The possibility of unusual murmurs in cases of ventricular aneurysm has been mentioned repeatedly. However, different types of murmurs can be heard in such cases or there may be the absence of murmur. The following clinical case deserves to be reported because of the rarity of findings and the part played by phonocardiography in explaining the findings.

**CASE REPORT**

A 66-year-old woman, resident of a nursing home, had a long history of hypertension and of psychiatric disorders. She had also been complaining of attacks of precordial pain for several years. The patient was admitted to Mount Sinai Hospital in February, 1968 for treatment of inferior myocardial infarction. Following recovery, she returned to the nursing home. In November, 1968, as her episodes of precordial pain were becoming more frequent and more severe, she was again sent to Mount Sinai Hospital for evaluation.

**Physical Examination**

The patient was a poorly nourished white woman with obvious orthopnea. Her pulse rate was 80 and regular; blood pressure, 140/90. The jugular veins were distended and showed marked pulsations. There were a few crepitant rales at the lung bases.

The point of maximal cardiac impulse was in the fifth intercostal space 2 cm outside the midclavicular line. Both at the apex and in the third to fourth left intercostal space a diffuse, heaving systolic pulsation was palpated. The heart sounds were within normal limits. A loud third sound was heard at the apex and midprecordium. There was a grade 2 systolic murmur over the entire precordium with maximum at the apex. Abdomen and extremities were normal. The possibility of a ventricular aneurysm was discussed.

**Electrocardiogram—Vectorcardiogram**

The 12-lead electrocardiogram showed evidence of diffuse ischemia. There was a QS pattern with a positive T wave in leads 3 and aVF. There was lack of progression of the R waves in V1-V4. There also was an elevation of S-T in V1-V4. This pattern remained unchanged throughout a series of tracings recorded during 14 days. In the absence of signs of recent infarct, this elevation was interpreted as evidence of ventricular aneurysm.

The vectorcardiogram confirmed the results of an old inferior and anteroseptal infarct. There was an open loop that was interpreted again as evidence of ventricular aneurysm.

**Roentgenogram**

Chest films were taken in the various projections. They showed a large left ventricle and a dilated ascending aorta. No definite bulge was visible over the contour of the left ventricle.

**Phonocardiogram**

The first sound was of normal amplitude and was delayed over Q (Q-I = 80 msec). The second sound was increased in amplitude and showed marked splitting (40 msec) in inspiration with normal sequence of the A (aortic) and P (pulmonic) components.

At the apex, there was a complex series of vibrations in presystole, superimposed over a low frequency deflection (IV sound); these vibrations terminated well before the first heart sound (Fig 1). There was a short, diamond-shaped systolic murmur over the second to third left intercostal
space. Without filtration, a III sound was recorded. An opening snap was recorded. The interval between the A component of the II sound and the opening snap was 110 msec. With medium filtration, an early-diastolic series of vibrations occurring 80-100 msec after the A component of the II sound was recorded (Fig 2). High filtration permitted the recording of a large presystolic murmur, well separated from the I sound; a pansystolic murmur with an increase in late systole; and a large, early diastolic series of vibrations, not in decrescendo, often preceded by a large vibration (click) (Fig 3). This click occurred about 60 msec after the A component of the II sound. The low frequency tracing (cardiogram) recorded over the fourth left intercostal space had a large, negative, presystolic wave, a rapid negative deflection in early systole, and a late-systolic positive wave; followed by another positive, early-diastolic wave (Fig 4).

The carotid and jugular pulses were normal.

**DISCUSSION**

The phonocardiograms of this patient revealed extremely interesting phenomena, which had been either overlooked or misinterpreted on auscultation.

1. **The presystolic vibrations.** There was a peculiar presystolic sound complex containing low frequency (IV sound) and high frequency vibrations. Being widely separated from the first sound and having no crescendo characteristics, it had different graphic characteristics from those of the presystolic murmur of mitral stenosis. High frequency tracings, on the other hand, revealed a blowing, large, and short murmur in presystole. Neither the IV sound nor the presystolic murmur had been noted on auscultation. However, the report of auscultation mentions a III sound.

