Cardiac sources of embolic cerebral infarction in transesophageal echocardiography

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Previous reports have suggested that 6% to 39% of ischemic strokes are caused by cardiogenic emboli.[1] Thrombus formation associated with atrial fibrillation has been reported as one of the most important cardiac sources of embolism.[2] Using transesophageal echocardiography (TEE), other possible sources of embolism, including atrial septal aneurysm,[3] patent foramen ovale (PFO),[4] aortic atherosclerotic plaque,[5] annular calcification of the mitral valve,[6] mitral valve prolapse (MVP),[7] prosthetic cardiac valves and endocarditis,[8] mural thrombi,[9] cardiac tumors,[10] and cardiac transplants[11] have been reported as risk factors for ischemic stroke. TEE is considered more sensitive than transthoracic echocardiography (TTE) in detecting cardiac abnormalities in patients with stroke and transient ischemic attacks.[12] As there is no data available in Iran regarding TEE findings after embolic cerebrovascular accident (CVA), this study was undertaken to assess the prevalence of cardiac abnormalities by the TEE technique in patients with stroke.

Patients and Methods

Between September 2001 and July 2002, 98 consecutive patients, including 54 males and 44 females (mean age, 50.82 ± 18.1, years; range, 16-81 years) admitted to the neurology ward of Nemazi Hospital of Shiraz University of Medical Sciences, Shiraz, Iran were prospectively enrolled in this study. The inclusion criteria were: 1) completed embolic CVA confirmed by two expert neurologists considering neurological deficits, age of the patient, the form of the lesion in a computed tomography (CT) scan 12 hours after the beginning signs and symptoms of CVA, the existence of risk factors for defining embolic CVA from other types of CVA, the ability of patients to cooperate, and the patient's consent to undergo a detailed etiological investigation. Patients with hemorrhagic stroke proven by MRI or brain CT scanning, were excluded from the study. All patients underwent a general medical examination, electrocardiogram, general blood chemistries and complete blood count, and TEE using a standard protocol. Established risk factors for stroke such as hypertension, diabetes, a history of myocardial infarction, hypercholesterolemia, alcoholism, obesity and smoking habits were assessed. TEE was performed with a 5.0 MHz biplane probe using air contrast, introduced after topical oropharyngeal anesthesia. Cardiac pathologies were evaluated and the echocardiographic images were recorded for later analysis. No complications occurred during TEE. Statistical analyses were performed using SPSS version 8.01-J (SPSS, Chicago, IL).

Table 1. TEE congenital abnormalities in patients with embolic cerebrovascular accident.

TEE findings	Number	Percent (%)
Patent foramen ovale	9	9.1
Bicuspid aortic valve	6	6.1
Atrial septal defect	3	3
Ventricular septal defect	2	2
Aneurismal interatrial septum	2	2

Table 2. TEE valvular abnormalities in patients with embolic cerebrovascular accident.

TEE findings	Number	Percent (%)
Mitral regurgitation	51	52
Mitral valve prolapse	31	31.6
Mitral stenosis	8	8.1
Thick aortic valve	6	6.1
Aortic stenosis	5	5.1
Mass on aortic valve	7	7.1
Prolapse of aortic valve	2	2
Mitral valve vegetation (prosthetic valve)	1	1

Table 3. Other TEE findings in patients with embolic cerebrovascular accident.

TEE findings	Number	Percent (%)
Decreased left ventricular systolic function	12	12.2
Clot	8	8.1
Mass in LV* or LA**	5	5.1
Aorta atherosclerosis	4	4
Left ventricular hypertrophy	3	3
Pericardial effusion	1	1

* Left ventricle
** Left atrium

Results

Five patients (5.1%) had no significant pathology by TEE. The most prevalent congenital abnormality was PFO (Table 1) and the least frequent was ventricular septal defect (VSD). Valvular findings included mitral regurgitation and mitral valve vegetation associated with a prosthetic valve (Table 2). Among the other cardiac pathologies, the most prevalent abnormality was decreased left ventricular systolic function and the least was pericardial effusion (Table 3). More thrombi were observed in the left ventricle (6 patients) than the left atrium (2 patients), and the presence of any masses was more common in the left atrium and ventricle (2 patients for each) than the right atrium (1 patient).

Discussion

This study confirmed earlier observations that patients with a clinical diagnosis of embolic stroke have a high prevalence of certain specific cardiac abnormalities found by TEE. Left atrial and ventricular thrombi, atrial septal aneurysm, atrial septal defect, PFO and MVP have all been reported as possible sources of cerebral embolism.[13] Barkin et al demonstrated that the frequency of cerebral infarction was 28% in patients with atrial septal aneurysm.[14] In the present study, atrial septal aneurysm was detected in 3% of patients, which can be expected based on previous studies that include a wide age range of patients.[15-18]

PFO is present in 3.2% to 22% (average 12%) of normal subjects by TEE.[19] Left atrial pressure may remain higher than the right atrial pressure after the Valsalva maneuver in some PFO cases. In this study, we found that the overall prevalence of PFO was similar to that previously reported in all age groups. Several investigators have reported a strong association between atherosclerotic plaque of the aorta and ischemic stroke.[16] Large and complex atheromas are reported to be risk factors for aorta-arterial embolization.[21] We found aortic atheromas in 4% of our patients, supporting other reports.[21]

TEE is obviously useful for assessing the hemodynamic consequences of the lesions and can detect giant ball thrombi associated with mitral stenosis. Mitral stenosis leads to disturbed flow, which can be detected with TEE. TEE is useful for difficult cases, such as those with rheumatic involvement of the valves but is limited in stenosis, or in those with only mild or moderate mitral regurgitation, especially in patients who have other apparent risk factors for the event. In some echogenic patients with mitral stenosis or a mitral valve prosthesis, these echoes appear to overflow into the left ventricle,[22] and they can also be detected in the body of dyskinetic ventricles. In some circumstances platelet aggregation may contribute toward this phenomena. These echoes can coexist with intracardiac thrombus and be associated with an increased risk of systemic embolism.[23] Annular calcification of the mitral valve is also believed by some to be associated with embolic events. This abnormality is

relatively common, especially in elderly women and is associated with enlargement of the left atrium and atrial fibrillation leading to left atrial thrombus formation. It is also associated with aortic stenosis, mitral regurgitation and thromboembolism.[6]

Embolic stroke in young patients with mitral prolapse is reported to be associated with atrial septal defect, PFO and atrial septal aneurysm, which are all alternative sources for a presumed embolic event.[24]

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