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Abstract 15173: Validation of a Heart Murmur Detection Algorithm by Virtual Clinical Trial

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Abstract

Introduction: Signal processing algorithms designed to detect and analyze heart murmurs could dramatically improve screening for valvular and congenital heart disease (CHD), however development has been hampered by lack of objective validation strategies. We sought to evaluate a new algorithm by virtual clinical trial.

Methods: We selected 3180 heart sound recordings from 603 outpatient encounters collected in the Johns Hopkins Cardiac Auscultatory Recording Database (CARD) along with the associated echocardiographic diagnoses and a single cardiologist's clinical description of the heart sounds. Cases included those with abnormal echo and pathologic murmur by clinical description (AHA Class I, n=374, >20 different valvular and CHD diagnoses represented), and those with normal echo and an innocent or no murmur (Class III, n=90 and 139, respectively). Heart sound WAV files were analyzed by automated batch processing using the test algorithm (eMurmur, CSD Labs), developed without prior exposure to any CARD recordings for training and blinded to the clinical data associated with each file. Sensitivity and specificity of the algorithm for detection of pathologic murmurs were calculated. Additional output included algorithm confidence level for murmur classification, murmur timing and intensity grading, and heart rate estimation.

Results: The algorithm was able to analyze 2823 (89%) of the files. Using recordings from the "best heard at" (per clinical description) location for cases with and left mid sternal border for cases without a murmur, sensitivity and specificity for detection of pathologic murmurs were 93% (C. I. 90-95%) and 81% (C.I. 75-85%), respectively, with accuracy 88%. When stratified by highest algorithm confidence level (95%, n=355 cases) sensitivity was 93% (C.I. 89-96%) and specificity 97% (C.I. 93-99%), with accuracy 95%.

Conclusions: This is the first large, virtual clinical trial of an automated murmur detection algorithm using heart sounds recorded independently from algorithm development. The algorithm tested has high sensitivity and specificity for pathologic murmur detection in this dataset. This same dataset can be reused to objectively validate and compare performance of other algorithms prior to clinical use.