Spectrum of echocardiographic findings in tricuspid valve endocarditis

P. A. N. CHANDRARATNA AND W. S. ARONOW

With the technical assistance of K. Murdock and H. Milholland

From the Division of Cardiology, Long Beach Veterans Administration Medical Centre, Long Beach, California, and the University of California College of Medicine, Irvine, California, and the University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma, USA

SUMMARY This report describes a spectrum of M-mode and cross-sectional echocardiographic abnormalities in eight patients with infective endocarditis of the tricuspid valve. The M-mode echocardiogram of the tricuspid valve was abnormal in all but one patient in whom abnormal echoes were seen anterior to the tricuspid valve, in the right ventricular cavity and right ventricular outflow tract. Six patients had shaggy echoes on the tricuspid valve; and one patient showed multilayered echoes on the tricuspid valve which resembled a right atrial myxoma. Irregular diastolic fluttering of the tricuspid valve, indicative of ruptured chordae tendineae, was noted in three patients.

The cross-sectional echocardiogram showed abnormal thick shaggy echoes on the tricuspid valve in all five patients on whom the procedure was performed. Contrast echocardiography confirmed the presence of tricuspid regurgitation in four patients.

We conclude that echocardiography is useful in the diagnosis of tricuspid valve vegetations, and in detecting complications such as ruptured chordae tendineae and tricuspid regurgitation.

Several reports have outlined the usefulness of echocardiography in the diagnosis of infective endocarditis of the aortic and mitral valves (Dillon *et al.*, 1973; DeMaria *et al.*, 1975; Wray, 1975). Though echocardiographic diagnosis of tricuspid valve endocarditis has been described, the spectrum of abnormalities that may be seen on the echogram in this condition has not been clearly delineated (Lee *et al.*, 1974; Kisslo *et al.*, 1976a; Andy *et al.*, 1977; Thomson *et al.*, 1977). This report describes a variety of M-mode and cross-sectional echocardiographic findings that were observed in patients with infective endocarditis of the tricuspid valve.

Subjects and methods

Echocardiography was performed on eight patients with clinical and bacteriological evidence of infective endocarditis. Six patients gave a history of intravenous drug abuse. The source of infection in the other two patients was an infected antecubital cut-down site, and an infection after an operation on the large bowel, respectively. A grade 2-3/6 systolic murmur was heard at the left sternal border in five patients, only one of whom had the charac-

teristic jugular venous pulse and hepatic pulsations suggestive of tricuspid regurgitation.

The diagnosis was confirmed at the time of operation in two patients whose infection was resistant to antibiotic therapy. In one patient a large finger-like vegetation was removed without damage to the tricuspid valve, and the other had excision of the tricuspid valve.

M-mode echocardiography was performed on all patients, using an Ekoline 20 ultrasonoscope, a 2.25 MHz, 0.5 inch, 7.5 cm focus transducer, and a Honeywell 1856 recorder. Cross-sectional echocardiography was done on five patients, using a SKI 30° mechanical sector scanner. Echograms of the long axis and short axis of the heart were obtained from the left sternal border, and a hemi-axial view recorded from the cardiac apex (Kisslo *et al.*, 1976b). In these five patients, 10 ml saline were injected into a peripheral vein, while the right atrium and right ventricle were being visualised simultaneously by cross-sectional echocardiography (DeMaria *et al.*, 1978; Lieppe *et al.*, 1978).

Results

M-MODE ECHOCARDIOGRAPHY

The tricuspid valve was abnormal in all but one

Fig. 1 Echocardiogram illustrating shaggy echoes on the tricuspid valve (TV) consistent with vegetations on the anterior leaflet of the tricuspid valve.

patient. Shaggy echoes were noted on the tricuspid valve in six patients (Fig. 1 and 2). Multilayered echoes were seen on one patient (Fig. 3). The main body of the tricuspid valve was normal in one patient who, at operation, had a long finger-like vegetation attached to the base of the valve. Abnormal echoes which probably represented the tricuspid vegetation were noted anterior to the tricuspid valve, in the right ventricular cavity, and right ventricular outflow tract (Fig. 4 and 5). These abnormal echoes were not present in the echocardiogram performed after resection of the tricuspid vegetation (Fig. 6).

Irregular diastolic fluttering of the tricuspid valve, indicative of ruptured chordae tendineae, was noted in three patients (Fig. 7). There was no clinical evidence of pulmonary regurgitation in these patients.

