Third International Conference on Lung Sounds

第3回 国際 肺音 学会

September 21, 22, 23, 1978

Room 6065

Tulane University School of Medicine

New Orleans, Louisiana

Conference Steering Committee:

Leslie H. Capel	- London
Shoji Kudoh	- Tokyo
Robert G. Loudon	- Cincinnati
Raymond L.H. Murphy, Jr.	- Boston
William W. Waring	- New Orleans

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THIRD INTERNATIONAL CONFERENCE ON LUNG SOUNDS

TULANE UNIVERSITY SCHOOL OF MEDICINE

NEW ORLEANS, LOUISIANA

PROGRAM

Thursday, September 21, 1978

Registration 8:30 am

Welcome 9:00 am

Introduction ------------------------------Leslie H. Capel 9:15 am

Session A 9:30 am - 12:00 Noon

Lunch 12:30 pm - 1:30 pm

Session B 1:30 pm - 4:30 pm

Cocktails and Buffet 7:00 pm

Friday, September 22, 1978

Session C 9:00 am - 11:30 am

Business Meeting 11:30 am - 12:00 Noon

Lunch 12:30 pm - 1:30 pm

Session D 1:30 pm - 3:30 pm

Summary of the Conference -----------------Dan E. Olson 3:30 pm

Saturday, September 23, 1978

Steering Committee 9:00 am

Session A

Chairman: Jere Mead

Session A

Chairman: Jere Mead

9:30 am	Detection of Ventilation Sequences in Normal Non-Smokers and Smokers by Breath Sounds	Y. Ploy-Song-Sang R.G. Loudon
10:00 am	Origin of Normal Breath Sounds	M. Mori K. Kinoshita H. Morinari T. Shiraishi S. Koike S. Murao
10:30 am	Gas Density Flow Dependence and Forced Expiratory Sound	R.G. Loudon A.G. Leitch R.P. Corbin
11:00 am	Mechanism of the Generation of Crackles After Alveolar Lavage	P. Krumpe
11:30 am	Historical Review	R. Murphy

DETECTION OF VENTILATION SEQUENCES IN NORMAL NON-SMOKERS AND SMOKERS BY BREATH SOUNDS

Y. Ploy-Song-Sang
R.G. Loudon

We recorded lung sounds from the chest wall with two microphones simultaneously in 19 normal subjects and 15 asymptomatic smokers. There were two methods of recording. First, one microphone was placed at 5 cm from the apex of the lung (M_5) and the other microphone at 20 cm from the apex in the right midclavicular line (M_{20a}). The sound signals were rectified and integrated to obtain electrical signals proportional to sound intensities. The M_5 signals were plotted on the x axis and those of M_{20a} on the y axis of an oscilloscope. Secondly, one microphone was placed at M_{20a} and the other at the same horizontal level but 7-10 cm apart (M_{20b}). The M_{20a} signals were plotted on the x axis and M_{20b} signals on the y axis of the oscilloscope. The breath sounds were recorded while subjects breathed from FRC with tidal volumes of about 500-1000 ml and at flow rates of about 1-5 LPS. We found that in both smokers and non-smokers M_5 signals always lead M_{20a} signals suggesting that the upper zones of the lung which have shorter time constants ventilate earlier than the lower zones. In non-smokers M_{20a} and M_{20b} signals were more in phase than those in smokers. We interpret these findings as showing that the time constants of lung units in the same horizontal zone of non-smokers are more comparable than those of smokers, therefore the ventilations of various units are more uniform.

ORIGIN OF NORMAL BREATH SOUNDS

M. Mori
K. Kinoshita
H. Morinari
T. Shiraishi
S. Koike
S. Murao

The purpose of this study is to investigate the origin of normal breath sound by spectral analysis.

Breath sounds were recorded from four adults and three infants. After slowing down the tape speed to one-eighth of the originally recorded speed, the taped signals were fed to computer (TOSBAC 5400) for Fourier transform. The sampling frequency and the time window were 1,000 Herz (Hz) and 1 sec respectively. The power spectrum of normal breath sounds consisted mainly of seven to nine discrete spectra within the frequency range of 100-300 Hz in the adults and twelve to thirteen discrete spectra within the frequency range of 100-400 Hz in the infants.

