

Accuracy of Interpretation of Computerized Multichannel Lung Sound Analyses

R. Murphy, A. Wong-Tse, and A. Vyshedskiy, Brigham and Women's / Faulkner Hospitals, Boston MA

Background

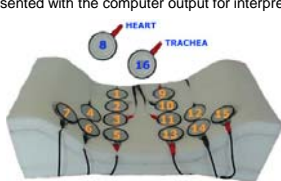
Multichannel lung sound analysis provides clinicians with waveform displays and computerized assessment of lung sounds at the bedside. Although patterns of typical sounds in common illnesses are easily recognized, how well observers can interpret unknown patterns has not been studied.

Purpose

To test the accuracy of interpretation of the information provided by multichannel lung sound analysis.

Materials and Methods

Sixty two patients from a community teaching hospital were examined with a 16 channel lung sound analyzer (Stethographics model 1602) during deeper than normal breathing. The patients had been diagnosed as having a cardiopulmonary disorder or as having no recognized evidence of a cardiopulmonary disorder. 3 investigators, unaware of the diagnosis, were independently presented with the computer output for interpretation.



Waveform examples: figures to the right present time amplitude plots of a single breath displayed as they appear at multiple sites in six patients. Fourteen microphones are placed on the back; numbers 1 through 7 are on the right side, 9 through 15 are on the left. One microphone is positioned over the trachea - number 16. Waveforms are presented in both the unexpanded (top) and expanded (bottom) modes. The unexpanded waveform shows one full breath. The unexpanded and expanded waves corresponding to the same channel are shown in the same color. The choice of colors is arbitrary. The solid bars under the unexpanded waves mark respiratory cycle - **green bars** indicate inspiration and **blue bars** indicate expiration. The arrow indicates the location of the expanded interval. The duration of the expanded interval is 100 milliseconds. Abnormal sounds on the full breath waveform are marked: 'w'=wheeze; 'r'=rhonchus; 'c'=coarse crackle; 'f'=fine crackle.

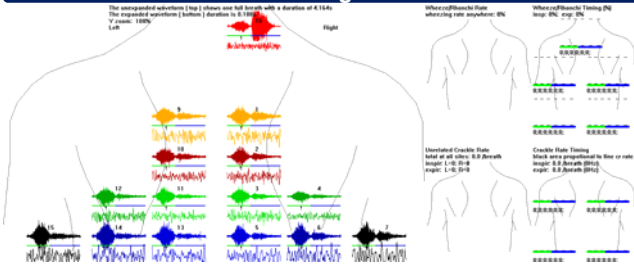
The summary of automated analysis is presented to the right of the waveforms. The two top graphs indicate wheeze and rhonchi analysis: the circles are proportional to the wheeze rate on each chest site; the bar graphs show the relative wheeze rate in each 1/3 of inspiration and expiration. The two bottom graphs show crackle analysis: the circles are proportional to the crackle rate on each chest site; the bar graphs show the crackle rate in each 1/3 of inspiration and expiration.

Results

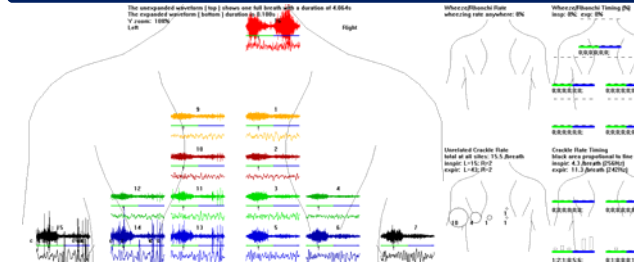
	Normal	Pneumonia	CHF	IPF	Obstructive lung disease	Pneumothorax
Total	11	13	6	4	18	2
Observer 1	6	8	2	3	13	1
Observer 2	9	8	3	4	15	2
Observer 3	8	8	4	3	16	2
% correct averaged among 3 subjects	70	62	50	83	81	83

The average of interpretations was 71% (range 50 to 100).

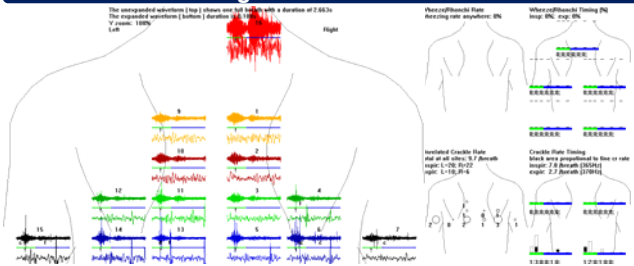
Normal Lung Sounds



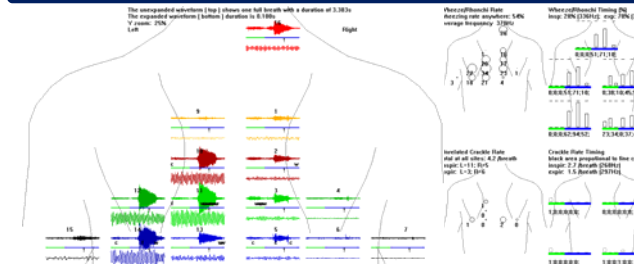
Pneumonia



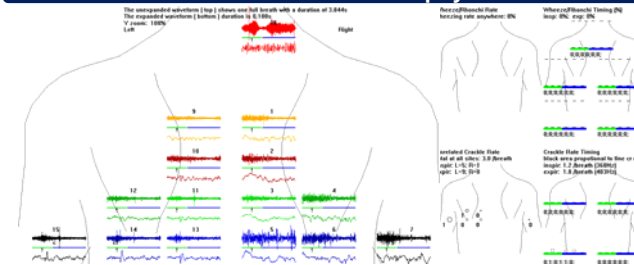
Congestive Heart Failure



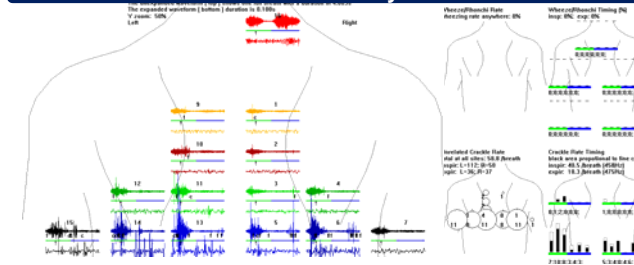
Asthma



Chronic Bronchitis and Emphysema



Interstitial Pulmonary Fibrosis



Discussion

- The results show that observers were able to properly diagnose on average 71% of the patients.
- In our opinion this is reasonably high as compared to other single tests that might be employed in diagnoses when no other clinical information is available (chest X-rays, pulmonary function tests and laboratory studies).

- The multichannel lung sound analysis technique is not intended to be used in the absence of the clinical information. It does provide important information rapidly and requires little patient cooperation.
- As algorithms are being developed to detect the acoustic patterns in various diseases the interpretation of this type of data is likely to be improved in the future. This has the potential of improving bed-side diagnosis.