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Original Article

Diagnostic Accuracy of Transthoracic Echocardiography in Detecting the Cardiac Source of Emboli in Ischemic Stroke Patients in a Tertiary Hospital

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Abstract

Background: *Transesophageal Echocardiography (TEE) is superior in identifying potential cardiac sources of emboli in stroke workup. But it is more costly and difficult to perform than Transthoracic Echocardiography (TTE). Moreover, facilities for TEE are not evenly distributed in Bangladesh. The study aimed to assess the diagnostic accuracy of TTE in detecting the cardiac source of emboli in admitted ischemic stroke patients in a Neurology ward of a tertiary hospital in Bangladesh.*

Materials and methods: *Ninety-two consecutively admitted patients admitted with a diagnosis of ischemic stroke without any preexisting indication of anticoagulation and known heart disease were enrolled in this study from the Neurology ward of Chittagong Medical College Hospital (CMCH) Chattogram, Bangladesh. All patients were underwent TTE and TEE.*

Results: *Mean age was 48.36±12.64 years with male predominance (Male to Female ratio was 1.88: 1). Eleven cardioembolic sources were detected by TEE (8 Left atrial appendage thrombus, 2 patent foramen ovale and 1 mild mitral stenosis) in 10 patients. Among these TTE could identify only one case (mild mitral stenosis). The sensitivity, specificity, positive predictive value, negative predictive value, and overall accuracy of TTE to detect cardioembolic sources were 10%, 100%, 100%, 90.11% and 90.22% respectively.*

Conclusion: *Diagnostic yield of TTE was very low in detecting the cardiac source of embolism in selected patients with ischaemic stroke.*

Key words: Cardioembolic source; Echocardiography; Ischemic stroke.

INTRODUCTION

Cardioembolic stroke which accounts for 15%–40% of all ischemic strokes has significance for its high risk of early and late embolic recurrences, and high mortality.[1] Moreover, as treatment of hypertension and dyslipidemia, improves cardiac embolism has accounted for an increasing share of strokes in high-income countries.[2] Given demographic changes and increasing life expectancy, risk factors for cardiac embolism may become more common in low- and middle-income countries as well.[3]

Cardioembolic stroke is largely preventable, warranting efforts at primary prevention for major risk cardioembolic sources.[4] Echocardiography is performed to identify the cardiogenic source of embolus and has been recommended as a routine test in stroke workup. However, the cost-effectiveness of echocardiography in the secondary prevention of stroke has generated controversy.[5] To detect the source of emboli, Transthoracic echocardiography (TTE) is usually the initial cardiac imaging modality, and reliably detects left ventricular wall motion abnormalities, left ventricular thrombi, and (with contrast) interatrial shunts.[6] However, Transesophageal Echocardiography (TEE) provides more information about the atria than does TTE.[7,8]

In the developing world cost of evaluation of stroke patients is a major issue and access to diagnostic modalities is limited requiring prioritization. To date, TTE is practised infrequently, and TEE is not practised at all to determine the aetiology of stroke patients in CMCH. Fortunately, machines and expertise for TEE are available in the cardiology department of this institution. In this context, the study was conducted to assess the diagnostic accuracy of TTE in comparison to TEE in patients with ischemic stroke. The study result would help in clinical decision making in the management of stroke patients.

MATERIALS AND METHODS

This cross-sectional observational study was conducted between February 2018 to January 2019 in the Department of Neurology and Department of Cardiology of CMCH. Patients were selected from the admitted patients in the Neurology ward with a diagnosis of ischemic stroke.Written consent was obtained from each patient for the TEE, and the Ethical Review Committee of CMC approved the protocol.

Consecutively selected 92 patients were included in the study. Patients with a history of TIA, acute or recurrent ischemic stroke and patients without definite cause and indication for anticoagulation based on standardized diagnostic work-up were included in the study. Patients with a pre-existing indication of anticoagulation (Mitral valve stenosis, Mechanical valve prosthesis, left ventricular systolic dysfunction, dilated and restrictive cardiomyopathy, left atrial or left ventricular masses that were easily detected by TTE) Carotid Duplex revealing carotid stenosis more than or equal to 70%, patients who had any contraindication to TEE e.g. oesophagal stricture, diverticula, tumour, recent suture line, symptomatic hiatus hernia, unexplained upper gastrointestinal bleed.

