Improved Surgical Approach to Cardiac Tumors with Intraoperative Two-dimensional Echocardiography*

Francisco Mora, M.D.;† Bruce P. Mindich, M.D., F.C.C.P.;† Theresa Guarino, R.N.;§ and Martin E. Goldman, M.D.¶

Intraoperative two-dimensional echocardiography allows visualization of cardiac anatomy and function not possible by other techniques. Although preoperative evaluation by noninvasive methods is usually adequate for diagnosis of cardiac tumors, two-dimensional echocardiography can be beneficial intraoperatively. Intraoperative echocardiography provides an accurate evaluation of cardiac anatomy, extent of tumor invasion, valvular function and the possible presence of intracardiac communications. Importantly, following tumor resection and a complex operative reconstructive procedure, the echocardiogram can confirm complete intracardiac tumor excision, evaluate post-repair ventricular function, and exclude an intracardiac communication or valvular insufficiency.

Intracardiac tumors are unusual, and often misdiagnosed. Clinically, they can masquerade as valvular or myocardial disease or present as a major catastrophic thromboembolic event.† Importantly, successful surgical removal of certain tumor types, particularly myxomas, carries a good prognosis.†

Preoperative evaluation of intracardiac masses is primarily done by two-dimensional echocardiography since cardiac catheterization may be hazardous due to the friable nature of the mass.‡ However, the extent of cardiac invasion and the potential involvement of contiguous valves may not be fully appreciated.‡ Therefore, the intraoperative evaluation of the extent of intra- and extracardiac involvement of the malignancy is important.

Intraoperative two-dimensional echocardiography has recently been applied to evaluate ventricular function,§ valvular operations’ and myocardial perfusion.¶ This technique has proven to be a safe and effective method for evaluating cardiac anatomy and function which otherwise can be only indirectly assessed. Moreover, it can be utilized prior to and immediately following the operative procedure. We applied intraoperative echocardiography in the operations of two patients with intracardiac masses which proved valuable in delineating the precise location and extent of tumor, identifying intracardiac shunts, and assessing the operative procedure prior to closure of the chest wall.

CASE REPORTS

Case 1

An 83-year-old woman without prior cardiac problems presented...

Figure 1. Contrast intraoperative echocardiogram demonstrating mitral regurgitation with reflux of microbubbles from the left ventricle (LV) into the left atrium (LA) (open arrow), as well as antegrade flow out the aorta (Ao) (solid white arrow). M = myxoma.

to a local hospital in atrial fibrillation and left-sided weakness. Physical examination was significant for a diastolic murmur, a tumor plop, as well as a holosystolic murmur consistent with mitral regurgitation. Two-dimensional echocardiogram demonstrated a large left atrial myxoma attached to the interatrial septum, prolapsing into the left ventricle during diastole. However, mitral regurgitation could not be excluded by preoperative Doppler due to the distortion of the Doppler signal due to the myxoma motion. Cardiac catheterization was not performed prior to surgical excision of the tumor. Following sternotomy and pericardiotomy, a sterilely prepared 5 MHz two-dimensional mechanical transducer (Advanced Technology Laboratories, Bothell, Washington) was placed directly on the exposed right ventricle providing modified long, short and four-chamber views. The left atrial myxoma and its base were clearly demarcated and separate from the mitral valve. To evaluate mitral valve competency, a 21-gauge spinal needle was positioned transseptally in the left ventricular cavity under echocardiographic guidance to avoid contact with the tumor, and 5 ml of DSW was injected, generating echogenic microbubbles (contrast). This baseline contrast injection demonstrated mitral regurgitation—reflux of microbubbles from the left ventricle into the left atrium during systole (Fig 1). The patient was then placed on cardiopulmonary bypass by routine methods and the tumor excised. Following discontinuation of bypass, before deannulation, with the patient in sinus rhythm, the left ventricular contrast injection was repeated. This demonstrated no mitral regurgitation. A similar injection in the left atrium excluded an interatrial communication. The patient had an uneventful postoperative course. The final pathology report confirmed a left atrial myxoma.

Case 2

A 21-year-old man presented with blackout spells and right-sided weakness. The patient was admitted to a local hospital, had a CAT scan of the head which revealed two discrete lesions consistent with a metastatic tumor. The patient underwent radiation therapy with documented regression of the cerebral lesions. A workup, which included a bone scan, liver-spleen scan, bone marrow, and CAT scan of the abdomen all gave negative findings. His physical examination was significant for a diastolic murmur which varied with position and respiration, and a loud mid-diastolic plop. Echocardiogram demonstrated a large, pedunculated, irregular right atrial mass attached to the interatrial septum, but also possibly to the free wall of the right...
atrium. Additionally, a large pericardial effusion was seen. No left atrial abnormality was noted. Contrast studies performed by injection of 10 ml of DSW through a peripheral vein demonstrated no interatrial communication. The following day, the patient was taken to surgery for exploration and excision of the right atrial mass. Following sternotomy and pericardiotomy, a sterilely prepared 5MHz transducer was placed directly on the exposed heart. The right atrial mass was easily identified; however, its extent was much greater than originally appreciated by the closed chest echocardiogram (Fig 2). The tumor invaded the right atrial free wall, interatrial septum, and pulmonary veins as they entered the left atrium. Additionally, an interatrial communication was clearly identified during a 5 ml injection of DSW into the left atrium with contrast passing into the right atrium (Fig 3). Frozen section identified the tumor as spindle cell sarcoma. In view of the patient's age and the tumor's response to radiotherapy, removal of bulk tumor was undertaken. The operation consisted of removing virtually the entire right atrium and interatrial septum, and reconstructing them from pericardium and Dacron patch material. Additional tumor was removed from the pulmonary veins and adventitia of the pulmonary arteries. Following discontinuation of cardiopulmonary bypass, prior to decannulation, with the patient in sinus rhythm, a repeat echocardiogram with contrast injections was performed. No further tumor could be visualized and no further interatrial communication was evident. The patient underwent chemotherapy shortly after surgery. The final pathology report was angiosarcoma.