Based on these observations we speculated Helmholtz's resonators at each bronchial generation (Z) as sound sources. Using Weibel's model we calculated resonant frequencies at each bronchial generation and found that the observed frequency range of discrete spectra (100-300 Hz) corresponded to the resonant frequencies at the third to the ninth bronchial generation.

We conclude therefore that normal breath sounds originate from resonators corresponding to each bronchial generation and that the energy required to excite resonators comesfrom turbulence in the airways.

○ それでどうかわからない
○ Energyがどこで加わっているかわからないが……
○ Olsen自身がよく理解していたか不明

FORCED EXPIRATORY SOUND IN NORMAL MAN

R.G. Loudon
A.G. Leitch
Y. Ploy-Song-Sang
R.P. Corbin

We have investigated the mechanism underlying forced expiratory sound production in 16 normal subjects by measuring for each subject 3 flow-volume curves breathing air and three breathing a helium (80%) oxygen (20%) mixture (He-O_2). In addition to recording flow and volume we have recorded "integrated" and direct sound using a throat microphone during the forced expiratory maneuvers.

Our findings indicate no relationship between the volume of isoflow breathing air and He-O_2 mixtures and the point at which sound production ceases during a forced expiratory maneuver. This would suggest that forced expiratory sound is, at least at low lung volumes, unrelated to turbulent flow since, below the volume of isoflow, the site of flow resistance is believed to be in a laminar-flow system almost certainly located in the peripheral airways.

We found no consistent differences between "integrated" sound recorded breathing the two gas mixtures although considerable test to test variation was obvious with both mixtures.

Analysis by sound spectrography of the frequency content of sound recorded when the subjects were breathing air and when they were breathing He-O_2 mixtures revealed no consistent differences for the two gas mixtures. One subject appeared to abbreviate an early low pitched expiratory wheeze when breathing He-O_2 and another subject breathing He-O_2 did not have a "multi-harmonic" component during a forced expiratory maneuver which was present in two of three occasions when he was breathing air.

In general, our findings are entirely consistent with Forgac's belief (1) that forced expiratory wheeze is generated by bronchial wall vibration. The absence of relation to aerodynamic events is demonstrated by our failure to show any effect on quantity or quality of sounds recorded by breathing an He-O_2 mixture.

1. Forgacs, P.: Crackles and Wheezes, Lancet, 2:203, 1967.

(○ Bronchial vibration は どうか？
○ Meed は 反論
しかし 興味は強い

MECHANISM OF THE GENERATION OF CRACKLES AFTER ALVEOLAR LAVAGE

P. Krumpe
T.N. Finley
R. Kops

We have compared serial studies of lung function and chest roentgenograms with the presence of discontinuous lung sounds (crackles) which develop after alveolar lavage. Four normal non-smoking volunteers underwent lavage of the right lower lobe using the balloon occlusion technique. Three hundred (300) cc normal saline was instilled during each subject's lavage; 200 $\pm$ 50 cc of saline and surface active material are recovered. Maximum expiratory flow volume curves breathing air and 80% helium subdivisions of lung volume by 7 minute washout technique and closing volume by resident gas technique were measured before and at intervals after alveolar lavage. The following parameters were calculated: total lung capacity (TLC), residual volume (RV), vital capacity (VC), the forced expiratory volume in 1 second (FEV_1), maximum air flow at 50% VC ($\dot{V}$ max 50), the increase in flow rate at 50% VC compared to air ($\Delta\dot{V}$ max 50), volume of isoflow (Viso$\dot{V}$), and closing volume (CV). These studies were correlated with an auscultatory estimation of crackles by two observers. Crackles were graded according to intensity, pitch, and the lung volumes at which crackles occurred. Before lavage, all subjects were normal by pulmonary function testing, x-ray and physical examination. Crackles developed in the lavaged lobe in all subjects immediately after lavage, were characterized as being of low intensity, high pitch, and as occurring in the tidal breathing range. Roentgenograms demonstrated soft acinar shadows in all subjects, and increased interstitial markings in two of four subjects. TLC remained unchanged but VC, FEV_1 decreased and RV increased by 10 $\pm$ 5%. By five hours post lavage air flow and lung volumes had returned to control values. At 24 hours post lavage all subjects had completely clear chest x-ray exams; however, tests of small airway dysfunction (CV%, $\Delta\dot{V}$ max 50, and Viso$\dot{V}$) all remained distinctly abnormal. Crackles were absent in the tidal breathing range. In three of four subjects crackles could be generated by instructing the subject to first exhale to RV then inspire to TLC (crackles occurred between 70 to 90% of TLC). We speculate that either surfactant depletion or increased interstitial lung water caused by alveolar lavage results in airway instability and closure of units at low lung volumes. The characteristic volume history of crackles generated at 24 hours post lavage supports the hypothesis that crackles are opening sounds of units previously closed by high surface active forces. If lung units remain stable at FRC then no crackles are generated. Once closed, the critical opening pressure of such units would be high, thus a high transpulmonary pressure would be required to produce a crackle.