CROSS-SECTIONAL ECHOCARDIOGRAPHY

The cross-sectional echogram was abnormal in all five patients on whom the procedure was performed. The cusps of the normal tricuspid valve appear as thin linear echoes. In contrast, our patients had thick shaggy echoes on the tricuspid valve (Fig. 8). In one patient besides a large vegetation on the septal leaflet of the tricuspid valve, another much smaller vegetation, which showed high frequency fluttering, was noted. The patient who had multilayered echoes resembling a myxoma showed dense echoes on the tricuspid valve and no mass was noted in the right atrium.

Fig. 2 Echocardiogram illustrating shaggy echoes caused by vegetations on the posterior leaflet of the tricuspid valve (PTV). ATV, anterior leaflet of tricuspid valve.

CONTRAST ECHOCARDIOGRAPHY

Injection of saline into a peripheral vein is followed by the appearance of micro-cavitations ('bubbles') in the right atrium and then in the right ventricle. In the normal subject these echoes disappear in five to six beats. In patients with tricuspid regurgitation the micro-cavitations move back and forth from the right ventricle to the right atrium and they persist for a much longer period of time (DeMaria *et al.*, 1978; Lieppe *et al.*, 1978). The micro-cavitations ('bubbles') are also seen in the inferior vena cava suggesting reversal of blood flow because of tricuspid regurgitation. Contrast echocardiography showed appearances suggesting tricuspid regurgitation in four of the five patients; all four had a systolic murmur though only one had a characteristic jugular venous pulse.

Discussion

Characteristic echocardiographic findings have been described in aortic and mitral valve endocarditis (Dillon *et al.*, 1973; DeMaria *et al.*, 1975; Wray, 1975). Shaggy diastolic echoes on the valve leaflets are typical of valvular vegetations. Other echocardiographic abnormalities are attributable to cusp or chordal rupture (Feigenbaum, 1973). All except one of our patients had abnormal tricuspid

Fig. 3 Echocardiogram shows layering of echoes on the tricuspid valve (TV) caused by vegetations. This echo could have been misinterpreted as a right atrial myxoma.

Fig. 4 Echogram of a patient who had a vegetation on the tricuspid valve proven at surgery. Note that the tricuspid valve appears normal, because the echo-beam probably did not transect the area of the valve where the vegetation was attached. There is an abnormal echo (V) anterior to the valve which probably represents the vegetation.

valve echograms. Shaggy echoes on the tricuspid valve were the commonest abnormality noted. One of our patients had multilayered echoes on the tricuspid valve, which could have been misinterpreted as a right atrial myxoma. The tricuspid valve echogram was normal in a patient who had a long finger-like vegetation arising from the base of the tricuspid valve. The vegetation was noted to protrude into the right ventricular outflow tract at surgery. Abnormal echoes were noted anterior to the tricuspid valve, in the right ventricle, and right ventricular outflow tract of this patient. This case illustrates the importance of scanning the right ventricle and right ventricular outflow tract in patients suspected of having infective endocarditis of the tricuspid valve. No such echoes have been seen in patients without endocarditis. Irregular diastolic fluttering of the tricuspid valve which suggested chordal rupture was observed in three

patients. This indicates that besides diagnosing tricuspid valve vegetations, progressive damage to the valve can be assessed by echocardiography.

The cross-sectional echocardiogram was abnormal in all five patients on whom studies were performed. While the M-mode echogram permits diagnosis of valvular vegetations, the cross-sectional echocardiogram enables assessment of the size and extent of vegetations. In one patient the cross-sectional echogram showed a large vegetation on the septal leaflet of the tricuspid valve, and another much smaller vegetation which demonstrated high frequency fluttering. Since in our experience, as well as in the experience of others, successful medical management is accompanied by persistence of the abnormal echocardiogram in most instances, the ability to detect a new vegetation on a valve and hence recurrence of endocarditis, is a potential application of cross-sectional echocardiography. The cross-sectional echogram was also useful in ruling out a right atrial myxoma in a patient whose M-

Fig. 5 Echocardiogram of the right ventricle in the patient referred to in Fig. 4. Abnormal shaggy echoes (V) which represent the vegetation are seen in the right ventricular cavity. AMV, anterior mitral leaflet.

Fig. 6 Echogram of patient referred to in Fig. 4 recorded after resection of a tricuspid vegetation. The abnormal echo in the right ventricle (RV) is no longer present. IVS, interventricular septum; LV, left ventricular cavity.

mode echogram showed multilayered echoes on the tricuspid valve which resembled a myxoma.

