A New Stereostethoscope Devised for Both Monaural and Binaural Auscultation

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SUMMARY

A new stereostethoscope for both monaural and binaural auscultation was devised. Two channels from chest to ear pieces are separate in binaural use but interchangeable for monaural use by a simple 3 way cock set in between. In binaural use, one heart sound or murmur can be heard stereophonically, and more than 2 separate sounds can be heard simultaneously. Recognition of, or distinction of, the heart sounds or murmurs are thus made easy and help to contribute in diagnosing heart diseases more precisely. Respiratory auscultation can be done even more precisely and time savingly.

Additional Indexing Words:
Cardiac auscultation  Stethoscope  Phonocardiography  Cardiac catheterization  Heart sound  Heart murmur  Maximum point  Inching method  Physical examination  Respiratory auscultation

Cardiac auscultation had been done by listening directly by ear through the chest wall and the way to the invention of the stethoscope had been a long one. But 151 years ago, in 1819, Laennec invented the stethoscope and described the meaning of the sound heard with it.1 It was originally a wooden pipe since his idea was born when he watched 2 small boys playing with a hollow log, the one holding it to his ear while the other tapped on the other end of it. Cammann has added 2 ear pieces to it and still many others improved it in an attempt to obtain better quality and intensity of sound. Among the countless stethoscopes thus introduced, Rappaport-Sprague, Leatham and Littman types are now among the most popular.2

Recently, many methods which, whether directly or indirectly, help to confirm the stethoscopic findings have been introduced, viz., ordinary phonocardiography, intracardiac phonocardiography, functional phonocardiography and cardiac catheterization, etc. They are now in daily use and any abnormalities in cardiac hemodynamics are confirmatively detectable. In addition, many heart diseases are now listed in surgically curable form, and,

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therefore, even more accurate auscultation during the first physical examination is becoming of a greater practical significance.

So far as the monaural use of the stethoscope is concerned, however, it seems to have little room left to be improved. In order to make it more useful for precise auscultation, especially in such difficult cases as atypical, complicated or combined valve failures, we have added one more extra chest piece and a 3 way cock for both monaural as well as binaural stereophonic uses. The idea of binaural stethoscope appeared quite a long ago, but it was not interchangeable and was limited only for binaural use. Very probably, its use must have been rather troublesome, especially in those days when clinical diagnosis did not necessarily lead to the curability and did not require such a precise auscultatory analysis as does nowadays realistically.

**Method**

As is shown in Fig. 1, both right and left side channels (ABC and A'B'C' in Fig. 1) from ear to chest pieces are separated independently. Both channels are connected by a small piece of rubber tube (D) with a 3 way cock (E) to make it useful for both binaural and monaural purposes. If the 3 way cock is

![Fig. 1. A stereostethoscope devised for both monaural and binaural auscultation. With a 3 way cock set as figured (E), each channel (ABC and A'B'C') is separate for binaural use.](image)

![Fig. 2. A stereostethoscope devised for both monaural and binaural auscultation. When the 3 way cock (E) is set as shown in the figure, a sound from a chest piece C' goes to the both ear pieces, while another chest piece C is kept away from the channel, for the monaural auscultation.](image)
set as shown in Fig. 1, both channels are completely shut out each other and is used as a stereostethoscope. If set as in Fig. 2, the sound from the chest piece C' goes, not only to A', but also to A through D and E, while another chest piece C is kept away from the channel.

RESULTS

1) Advantages of Auscultating Cardiac Sounds and Murmurs with the Stereostethoscope

**Determination of the phase of the cardiac cycle**

Distinction of, and the recognition of any abnormalities in the first and second heart sounds are fundamentally important in cardiac auscultation, and sometimes, takes time by ordinary stethoscope. But this is easily done binaurally. One may hear the first heart sound by his right ear through one chest piece placed at the apex and the second heart sound by his left ear through the other chest piece placed at the base.

The first heart sound thus detected is often referred to when one is to determine the phase of the other heart sounds or murmurs. In fact, the phases of the heart sounds and murmurs are usually determined from their relation to the first heart sound at apex. Inching method helps to recognize the first heart sound but it may be difficult and troublesome, when the area to be auscultated is too far from the apex, or accompanied with tachycardia or atrial fibrillation. Binaural auscultation makes it instantly recognizable even without inching.