大変興味深い。
小気道のedemaで発生 [illegible] 説明

Session B

Chairmen: R. Mikami and S. Ishikawa

Session B

Chairmen: R. Mikami and S. Ishikawa

1:30 pm	Importance of time-expanded wave-form analysis for the spectral analysis of crackles.	M. Mori K. Kinoshita H. Morinari T. Shiraishi S. Koike S. Murao
2:00 pm	The Mechanism of the Production of Velcro Rale	Y. Homma Y. Minami Y. Ohsaki M. Murao
2:30 pm	Acoustic Characteristics of "Crackle" Analyzed by the Sound Spectrograph - Comparison with Time-Expanded Wave-Form and Power Spectrum by FFT	S. Kudoh K. Kosaka A. Shibuya N. Aisaka I. Ono S. Shirai R. Mikami
3:00 pm	Classification of Discontinuous Adventitious Lung Sounds by the Minimum Distance Technique	S. Holford
3:30 pm	Computerized Crackle Counter	P. Wright
4:00 pm	Lung Crackles in Bronchiectasis	A.R. Nath

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IMPORTANCE OF TIME-EXPANDED WAVE-FORM ANALYSIS

FOR THE SPECTRAL ANALYSIS OF CRACKLES

M. Mori
K. Kinoshita
H. Morinari
T. Shiraishi
S. Koike
S. Murao

Spectral analysis is a powerful method for the study of transient phenomena such as crackles. However, Fourier spectra may be misleading unless we can identify exactly the numbers and wave-forms of crackles selected for the analysis. For the selection and sampling of crackles, time-expanded wave-form analysis proposed by Murphy is the best method. In this presentation we report a method of sampling a single crackle for the analysis and discuss the importance of time domain wave-form analysis for the correct interpretation of frequency domain spectral analysis.

粗いと、小さい、二つのtypeが
あるのを注目した

いろ、音が出るところで起っている。
はっきりしない部分。

音の生じたところから、はなれているところで
pick upされる。
transmitしたものをとらえているのかも
しれない、　実際は小さいもの

THE MECHANISM OF THE PRODUCTION OF VELCRO RALE

Y. Homma
Y. Minami
Y. Ohsaki
M. Murao

The characteristics of Velcro rale heard in idiopathic pulmonary fibrosis have been reported by many investigators. However, the mechanism of the production of the rale is still obscure.

To clarify the acoustic characteristics, the analyses of the wave were done by sound spectrograph and Fourier analysis technique. As a result, it was noted that the Velcro rale was the resonant sound. Moreover, it was known after respiratory-physiologic studies that the rales related closely to inspiratory flow.

From these results, we tried to simulate the sound on the standpoint that the rales were produced by vibration of the lung tissue walls, applying Duffing's equation, in which the coefficient of non-linear term was controlled as a parameter meaning the degree of stiffness of the wall. The results showed that the Velcro rale was well simulated when the coefficient was increased. These may suggest that Velcro rales occur in the certain situation such as idiopathic pulmonary fibrosis, lung edema, or alveolar proteinosis where the movement of the wall is limited.

