Two-dimensional Echocardiographic Guiding of Endomyocardial Biopsy*

Luc Piérard, M.D.; Dia El Allaf, M.D.; Vincent D’Orio, M.D.; Jean-Claude Demoulin, M.D.; and Jean Carlier, M.D.

Two-dimensional echocardiography provides adequate spatial orientation and anatomic definition. Eighteen consecutive patients undergoing myocardial biopsy had concomitant two-dimensional echocardiography during 22 biopsies of five to six samples each. The transducer was placed at the apex and in the subcostal area and four-chamber views were used. The bioprome was seen entering the right atrium and crossing the tricuspid valve to the right ventricle. The catheter was then manipulated under two-dimensional echocardiography and the tip’s position was strictly adapted, using two different classic views before sampling. The success rate in visualizing the forceps and in defining the site of sampling was 100 percent, and no complication was noted. Radiation exposure was largely reduced. Two-dimensional echocardiography to guide endomyocardial biopsy may reduce the risk of perforation by a better anatomic definition of the sampling site. It permits sampling from different ventricular sites or from the same site during serial procedures for monitoring evolution or treatment.

Endomyocardial biopsy is a diagnostic tool that has gained widespread acceptance. Safe in experienced hands, the technique may lead to several complications, the most serious being tamponade secondary to perforation of the right ventricle. Two-dimensional echocardiography is a noninvasive, nonionizing technique providing real-time, adequate spatial orientation and anatomic definition. It has been shown to be helpful in the detection of intracardiac catheters and in the catheter placement and localization in a pediatric population.

We present our experience with two-dimensional echocardiography to guide endomyocardial biopsy examination. We emphasize the ultrasonic technical precautions and the relative advantages of its use in fluoroscopic guidance.

METHODS

Since the introduction of endomyocardial biopsy in our institution, all 18 patients undergoing myocardial biopsy had concomitant two-dimensional echocardiography during 22 biopsy studies of five to six samples of myocardium at each procedure.

Biopsy Technique

Endomyocardial biopsy was carried out in the right ventricular cavity and was associated with a right heart catheterization (Swan-Ganz catheter). A percutaneous right femoral vein approach was used in the first four patients. Thereafter, the percutaneous right jugular vein approach was employed due to its facility (absence of a guiding catheter or sheath). A King bioprome was used, and five to six samples were taken for light and electron microscopy.

Echocardiography

Two-dimensional echocardiography was performed using a Diasonics V 3400 R apparatus with a 2.25-MHz transducer. With the patients in the supine position, a wide-angle (90°) two-dimensional echocardiograms were obtained in all classic views.

RESULTS

The age of the patients and the clinical and histologic diagnosis are listed in Table 1.

Bioprome Manipulation and Placement

The bioprome advance is followed by fluoroscopy until there occurs transition of superior or inferior vena cava and the right atrium. The echocardiographic transducer is then located in the subcostal position, and a short-axis plane is visualized, showing the junction between the inferior vena cava and the right atrium. If the femoral vein approach is used, the bioprome can be seen entering the right atrium from the inferior vena cava.

When the forceps enters the right atrium, the transducer is rotated to obtain, from a frontal plane, the subcostal four-chamber view. The apical four-chamber view is used when more appropriate (Fig 1). The forceps advances under echocardiographic control and is seen crossing the tricuspid valve and entering the right ventricular cavity. Generally, the primary positioning is not satisfactory, and the catheter must be manipulated using two-dimensional echocardiography to position the tip optimally, in front of the interventricular septum (Fig 2).

