Ultrasonic Debridement of Calcified Pericardium in Constrictive Pericarditis

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Debridement of heavily calcified and adherent pericardium with an ultrasonic surgical aspiration device is described. The device proved to be a useful adjunct to the complete debridement of densely adherent pericardium.

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Extensive calcification of the pericardium is a well-known complication of pericarditis. The development of constrictive pericardial physiology may necessitate pericardiectomy. Complete resection of the pericardium is desirable [1], but can be compromised by the presence of densely adherent, calcified pericardium. In an attempt to separate the parietal pericardium from the visceral surface of the heart, it may be necessary to leave substantial amounts of calcified plaques over the epicardium to avoid risk of injury to the myocardium or vessels. In view of these technical difficulties, we elected to employ a hand-held ultrasonic surgical aspirating device (Cavitron ultrasonic surgical aspirator [CUSA] System 200 console; Cavitron Surgical Systems, Inc, Stamford, CT) to debride the pericardium in a patient with calcific constrictive pericardial disease.

A 43-year-old man was seen with complaints of "neck fullness" during exercise 1 year before admission. A chest roentgenogram at that time revealed substantial pericardial calcification. Over the next year, the symptoms increased. The patient began to limit his activities and was reevaluated. He gave no history of an illness suggestive of acute pericarditis, rheumatic illness, or prior fungous diseases. He was transferred to our institution with the diagnosis of constrictive pericardial disease.

On examination, he had a resting brachial blood pressure of 112/78 mm Hg, and was found to have major jugular vein distention to the mandible at 30 degrees' elevation. Hepatic pulsations were palpable after moderate exercise (12 sit-ups). There was only a trace of peripheral edema. The serum blood urea nitrogen to creatinine ratio was 22/1.3.

Catheterization was performed. Hemodynamic study revealed equalization of the left and right ventricular diastolic pressures at approximately 18 mm Hg during simultaneous recording. Prominent x and y descents were noted in the right atrial waveform, and a characteristic "square-root" appearance of the right ventricular waveform was noted. Plain chest roentgenograms showed extensive calcification of the pericardium (Fig 1). The diagnosis of chronic constrictive pericardial disease was made, and complete pericardiectomy was planned. Informed consent, including discussion of the probable use of the Cavitron ultrasonic surgical aspirator was obtained.

The operation was performed through a median sternotomy. The pericardium was heavily calcified and quite adherent to most of the heart. Calcific involvement was particularly severe at the inferior cavoatrial junction, over the anterior right ventricle, and over the diaphragmatic surface of the heart. After incision of the pericardial sac, the ultrasonic device was brought into use.

The Cavitron ultrasonic surgical aspirator is an electrically powered, hand-held device with a tip that vibrates at a frequency of approximately 23,000 times per second.

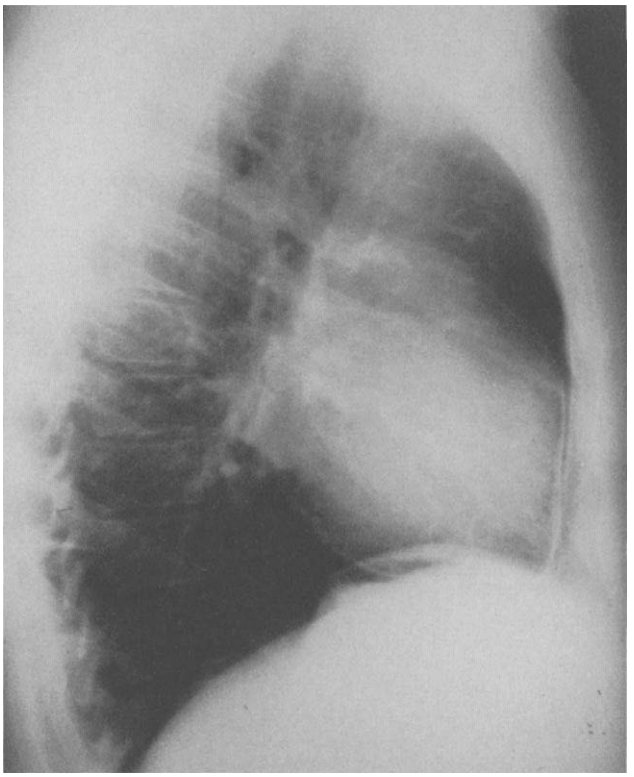

Fig 1. Preoperative lateral chest roentgenogram showing inferior pericardial calcification.

