VALIDATION OF AN AUTOMATIC WHEEZE COUNTER

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BACKGROUND

Lung sounds are useful in diagnosis and monitoring of cardiopulmonary conditions as they reflect the underlying pulmonary physiology and pathophysiology. Unfortunately there is considerable observer variability in detection of these sounds and careful auscultation can be time consuming. This limits the clinical utility of the stethoscope. Computer assisted detection and analysis of lung sounds provides objective information, circumventing the observer variability problem. Multichannel lung sound analyzers obtain acoustic data from multiple sites simultaneously reducing the time required for an examination. This has the potential of providing objective non-invasive monitoring of such conditions as exacerbations of asthma and COPD.

PURPOSE

To quantify the relationship of an automated wheeze analyzer to quantification of the degree of wheezing as done by experienced pulmonologists. Accordingly we were interested in how well computerized analysis compared to experienced pulmonologists in assessing the severity of wheezing.

METHODS

Sounds were obtained utilizing a multichannel lung sound analyzer (Stethographics STG16). This device collects sound from 16 sites simultaneously. In our usual routine 14 microphones are placed over the chest, one over the trachea and one over the heart as seen in Figure 1. The device identifies and quantifies sounds in real time providing displays as shown in Figure 2. 7 experienced pulmonologists were asked to classify and grade 16 twenty-second segments of lung sounds detected by this device. These segments contained from 3 to 10 full breaths. They were played through headphones.

FIGURE 2. TYPICAL EXAMPLES OF ACOUSTIC ANALYSIS IN COMMON LUNG DISORDERS

NORMAL LUNG SOUNDS

PNEUMONIA

CONGESTIVE HEART FAILURE

INTERSTITIAL PULMONARY FIBROSIS

ACUTE ASTHMA

CHRONIC BRONCHITIS AND EMPHYSEMA

RESULTS

The STG detected inspiratory wheezes or rhonchi in 6 of these sounds and expiratory wheeze or rhonchi in 14 of the sounds. In all sound segments in which the STG detected continuous abnormal breath sounds all 7 pulmonologists reported wheeze or rhonchi. The reverse was also true. In all sound segments in which pulmonologists reported continuous abnormal breath sounds the STG detected wheeze or rhonchi. There was general agreement on the duration of continuous abnormal breath sounds in relationship to the duration of the breath cycle among physicians, although variation among individual physicians in assessing the duration of the wheezes and rhonchi was considerable, Fig. 3. The classification of continuous abnormal breath sounds into wheeze and rhonchi by pulmonologists showed a strong relationship to the peak spectral frequency, Fig. 4. All sounds with frequency 300Hz or higher were classified as wheeze by all observers. All sounds below 170Hz were classified as rhonchi by all observers. The STG classifies sound with spectral peak below 200 Hz into rhonchi and above 200 Hz into wheezes.

CONCLUSIONS

Automated lung sound analyses agrees closely with categorization done by experienced pulmonologists.