The use of echocardiography for stroke and peripheral embolus: is it time for British/European guidelines?

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Abstract

The American College of Cardiology and the American Heart Association recommend echocardiography in patients with stroke or peripheral embolus who are less than 45 years of age or in those without evidence of cerebrovascular disease or other obvious cause.[1] There are no equivalent guidelines from British or European Cardiac Societies.

The prevalence of stroke and peripheral embolus has made it a common indication for the use of echocardiography. Despite this, to our knowledge there has been no previously published evaluation of the use of echocardiography in such patients in the UK. We undertook a retrospective review of transthoracic (TTE) and transoesophageal echocardiogram (TOE) reports (n=7,870) over 37 months at St. Bartholomew's Hospital department of cardiology. This identified 153 (1.9%) patients investigated for stroke/transient ischaemic attack (TIA) or peripheral embolus. Of these, six patients had two or more examinations producing a total of 160 reports; five reports were unrecorded and, therefore, 155 reports were analysed. A total of 12 reports (7.7%) identified possible cardiac sources of emboli with a further n=3 reporting spontaneous contrast in the left atrium. The potential embolic sources included patent foramen ovale (PFO)(n=3), aortic atheroma (n=3), aneurysmal atrial septum (n=2), mobile lesions on the mitral valve (n=3) and thrombus in the left atrial appendage (LAA)(n=1).

These results have led to the development of standardised criteria with the design of a template on the performing and reporting of echocardiograms in this type of patient.

Key words: echocardiogram, audit, cerebrovascular accident.

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Aim

The basis for this audit was to assess the use of echocardiography as a diagnostic tool in the setting of stroke/peripheral embolus at a single tertiary cardiac centre. It was perceived that the utilisation of this investigation was inconsistent. Information gained on the sensitivity of the investigation and the quality and completeness of reporting were to be used to construct criteria for the optimal use of echocardiography in this common clinical scenario.

Method

We performed a retrospective review of 7,870 consecutive echocardiogram reports generated from a computerised database at St. Bartholomew's Hospital, London. This covered a 37-month period (30th July 1997 to 8th September 2000). Patients having echocardiograms for research purposes were excluded. Data collection included type of echocardiography (TTE or TOE), indication for study, referral pattern and details of completed report.

Request forms containing 'source of embolus?', 'stroke cause?', 'patent foramen ovale?' or 'transient ischaemic attacks' in the reason for referral section were included in the review. Details of the report included positive findings of the study. Documentation of important negative findings were also reviewed.

Results

Over the period of review, 7,358 TTEs (93.5%) and 512 TOEs (6.5%) were performed. In total, 160 (2.0%) were performed for patients with recent stroke or peripheral embolus: 108 were TTEs (67.5%) and 52 were TOEs (32.5%); six patients overlapped both groups. Details of reports for five patients were not recorded on the database. The majority of patients were referred from cardiology, followed by the departments of neurology, nephrology and oncology/haematology. A total of 24 patients were referred from five other departments (see table 1).

From our analysis, the average age of all patients in the review was 53.9 years with a median age of 56 years. The average age of those referred for TTE and TOE was 54.6 and 52.5 years, respectively. The average age of patients identified with possible cardiac sources of emboli was 57 years.

In 12 patients, abnormalities were found which were possible cardiac sources of emboli; three of these patients had two different possible causes identified. These included PFO, atrial septal defect (ASD), atheroma of the ascending thoracic aorta,

Table 1. Demography of patient referral pattern (n=174)

Department of referral	Number	Percentage (%)
Cardiology	81	50.7
Neurology	26	16.3
Nephrology	16	10.0
Oncology/haematology	13	8.1
Cardiothoracic surgery	7	4.4
Endocrinology	7	4.3
Immunology	4	2.5
Clinical pharmacology	4	2.5
NT/ophthalmology	2	1.2
Total	160	100

Table 2. Potential causes for emboli detected and modality used

Finding	Frequency	TOE/TTE
Patent foramen ovale	3	TOE,TTE
Aortic atheroma	3	TOE
Atrial septal aneurysm	2	TTE
Mobile lesions on mitral valve	3	TOE
Left atrial appendage thrombus	1	TOE
Spontaneous echo contrast in the left atrium	3	TOE

Key: TOE = transoesophageal echocardiography; TTE = transthoracic echocardiography

aneurysmal dilatation of the inter-atrial septum, mobile lesions attached to the mitral valve and thrombus in the left atrial appendage, and three detected spontaneous echo contrast in the left atrium. Thus, 7.7% of patients referred for echocardiography for stroke or peripheral embolus were found to have a possible cardiac cause. Of these, nine were identified by TOE (75%) and three by TTE (25%) (see table 2).

