Assessment of Cardiac Function in Patients with the Acquired Immunodeficiency Syndrome*

Stephen P. Raffanti, M.D.; Anthony J. Chiaramida, M.D.; Purnendu Sen, M.D.; Phyllis Wright, B.A.; John R. Middleton, M.D.; and Salvatore Chiaramida, M.D.

We have assessed right and left ventricular function by multigated radionuclide ventriculography in 12 consecutive patients with acquired immunodeficiency syndrome (AIDS) grouped according to the CDC classification system for HIV infection. Results were correlated with clinical, electrocardiographic and echocardiographic findings. Clinical examination and chest x-ray films showed no evidence of acute cardiac or pulmonary pathology. Five patients had evidence of ventricular dysfunction by radionuclide ventriculography along with significant ECG abnormalities. Three patients had abnormal ECG findings with normal ejection fractions. Echocardiography showed no evidence of significant valvulopathy or pericardial disease except for one patient with fibrinous strands associated with the pericardium. Decreased ejection fractions did not correlate with disease classification, risk group or survival. This study suggests that a major percentage of AIDS patients have some evidence of cardiac abnormalities. We conclude that abnormal ECG findings in an AIDS patient should alert the clinician to possible underlying ventricular dysfunction.

The acquired immunodeficiency syndrome (AIDS) is a complex disease characterized by progressive dysfunction of multiple organ systems, presumably the result of severely compromised T-cell immunity. Major organ involvement has included pulmonary, gastrointestinal and neurologic systems. Morbidity has been principally related to infectious or neoplastic causes with death usually due to overwhelming sepsis or pneumonia. Cardiac manifestations described in patients with AIDS have included pericardial effusions, ventricular dysfunction, marantic endocarditis, infiltrative Kaposi's sarcoma and congestive cardiomyopathy.

In this study we assessed right and left ventricular function in 12 consecutive AIDS patients grouped according to the CDC classification system for HIV infection. Results were correlated with clinical, echocardiographic and electrocardiographic findings.

MATERIALS AND METHODS

Patients

All patients included in the study were admitted to Raritan Bay Medical Center, Perth Amboy Division, from October through December, 1986. All patients were ambulatory, were admitted to a general medical floor and were discharged to home. All subjects were positive for HIV antibody as determined by enzyme linked immunosorbent assay (ELISA) and western blot immunosassay. Of the original 15 patients, three were excluded because of their refusal to undergo radionuclide ventriculography. Ten men and two women, ages ranging from 26 to 57 years, made up the study group. Of these 12 patients, eight were intravenous drug abusers (IVDA), three were homosexuals, two belong to both risk groups, and one was the spouse of an IVDA. None of the patients had a prior history of angina, myocardial infarction, myocarditis, endocarditis or ethanol abuse. Five patients had been admitted previously for treatment of atypical pneumonias, but none had a history of chronic pulmonary disease. Patients were grouped according to the CDC classification of HIV infection based on clinical examination and past medical history.

Radionuclide Ventriculography

Patients were placed supine in the left anterior oblique (LAO) 45° position beneath the scintillation camera detector (Technicare MCC-490/550) equipped with an all purpose parallel hole collimator. Gating electrodes were placed on the patient's chest and a gating device was attached to an on-board computer. Two ml of stannous pyrophosphate and saline mixture were injected antiseptically into a peripheral vein. Ten to 15 minutes later, 20 mCi of NaTcO₄ were injected into a peripheral vein. Scanning was performed five minutes after the NaTcO₄ injection. Three views were routinely obtained: the anterior, modified LAO and left lateral. Normally a 45° LAO view was obtained with a slight caudal (5 to 15°) tilt to correct for dimensional rotation of the major axis of the heart. Tilt was adjusted for maximal delineation of the left ventricular and septal wall. Acquisition was completed when approximately 250,000 counts per frame had been accumulated in the region of interest. Images obtained were in a 64 x 64 matrix with one R-R interval represented in 16 frames. Any R-R intervals that were ≥ 20 percent of the selected acquisition period were rejected. With this protocol, normal values for left and right ventricular ejection fractions are 0.63 ± 0.8 and 0.48 ± 0.05 respectively.