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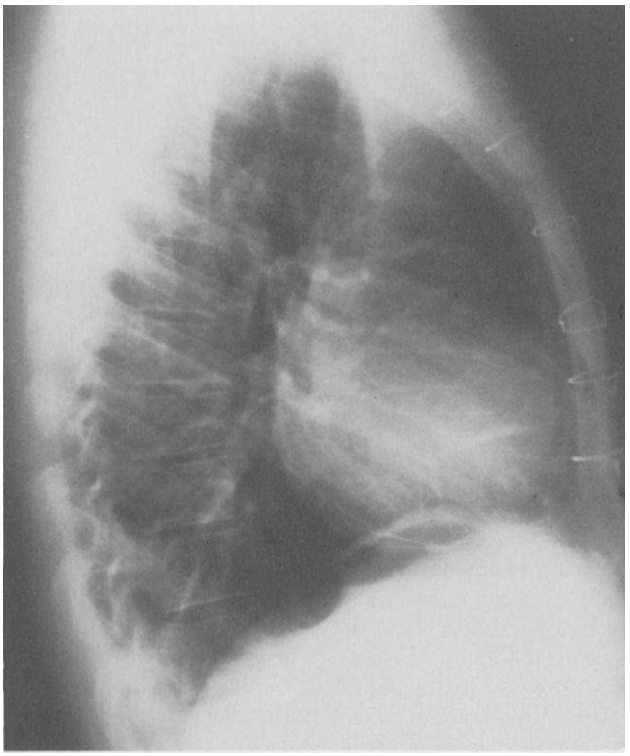

Fig 2. Postoperative lateral chest roentgenogram showing removal of virtually all calcium.

Irrigation and suction are provided at the tip. Intermittent irrigation and use of the ultrasonic dissecting tip can be controlled by the operator. Both the amount of suction and the amplitude of tip variation are adjusted on the console apart from the operative field. It was used at approximately 80% to 90% of its maximum amplitude, and 50% of its maximum suction.

We used the ultrasonic device to make a plane between the surface of the heart and the calcified pericardium. Most of the calcified material could be elevated from the epicardium or myocardium and removed in sheets. Some of the calcium, however, was so adherent to the myocardium as to preclude resection of calcium in layers. This material could be pulverized by the ultrasonic device without producing any myocardial or epicardial bleeding. Several coronary branches were stripped of their epicardial fat and all surrounding calcium without bleeding. The area around the inferior cavoatrial junction was particularly easy to debride with this device. Irrigation and suction were provided primarily from conventional sources, rather than from the device itself.

Cardiopulmonary bypass was not required. The patient tolerated the procedure very well with minimal blood loss and no blood replacement. A pulmonary artery catheter did demonstrate a slight decrease in central venous pressure and pulmonary diastolic pressure. Twelve hours later, immediately before catheter removal, right heart filling pressure was 13 mm Hg and pulmonary diastolic pressure was 12 mm Hg. Histological evaluation of the pericardium revealed only chronic inflammation. A chest roentgenogram obtained on the fifth postoperative day before discharge showed virtually complete removal of the pericardium (Fig 2).

In the 9 months since the procedure, the patient has been able to resume vigorous physical activities without limitation. A recent evaluation revealed no jugular vein distention and no pericardial rub or cardiac murmur.

Comment

The ultrasonic device used in this patient is commonly employed by neurosurgeons for the resection of brain tumors and by general surgeons for hepatic resections. The device is noted for its ability to resect soft tissue without harming blood vessels. It has not yet been approved by the Food and Drug Administration for marketing as a surgical tool in the field of cardiac surgery. Its use has been reported for the division of a myocardial muscle bridge [2]. It has also been used by us and others (Bruce P. Mindich, MD, New York, NY: personal communication, 1989) for the successful debridement of calcified aortic valve leaflets. These new applications stimulated our interest in testing the device in this patient with calcific pericardial constriction. The device was equally effective at removing fibrotic and calcified material.

For most cases of constrictive pericarditis, standard techniques of dissection are safe and effective. Occasionally, however, dense adherence of the pericardium to the underlying epicardium, and even infiltration of the myocardium by calcium, present the surgeon with the choice of safe, though inadequate dissection versus a more complete pericardiectomy and the hazards of myocardial and coronary artery injury [1]. This particular patient represented the far end of the spectrum with respect to the degree of calcification and dense pericardial fusion. The successful management of this patient suggests that the ultrasonic surgical aspiration device is extremely effective in performing a safe, complete pericardiectomy.

References

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