The role of echocardiography in the investigation of focal cerebral ischaemia

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Summary

One-hundred and ten patients referred for echocardiography to exclude a cardiac source of cerebral emboli were prospectively studied. Four patients with known cardiac abnormalities, for which they were receiving inadequate anticoagulation, were excluded from the study, and 18 patients were subsequently found to have a non-embolic cause for their cerebral pathology. Twenty-eight patients with a normal clinical examination, chest X-ray and electrocardiogram, and 27 patients with hypertension alone had echocardiograms which did not reveal a cardiac source of embolus. Of the remaining group of 33 patients, six were found to have a probable cardiac source of embolus and nine had abnormalities which may be associated with cerebral emboli. Echocardiography may not be indicated in patients with a normal clinical examination, chest X-ray and electrocardiogram, and in patients with hypertension alone. However, if these patients are excluded echocardiography gives a high yield of positive findings which may be of practical importance in the management of the patient.

KEY WORDS: hypertension, rheumatic heart disease, myxoma, myocardial diseases.

Introduction

Embolic cardiac disease may cause up to 35% of cerebral infarcts (Gautier and Morelot, 1975; Mohr *et al.*, 1978). Underlying cardiac pathologies which have been implicated such as rheumatic mitral valve disease (Nielson, Galea and Hossack, 1978), mitral valve prolapse (Barnett *et al.*, 1980), bacterial endocarditis (Harrison and Hampton, 1967), left atrial

myxoma (Yufe, Karpati and Carpenter, 1976), and intracardiac thrombus due either to acute myocardial infarction (Thompson and Robinson, 1978) or cardiomyopathy (Rogers and Sherry, 1976) may not be clinically apparent and therapeutic opportunities may be missed. It is for this reason that the use of echocardiography has become widespread. Recently, Grimmer, Tindall and Hill (1982) have suggested that echocardiography rarely reveals clinically useful information in the absence of known cardiac disease. The purpose of this study was to determine whether routine M mode and two dimensional (2D) echocardiograms were useful in the diagnosis and management of patients presenting with cerebral emboli, or whether clinical criteria could be used to define a subgroup in whom routine echocardiography might be indicated.

Patients and methods

One-hundred and ten consecutive patients referred for echocardiograms to exclude a cardiac source of cerebral emboli were prospectively studied. All patients had a full clinical evaluation, including an electrocardiogram, chest X-ray and examination by a cardiologist prior to the echocardiogram.

M-mode and 2D echocardiograms were then taken using a Smith-Kline Instruments Ekosector (Smith-Kline Instruments Co Ltd, Welwyn Garden City, Herts) 1 and a 2.25 MHz transducer with a 30° scanning arc. M-mode echocardiograms were obtained from the standard left parasternal position, while the 2D studies included the long and short axis and apical four chamber views as previously described by Tajik *et al.*, (1978). The echocardiograms were analysed by two experienced echocardiographers.

FIG. 1. Flow chart showing the echocardiographic abnormalities for the different clinical groups.

The clinical examination was thus 'blind' and was subsequently compared with the results of echocardiography. Four patients who were previously known to have a cardiac abnormality, three with prosthetic valves and one with mitral stenosis were excluded from the study, as their embolic episodes were thought to be due to inadequate anticoagulation.

Results

The study population of 106 patients (Fig. 1) consisted of 72 males and 34 females with a mean age of 58.1 years. The carotid circulation was involved in 75 patients. Fifty-three had completed infarcts and in 22 the neurological deficit lasted less than 24 hr. The posterior cerebral circulation was involved in 13 patients with nine completed strokes and four transient ischaemic attacks. After further neurological investigation, 18 patients were found to have a diagnosis which could not be related to an embolic event (for example, subdural haematoma, cortical venous thrombosis and arterio-venous malformation) and were therefore excluded from further analysis. This group included four patients with abnormal echocardiograms, two with mitral valve prolapse, one with poor left ventricular function and one with hypertrophic obstructive cardiomyopathy.

The cardiovascular examination revealed 28 normal patients with an average age of 46.1 years. Of these, only two echocardiograms were abnormal; one with asymmetrical septal hypertrophy and one with abnormal septal motion. The clinical abnormalities of the remaining 60 patients are shown in Table 1 and include 27 patients with hypertension alone. Hypertension was defined as a diastolic blood pressure of greater than 100 mmHg 72 hr after the cerebral ischaemic episode.

TABLE 1. Findings in 60 patients with clinical abnormalities

Clinical findings	Number
Hypertension alone	27
Hypertension with other findings	6
Evidence of previous infarct	10
Atrial fibrillation	7
Mitral valve disease	2
Aortic valve disease	3
Basal systolic ejection murmur	5
Apical systolic murmur	4
Left ventricular hypertrophy (ECG)	4
Left bundle branch block	1
Pacemaker	1
Atrial septal defect	1
Loud 1st heart sound	1

Sixty-one patients had normal echocardiograms and 27 were abnormal (Table 2). Of the patients with abnormal echocardiograms, six had pathology which was likely to be related to the cerebral event. Two patients had left ventricular apical thrombi, two rheumatic mitral valve disease, one an atrial septal defect (ASD) and the sixth patient a left atrial myxoma. All these patients had clinical findings which suggested the echocardiographic diagnosis. Both patients with left ventricular thrombus had evidence of anterior infarction on the electrocardiogram. The two patients with mitral valve disease were recognized clinically, although the diagnosis was not made prior to the neurological presentation. The 14-year-old male with an ASD presented with two transient ischaemic episodes. Clinically and echocardiographically, the diagnosis was an ASD with pulmonary hypertension and paradoxical emboli. He subsequently underwent catheterization and was found to have total anomalous pulmonary venous drainage with a large ostium secundum defect. The

TABLE 2. Abnormal echocardiograms

Related to cerebral emboli		Possibly related to cerebral emboli		Unrelated to cerebral emboli or of uncertain significance	
Apical mural thrombus	2	Poor left ventricular function	5	Aortic valve thickening	4
Rheumatic mitral valve disease	2	Mitral annular calcification*	3	Asymmetric septal hypertrophy	4
TAPVD with associated atrial septal defect	1	Hypertrophic obstructive cardiomyopathy	1	Left ventricular hypertrophy	1
Left atrial myxoma	1			Abnormal septal motion	1
				Dilated ascending aorta	1
				Enlarged left atrium	1
Total	6	Total	9	Total	12

*One with associated aortic valve disease.