2. **The early-diastolic vibrations.** The tracing reveals an opening snap (OS) 110 msec after the aortic component of the second sound (IIA). This is most likely a mitral opening snap. The interval IIA-OS is such as to exclude significant mitral stenosis. We have recorded such a snap.

**FIGURE 2.** Phonocardiograms recorded with a filter at 400 cps (high frequency) at base (above) and apex (center). At the apex: presystolic murmur, small pansystolic murmur, and murmur in early diastole, preceded by a click (C). At the base: diamond-shaped systolic murmur, split II sound.

**FIGURE 3.** Phonocardiogram recorded at the apex with a filter at 600 cps (ultra-high frequency). Peculiar presystolic murmur; pansystolic murmur with a large group of vibrations in early-systole and one in late-systole. Peculiar early-diastolic murmur, well separated from the II sound.

**FIGURE 4.** Phonocardiograms at base (above) and apex with filter at 100 cps (medium-low frequency). Apex cardiogram (Card) with a large negative wave in presystole (A) and a late-systolic, slow rise.
occasionally in patients in whom either catheterization or subsequent autopsy excluded mitral lesions. High frequency tracings revealed a blowing, large murmur in the apical tracing, completely different in configuration, duration, and location from that of aortic or pulmonic insufficiency. Such a murmur has been described in ventricular aneurysm\(^1,2\) and is different from any murmur caused by valvular lesions. It is probable that this murmur was heard on auscultation as a III sound.

It is interesting to note that it was preceded by a high pitched clicking sound, and that this occurred earlier than the opening snap recorded with lower filtration.

(3) **The systolic murmurs.** The murmur, recorded best at the base, was considered as an aortic flow murmur because of its diamond-shaped aspect. On the other hand, there was another systolic murmur, recorded only at the apex with high filtration. This was pansystolic and may have been caused by either mitral insufficiency or the aneurysm.

In conclusion, the following murmurs were recorded: (a) a bizarre presystolic murmur; (b) a bizarre early-diastolic murmur; (c) an apical pansystolic murmur; and (d) a basal diamond-shaped murmur.

The first two are definitely related to the two phases of diastolic filling of the ventricular aneurysm; the last two may or may not be caused by it. While a ventricular aneurysm may not be revealed by typical auscultatory and phonocardiographic findings, there are reports of occasional unusual phenomena: musical systolic murmur\(^1,2\), short apical systolic murmur\(^3,4\), early diastolic murmur or diastolic-presystolic murmur\(^1\). Twenty-five percent of Vakil's cases\(^5\) had musical murmurs in both systole and diastole.

The murmurs of our patient did not have a musical quality. The murmurs recorded at the apex had unusual graphic features that cannot be reconciled with any valvular disease. In conjunction with the history, physical examination, graphic recording of precordial pulsations, and electrocardiogram of the patient, they were accepted as evidence of abnormal characteristics of the left ventricle, i.e. of a ventricular aneurysm.

**Summary**

The data of a clinical case of ventricular aneurysm are reported. While auscultation failed to reveal unusual murmurs, phonocardiography revealed bizarre diastolic murmurs and more conventional systolic murmurs. Discussion of these murmurs follows.

**References**


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**EXPERIMENTAL PROOF OF ALVEOLAR PORES**

Working with Lindskog, Dr. Bradshaw took advantage of the facilities of my laboratory to work on the problem of the amount of air which might reach obstructed alveoli through collateral paths. They found that when an entire lobe was blocked, the contained gas rapidly came into equilibrium with the venous blood gas tensions. When, however, the obstruction was lobular, so as to permit collateral respiration, the carbon dioxide tension of the gas was that of the arterial blood; and, while the oxygen tension did not reach that of typical arterial blood, it was above the venous blood tension. They found that an obstructed lung lobe may receive at least 10 per cent of the normal ventilation through collateral channels. This does not seem to be very much, but when one considers the possible beneficial effects of breathing pure oxygen, and particularly the use of oxygen under some degree of pressure, one appreciates how important even a small degree of access to blocked alveoli may be.