Systolic Atrial Sounds during Atrioventricular Dissociation: The "Wandering" Fourth Heart Sound

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The fourth heart sound consists of low frequency vibrations which are heard in presystole during sinus rhythm. Fourth heart sounds have been described during various phases of diastole in subjects with ventricular pacemakers, by virtue of complete atrioventricular dissociation and/or block. Although such sounds are commonly heard during diastole, there has not been adequate emphasis on their occurrence during systole. We describe here the phonocardiograms recorded from patients with right ventricular pacemakers in whom audible fourth heart sounds were heard and recorded during systole.

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Figure 1 shows the simultaneously recorded phonocardiograms, external femoral arterial pulse tracing and electrocardiogram from an 82-year-old patient with a right ventricular pacemaker. The electrocardiogram demonstrates sinus bradycardia (rate, 45/min), atrioventricular dissociation and a pacemaker-induced ventricular rhythm at a rate of 65/min. Prominent fourth heart sounds can be seen throughout the tracing, which are recorded during diastole and systole. The most prominent fourth heart sound on the record occurs during late systole and follows the second P wave of the electrocardiogram. Figure 2 shows the simultaneously recorded phonocardiograms, jugular venous pulse tracing and lead 2 of the electrocardiogram in a 68-year-old woman with sinus rhythm, complete heart block and a pacemaker-induced ventricular rhythm. Here,

**Figure 1.** Simultaneous recordings of mitral (MA), tricuspid (TA), pulmonic (PA) and aortic (AA) area phonocardiograms, external femoral arterial pulse and lead II of electrocardiogram in 82-year-old man with right ventricular pacemaker. P waves of electrocardiogram are indicated. (4, 1, and 2 = fourth, first and second heart sounds respectively.) (See discussion.)

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"wandering" fourth heart sounds were inscribed concurrently with "a" waves on the jugular venous recording. Interestingly, systolic atrial sounds were associated with very large jugular venous "cannon" waves, due to right atrial contraction at a time when the tricuspid valve was closed.

It is generally accepted that the atrial sound is comprised of two types of vibrations, namely those arising from atrial contraction and a second component, which is produced by impact of blood on the ventricular wall. The systolic fourth heart sounds described here can be attributed to either: 1) forceful atrial contraction against a closed mitral valve or 2) a brief movement of the mitral valve apparatus, giving rise to audible and recordable systolic vibrations. It is of interest that systolic fourth heart sounds during atrioventricular block have been recognized for over 40 years, yet inadequate stress has been placed on them in recent times. "Wandering" fourth heart sounds can be mistaken for other auscultatory phenomena, particularly in the setting of isorhythmic atrioventricular dissociation during ventricular pacing. In the event that the atrial sound occurs in systole, the differential diagnosis would include ejection and nonejection clicks, extracardiac sounds and wide splitting of the second heart sound. As demonstrated in the second case described here, jugular pulse "cannon waves" will provide a clue as to the underlying physiologic mechanism responsible for the systolic atrial sounds. Third heart sounds and pericardial knocks are acoustic events which could also be mimicked by the diastolic wandering atrial sound.

In conclusion, simultaneous measurement of the electrocardiogram, jugular venous pulse tracing and multiple phonocardiograms provide a graphic method for characterizing unusual consequences of atrial contraction during ventricular systole.
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Versatile Sea Shells

The shells in the Cowry family Cypraeidae have been many things to many people. Cowries are tropical shells. A few are found in Florida and Southern California. They are highly polished shells, boasting bizarre designs and brilliant colors. They are more or less egg-shaped. They grow in spirals like the shells of most snails. Cowries have been found in prehistoric graves near the Baltic. Marco Polo saw them used as money in China. Many years ago man used to gather Cowries in the Indian and Pacific Oceans to trade with West Coast Africans for ivory. One particular Cowrey was used as money for so many countries that it was given the scientific name Cypraea moneta, Money Cowrey. Two to three thousand equaled one dollar. In some tribes, girls wear belts and head bands of Cowries that are set aside for their dowries. In India, Cowries decorate the trapping of horses and elephants. In the Hawaiian Islands, native fishermen use these colorful shells just as our sportsmen use brightly feathered "flies" and painted "minnows."