding AF onset.

Conclusion One-minute HRV windows fail to provide reliable estimates for HRV-based short-term AF onset prediction, underscoring the necessity of longer recording durations for accurate autonomic assessment.

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New ECG signal derivation reconstruction from PPG using deep learning network AI approach

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Introduction Non-invasive ECG recordings are still required in the area of atrial fibrillation detection in order to prevent stroke and heart failure. In this clinical setting PPG signal via smart watch technologies have been developed therefore many automated diagnoses are deemed inconclusive, despite yielding a readable single-lead electrocardiogram tracing.

Objective Based on the existing relationship between electrical ECG signal and PPG signal measured using light sensors, we sought to set up a new signal transformation method based on artificial intelligence (AI) algorithms in order to elaborate a reproducible ECG derivation.

Method Our work was based on data (PPG and ECG collected simultaneously) from thousands of patients with and without cardiac abnormalities, which have been pooled in databases (MIMIC and VitalDB). Pre-processing steps ranging from filtering to slicing of these millions of coupled PPG-ECG data segments preceded the training processes of the Deep Learning Network AI (DLN AI) models for signal transformation.

Results We tested the new DLN AI model in a large series of ECG datasets via MIMIC III subset, VitalIDB, PulseDB, and MIMIC III subset vs. VitalIDB together for a sequence train and test. The performance was tested on RR plus interpolation, RR plus padding, 2 seconds and 4 seconds respectively for MIMIC III subset (P = 0,92; rRMSE = 0.08), (P = 0.94; rRMSE = 0.16), (P = 0.84; rRMSE = 0.10), (P = 0.86; rRMSE = 0.09); for VitalDB (P = 0,93; rRMSE = 0.09), (P = 0.91; rRMSE = 0.10), (P = 0.88; rRMSE = 0.11), (P = 0.89; rRMSE = 0.10); for pulsed DB (P = 0,91; rRMSE = 0.10), (P = 0.92; rRMSE = 0.09), (P = 0.84; rRMSE = 0.13), (P = 0.88; rRMSE = 0.11). Mixed performance was also tested via Mimic III for train and vitalDB subset for testing respectively: (P = 0,93; rRMSE = 0.09), (P = 0.82; rRMSE = 0.7), (P = 0.76; rRMSE = 0.20), (P = 0.75; rRMSE = 0.18) and via vitalDB for train and Mimic III for test respectively: (P = 0,83; rRMSE = 0.17), (P = 0.69; rRMSE = 0.19), (P = 0.69; rRMSE = 0.19), (P = 0.68; rRMSE = 0.19).[EV1] [LO2] [LO3] The correlation values of PPG and ECG derivation reconstruction varied from 0.69 to 0.94 with a strong positive correlation and rRMSE values closer to 0.

Conclusion This preliminary study found that reconstructing the PPG signals into an ECG derivation using algorithms based on an AI model were well correlated to the true ECG derivation.

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