It is also often noticed by phonocardiography that the maximum intensity of the heart murmur, even though still within the same phase, varies from area to area. It is almost impossible to recognize it by the monaural stethoscope, but the binaural listening makes it easy even when the phasic change of the sound is very slight.

**Determination of the maximum point and radiating direction of the heart sound and murmur**

Auscultation of the second sounds gives important information and puts a different meaning depending on which component (either IIa or IIp) of the second sounds is changed. This may be difficult monaurally, but is quite easy binaurally, by placing both pieces at the aortic and pulmonic areas, respectively.

Significance of detecting the point of maximum intensities of either heart sound or murmur in the diagnosis of cardiac diseases has been well known. For example, in ventricular septal defect, the defect of the ventricular septum is often found directly beneath the point of maximum intensity of the systolic
murmur audible from the chest surface. This even helps to determine where the blood sample should be taken and where the platinum electrode to be placed in cardiac catheterization. The use of this stereostethoscope makes it much easier to find the point of maximum because it always enables one to hear 2 areas separately and simultaneously. One may put a chest piece at the area where one thinks it is maximum, and, compare it with the other chest piece being moved all the areas around. In this way, one may also readily detect the direction where the heart murmur is radiating to, not only on the anterior, but also to the posterior surface, three dimensionally.

**Determination of the change in quality of the sound**

Monaural auscultation of the heart murmur in combined valve failure is especially difficult because of the coexistence of more than 2 murmurs which are different in origin, and, one must recognize even the slightest difference in quality of the sound for the correct diagnosis. This is difficult because when done with an ordinary monaural stethoscope, one must compare the quality of the sound of one area to that of the other area in his memory, while the memory of the sound easily fades when one is concentrating on another sound. Binaurally, however, the comparison of the murmurs is easily done, because it does not need to rely on memory but is realistically heard by both ears simultaneously.

When any change of the sound is expected by the use of pharmacological drug administration, binaural auscultation works like a 2 channel phonocardiography making the right and left heart sounds audible separately and contribute to differential diagnosis.

2) **Advantages of Auscultating Respiratory Sound with the Stereostethoscope**

Comparison of the both sides of auscultation is one of the most fundamentals in auscultation of the respiratory organ. With the ordinary monaural stethoscope, one should remember, here too, the sound of the other side in his memory when auscultating one side. They may be unprecise and time consuming. If it is done binaurally, however, the examination is more precise and takes only the half time because of the simultaneous audibility of the both sides. Furthermore, the comparison is easily done not only between right and left, but also upper and lower, or even anterior and posterior of the chest.

Advantage in shortening the time of examination by the use of binaural stereostethoscope may be realized especially when the physical examination is done in number such as regular check up examinations of school children.
DISCUSSION

It was when we were examining one patient with tachycardia and heart murmur that the idea of present device occurred to us. The patient had blowing systolic murmurs of grade II both at apex and Erb's areas. The former was soon recognized to be mitral regurgitant murmur, but the latter was difficult even in judging the phase of the murmur. Inching method did not help convincingly because it was interfered with the accompanied tachycardia. By applying 2 stethoscopes to the both sites each stethoscope to each ear, the murmur was readily recognized to be systolic. Afterwards, it was confirmed from the results of the other clinical examinations to be combined valve failure of mitral and aortic regurgitation due to rheumatic heart disease. By combining 2 stethoscopes, we have developed here a stereostethoscope with an advantage of monaural usage still kept in it.

There are certainly some conditions for the above mentioned advantages of the binaural auscultation to be taken. Above all, both ears must be of identical audibility. Secondly, both channels including ear pieces A and A', tubes ABC and A'B'C', and the chest pieces C and C', should be also identical in length, diameter and materials.

When used monaurally as shown in Fig. 2, the sound reaching the left ear should travel longer than right side by the length of connecting tube D in Fig. 2. But, calculating from the velocity of sound, this difference of the extra length should result in a difference of only about 0.00001 sec. in time and does not seem to affect the practical use.

More practical difficulty we have come across in using the binaural stethoscope was the diminution of the intensity of the sound heard with it. Still one more difficulty may be the fact that one has not been quite accustomed to the use of binaural auscultation and takes a little time to get used to the different and independent sounds heard to each ear, respectively. Those disadvantages are minor, being only the matter of a little further improvement or training, and, cannot be compared to the great many advantages mentioned above.

REFERENCES