Ultrasound Cardiography in the Diagnosis of Left Atrial Thrombus*

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Layers or clusters of echoes located posterior to the echo of the mitral valve leaflet have been considered to be suggestive of left atrial thrombus. However, in two of five patients with characteristic echo-layering the left atrium was found to be free of thrombi. It is concluded that present methods of ultrasound cardiography are not reliable in the diagnosis of left atrial thrombi.

Left atrial mural thrombi are common in patients with pure mitral stenosis, particularly in the presence of longstanding atrial fibrillation.\(^1\) The diagnosis of left atrial thrombus may be made during life by cardiac catheterization and cineangiocardiography or during open-heart surgery.\(^2\) An indirect method for the diagnosis of atrial thrombus would be of obvious value. Recently it has been suggested that ultrasound cardiography may be useful in the detection of left atrial thrombi.\(^3\)–\(^5\) Thus, a series of clustered or layered echoes located posterior to the echo from the anterior leaflet of the mitral valve has been considered to be suggestive of left atrial thrombus. Because of the importance of this observation, ultrasound cardiograms from five patients with mitral stenosis which displayed characteristics suggestive of left atrial thrombus were correlated with the findings at autopsy or surgery.

**METHODS**

Ultrasound cardiograms of mitral valve motion were recorded by means of a Physionic Portoscan apparatus. The Portoscan apparatus has a frequency of 2.0 megacycles per second, with a pulse duration of 2.5 microseconds and a pulse rate of 500 per second. Movement of the anterior leaflet of the mitral valve was searched for in the "A" presentation and the image was photographed in the "B" presentation from a calibrated storage oscilloscope screen by means of a Polaroid camera.

Echocardiograms were recorded with the patient in the supine position with the transducer in the fourth left intercostal space 1 to 4 cm from the midsternal line and with the ultrasonic beam directed anteroposteriorly and slightly medially.

The patients ranged in age from 38 to 61 years (mean 47 years). Atrial fibrillation was present in patients 1, 2, 3 and 5. Ultrasound cardiograms were recorded on the day before surgery in four patients and in one patient two days before death.

**Figure 1.** Ultrasound cardiograms of patients 1 and 2 displaying echo-layering posterior to the echo of mitral valve motion (MVE). In this and all illustrations an upward deflection indicates movement anteriorly towards the transducer and a downward deflection indicates movement posteriorly away from the transducer. Both patients had anatomically demonstrated left atrial thrombi.

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The UCG displayed a slow diastolic slope velocity and a plateau configuration characteristic of mitral stenosis in all patients. The most rapid E-F slope velocity was 15 mm per second (normal 80 to 200 mm per second) which according to currently accepted UCG criteria indicates that hemodynamically significant mitral stenosis was present in all patients.

Patient 1 died two days after registration of the UCG and at autopsy a large organized thrombus, 6 cm in diameter, was found in the left atrium. Left atrial thrombi were demonstrated during surgery in patients 2 and 5. The thrombi were soft and measured 3 and 4 cm respectively in diameter. No left atrial mural thrombi were found during surgery in patients 3 and 4. In all patients the left atrium was dilated and the mitral valve orifice measured less than 0.8 cm in diameter.

**DISCUSSION**

During ventricular diastole the mitral valve leaflets descend into the left ventricle to form the mitral valve funnel. Since the mitral valve funnel is in the path of the ultrasonic beam during ventricular diastole, the area on the UCG posterior to the echo of mitral valve motion represents the mitral valve funnel. Because no echoes are normally reflected from the mitral funnel, the area posterior to the mitral valve echo appears clear in the UCG, i.e., echo-free. On the other hand, it has been postulated that a mass in the left atrium may descend into the mitral valve funnel during ventricular diastole and thereby give rise to echoes located posterior to the mitral valve echo. Several reports have indicated that a left atrial myxoma may produce echo clusters posterior to the mitral valve echo during the latter part of ventricular diastole. Because a left atrial thrombus constitutes a medium with numerous interfaces, it would be expected that such a mass in the mitral valve funnel would be represented in the UCG. Several groups of investigators have reported UCG's displaying parallel layers of echoes posterior to the mitral valve echo in patients with left atrial thrombi. It is evident that either a left atrial myxoma or thrombus which does not descend into the mitral valve funnel would not influence the UCG. Thus, it would be expected that the incidence of a false-negative UCG would be relatively high in both of these conditions since atrial myxoma as well as thrombi are often fixed to the atrial wall and therefore do not descend into the mitral valve funnel to interrupt the ultrasonic beam.

In the present study a left atrial thrombus was demonstrated in three of five patients who had
UCG's suggestive of atrial thrombus. The mechanism whereby echo-layering was produced in two patients (patients 3 and 4) in the absence of atrial thrombi is not clear. It is possible that these false-positive patterns may have been produced by vibrations of a rigid mitral valve during ventricular filling. Both of the patients with false-positive UCG patterns had severe mitral stenosis.

Under such circumstances, blood flow at a high pressure gradient through the mitral orifice may have caused the mitral leaflets to vibrate producing layering of the mitral valve echo. It should be pointed out that at high amplifier sensitivity virtually any medium may produce clusters of echoes. However, echo-layering in the patients included in the present studies was observed at amplifier sensitivities used in this laboratory to study mitral valve motion and at which the area posterior to the echo from the mitral valve motion is normally echo-free. Furthermore, artifacts produced by high amplifier sensitivity would be expected to be scattered throughout the UCG and not localized to the area posterior to mitral valve motion.

Since present techniques of ultrasound cardiography do not detect thrombi which are fixed to the atrial wall and since layers or clusters of echoes may occur posterior to the mitral valve echo in patients without atrial thrombi, it would appear that the UCG is not reliable in the diagnosis of left atrial thrombi.

REFERENCES

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Assumed Names of Performing Artists

Besides being the daughter of Prince Alexander Astafiev, a grand niece of Count Tolstoy, Seraphine Astafieva was a very fine dancer in her own right, one of the most colorful figures in the ballet world of her time. Astafieva decided to give a party at her studio for members of the Diaghileff Ballet of which she had once been a member. The party was attended not only by Sergei Diaghileff but by all the leading dancers of his company and many of his London friends. Someone at the piano played a few introductory chords to Rubinstein's Valse Caprice and Alicia Marks appeared. Her performance was strangely unreal. I smiled as I saw the great Diaghileff ballerinas watch this little English girl of thirteen dancing so technically correct and so flawlessly right that she must have made even them a little envious. She turned three, four pirouettes on the toe with an ease that was almost uncanny. The applause was terrific. Getting up from his chair, Diaghileff embraced the little dancer. There were tears in his eyes. Words for once seemed to fail him as he clasped her closely to him. Then he turned to Astafieva, "Seraphine, you have given a genius to the world", he said. "The ballet has found its next generation. I will take this child in my company. Her name shall be—let me see—Alicia Markova". So Lillian Alicia Marks became Alicia Markova. At the Albert Hall, on Tuesday evening, June 26, 1923, Astafieva gave a performance with her company of Anglo-Russian dancers. I discarded my name of Patrick Kay and appeared for the first time as Anton Dolin, dancing Rimski-Korsakov's Hymn to the Sun, a Dance Russe by Kolin and a Chopin mazurka.

Dolin, A: Alicia Markova—Her Life and Art, Hermitage House, New York, 1953