Echocardiography

M-mode and cross-sectional echocardiographic examinations were performed using a standard phased array echocardiographic system (Hewlett-Packard) employing 2.5 mHz and 3.5 mHz transducers. All examinations were performed in the anterior and left lateral decubitus positions using standard techniques. Left ventricular ejection fractions were calculated using previously de-
Table 1—Cardiac-Associated Findings in 12 AIDS Patients

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age/risk</th>
<th>CDC Class</th>
<th>Lung Disease</th>
<th>LVEF</th>
<th>RVEF</th>
<th>EF</th>
<th>LVIDd</th>
<th>ECG</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>36/IVDA</td>
<td>III</td>
<td>No</td>
<td>0.69</td>
<td>0.33</td>
<td>0.66</td>
<td>5.16</td>
<td>T-wave abnormalities</td>
</tr>
<tr>
<td>2</td>
<td>33/IVDA</td>
<td>IV B</td>
<td>No</td>
<td>0.62</td>
<td>0.53</td>
<td>0.65</td>
<td>5.24</td>
<td>Normal</td>
</tr>
<tr>
<td>3</td>
<td>26/IVDA</td>
<td>IV B</td>
<td>No</td>
<td>0.58</td>
<td>0.44</td>
<td>ND</td>
<td>ND</td>
<td>ST and T wave abnormalities</td>
</tr>
<tr>
<td>4</td>
<td>30/IVDA</td>
<td>IV C1</td>
<td>Yes</td>
<td>0.65</td>
<td>0.53</td>
<td>0.63</td>
<td>5.50</td>
<td>ST and T wave abnormalities*</td>
</tr>
<tr>
<td>5</td>
<td>46/HS</td>
<td>IV C1</td>
<td>Yes</td>
<td>0.67</td>
<td>0.51</td>
<td>0.60</td>
<td>4.98</td>
<td>Low voltage</td>
</tr>
<tr>
<td>6</td>
<td>30/IVDA</td>
<td>IV C1</td>
<td>No</td>
<td>0.67</td>
<td>0.52</td>
<td>ND</td>
<td>ND</td>
<td>Normal*</td>
</tr>
<tr>
<td>7</td>
<td>36/IVDA</td>
<td>IV C1</td>
<td>No</td>
<td>0.55</td>
<td>0.34</td>
<td>0.58</td>
<td>5.39</td>
<td>ST and T wave abnormalities*</td>
</tr>
<tr>
<td>8</td>
<td>34/IVDA-HS</td>
<td>IV C1</td>
<td>Yes</td>
<td>0.64</td>
<td>0.49</td>
<td>0.63</td>
<td>5.07</td>
<td>Normal†</td>
</tr>
<tr>
<td>9</td>
<td>57/spouse</td>
<td>IV C1</td>
<td>No</td>
<td>0.73</td>
<td>0.35</td>
<td>0.70</td>
<td>4.51</td>
<td>RBBB*</td>
</tr>
<tr>
<td>10</td>
<td>36/IVDA-HS</td>
<td>IV C1</td>
<td>No</td>
<td>0.42</td>
<td>0.51</td>
<td>ND</td>
<td>ND</td>
<td>ST and T wave abnormalities*</td>
</tr>
<tr>
<td>11</td>
<td>34/HS</td>
<td>IV C2</td>
<td>Yes</td>
<td>0.51</td>
<td>0.49</td>
<td>0.48</td>
<td>5.42</td>
<td>T-wave abnormalities</td>
</tr>
<tr>
<td>12</td>
<td>38/IVDA</td>
<td>IV D</td>
<td>Yes</td>
<td>0.73</td>
<td>0.41</td>
<td>0.78</td>
<td>5.15</td>
<td>Normal</td>
</tr>
</tbody>
</table>

IVDA = intravenous drug abuser; HS = homosexual; spouse = spouse of IVDA; LVEF = left ventricular ejection fraction by radionuclide ventriculography; RVEF = right ventricular ejection fraction by radionuclide ventriculography; EF = left ventricular ejection fraction by echocardiography; LVIDd = left ventricular internal diameter in centimeters at diastole by echocardiography; ND = not performed; * = patient expired of non-cardiac causes on a subsequent admission; † = echocardiography showed fibrinous strands associated with the pericardium.

Results

Results obtained for all 12 patients are shown in Table 1. Clinical examination revealed no jugular venous distension, S, gallop, pulmonary rales or pedal edema in any patient. Serum calcium and electrolyte levels were within normal limits in all subjects at the time they underwent ECG, echocardiographic and ventriculographic testing. Posterior-anterior and lateral view chest x-ray films showed normal cardiothoracic ratios with no sign of congestive change in all patients. Five patients had evidence of ventricular dysfunction, demonstrated by radionuclide ventriculography; three had decreased right ventricular ejection fractions (RVEF), while two had below normal values for left ventricular ejection fractions (LVEF). All patients with decreased ejection fractions had abnormal ECG findings as did three patients with normal radionuclide scans.

