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. They also allow more accurate documentation of the information. Accordingly we were interested in how well computerized lung sound analysis compared to experienced clinicians.

PURPOSE

To quantify the relationship of a computerized lung sound analytic device (Stethographics, STG1602) to auscultation by experienced pulmonologists.

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. A total of 12 twenty-second segments of lung sounds identified by this device were played through headphones to 9 experienced pulmonologists. The sound segments contained from 4 to 13 full breaths. Physicians were asked to report the presence of normal or abnormal sounds.

Figure 1.

RESULTS

As seen in the Table 1, all physicians agreed on the classification of normal breath sounds as classified by the STG (i.e. the STG detected no abnormal sounds in the sound segment). All physicians reported presence of crackles when crackles were detected by the STG. The majority of physicians agreed on the classification of the crackles into fine and coarse as done by the STG. All physicians reported presence of continuous abnormal breath sounds (that is wheeze or rhonchi) when wheeze or rhonchi were detected by the STG. There was some disagreement on the classification of sounds in the diminished lung sound category (17%). (This categorization is a bit difficult as the physician does not have the visual clues usually present during auscultation such as observation of the degree of chest wall motion).

Table 1. The relationship between the sound classification as determined by the STG and classification by experienced physicians.

<table>
<thead>
<tr>
<th>Sound classification as determined by the STG</th>
<th>% of physicians agreeing with the STG classification</th>
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<tbody>
<tr>
<td>Normal breath sounds</td>
<td>Normal</td>
</tr>
<tr>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>Fine Crackles</td>
<td>(98%)</td>
</tr>
<tr>
<td>Coarse Crackles</td>
<td>(10%)</td>
</tr>
<tr>
<td>Rhonchi</td>
<td>100%</td>
</tr>
<tr>
<td>Wheeze</td>
<td>100%</td>
</tr>
<tr>
<td>Diminished breath sounds</td>
<td>(17%)</td>
</tr>
</tbody>
</table>

DISCUSSION

This work is part of a multi-pronged effort to evaluate computerized lung sound analysis. Previous work can be found in the following references:


Holford developed computer generated sounds with the waveforms of crackles and systematically varied amplitude, frequency and duration to examine which of these features were responsible for observers classifying them as fine or coarse. After analysis of the classification by experienced observers he developed a computerized algorithm that automated the classification.


In this study a technician to was trained to determine the presence or absence of crackles in workers exposed to asbestos. The accuracy of the technician in this study in classifying crackles as fine or coarse compared with the computer classifier developed by Holford was 84.4% (kappa=0.68)

Workman et al, CHEST 1989/ JANUARY 1986

This was a study of observer agreement in auscultation of 64 asbestos exposed workers where direct auscultation was compared with tape playback auscultation. Unanimous agreement among four observers was 83% (kappa =0.69).

FDA 510k Approval for a Multichannel Lung Sounds Analyzer (K012387 April 23, 2002)

This was a study where auscultation was compared to listening to tape recordings. Auscultation with a stethoscope and listening to the sounds played back with the STG provided almost identical results.

CONCLUSIONS

Automated lung sound analysis agrees closely with categorization done by experienced pulmonologists. This has the potential of improving noninvasive diagnosis.