Data Augmentation for Discrimination of Atrial Flutter Mechanism Using 12-Lead Surface Electrocardiogram

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Aim: In the previous study, the atrial flutter mechanism (i.e., Focal or Macroreentrant) was differentiated from the standard 12-lead ECG by the variability of the cycle length of visible successive P-waves (between the R-R waves). This study aims to help researchers reduce imbalances through two different techniques, especially in atrial flutter. Besides, early detection of the AFL mechanism can increase the efficacy of invasive elimination.
Methods: Forty-eight patients were undergone endoscopic catheter ablation for the identifications of the AFL mechanism. Accessed data only 5 Focal AFL against 41 Macroreentrant AFL. Two different techniques, SMOTE and Smoothed-Bootstrap, have been used to augmented and re-balance the dataset. Furthermore, three different techniques, the Goodness-of-Fit test (Chi-Square), the Root Mean Square Error between synthetic and original performance (accuracy, specificity, sensitivity), and the descriptive statistical test, have been used to validate the augmented dataset. The proposed model has been extracted several features derived from statistical analysis of the intervals of successive atrial rhythm to discriminate the AFL mechanism. The performance has been evaluated by three linear classifiers Linear Discriminant Analysis (LDA), Logistic Regression (LOG), and Support Vector Machine (SVM). **Results:**The synthetic data generated by Smoothed-Bootstrap has been much closer to the original dataset and relatively better than SMOTE technique. The LOG classifier achieved its average performance with accuracy, specificity, sensitivity, 71.08%, 77.13%, and 65.12%, respectively. **Conclusion:** The variability in cycle length of consecutive P-waves from the surface ECG has differentiated the Focal AFL from Macrorrentrant AFL. Smoothed-Bootstrap is a suitable technique in AFL cases to minimize the imbalance issue.