ECG abnormalities included nonspecific ST-T wave abnormalities (seven patients), right bundle branch block (one) and low voltage (one). Echocardiography performed in all but three patients demonstrated no significant valvulopathy or pericardial disease except for pericardial effusion with fibrinous strands in a patient with normal ejection fractions. Left ventricular ejection fractions and left ventricular internal diameters at diastole determined by echocardiography were in good agreement with radionuclide findings. In this limited study, decreased ventricular ejection fractions did not correlate with disease classification or risk group. Five patients were subsequently readmitted and expired from non-cardiac causes; three of these subjects had abnormal ejection fractions. Autopsies were not obtained.

Discussion

Previous reports have described cardiac involvement in 28-73 percent of AIDS patients studied. Cardiac lesions have included Kaposi's sarcoma, nonbacterial thrombotic endocarditis, fibrinous pericardial disease, and congestive cardiomyopathy. In the present study, nine of 12 patients had ECG, echocardiographic or ventriculographic abnormalities (Table 1). Five of these patients had evidence of significant ventricular dysfunction without any echocardiographic evidence of the previously reported lesion. An additional three subjects had ECG findings without any abnormal echocardiographic or ventriculographic results. Cardiac abnormalities were not correlated with disease class or survival, nor was there any evidence that cardiac dysfunction affected clinical presentation or course of the disease. In the only similar study published to date, Reitano and co-workers found no cardiac abnormality in four patients with AIDS prodrome and some evidence of ECG, echocardiographic or radionuclide study abnormalities in 16 of 21 patients with AIDS. The clinical status of these patients was not reported. The etiology and significance of cardiac findings in AIDS patients, especially in the absence of evident lesions, is unknown. Bacterial, viral or fungal infections, neoplastic disease, HIV infection itself or effects secondary to pulmonary or neurologic involvement could all influence cardiac function.

Post-mortem studies of patients with AIDS have shown pericardial disease to be the most common lesion. Focal deposits of Kaposi's sarcoma in the subepicardial adipose tissue have also been reported frequently in autopsies on homosexual men with disseminated Kaposi's sarcoma. A recent report described severe congestive cardiomyopathy with four chamber dilation in two critically ill patients with AIDS.

Although AIDS remains an incurable disease, preliminary reports indicate that new therapeutic agents may affect survival. In the setting of prolonged survival and diverse treatment protocols, cardiac evaluation may become a necessity. This preliminary report indicates that a major percentage of AIDS patients have some evidence of cardiac abnormalities, even in the absence of clinical findings. Significant dysfunction, however, occurs in a smaller percentage of patients, all of whom have abnormal ECG findings. We therefore suggest that abnormal ECG findings in an AIDS patient should alert the clinician to consider the possibility of associated ventricular dysfunction.
Subjects with abnormal ECG findings should undergo further evaluation to determine the extent of their cardiac involvement. Long-term, statistically significant studies are needed to determine the role of cardiac manifestations in the natural history of this disease.

ACKNOWLEDGMENTS: The authors wish to thank William Perks and Janet Oertel for their technical assistance and Alice Walsh and Helen Duca for their help in preparing the manuscript.

REFERENCES
4 Pink L, Reichel N, St. John Sutton M. Cardiac abnormalities in the acquired immunodeficiency syndrome. Am J Cardiol 1984; 54:1161-63
5 D'Cruz IA, Sengupta EE, Abrahams C, Reddy HK, Turlapati RV. Cardiac involvement, including tuberculous pericardial effusion complicating acquired immunodeficiency syndrome. Am Heart J 1986; 112:1100-02
7 Issenber HJ, Charytan M, Rubenstein A. Cardiac involvement in children with acquired immune deficiency. Am Heart J 1986; 110:710
10 Sarngadharan MG, Popvic M, Bruch L, Schubach J, Gallo RC. Antibodies reactive with a human T-lymphotropic retrovirus (HTLV-III) associated with AIDS. Science 1984; 224:506-08
13 Polland ED, Partsi AF, Moynihan BS, Jone DR, Feldman CL, Tow DE. Assessment of left ventricular ejection fraction and volumes by real-time, two-dimensional echocardiography. Circulation 1979; 60:760-66