Audit of the echocardiogram report documentation is summarised in table 3. Of note, comment on left atrial (LA) size, right heart size, atrial septal morphology (i.e. PFO, ASD or aneurysm), and presence of left atrial thrombus was low, with less than 50% of reports specifically recording these characteristics.

For transoesophageal echocardiograms, documentation of the presence of intra-cardiac shunt (visualised by colour-flow Doppler or using agitated saline), aortic atheroma and the presence of thrombus in the left atrial appendage were low at 62%, 33% and 51%, respectively.

Discussion

The indications for using echocardiography to investigate stroke have been set out by the American College of Cardiology (ACC)/American Heart Association (AHA) Task Force on Practice Guidelines (Committee on Clinical Application of Echocardiography), most recently in 1997. The indications classification system is used for recommendation of investigations.

Table 3. Analysis of documentation of echocardiogram reports

Finding	Frequency of documentation	Percentage (%)
LV size/function	135/160	85
LA size	72/160	45
Presence of thrombus	118/160	74
Valve structure/function	142/160	89
Right heart size	43/160	27
Atrial septum morphology	35/160	22
Left atrial thrombus	19/160	12
Presence of shunt (with Doppler/ agitated saline technique)†	32/52	62
Ascending aortic atheroma†	19/52	37
Left atrial appendage thrombus†	30/52	58

Key: † Transoesophageal echocardiography only; LV = left ventricle; LA = left atrium

Class I indications are for conditions for which there is evidence and/or general agreement that a given procedure or treatment is useful and effective. Class I indications for echocardiography include patients of any age with abrupt occlusion of a peripheral or visceral artery, patients under 45 years with cerebrovascular events, patients over 45 years with cerebrovascular events and without evidence of cerebrovascular disease or other obvious cause, and patients for whom a clinical therapeutic decision will depend on the result of echocardiography (e.g. anticoagulation).[1]

The guidelines list potential cardioembolic sources that are equally well identified with both TTE and TOE. The former include mitral stenosis, dilated cardiomyopathy, left ventricular aneurysm, left ventricular thrombus, mitral valve prolapse, vegetation and atrial septal defect. Therefore, TOE is recommended for detecting left atrial thrombus and spontaneous echo contrast, atrial septal aneurysm, patent foramen ovale and aortic atheroma. A comparable set of guidelines from the British Cardiac Society, the European Society of Cardiology or the British Society of Echocardiography are not published.

Structural abnormalities

Of the 13 patients with possible cardiac sources of emboli from our audit, only the patients with PFO and aortic atheroma would be potential candidates to be offered treatment other than anticoagulation as a means of secondary prevention. Although there is evidence for an association between PFO and paradoxical emboli, causality has not been established and optimum management for such patients with PFO and stroke remains undetermined.[2] Options include lifelong anticoagulation, surgical closure of the PFO or percutaneous, transcatheter PFO closure. The superiority of the latter over medical management has yet to be shown conclusively, but preliminary reports (in selected cases) are promising.[3]

The correct therapeutic approach for managing stroke patients identified to have aortic atheroma on TOE is not fully established.[4] Prevalence of aortic atheroma in patients with

Table 4. Example of echocardiography request form for patients with stroke/peripheral embolus at St. Bartholomew's Hospital

Hospital number:	In-patient (ward):
Surname:	Out-patient:
First name:	Consultant:
DOB:	Date of request:

Requesting doctor:
Bleep number:
Results to:

REQUESTED MODALITY (tick one)

Transthoracic echocardiogram	
Transoesophageal echocardiogram	

CRITERIA (tick one)

Patient of any age with abrupt occlusion of a major peripheral or visceral artery	
Patient (less than 45 years) with cerebrovascular event	
Patient (over 45 years) with cerebrovascular event but without evidence of cerebrovascular disease or other obvious cause	
Patient for which the result of echocardiography will directly influence therapeutic management (e.g. anticoagulation)	

For TOE requests:
Have the following been ruled out on transthoracic echocardiography? (please tick if yes)

Mitral stenosis	
Dilated cardiomyopathy	
Left ventricular aneurysm	
Left ventricular thrombus	
Atrial septal defect	

REPORTING

LV end diastolic diameter (cm)	
LV end systolic diameter (cm)	
LA size (cm)	

Right heart enlargement	Yes/No

Mitral valve (structure + function)	
Aortic valve (structure + function)	

Atrial septum:	Normal	
	Aneurysmal	
	ASD	

Thrombus present:	LV	
	LA	
Spontaneous echo contrast		

Presence of shunt on colour flow Doppler	

Additional for TOE reporting

Presence of shunt on injection of agitated saline	
Ascending aortic atheroma	
Thrombus in left atrial appendage	
Patent foramen ovale	

