Appearance of atrial sound after reversion of atrial fibrillation

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To determine the incidence and time of onset of the atrial sound after reversion of atrial fibrillation in patients with myocardial disease, 12 patients with arteriosclerotic heart disease and 4 patients with primary myocardial disease were followed with serial auscultation as well as daily simultaneous apical phonocardiogram, apex cardiogram, and lead II electrocardiogram. Their average age was 52.3 years. Each patient had been in atrial fibrillation for 6 months to 2 years' duration; 13 were reverted to sinus rhythm with DC capacitor discharge and 3 with quinidine sulphate.

All 16 patients developed an atrial sound when in sinus rhythm, but only 2 on the day of reversion; the other 14 patients developed an atrial sound on the first to the sixth day after reversion (average third day). The atrial sound persisted in each patient.

This study indicates that the atrial sound as a manifestation of diminished ventricular compliance may be absent in patients with myocardial disease immediately after reversion of atrial fibrillation and may later appear as left atrial function improves.

The audible atrial sound is produced in the ventricle during the ventricular filling associated with atrial contraction (Muiesan et al., 1961) and is frequently present in patients with myocardial infarction or coronary artery disease (Harvey and Perloff, 1961; Hill et al., 1969). The presence of an atrial sound is usually dependent on three factors: (1) effective atrial contraction, (2) unimpeded ventricular filling, and (3) diminished ventricular compliance (O'Rourke, 1970). The atrial sound may be absent, despite ventricular disease, when ineffective atrial contraction results from atrial ischaemia, fibrosis, or infarction, and may appear with the improvement in atrial function and cardiac output which accompanies digitalis therapy (Gould, McGinn, and Lyon, 1968; Hill et al., 1969).

A reduced contribution of left atrial contraction to ventricular diastolic filling may persist for several days after the reversion of atrial fibrillation to sinus rhythm (Rodman, Pastor, and Figueroa, 1966; Ikram, Nixon, and Arcan, 1968). The purpose of this study was to determine both the incidence and time of onset of the left-sided atrial sound in patients with myocardial disease after reversion of atrial fibrillation.

Subjects and methods

Sixteen patients are included in this study. The group consists of 13 men and 3 women who presented with atrial fibrillation of 6 months' to 2 years' duration, as could best be ascertained by history and previous electrocardiograms. The diagnosis in 12 patients was arteriosclerotic heart disease and in 4 was primary myocardial disease. None was hypertensive. Their ages ranged from 38 to 60 years and averaged 52.3 years. Thirteen patients were reverted to sinus rhythm with DC capacitor discharge and three with quinidine sulphate.

Simultaneous apical phonocardiogram, apex cardogram, and lead II electrocardiogram were recorded on each patient while in atrial fibrillation, twice on the day of reversion to sinus rhythm and daily for 5 to 10 days after reversion of atrial fibrillation. In addition, a repeat phonocardiogram was obtained on each patient one month after the reversion to sinus rhythm.

Phonocardiograms were recorded with a Rochelle salt crystal microphone. The apex cardiogram, used for timing purposes, was obtained with the same 5 cm. diameter bell connected by rubber tubing to an enclosed diaphragm (piezo-electric effect). Recordings were made at the end of a normal expiration with the patient in the left lateral position. The phonocardiograms were recorded at a paper speed of 75 mm. per second, with a filter slope of 24 decibels per octave and
with attenuation of frequencies below 50 cycles per second. Tracings were recorded on a Hewlett-Packard 4560 polybeam recorder using a 350-1700 C heart sound pre-amplifier and a 4-channel Hewlett-Packard oscilloscope. An atrial sound was identified on the tracings as a low frequency sound coincident with the presystolic ‘a’ wave of the apex cardiogram and beginning before the QRS complex of the simultaneous electrocardiogram. All atrial sounds recorded in this study were audible and frequently the presystolic wave of the apex cardiogram was visible and palpable.

**Results**

All 16 patients in this study developed an atrial sound after reversion to sinus rhythm, but at variable time intervals (Fig. 1). Two patients had an atrial sound documented with phonocardiograms on the day of reversion and one patient had no atrial sound until the sixth day after reversion to sinus rhythm. The average appearance time of the atrial sound in these 16 patients with myocardial disease was on the third day after reversion of atrial fibrillation.

Fig. 2 shows one of the tracings which was recorded on a patient with arteriosclerotic heart disease, who developed an atrial sound on the third day after reversion of atrial fibrillation by DC capacitor discharge. This tracing (Fig. 2), taken on the day of reversion to sinus rhythm shows an ‘a’ wave on the apex cardiogram but no atrial sound. Similar tracings were obtained later on the day of reversion and on the subsequent two days. The second tracing (Fig. 3), taken on the third day after reversion to sinus rhythm, shows both an ‘a’ wave on the apex cardiogram and a prominent atrial sound on the apical phonocardiogram.
The time of onset of the atrial sound in these 16 patients bore no relation to the duration of atrial fibrillation, the method of reversion to sinus rhythm, or the aetiology of heart disease. There was no correlation with the presence or absence of left atrial enlargement on cardiac x-ray series.

All patients in this group had at least one phonocardiogram recorded one month after reversion of rhythm, and each had a persistent atrial sound.

Discussion
Effective left atrial contraction may be absent in sinus rhythm (Bramwell and Jones, 1944; Logan et al., 1965), and the full haemodynamic benefit of atrial systole may be delayed many hours or even days after the return of normal atrial activity in patients with atrial fibrillation. This electrical-mechanical dissociation between atrial excitation and effective left atrial contraction has been most evident in patients with rheumatic heart disease (Braunwald, 1964; Logan et al., 1965; Ikram et al., 1968).

Ikram et al. (1968) evaluated mechanical left atrial activity in 12 patients after the reversion of atrial fibrillation by observing the form of the presystolic 'a' wave on the left ventricular 'apex displacement curve'. In seven patients there was a delayed return of the 'a' wave after reversion to sinus rhythm. Six of these patients had rheumatic heart disease and one had arteriosclerotic heart disease.

The present study includes only patients with arteriosclerotic heart disease or primary myocardial disease. Impeded left ventricular filling such as occurs in mitral stenosis is therefore eliminated as a factor in the delayed appearance of the atrial sound. None of the 16 patients had systemic hypertension which is frequently accompanied by an audible atrial sound, even in the absence of arteriosclerotic heart disease (Kincaid-Smith and Barlow, 1959).

An atrial sound, coincident with the 'a' wave of the left ventricular apex cardiogram, developed in each patient after reversion of atrial fibrillation. In most of these patients with left ventricular disease there was a delay of several days before the appearance of the atrial sound. This delayed appearance of the atrial sound is due to the ineffective left atrial contractions which may occur for a variable period of time after the reversion of atrial fibrillation to sinus rhythm.

References
Kincaid-Smith, P., and Barlow, J. (1959). The atrial sound in hypertension and ischaemic heart disease; with reference to its timing and mode of production. British Heart Journal, 21, 479.
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