よりいっそうに正確な方法.

Resonant sound
Explosive sound } それぞれあるか不明.

現象そのものを記録しているのか？

Olsenは理解しているか

どうか不明

ACOUSTIC CHARACTERISTICS OF "CRACKLE" ANALYZED BY THE SOUND SPECTROGRAPH--COMPARISON WITH TIME-EXPANDED WAVE-FORM AND POWER SPECTRUM BY FFT.

S. Kudoh
K. Kosaka
A. Shibuya
N. Aisaka
I. Ono
S. Shirai
R. Mikami

In this paper the acoustic meaning of the analogue information from the sound spectrogram of crackles was evaluated.

Crackles analyzed by sound spectrograph using the narrow band (45 Hz) were compared to the time-expanded wave-form and its power spectrum by FFT.

The striped patterns appeared in the sound spectrogram of the individual crackling sound. These striped patterns were classified into two types: One was the coarse striped pattern with large frequency intervals (f=300-1000 Hz). The other was the fine striped pattern with small regular frequency intervals of harmonics (f=50-100 Hz).

The coarse striped pattern well corresponded to the power spectrum by FFT, when only one crackle was within a time window. It was suggested that the stripes represent the wave forms; shape, width and number of waves.

The fine striped pattern with regular frequency interval of harmonics was more frequently seen in the fine crackles than in the coarse crackles. This fine striped pattern appeared in the latter of two crackles with close time-interval: theoretically within 22 msec under the narrow band (45 Hz). The following equation was applicable: $f = \frac{1}{T}$ (f: frequency interval of the stripes, T: time interval between two crackles.)

The relationship of these striped patterns to resonance or non-resonance of crackles, which have been considered as an important point in Japanese acoustic diagnostics, is briefly discussed.

時間は一寸遅れは ?

CLASSIFICATION OF DISCONTINUOUS ADVENTITIOUS LUNG SOUNDS

BY THE MINIMUM DISTANCE TECHNIQUE

S.K. Holford
R.L.H. Murphy, Jr.

A mathematical pattern recognition method known as minimum distance classification will be described. The use of this technique in categorizing discontinuous adventitious lung sounds (crackles, rales, DALS) will be discussed. Such a classifier was "trained" using DALS waveforms from patient recordings having crackles described clinically as fine and coarse. The measurements used were the width of the initial deflection of the DALS complex (IDW) and the duration of the first two complete cycles (2CD). The classifier was tested using independent DALS complexes obtained from patient recordings and teaching tapes provided by others. Nearly all the test crackles were correctly classified by this algorithm. The mathematical methods are extendable to more variables, and this should make the method useful for investigating the disease specificity of discontinuous adventitious lung sounds.

Supported by the Institute of Occupational and Environmental Health and the American Lung Association.

大変、おもしろい。
この方法で、[illegible]が一つ考えられる
かもしれない。可能性あり。

LUNG CRACKLES IN BRONCHIECTASIS

A.R. Nath
L. Capel

The precise timing of lung crackles in inspiration and expiration can be achieved by the simultaneous recording of lung sounds and airflow. Forgacs (1967) pointed out that the lung crackles of fibrosing alveolitis occur typically late in inspiration, and suggested that these sounds coincide with the late opening of the peripheral airways in this condition. Nath and Capel (1974) contrasted the late timing of inspiratory crackles of fibrosing alveolitis and related disorders with the characteristic early timing of the inspiratory crackles in severe obstructive chronic bronchitis and emphysema. In this paper the inspiratory timing of lung crackles in bronchiectasis is compared with the timing of lung crackles in fibrosing alveolitis and obstructive chronic bronchitis. It was observed that the lung crackles in uncomplicated bronchiectasis occur typically in early and mid-phase of inspiration and so contrast with the early timing of obstructive chronic bronchitis and the late timing of fibrosing alveolitis and related disorders. Additional distinguishing features of the lung crackles in the three conditions are discussed.

