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Development and validation of a novel premature ventricular contraction detector in an insertable cardiac monitor

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Background: High premature ventricular contraction (PVC) burden may increase the risk of cardiac arrhythmias, PVC-induced cardiomyopathy and heart failure.

Purpose: We developed and validated an algorithm for continuous long-term monitoring of PVC burden in implantable loop recorders or insertable cardiac monitors (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 a single PVC beat. Various threshold combinations were used for long-short-long RR interval sequence and degree of difference and similarity of R-wave morphology to be able to detect various types of PVCs including monomorphic, polymorphic, bigeminal, trigeminal, and interpolated PVCs. For example, a high degree of difference in R-wave morphology only required the short interval to be less than the longer interval by a smaller amount. The algorithm was designed with the intention to achieve minimum over reporting of PVC burden, i.e. maximum specificity. The algorithm was developed and validated using ECG strips stored in an ICM from real world patients. Gross, patient average and generalized estimating equation (GEE) estimates for sensitivity, specificity, positive and negative predictive value are reported.

Results: The PVC detection algorithm was developed using 87 2-minute ECG strips recorded by an ICM containing 2129 single PVC beats and 12,402 non-PVC beats to obtain a gross sensitivity and specificity of 75.9% and 98.8%. The validation data cohort consisted of 787 ICM recorded ECG strips 7–10 minutes in duration from 134 patients, providing over 460,000 beats of which 439,106 (94%) were normal beats, 8398 (2%) single PVC beats and 16,634 (4%) noisy beats. Couplets and triplets were excluded. Table 1 shows the performance results of the PVC detection algorithm in this validation set.

Conclusions: The PVC detection algorithm was able to achieve a high specificity, which ensures that 99.6% of the normal events are not incorrectly identified as PVCs, while detecting 75% of PVCs on a continuous long-term basis in insertable cardiac monitors. The accuracy of PVC burden estimates during continuous monitoring using this algorithm needs further validation using Holter studies.

Performance of PVC detector

	Gross	Patient average	GEE (95% CI)
Sensitivity	75.2%	69.9%	72.5% (65.8–78.3)
Specificity	99.6%	99.4%	99.4% (99.2–99.6)
Positive Predictive Value (PPV)	75.9%	40.6%	40.6% (33.6–48.0)
Negative Predictive Value (NPV)	99.5%	99.6%	99.6% (99.3–99.7)