

Ratio Of Low Frequency Energy To High Frequency Energy Of Lung Sounds In Patients With COPD

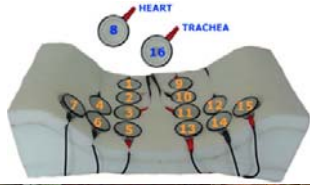
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Purpose

To determine if the frequency characteristics of lung sounds differed in non-wheezing patients with chronic obstructive lung disease (COPD) as compared to normal subjects.

Materials and Methods

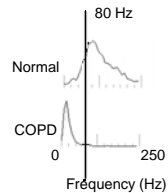
A 16-channel lung sound analyzer was used to collect 20 seconds samples of sound during deeper than normal breathing.



Patients: COPD (n=103), Normals (n=379), Pneumonia (PN, n=118), Congestive heart failure (CHF, n=92), Bronchial asthma (n=62), Interstitial pulmonary fibrosis (IPF, n=39)

Materials and Methods

Typical power spectral density of sound recorded at lung bases during deeper than normal breathing in a normal subject and in a patient with COPD.



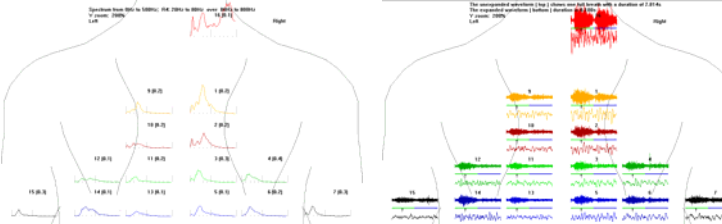
o To quantify the energy of lung sounds at low frequency, the ratio of sound energy from 20 Hz to 80Hz to that from 80 to 800 Hz was calculated (R4).

o The maximum value of the R4 ratio at 8 basilar sites was chosen for each subject.

Normal

Normal:

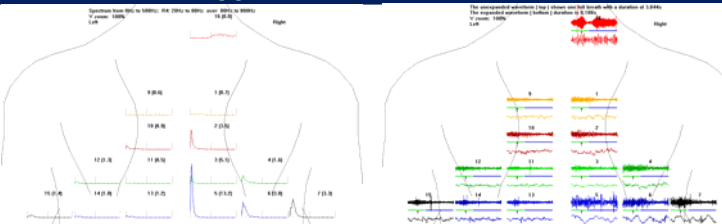
Note the spectrum of normal inspiratory sounds – most energy is concentrated between 80 and 200 Hz.



COPD

COPD:

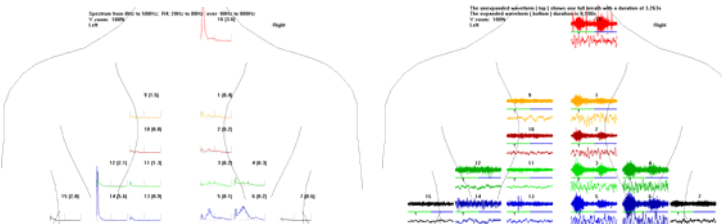
Note the high power peaks at frequency 0 to 80Hz (arrows)



Pneumothorax

Pneumothorax:

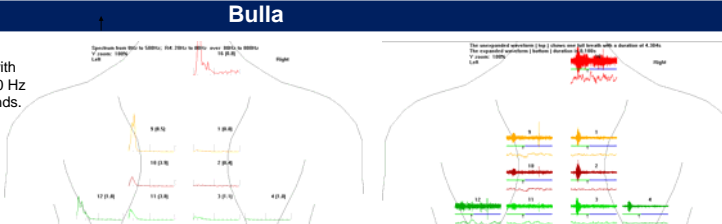
Spontaneous collapse of the left lung. Note the spectrum of normal inspiratory sounds on the right – most energy is concentrated between 80 and 200 Hz. On the left note the presence of a very low frequency peak at 20Hz (arrow) and the absence of energy at higher frequencies.



Bulla

Bulla:

A bulla in the left lung is associated with increased energy at frequency 0 to 80 Hz and decreased vesicular breath sounds.



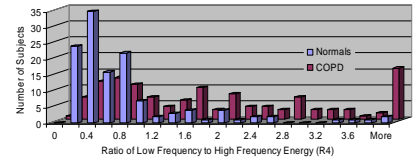
Results

	Normals	IPF	CHF	Asthma	PN	COPD
Mean R4 left	0.3±0.4	0.4±0.6	0.5±0.5	0.5±0.7	0.6±0.7	0.9±0.8
Mean R4 right	0.4±0.4	0.4±0.5	0.5±0.5	0.6±0.5	0.6±0.7	0.9±0.8

o Notice that R4 was significantly greater in COPD as compared to normals (p<0.05).

Frequency Distribution of R4

Age matched COPD (n=128) and Normals (n=128)



Discussion

- o The mechanism of the increased R4 in COPD is unknown.
- o A possible explanation is that it may be due to the relatively increased size of the air spaces in the lung of COPD patients as we have noted a similar increase in low frequency peaks in patients with pneumothorax and pneumonectomy as well in a patient with a giant bulla.

Conclusions

- o Acoustic energy at low frequency is increased in patients with COPD as compared to normals.
- o This finding combined with other observations such as decreased amplitude and prolonged expiratory phase is useful in identifying the presence of COPD by a bed-side technique that requires little patient cooperation.