○ Bronchiectasis の[illegible]

○ 大きな[illegible]をかけて書いたのか。
それとも、打診して[illegible]

Wright の仕事.
[illegible]の[illegible]を使っていたから
答をもっていない

SESSION C

CHAIRMAN: FORBES DEWEY

Session C

Chairman: Forbes Dewey

9:00 am	Engineering Aspects of Stethoscope Performance	C.K. Druzgalski R.L. Donnerberg R.M. Campbell
9:30 am	High Frequency Sound Propagation in Upper Airways	D. Rice
10:00 am	Airway Area by Acoustic Reflectometry in Man	J. Fredberg M.E. Wohl H. Dorkin R. Sidell
10:30 am	Acoustic Methods for Investigating Lung Disease	J.E. Jacobs J.D. Lewis L.F. Mockros
11:00 am	Sound Transfer Function of the Lung	R.L. Donnerberg C.K. Druzgalski R.M. Campbell
11:30 am	Business Meeting : Chairmen: R.L.H. Murphy R.G. Loudon	

ENGINEERING ASPECTS OF STETHOSCOPE PERFORMANCE

C.K. Druzgalski
R.L. Donnerberg
R.M. Campbell

An acoustical analysis of stethoscope performance including segmental as well as cumulative analysis was conducted. A lack of detailed standards for stethoscope acoustic characteristics and methodology for testing these qualities undoubtedly contributes to the fact that available stethoscopes differ markedly in design and acoustic performance. For these reasons we have investigated significant measurable factors and emphasized comparative analysis.

The influence of the geometry of the coupling cavities was tested by recording sound using the ECM 50 microphone with various chest-pieces. The recorded frequency response was compared with reference and laboratory microphones. Shallow bell-type chestpieces cause amplification of sound above 200 or 300 Hz depending on their dimensions while deep chestpieces amplify sound above 400 Hz. Resonance peaks attributed to the chestpieces occur at higher frequencies depending on the design. Additional resonance frequency peaks attributed to the axial and cross mode resonance frequencies of other elements were also defined using analytical methods. In addition, 1) variability of characteristics due to static and dynamic conditions including a pseudo-diaphragm formation; 2) filtering properties of a diaphragm, (dependence on design and elastic properties) and its tunability; 3) peculiar peaks in frequency response corresponding to specific resonances and multiples of the quarter-wave length; 4) performance of traditional, specially designed stethoscopes; 5) possible modifications of stethoscope characteristics in patient management were investigated.

Specific examples of stethoscope characteristics, their significance and methods of determination will be discussed.

Supported by a grant from the American Heart Association, Central Ohio Chapter, 77-13.

no comment

HIGH FREQUENCY SOUND PROPAGATION IN UPPER AIRWAYS

David A. Rice

Velocity of sound was measured using a spark gap sound source in the trachea and larger airways of dogs. In the trachea the velocity was measured to be 349 m/s $\pm$ 1% for frequencies between 10 and 20 kHz at end expiration with zero flow. With path length fixed, the transit time is dependent upon volume flow and gas composition. The transit time is independent of lung volume, transpulmonary pressure, and moderate changes in bronchomotor tone. With a time resolution of 2 microseconds, changes in sound source position of 0.7 mm can be resolved.

AIRWAY AREA BY ACOUSTIC REFLECTOMETRY IN MAN

J. Fredberg
M.E. Wohl
H. Dorkin
R. Sidell

The geometry of the upper airway of the respiratory system in normal adults has been inferred non-invasively by an acoustic reflectometry technique. Short duration pressure transients launched into the respiratory system at the mouth give rise to echoes reflecting from the inhomogeneous airway structure. This data is transformed into an inference of the cross-sectional area of the airway as a function of distance from the lips. The results indicate a local area maximum in the vicinity of the uvula (velum closed), a local minimum in the oropharynx near the top of the epiglottis, and another local maximum in the vicinity of the hypopharynx. The area contracts passing through the thyroid and cricoid cartilages, and expands to a plateau in the extrathoracic and intrathoracic trachea. At fixed lung volume the areas of the larynx and extrathoracic trachea are sensitive to trans-respiratory system pressure while the area in the vicinity of the thyroid and cricoid cartilages and intrathoracic trachea are not. Radiographic determinations indicate that this method tends to systematically overestimate the anatomic area in the subglottic region as a result of non-rigidity of the airway walls. (Supported by NHLBI contract N01-HR-6-2901).