Injection of saline into a peripheral vein while simultaneously recording the echocardiogram of the right atrium and right ventricle has been shown to be a reliable non-invasive method of diagnosing tricuspid regurgitation (DeMaria *et al.*, 1978; Lieppe *et al.*, 1978). The diagnosis of tricuspid regurgitation at the bedside may be particularly difficult in patients who have normal or low right ventricular pressures ('low pressure' tricuspid regurgitation) since the classical triad of a holosystolic murmur, prominent 'V' waves in the jugular venous pulse, and hepatic pulsations, may not be present in this setting (Wooley and Fontana, 1975). Only one of the four patients with positive contrast studies for tricuspid regurgitation had the classic triad of physical signs indicative of tricuspid regurgitation.

A spectrum of echocardiographic abnormalities

Fig. 7 Echogram of the tricuspid valve in a patient with endocarditis, which demonstrates irregular fluttering of the anterior tricuspid leaflet (ATV) indicative of ruptured chordae tendineae.

Fig. 8 Cross-sectional echocardiogram in the short axis view, illustrating a large mass (V) on the tricuspid valve consistent with a vegetation. Ao, aortic root.

was noted in patients with tricuspid valve endocarditis. M-mode and cross-sectional echocardiography, in conjunction with echocardiographic saline contrast studies, should prove valuable in the diagnosis and serial follow-up of such patients. The technique is useful in detecting complications such as chordal rupture and tricuspid regurgitation.

References

- Andy, J. J., Sheik, H. M. U., Ali, N., Barnes, B. O., Fox, L. M., Curry, C. L., and Roberts, W. C. (1977). Echocardiographic observations in opiate addict with active infective endocarditis. *American Journal of Cardiology*, **40**, 17-23.
- DeMaria, A. N., Bommer, W., George, L., Newmann, A., Weiner, T. L., and Mason, D. T. (1978). Combined peripheral venous injection and cross-sectional echocardiography in the evaluation of cardiac disease (abstract). *American Journal of Cardiology*, **41**, 370.
- DeMaria, A. N., King, J. F., Saul, A. F., Caudill, C. C., Miller, R. R., and Mason, D. T. (1975). Echography and phonography of acute aortic regurgitation in bacterial endocarditis. *Annals of Internal Medicine*, **82**, 329-335.
- Dillon, J. C., Feigenbaum, H., Konecke, L. L., Davis, R. S., and Chang, S. (1973). Echocardiographic manifestations of valvular vegetations. *American Heart Journal*, **86**, 698-704.
- Feigenbaum, H. (1973). *Echocardiography*, p. 128. Lea and Febiger, Philadelphia.
- Kisslo, J., von Ramm, O. T., Haney, R., Jones, R., Juk, S., and Behar, V. S. (1976a). Echocardiographic evaluation of tricuspid valve endocarditis. *American Journal of Cardiology*, **38**, 502-507.
- Kisslo, J., von Ramm, O. T., and Thurston, F. L. (1976b). Cardiac imaging using a phased array ultrasound system. II. Clinical technique and application. *Circulation*, **53**, 262-267.
- Lee, C. C., Ganguly, S. N., Magnisalis, K., and Rogin, E. (1974). Detection of tricuspid valve vegetations by echocardiography. *Chest*, **66**, 432-433.
- Lieppe, W. M., Behar, V. S., Scallion, R., and Kisslo, J. (1978). Detection of tricuspid regurgitation with contrast two-dimensional echocardiography (abstract). *American Journal of Cardiology*, **41**, 371.
- Thomson, K. R., Nanda, N. C., and Gramiak, R. (1977). The reliability of echocardiography in the diagnosis of infective endocarditis. *Radiology*, **125**, 473-476.
- Wooley, C. F., and Fontana, M. E. (1975). Intracardiac sound and pressure: right heart events. Towards an ultimate classification of auscultatory events. In *Diagnostic Methods in Cardiology*, p. 57. Davis, Philadelphia.
- Wray, T. M. (1975). Echocardiographic manifestations of flail aortic valve leaflets in bacterial endocarditis. *Circulation*, **51**, 832-835.

Requests for reprints to Dr Premindra A. N. Chandraratna, Division of Cardiology, Veterans Administration Medical Center, 5901 East Seventh Street, Long Beach, California 90822, USA.