Care must be taken to consider only the strict classic planes with their usual anatomic landmarks and to visualize the tip’s position in two different views—generally the apical and subcostal four-chamber views. After the opening of the jaws, the forceps is withdrawn (Fig 2), and when the sample is excised, a slight resistance and rigidity is generally observed at the

*From the Department of Cardiology, Institute of Medicine, University Hospital, Liège, Belgium. Manuscript received November 14; revision accepted February 7. Reprint requests: Dr. Pierard, Université de Liège, Service de Cardiologie, Bld de la Constitution 59, B-4020 Liège, Belgium.
Table 1—Clinical Diagnosis and Results of Biopsies

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age, yr</th>
<th>Sex</th>
<th>Clinical Diagnosis</th>
<th>Confirmed</th>
<th>No Pathologic Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>67</td>
<td>F</td>
<td>Cardiac amyloidosis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>58</td>
<td>M</td>
<td>Alcoholic heart muscle disease</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>71</td>
<td>M</td>
<td>Congestive cardiomyopathy</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>57</td>
<td>M</td>
<td>Myocarditis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>56</td>
<td>M</td>
<td>Alcoholic heart muscle disease</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>59</td>
<td>M</td>
<td>Alcoholic heart muscle disease</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>52</td>
<td>M</td>
<td>Congestive cardiomyopathy</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>8 (3)*</td>
<td>23</td>
<td>M</td>
<td>Toxic myocarditis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>59</td>
<td>M</td>
<td>Hypertrophic cardiomyopathy</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>10 (2)*</td>
<td>72</td>
<td>M</td>
<td>Myocarditis</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>11 (2)*</td>
<td>27</td>
<td>M</td>
<td>Toxic myocarditis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>60</td>
<td>M</td>
<td>Cardiac hemochromatosis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>28</td>
<td>F</td>
<td>Myocarditis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>61</td>
<td>M</td>
<td>Adriamycin cardiotoxicity</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>28</td>
<td>M</td>
<td>Myocarditis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>29</td>
<td>F</td>
<td>Hypertrophic cardiomyopathy</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Myocarditis</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>27</td>
<td>M</td>
<td>Myocarditis</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>42</td>
<td>F</td>
<td>Congestive cardiomyopathy</td>
<td>+</td>
<td></td>
</tr>
</tbody>
</table>

* = No. of procedures.

level of the concerned myocardial site.

The procedure is repeated identically four to five times, but care must be taken to reposition the bioptome to avoid performing a second biopsy at the same site.

Experience

Using this approach, right ventricular endomyocardial biopsy was easily carried out in our 22 procedures. The success rate in visualizing the tip of the bioptome and in defining the site of sampling was 100 percent. The entire procedure took between 20 and 30 minutes. Failure to obtain specimens sufficient for histologic studies did not occur. No complication was observed.

Chest discomfort was reported by two patients during the procedure. Premature ventricular contractions were common, but sustained ventricular arrhythmia did not occur. Atrial fibrillation occurred in only one patient and was successfully reversed by cardioversion.

Discussion

Since the development of the biopsy catheter by Sakakibara and Konno in 1962,* transvascular endomyocardial biopsy has become safer and more convenient. The published rates of complications, which

![Figure 1](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21413/ on 04/03/2017)  
**Figure 1.** Apical four-chamber view obtained by two-dimensional echocardiography. The bioptome (B) is seen (arrow) in the right atrium (RA). RV = right ventricle; LV = left ventricle; LA = left atrium.

![Figure 2](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21413/ on 04/03/2017)  
**Figure 2.** Endomyocardial biopsy by two-dimensional echocardiography. The apical four-chamber view is used. The bioptome (B) (small arrow) is seen in the right ventricle (RV); the tip is positioned in front of the interventricular septum. The jaws are opened (large arrows). This stop-frame image is the moment of excision: some attraction of the sampling site is observed. Other abbreviations as in Figure 1.
were high with the needle biopsy method,\textsuperscript{9,10} have been reduced to lower than those observed for routine cardiac catheterization.\textsuperscript{1,11,18}

Nevertheless, perforation of the right or left ventricle remains the most serious risk, especially if the manipulation is done by an inexperienced team. We suggest that two-dimensional echocardiographic guiding of endomyocardial biopsy may reduce the incidence of perforation and tamponade by providing a better anatomic definition of the sampling site so that specimens are obtained from the septum, not from the right ventricular free wall. Using fluoroscopy, the tip of the bioptome is advanced to the apex of the cardiac shadow, assuming that the apical portion of the septum is involved.\textsuperscript{13} On the other hand, two-dimensional echocardiography adequately distinguishes the septum from the right ventricular free wall.