No comment.

ACOUSTIC METHODS FOR INVESTIGATING LUNG DISEASE

J.E. Jacobs
J.D. Lewis
L.F. Mockros

Tellier- eng.

The excitation of a system by wide-band low level acoustic energy with subsequent detection and signal processing constitutes a recognized, reproducible, non-invasive method of determining the impulse response and hence the mechanical properties of the intervening system. We have used this technic to study a number of acoustic reproducers as well as the pulmonary systems of a variety of patients. The responses obtained with this technic have been compared with calculated responses of a variety of linear and non-linear systems. Using this experimental technic together with simulation models of normal and pathologic airway systems, we identify the response sensitivity to specific lung parameters. Airway geometry and material properties, respiratory gas properties, and mucus layer geometry and properties are all considered in the simulations. The procedure permits an association between specific physical aspects of airway systems and the characteristically observed response plots.

no comment

SOUND TRANSFER FUNCTION OF THE LUNG

R.L. Donnerberg
C.K. Druzgalski
R.M. Campbell

Sound transfer function of the bronchial-lung-thoracic system was accomplished in normal volunteers and in patients with pulmonary emphysema. Sinusoidal acoustic signals from 50 Hz to 2 kHz were induced through a large bore mouthpiece and transmitted sound was recorded over the right inferior posterior lung fields. Sweep periods of ten seconds and two minutes were utilized during quiet breathing and at different static lung conditions (RV, FRC and TLC). Simultaneous recordings of respiratory airflow were recorded. The logarithmic ratio of the detected and induced signals, defined as the sound transfer function of the bronchial-lung-thoracic system, was used to characterize normals, different static states of the lung, difference between normals and patients with emphysema and data variability in specific groups. Patterns of sound transfer function of the lung observed in these different conditions will be presented and described.

Supported by a grant from the American Heart Association, Central Ohio Chapter, 77-13.

No comment

SESSION D

CHAIRMAN: ATTILIO RENZETTI

Session D

Chairman: Attilio Renzetti

1:30 pm	Observer variation using acoustic and electronic stethoscopes for auscultation of the chest	A.G. Leitch A. Bentsen L. Mealey R.G. Loudon
2:00 pm	Sounds Remembered and Sounds Recorded	A. Bentsen A.G. Leitch R.G. Loudon
2:30 pm	Talking About Lung Sounds	L.H. Capel
3:00 pm	Lung Sounds in the Diagnosis of Asbestosis	R. Murphy
3:30 pm	Summary	D. Olson

OBSERVER VARIATION USING ACOUSTIC AND ELECTRONIC STETHOSCOPES FOR AUSCULTATION OF THE CHEST

A.G. Leitch
A. Bentsen
L. Mealey
R.G. Loudon

Three observers performed chest auscultation on 22 patients listening at one abnormal and one reference site (the right apex anteriorly) on five successive days. Two observers used acoustic stethoscopes and one an electronic stethoscope, the latter being allocated on a random weekly basis to one of the observers. Added sounds were heard by 2 or 3 observers at 67% of the abnormal and 34% of the reference sites. The intensity and character of the breath sounds and nature, intensity, character, profusion and timing of any added sounds were noted on a standard form.

Total disagreement between observers occurred at 6.2% of the abnormal (A) and 5.3% of the reference (R) sites and minority disagreements occurred on 21% (A) and 22.5% (R) of all occasions respectively. The principal sources of disagreement were related to the nature and intensity of added sounds (45% (A) and 37% (R)) of such observations, the character of the added sounds (34% (A) and 18% (R)), and the character of the breath sounds (34% (A) and 86% (R)). There were no significant differences in total numbers of minority disagreements recorded using the acoustic or electronic stethoscopes either on overall analysis or when each quality of breath or added sounds was considered separately. However, when the causes of disagreement were analyzed the electronic stethoscope was significantly more often associated with minority disagreement due to recording of isolated discontinuous sounds and also a coarser quality of added sounds.