Each stroke patient was assessed for eligibility by diagnostic workup which includes -12-lead ECG, carotid ultrasound if applicable, and routine blood tests with haematology included. Patients' baseline characteristics, such as age, sex, comorbidities, current medication and severity of stroke (NIHSS) were recorded. TEE was performed on the same day after TTE. Echocardiography was done by using Vivid S5 with a 2.5 MHz transducer. TEE was performed by omniplane probe under conscious sedation.

SPSS version 23.0 was used for data processing and analysis. Continuous variables were reported as the means±SD and categorical variables were reported as percentages. Sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of TTE were determined in comparison to TEE. Statistical significance was defined as $p \leq 0.05$, and the confidence interval was set at a 95% level.

RESULTS

The mean age was 48.36±12.64 years and 60 (65.2%) of the patients were men. Regarding stroke onset, all the patients except one had a sudden event and regarding the type of stroke majority (62.5%) had a new onset of ischemic stroke. The mean NIHSS score at the time of enrollment was 6.68±3.2 and the majority with moderate stroke severity (Table I). Out of 92 enrolled stroke patients, 10 (10.9%) had no risk factors for ischemic stroke. The most prevalent risk factor was smoking present in 49 (53.2%) patients followed by, a history of hypertension (52.2%), diabetes mellitus (33.7%), family history of stroke (26.1%) and dyslipidemia (14.1%).

Table I Age and sex distribution of the patients (n=92)

Variables		Frequency (%)
Age, in years	Mean ±SD	48.36±12.64
	Range	18-85
Sex	Male	60 (65.2%)
	Female	32 (34.8%)
Stroke onset	Sudden	91 (98.9%)
	Gradual	1 (1.1%)
Stroke type	New	60 (65.2%)
	Recurrent	32 (34.8%)
Stroke severity	Minor (NIHSS 1-4)	24 (26.1%)
	Moderate (NIHSS 5-15)	68 (73.9%)
NIHSS score	Mean ±SD	6.68±3.2
	Range	2-15

Data are expressed as frequency (Percentage) if not otherwise mentioned. SD: Standard Deviation, NIHSS: National Institute of Health Stroke Scale.

Eighty (86.95%) patients had normal TTE. Among the positive TTE finding cases, only 1 (1.1%) had findings suggestive of possible cardioembolism. 1 patient had mild aortic regurgitation, aortic sclerosis and mitral sclerosis. Other abnormal findings are described in Table II. Seventy-two (78.26%) patients had normal TEE. Among the positive TEE finding cases, 10 had findings suggestive of possible cardioembolism. 1 had mild aortic regurgitation, aortic sclerosis and mitral sclerosis,1 had both patent foramen ovale and left atrial appendage thrombus and 1 had both mild concentric LVH and patent foramen ovale. Left atrial appendage thrombus is the most common finding as a possible cardiac source of embolism by TEE in our studied patients. Besides PFO was detected in 2 cases and mild MS was detected in one case (Table II).

Table II Transthoracic and Transesophageal echocardiography findings (n=92)

Findings	TT, n (%)	TE, n (%)
Normal finding	80 (86.95%)	72 (78.26%)
Possible cardioembolic source		
Mild mitral stenosis	1 (1.1%)	1 (1.1%)
Left atrial appendage thrombus	0	8 (8.8%)
Patent foramen ovale	0	2 (2.2%)
Other findings		
Mild aortic regurgitation	2 (2.2%)	1 (1.1%)
Aortic sclerosis	0	3 (3.3%)
Mitral sclerosis	1 (1.1%)	1 (1.1%)
Mild concentric LVH	3 (3.3%)	6 (6.6%)
Mitral valve thickness	1 (1.1%)	2 (2.2%)
Asymmetrical septal hypertrophy	6 (6.6%)	1 (1.1%)

The agreement between TTE and TEE is poor in the diagnosis of cardiac sources of embolism and TTE has very low sensitivity (Only 10%) as compared to TEE. 90% cardioembolic source could not be detected by TTE (Table III).

