Atrial Heart Sounds in Atrial Fibrillation and Flutter

By Lewis M. Neporent, M.D.

Atrial contractions are occasionally audible in atrial flutter. These sounds are usually described as clicking or ticking in quality and are synchronous with the "f" waves of the electrocardiogram. Since they may be recorded during ventricular systole when the atroventricular valves are closed, an extracardiac origin for them has been suggested. However, attributed the atrial sounds occurring during systole to audible atrial contractions, and those occurring during diastole to vibrations originating in the ventricle or atroventricular valve.

In the case herein reported, atrial contractions were audible during atrial fibrillation and during the changes from fibrillation to flutter. No similar demonstration of audible atrial heart sounds during these phenomena was found in the literature.

Case Report

A 68-year-old white woman with known rheumatic mitral insufficiency and aortic stenosis entered the hospital complaining of substernal chest pain and shortness of breath.

Approximately 1 year previously, her cardiac rhythm had been converted from atrial fibrillation to normal sinus rhythm, and she had been placed on maintenance digitalis and quinidine sulfate. On admission she had a sinus tachycardia, the murmurs of mitral insufficiency and aortic stenosis, and bilateral basal rales. The electrocardiogram showed complete right bundle-branch block.

The following day the cardiac rhythm was irregular. Distinct rapid clicking sounds were audible over the base of the heart, loudest in the left third intercostal space parasternally. An electrocardiogram showed coarse atrial fibrillation with runs of impure flutter activity.

A phonocardiogram recorded from the left third intercostal space during the presence of coarse atrial fibrillation and runs of impure atrial flutter. Atrial contraction sounds correlate only roughly with the atrial activity of the electrocardiogram. Atrial sounds are recorded during ventricular systole. HF, high-frequency phonocardiogram; 1, first heart sound; SM, systolic murmur; 2, second heart sound; A, aortic closure; P, pulmonic closure; a, atrial contraction sound; EC, lead V1, electrocardiogram; JU, jugular venous pulse.

Figure 1
third intercostal space showed atrial contraction sounds which could be only roughly correlated with the electrocardiogram (fig. 1). Atrial contraction sounds were clearly visible during ventricular systole. Increasing doses of digitalis produced typical "fine" atrial fibrillation activity, and no atrial contraction sounds were then audible.

With bed rest, diuretics, and maintenance digitalis and quinidine, the cardiac rhythm reverted to normal sinus rhythm with first-degree heart block. Nine days following hospital discharge (with digitalis and quinidine discontinued), atrial flutter with 4:1 block was noted. Again, very loud clicking sounds were heard at the base of the heart (fig. 2).

These sounds were synchronous with the nadir of the flutter waves and were recorded during ventricular systole. Digitalis was started again. The following day the rhythm was converted to coarse atrial fibrillation with runs of impure flutter. The atrial clicking sounds remained clearly audible (fig. 3), and alternated in intensity. The atrial contraction sounds showed a definite pattern: a short interatrial contraction period alternated with a long, and each group showed approximately equal length through most of the tracing. This pattern was present even in areas of apparent frank atrial fibrillation.

Comment

When atrial flutter was recorded in previous cases, atrial contraction sounds were approximately synchronous with the nadir of the flutter waves. In the two cases of Hecht and Myers, there was always some

Figure 2

Phonocardiogram recorded in the left third intercostal space during atrial flutter with 4:1 block. Upper tracing, lead II shows typical flutter waves. Lower tracing, lead V₁ for comparison. HF, high-frequency phonocardiogram; 1, first heart sound; SM, systolic murmur; 2, second heart sound; A, aortic closure; P, pulmonic closure; a, atrial contraction sound; EC, electrocardiogram; f, flutter wave.

Figure 3

Phonocardiogram recorded in the left third intercostal space after conversion to coarse atrial fibrillation with runs of impure atrial flutter. HF, high-frequency phonocardiogram; 1, first heart sound; SM, systolic murmur; 2, second heart sound; A, aortic closure; P, pulmonic closure; a, atrial contraction sound; EC, lead V₁, electrocardiogram.
degree of delay in the sounds that followed ventricular systoles. This they explained by the change in position of the heart in the chest during ventricular systole.

In the present case there always appeared to be some shortening in ventricular systole of the audible atrial contraction period (fig. 2). This phenomenon, too, is best explained by a changed position of the atria during ventricular contraction.

The presence of atrial contraction sounds during coarse atrial fibrillation graphically demonstrates the close relation between atrial flutter and the transitional stages to atrial fibrillation. Atrial contraction sounds often correlated only generally with the electrocardiogram. They often appeared to have a periodicity not apparent in the atrial electrical activity. Possibly a local circus movement, or local repetitive focus, in that portion of the atrium which produced the audible atrial sounds, sometimes differed slightly from the manifest electrical atrial activity as recorded on the electrocardiogram. Some "I" waves were recorded with no corresponding atrial sounds. Prinzmetal et al.8 observed in atrial fibrillation many atrial deflections in the electrocardiogram which were not accompanied by visible atrial contractions. As expected, with the transition to "fine" atrial fibrillation and minimal atrial mechanical contractions, no atrial sounds were audible.

The precordial vibrations of the atrial contraction are frequently separable into two components.9-11 The first consists of inaudible low-frequency vibrations synchronous with the rise in atrial pressure during atrial systole.11 The second consists of later audible vibrations frequently recorded in situations in which there is increased resistance to ventricular filling.9 Rarely, double atrial sounds have been described during ventricular diastole.12 The components of these double sounds have been attributed to a ventricular filling sound followed by an audible ventricular rebound.13

In this patient, the atrial sounds were clearly recorded during ventricular systole when the atrioventricular valves were presum-ably closed. It is possible that these sounds represented audible forceful atrial contractions in an overdistended atrium, and could be analogous to the normally inaudible atrial systolic vibrations. Their intensity and high-frequency clicking quality, however, strongly suggest an extracardiac origin.

Hecht and Myers4 suggested that pericardial adhesions caused the audible sounds in one of their cases. In their second case, however, no pericarditis was found post mortem. It is postulated in the present case that atrial enlargement secondary to rheumatic mitral insufficiency caused the rapidly beating left atrium to strike the anterior chest wall, thus producing audible atrial contraction sounds. It is possible that audible atrial contraction sounds in flutter and related arrhythmias are more frequent than commonly appreciated.

Summary

Audible atrial contractions were recorded in a case of rheumatic heart disease during atrial fibrillation and the transition stage to atrial flutter. With coarse atrial fibrillation these correlated only roughly with the electrocardiogram, and appeared to have a regularity not always apparent on the electrocardiogram.

In atrial flutter, the atrial contraction sounds were synchronous with the "I" waves. The intensity, quality, and occurrence of the atrial sounds during ventricular systole suggest an extracardiac origin.

References

William Withering

"The Botanical Professor gives annually a gold medal to such of his pupils as are most industrious in that branch of science. An incitement of this kind is often productive of the greatest emulation in young minds, though, I confess, it will hardly have charm enough to banish the disagreeable ideas I have formed of the study of botany."

This was written by William Withering in a letter to his parents in 1764, when he was a medical student at Edinburgh. He was then twenty-three years of age and it is not a little remarkable that such a statement should have been made by one destined to be one of the greatest of botanists and perhaps the greatest of medical botanists. As a botanist it may be said that he flowered late, for he did not begin the study of that science until he was about thirty years old.—Louis H. Roddis, M.D., William Withering: The Introduction of Digitalis into Medical Practice. New York, Paul B. Hoeber, Inc., 1936, p. 1.
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