**DISCUSSION**

Cardiac tumors are extremely rare, occurring in approximately 0.0017 to 0.25 percent of the general population. Myxomas are the most common types of primary cardiac tumors, representing 30-50 percent of pathologic reports. Though 90 percent of myxomas occur in the atria, with up to 4:1 ratio of left-to-right atrium, they may be bilateral or even ventricular. Myxomas can present as valvular obstruction, syncope, an embolic event or fever of unknown origin. Surgical extirpation is essentially curative. Sarcomas are second in frequency only to myxomas and occur in decreasing order of frequency in the right atrium, left atrium, right ventricle and left ventricle. These tumors proliferate rapidly with widespread infiltration of the myocardium, obstruction of flow within the heart or distant metastases to the lungs, thoracic lymph nodes, mediastinum and vertebral column. Typical presentations include progressive congestive heart failure, pericardial effusion, arrhythmias and obstruction of the vena cava.

Intraoperative two-dimensional echocardiography provides a new modality in the surgical approach to intracardiac tumors giving the surgeon a clear anatomic picture of the extent of the tumor before exploration is undertaken. In addition, all chambers of the heart can be examined for the possible presence of multiple foci of tumor. This allows for a more precise excision of the tumor with minimal manipulation, thereby decreasing the possibility of embolism from the friable mass. Also, by direct visualization, a needle can be safely introduced into the left- or right-sided chambers to assess intracardiac shunts or valvular regurgitation without traumatizing the tumor mass. This may obviate the necessity for cardiac catheterization.

These two patients demonstrate the value of intraoperative two-dimensional echocardiography with contrast injections in evaluating cardiac anatomy and possible concurrent intracardiac communications. With intraoperative 2-D echocardiography, tumor extension can be assessed and adequacy of resection and possible residual valvular regurgitation accurately evaluated prior to the patient leaving the operating room.

ACKNOWLEDGMENTS: We are grateful to Ms. Irma Rosenblatt and Ms. Martha Kelly for assistance in the preparation of this manuscript.

**REFERENCES**

Unpredictable Cause of Early Recurrence of Angina Pectoris after Successful Double Coronary Angioplasty*

Antoon E. Weyne, M.D.; Yves R. Vandekerckhove, M.D.; and Denis L. Clement, M.D.

Early recurrence of symptoms after successful coronary angioplasty is usually due to restenosis of the angioplasty site. Multilesion progression of atherosclerosis in the presence of patent prior dilated segments has not, to our knowledge, been reported as a cause of early recurrent angina after successful double coronary angioplasty. As both new lesions were also successfully dilated, this case demonstrates that multivessel coronary angioplasty is a repeatedly effective and patient-friendly procedure to treat symptomatic coronary atherosclerosis with rapid and unpredictable rate of progression.

Percutaneous transluminal coronary angioplasty (PTCA) is now a widely accepted and effective treatment for single vessel coronary artery disease and recently also for multivessel disease.1 Early recurrence of symptoms, however, due to restenosis of the dilated segment is a major concern to all physicians performing PTCA. Symptomatic restenosis occurs in 10-15 percent of patients, whereas angiographic restenosis may occur in up to 30 percent, mostly within the first months after the procedure.2 This report describes a patient with recurrence of angina pectoris within five months after successful double vessel PTCA. In the meantime, weight loss of 42 pounds was obtained as secondary prevention. Restenosis of a prior PTCA segment was anticipated. Control coronary angiography revealed unexpected patency of both prior dilated segments. However, progression of atherosclerosis with significant narrowing occurred in previously normal and minimally narrowed segments. Both new lesions were successfully dilated in the same session.

CASE REPORT

A 58-year old man who was a moderate cigar smoker, was admitted to the coronary care unit because of unstable angina pectoris. For about six weeks, he complained of typical progressive symptoms of angina pectoris. Clinical examination was normal except for marked obesity (84 kg, 167 cm). Electrocardiography and laboratory results were normal. Despite medical treatment, angina persisted and coronary angiography was performed on day 3. This revealed (Fig 1) a high-grade lesion in the proximal right coronary artery (RCA) followed by a nonsignificant stenosis (<20 percent) distal to the marginal branch, and a significant lesion in the distal circumflex artery (CXA). The left anterior descending (LAD) artery was

*From the Department of Cardiology, University Hospital of Ghent, Belgium.
Reprint requests: Dr. Weyne, Department of Cardiology, State University of Ghent, Akademisch Ziekenhuis, B-9000 Ghent, Belgium.

1. Early Recurrence of Angina after Successful Coronary Angioplasty (Weyne, Vandekerckhove, Clement)