Table III Diagnostic accuracy of TTE in identifying the cardioembolic source in comparison to TEE

Cardioembolic source TTE	Cardio embolic source TEE		Total
	Detected	Not detected	
Detected	1	0	1
Not detected	9	82	91
Total	10	82	92
Diagnostic parameters	Statistics	95% confidence interval	
Sensitivity	10%	0.23%-41.28%	
Specificity	100%	95.55%-100%	
Positive predictive value	100%	---	
Negative predictive value	90.11%	88.11%-91.8%	
Accuracy	90.22%	82.24%-95.43%	

DISCUSSION

The present study demonstrated the decreased yield of TTE in the detection of a potential cardiac source of embolism in stroke patients compared with TEE. Various cardiac abnormalities were found on TTE in 12 (13.04%) patients in this study, including mild mitral stenosis, mild aortic regurgitation, aortic sclerosis, mitral sclerosis, mild concentric LVH, MVT and ASH. In contrast to our findings, a large percentage of studied patients (69.4% 71%) were found to have abnormal findings on TTE in previous studies.[9,10] Our study was conducted in a selected group of stroke patients who had no indications for anticoagulant or preexisting cardiac disease. On the other hand, both the previously mentioned studies[9,10] included all the ischaemic stroke patients (Non-selected) as a diagnostic workup of stroke classification.

The diagnostic yield of TTE in our study was only 1 (1.1%). The finding supported the ongoing debate regarding the cost-effectiveness of the TTE procedure as a diagnostic tool. A hospital-based study from Canada reports that TTE has a low yield, diagnosing only 4% of ischaemic stroke patients with abnormalities suggesting cardioembolic aetiology.[11]

In the present study, TEE findings revealed 11 abnormalities suggestive of cardiac source of embolism (1 mild MS, 2 PFO and 8 LAA thrombus). Of these, the mild MS case was the only major risk factor of cardioembolic stroke that was diagnosed by TTE too. This indicates that, in selected stroke patients with a normal TTE, a cardiac source of embolism was yet detected by TEE in 11% of patients. More than 1 of 13 patients with a normal TTE revealed a major cardiac risk factor on TEE, for whom anticoagulation therapy or other specific measures are recommended. The inferiority of TTE to TEE for diagnosing cardiac sources of embolism has also been demonstrated by several other studies and confirmed in our study.[12-14]

PFO and thrombus in LAA were the most common findings that were found in our patients underwent TEE. These findings were missed by the initial evaluation with TTE, as it is known that TTE has very poor sensitivity in the diagnosis of PFO (46% compared to the gold standard TEE.[15] Clearly, in our study TEE showed superiority over TTE in the detection of LAA thrombus in stroke patients of all ages. The reason for this discrepancy is unknown but based on the present results we do not consider TTE alone a valid screening tool to rule out an LAA as a potential cardiac source. None of the patients presented with aortic atheroma, left ventricle thrombus, atrial myxoma and left ventricular segmental wall motion abnormalities with myocardial infarction. In a systematic review of TEE in patients with cryptogenic ischemic stroke, the investigators observed a marked variation in the frequency of cardiac findings between studies in which patient populations were similar.[16]

LIMITATION

There are some limitations in the current study. This study is a non-randomized, cross-sectional study. The sample size was relatively small and collected from a single government hospital. The lack of an age-matched control group of volunteers without stroke was another potential limitation.

CONCLUSION

In conclusion, in this study in selected patients with ischemic stroke, a TTE reveals a very low yield of cardioembolic factors that might explain the stroke. On the other hand, TEE detects additional cardioembolic factors in 11% of cases. Therefore, TTE seems not to be adequate in such patients to detect the cardioembolic source of ischemic stroke.

RECOMMENDATION

We do not suggest TTE as a screening test to identify cardioembolic sources in selected patients with ischemic stroke. However, to make any recommendations regarding the routine use of echocardiography (Either TTE or TEE) for stroke patients further large-scale multicenter study is warranted keeping in view the prevalent ischaemic stroke subtype, cost involved and the accessibility of patients to these diagnostic modalities in Bangladesh.

DISCLOSURE

All the authors declared no competing interest.

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