Key: LV = left ventricle; LA = left atrium; ASD = atrial septal defect

emboli has been found to be approximately 25% in three different studies.[5] The presence of complex aortic plaque in patients with coexisting atrial fibrillation (AF) stratifies those at moderate or high risk of cerebral events from those at low risk.[6] It is unclear whether this is similar for those in sinus rhythm. HMG-CoA reductase inhibitors (statins) have been shown to reduce the incidence of stroke (by possibly stabilising aortic atheroma) in patients that have suffered a myocardial infarction (relative risk 0.76),[7] and are now widely used in the primary and secondary prevention of stroke. The role of anticoagulation for patients with stroke and aortic atheroma has not yet been clarified with a randomised intervention trial.

The relation between atrial septum aneurysm and ischaemic stroke is unresolved. Atrial vulnerability (defined as the inducibility of sustained AF) is associated with atrial septal abnormalities in patients with cryptogenic stroke and may increase the embolic risk in those with PFO/ASD or atrial septal aneurysms.[8] Antiarrhythmic therapy has not been evaluated in this setting.

Left atrial (LA) thrombus is usually thought to be the embolic source in non-valvular AF. Once identified, this usually results in formal anticoagulation followed by an elective attempt at DC cardioversion.[9] Reduced left ventricular ejection fraction may also stratify a subset of patients at higher risk for atrial thrombus formation. Finally, the presence of spontaneous echo contrast in the LA in the presence of AF has been strongly linked with thrombus formation and subsequent embolic events.[10] In isolation, however, this is not typically treated with anticoagulation.

Management

The relative lack of evidence on optimal management strategies, once these structural abnormalities are identified, has led to the question of whether echocardiography has any impact on patient management and subsequent outcome. In two studies (one TTE only), echocardiography has been shown not to alter patient management.[11,12] Three further studies reported a change in patient management in up to 10% of cases, but this included anticoagulation for atrial fibrillation.[13-15] One of these studies showed that TOE led to an alteration of management in 10% of patients who had previously had a normal TTE. Our data seem to support the use of TOE for investigating stroke patients since 75% of possible embolic sources were detected using TOE.

This first audit of echocardiography in stroke and peripheral embolus has identified some deficiencies in both the selection criteria used for investigation and in the reporting of echocardiographic findings. There were no guidelines used for patient selection, i.e. with respect to age and reporting of LA size, atrial septal morphology, and the presence of LA thrombus was low. Documentation of ascending aortic atheroma on TOE was especially low. It is not clear whether this was because it was not considered or whether it was simply not documented. The causes for these deficiencies are not yet clear, but lack of UK guidelines and the large number of operators involved may be contributory.

Limitations

We acknowledge that the patient population of St.

Key messages

- There are no current British/European guidelines for the use of echocardiography in patients with stroke
- From our data, approximately 2% of patients referred for echocardiography were for stroke or peripheral embolus
- In our series, approximately 8% of echocardiograms performed for stroke identified potential cardiac sources of embolus
- It is not yet clear what impact the identification of potential cardiac sources of emboli has on subsequent outcome

Bartholomew's Hospital is highly specialised and, as such, the findings may not be directly comparable or applicable to a district general hospital (DGH) setting. It seems likely that the proportion of patients referred for echocardiographic assessment following stroke or peripheral embolus would be significantly higher at a DGH than at a tertiary cardiothoracic centre. St. Bartholomew's does not have general medical admissions or clinics (most importantly no elderly care referrals) and patients in a DGH are more likely to be elderly. Our findings, we assume, are representative for other centres that perform echocardiography, although possibly not directly applicable.

The total numbers studied were relatively low and the audit criteria were limited as the study was retrospective. This was, however, a preliminary study and a more detailed prospective assessment is now planned.

Conclusion

New criteria for echocardiography requests for patients with stroke/embolus (based on the ACC/AHA guidelines) are being introduced in an effort to improve these measures (see table 4). These may be applicable to other units. This will hopefully aid the performance and reporting of TTE/TOE examinations in an effort to document all possible intracardiac abnormalities associated with stroke/embolus.

Although the majority of potential cardiac sources of emboli in our audit were identified by TOE, we have still recommended TTE as a first line investigation to exclude five structural abnormalities (see table 4). If these abnormalities are excluded, then TOE will be performed. TTE is non-invasive and more easily available than TOE. Its usefulness as a preliminary investigation for stroke/emboli will be reassessed in a repeat audit. Randomised trials to assess the benefit of intervention on identified structural abnormalities are needed, as are British/European guidelines on the echocardiographic investigation for stroke patients.

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