TAPVD = total anomalous pulmonary venous drainage.

patient with the myxoma presented with a left hemiparesis which resolved spontaneously. He had an abnormally loud first heart sound which made the physician suspicious of a cardiac lesion. All of these patients had ischaemia in the territory of the middle cerebral artery, four with completed infarcts and two with transient ischaemic episodes. Of this group, the two patients with mitral valve disease and one of the patients with left ventricular thrombus were anticoagulated. The second patient with left ventricular thrombus did not regain consciousness following the stroke and was therefore not anticoagulated. The patients with the left atrial myxoma and total anomalous pulmonary venous drainage in association with an atrial septal defect underwent cardiac surgery.

There were a further nine patients who had cardiac abnormalities which may be associated with embolic episodes. Five had poor left ventricular function, four on the basis of ischaemic heart disease and one due to long standing hypertension. Three patients had mitral annular calcification, one with associated aortic valve disease. There was one case of hypertrophic obstructive cardiomyopathy.

The abnormalities of the remaining 12 echocardiograms are shown in Table 2. All of the abnormal echocardiographic findings in this study except the two cases of left ventricular wall apical thrombus were detected by M-mode echocardiography.

If the patients with a normal clinical examination and hypertension alone are excluded, the remaining group of 33 patients included all those in whom the echocardiographic abnormality was thought to be related to the cerebral event.

Discussion

Echocardiography is valuable in confirming the clinical diagnosis of several cardiac lesions, which may be a source of cerebral embolus, and requiring specific treatment. Two recent studies by Greenham *et al.* (1981) and Lovett *et al.* (1981), in patients with recent cerebral or retinal ischaemic episodes, concluded that echocardiography is not routinely indicated in these patients because of the low yield of positive findings. Our study has confirmed this conclusion, and also failed to show the high incidence of mitral valve prolapse in young patients with cerebral ischaemia previously reported by Barnett *et al.* (1980).

In our study there were three cases of mitral annular calcification. De Bono and Warlow (1979) found mitral annular calcification in eight of 155 patients presenting with retinal or cerebral ischaemia compared with none from matched controls. The clinical relevance of this finding remains uncertain and as it affects elderly patients it is difficult to recommend anticoagulation, although a clinical trial of antiplatelet therapy may be indicated.

Although patients with coronary artery disease may have similar pathology in their cerebral vessels the presence of left ventricular thrombus in a patient with previous myocardial infarction and recent cerebral ischaemia makes the probability of an embolus high. In the present study, left ventricular thrombus was found in two of six patients with anterior myocardial infarction. In the four patients with inferior myocardial infarction no echocardiographic evidence of thrombus was found. Although these numbers are small, they are in keeping with the

work of Asinger *et al.* (1981), who found echocardiographic evidence of thrombus in 12 of 35 patients with acute anterior myocardial infarction, whereas in 35 patients with acute inferior myocardial infarction no thrombi were seen. Although the presence of left ventricular thrombus infrequently results in systemic emboli (Cabin and Roberts, 1980) anticoagulation is indicated when associated with cerebral ischaemia.

Whether the case of hypertrophic obstructive cardiomyopathy should have been included in the group of cardiac disorders which may cause cerebral ischaemia is debatable, particularly as an arrhythmia was not documented. Although Hardarson *et al.* (1973) reported an association between hypertrophic obstructive cardiomyopathy, atrial fibrillation and cerebral embolism, cerebral embolic episodes have recently been shown to be a rare complication by McKenna *et al.* (1981). The relevance of the cardiac lesions in three patients with clinical and echocardiographic evidence of aortic valve disease, and five patients with basal systolic ejection murmurs, two of whom had aortic valve thickening on echocardiography, is also uncertain. It was felt that these clinical and echocardiographic findings were probably not related to the cerebral ischaemic episode, because although the associations of retinal arterial occlusion (Wilson, Warlow and Ross Russell, 1979) and spontaneous calcific embolization (Holley *et al.*, 1963) with aortic valve disease are well recognised, focal cerebral ischaemia due to aortic valve disease in the absence of endocarditis appears to be uncommon.

As in previous studies, we found a relatively high incidence of atrial fibrillation in these patients. This again emphasizes the frequency of cerebral emboli in patients with atrial fibrillation from any cause (Wolf *et al.*, 1978; Hinton *et al.*, 1977) especially when associated with other cardiac disease.

The results of this study confirm that echocardiography is not indicated in patients presenting with cerebral ischaemia who have normal clinical examination, chest X-ray and electrocardiogram, or in patients with hypertension alone. In this study, two dimensional echocardiography had little or no advantage over M-mode echocardiography except in the presence of a large antero-septal infarct when left ventricular mural thrombus was suspected clinically. However, in patients with abnormal cardiac findings there is a high incidence of echocardiographic abnormalities. In five of the 33 patients in this subgroup, management was altered as a result of the echocardiographic findings. In particular, two-dimensional echocardiography is indicated following stroke in patients with previous anterior wall myocardial infarction to detect mural thrombus.

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