Our findings indicate that observer variation in recording lung sounds matches the variation found for most other respiratory signs (1,2,3). Considered in this context the minor but significant misinterpretation of added sounds with the electronic stethoscope is unlikely to be of clinical significance. Our study does suggest, however, that tape recordings made with the electronic stethoscope for, for example, teaching purposes may occasionally be misleading.

Fletcher, C.M. (1952). The clinical diagnosis of pulmonary emphysema - an experimental study. Proc. Roy. Soc. Med. 45, 577.

Godfrey, S. et al. (1969). Repeatability of physical signs in airways obstruction. Thorax 24, 4.

Smyllie, H.C. et al. (1965). Observer disagreement in physical signs of the respiratory system. Lancet 2, 412.

おもったより良い結果でした。心配なさそう

SOUNDS REMEMBERED AND SOUNDS RECORDED

A. Bentsen
A.G. Leitch
R.G. Loudon
L. Mealey

Listening at two sites three observers assessed added lung sound changes from the previous day and from the first day of listening for up to 5 successive days in 16 patients. Changes heard at the bedside and, at a later date, during replay of the lung sounds recorded with an electronic stethoscope on a tape cassette recorder were noted on a continuous 5 centimeter line.

Analysis of changes for all added sounds heard at the bedside revealed 77% disagreement among observers for changes from the previous day (PD) and 67% disagreement for changes from the first day (D1). There was no significant improvement when the assessment of changes was made on the tape recordings (66% (PD) and 60% (D1) disagreement). Analysis of continuous sounds showed significant improvement in assessment of changes on the tape recording when total disagreements about changes from day 1 and the previous day were considered (71% bedside and 52% tape disagreement).

Inconsistencies in assessment of change by each observer due to failure to remember previous findings improved from 17% at the bedside to only 2% with the tape recording replay.

When direct comparison of bedside and tape assessment of added sounds was made for one of the sites observer differences were found. Observer B heard more (14) discontinuous sounds on tape whereas observers A and C heard fewer (A7, B9). Observers B and C heard more profuse sounds on tape and observer B, in particular, heard sounds in more phases of the respiratory cycle on tape.

This first ever assessment of observer variation in recording lung sound changes from day to day finds substantial disagreement between observers at the bedside. Replay of tape recordings of the sounds eliminates inconsistencies due to memory defects and reduces disagreement in assessment of continuous lung sound changes. The presence of extraneous discontinuous sounds with our recording system resulted in over-and-under-recording of this added sound by different observers causing as much disagreement about changes on the tape as at the bedside.

	Bedside	Tape
c	[illegible]/116 (24%)	[illegible]/168 (2%)
b	14/180 (8)	3/180 (2)
Total	66/396 (17).	6/348 2

LUNG SOUNDS IN THE DIAGNOSIS OF ASBESTOSIS

R.L.H. Murphy, Jr.
E.A. Del Bono
P. Workum
S. Holford

To evaluate the utility of chest auscultation in the early detection of pulmonary fibrosis due to asbestos exposure, over 500 workers occupationally exposed to asbestos were examined. Detailed medical history, physical examination, chest roentgenograms and pulmonary function studies including ventilatory studies and diffusing capacity were obtained on all workers included in this study. The prevalence of rales (crackles) was examined with respect to duration of exposure as well as chest x-ray and pulmonary function analyses. The utility of adding quantitative study of auscultatory findings via time expanded waveform and spectral analysis will be discussed.

This work was performed with the cooperation of the Thoracic Services, Boston University, Dr. E.A. Gaensler, Director.

Most. [Clinic. X ray Physiolo

All [

	1965	1972
Rales.	13.0	19.5
X ray	10.4	15.6

SPONSORS

2日間の Conference で
答はでてなかった
しかし 150年前 の Fermat
の未解決のものを、かいけつしよう。
いちばんいいことは
~~未解決~~、分野間の[illegible]
一切 けんかしないでおこなった。

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Richard McConnell, M.D.
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Host. Dave Cugell.
Northwestern Univ.
Thurs. & Fri. Sept. 22. 23. 1977
Offield Auditorium Passavant Pavillon
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