Intracardiac positioning of the bioptome by echocardiography reduces radiation exposure, since fluoroscopy is only used to follow the catheter from the jugular vein to the right atrium and to ensure the opening of the jaws. Although the opening of the jaws of the bioptome can often be seen echographically (Fig 2), a short period of fluoroscopy is recommended.

We did not perform left ventricular biopsies; however, echocardiography is also recommended for monitoring this approach to avoid sampling from the mitral valve apparatus or the papillary muscles.

Small tissue samples obtained by bioptome are not always representative of the rest of the myocardium.\textsuperscript{14} This limits the endomyocardial biopsy in the assessment of the prognosis of cardiomyopathy and in monitoring the evolution of myocarditis or doxorubicin cardiotoxicity.\textsuperscript{15} Since echocardiography can very precisely visualize the site of sampling, serial biopsy procedures may now be performed at the same site.

Improved monitoring of disease or treatment by this method remains to be studied. In certain situations, such as hypertrophic cardiomyopathy, endomyocardial fibrosis, or cardiac tumors,\textsuperscript{16} echocardiography facilitates optimal visualization of the structure to be sampled. Echocardiography also permits patient follow-up after the procedure and immediate detection of complications such as pericardial effusion or the appearance of thrombus.

Two potential sources of misinterpretation of catheter localization are reverberations and off-axis echoes due to limited lateral resolution.\textsuperscript{17} Reverberations did not provoke interpretation errors in our series.

Lateral resolution problems occurred in one patient: the catheter first reached the coronary sinus. In two-dimensional echocardiography, the catheter was clearly absent from the right ventricular cavity in the strict apical and subcostal four-chamber views. However, by slightly tilting the transducer, the catheter appeared to be in the right ventricle (Fig 3). This pitfall can be identified by an intracavitary electrogram and by considering two different classic views before sampling.

We conclude that two-dimensional echocardiography is a simple and reliable technique to guide endomyocardial biopsy by providing enhanced anatomic definition of the sampling site. It permits sampling from different ventricular sites or sampling from the same site during serial procedures that monitor evolution or treatment. Radiation exposure is reduced. Early detection of complications such as pericardial effusion or appearance of thrombus can be obtained.

\textbf{REFERENCES}

4 Reeves WC, Nanda NC, Barold SS. Echocardiographic evaluation of intracardiac pacing catheters: M-mode and two-dimensional studies. Circulation 1978; 58:1049-56
7 Caves PK, Stinson EB, Graham AF, Billingham ME, Grehl TM, Shumway NE. Percutaneous transvenous endomyocardial biopsy. JAMA 1973; 225:288-91
9 Shirey EK, Hawk WA, Mukerji D, Effler DB. Percutaneous myocardial biopsy of the left ventricle: experience in 196 pa-
Echocardiographic Guiding of Endomyocardial Biopsy (Pierard)

10 Shugoll GI. Percutaneous myocardial and pericardial biopsy with the Menghini needle. Am Heart J 1973; 85:35-39
13 Mason JW. Techniques for right and left ventricular endomyocardial biopsy. Am J Cardiol 1978; 41:887-92
14 Baandrup U, Florio RA, Olsen EGJ. Do endomyocardial biopsies represent the morphology of the rest of the myocardium? Eur Heart J 1982; 3:171-8
15 Ferrans VJ, Roberts WC. Myocardial biopsy: a useful diagnostic procedure or only a research tool. Am J Cardiol 1978; 41:965-7