PVC burden accuracy of a PVC detector designed for continuous long-term monitoring using an Insertable Cardiac Monitor

Gautham Rajagopad
Jerry Reiland
Jodi Koehler
Shantanu Sarkar

Introduction: High premature ventricular contraction (PVC) burden may increase the risk of arrhythmia, PVC-induced cardiomyopathy and heart failure. Presently, 24-hour Holter monitoring is the most commonly used method to determine PVC burden. However, this may be insufficient to assess the exact PVC burden due to the day-to-day variability in the PVC burden. An insertable cardiac monitor (ICM) device capable of monitoring PVC burden over a longer period can be a useful tool for evaluating temporal dynamics of PVC burden leading to appropriate and timely clinical interventions in patients with high PVC burden. This study is aimed at evaluating the PVC burden accuracy of a PVC detection algorithm that was developed for continuous long-term monitoring of PVC burden in an ICM.

Methods: The PVC algorithm uses long-short-long RR interval sequence and similarity and differences in R-wave morphology for three consecutive beats to detect the occurrence of single PVC events. Various threshold combinations were used for long-short-long RR interval sequence and degree of difference and similarity of R-wave morphology to enable the detection of various types of PVCs including interpolated PVCs. The algorithm was designed to obtain a very high specificity and clinically reasonable sensitivity for reporting PVC burden. The algorithm was developed using ECG strips stored in an ICM from real-world patients. The validation was performed using episodes stored by an ICM in patients with unexplained syncope and Holter data, which uplinked ICM ECG over a 2-hour period. All ECG strips were manually annotated for PVCs and true PVC burden and detected PVC burden are compared using the Pearson's correlation coefficient. Sensitivity and specificity performance of the PVC detector will also be reported.

Result: The stored episode validation data set consisted of 787 patient-activated episodes from 134 patients, providing over 460,000 beats for analysis with 8386 PVCs (1.8%) in 91 patients. The Holter validation data set consisted of 2-hour snippets of 24-hour Holter files from 20 patients providing over 170,000 beats of which 2247 PVC beats (1.3%) in 16 patients. On the stored episode (Holter) validation data set, the algorithm detected PVC beats with a gross sensitivity of 75.2% (74.4%) and specificity of 99.6% (99.6%). The correlation between the detected PVC burden versus the true PVC burden for the two data sets is shown in Figure. The Pearson's correlation coefficient was 0.97 and 0.89 (p-value < 0.001 for both) in the stored episode and Holter data sets respectively.

Conclusion: The PVC detection algorithm designed for continuous long-term monitoring of PVC burden in an ICM had high specificity with only 0.4% of the normal events being incorrectly identified as PVCs, while detecting around 3 out of 4 PVCs which ensures high correlation of detected PVC burden with true PVC burden.