ACUTE CENTRAL
and
PERIFERAL EMBOLISM

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Recommendations for echocardiography use in the diagnosis and management of cardiac sources of embolism

European Association of Echocardiography (EAE) (a registered branch of the ESC)

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BACKGROUND

Stroke is a leading cause of mortality and long-term disability worldwide.

Cardioembolism accounts for 20% of all ischemic strokes (in another 30%, the aetiology cannot be established).

The diagnosis of a cardioembolic source of stroke is frequently uncertain and relies on the identification of a potential cardiac source of embolism in the absence of significant autochthonous cerebrovascular occlusive disease.

Because of its high sensitivity and specificity for defining detailed structure and function of the cardiovascular system, TTE and TEE has become an invaluable investigation in pts with cardioembolic events.
<table>
<thead>
<tr>
<th>High Risk</th>
<th>Medium or Uncertain Risk</th>
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</thead>
<tbody>
<tr>
<td>Atrial dysrhythmias</td>
<td>Interatrial septal abnormalities</td>
</tr>
<tr>
<td>• Atrial fibrillation</td>
<td>• Patent foramen ovale</td>
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<tr>
<td>• Sick sinus syndrome</td>
<td>• Atrial septal defect*</td>
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<tr>
<td>• Atrial flutter</td>
<td>• Atrial septal aneurysm</td>
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<tr>
<td><strong>Left atrial thrombus</strong></td>
<td>Pulmonary arteriovenous malformation</td>
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<tr>
<td>• Atrial dysrhythmias</td>
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<tr>
<td>• Mitral valve stenosis</td>
<td></td>
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<tr>
<td>Left ventricular thrombus</td>
<td>Spontaneous echo contrast (“smoke”)</td>
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<tr>
<td>• Acute myocardial infarction</td>
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<tr>
<td>• Dilated cardiomyopathy</td>
<td></td>
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<td>Primary cardiac tumors</td>
<td>Mitral valve prolapse</td>
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<tr>
<td>• Myxoma</td>
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<td>• Papillary fibroelastoma</td>
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<tr>
<td>Metastatic tumors to the heart*</td>
<td>Valvular calcification</td>
</tr>
<tr>
<td>• Infective</td>
<td>• Mitral annular calcification</td>
</tr>
<tr>
<td>• Noninfective (marantic)</td>
<td>• Aortic valve sclerosis/stenosis</td>
</tr>
<tr>
<td>Vegetations</td>
<td>Valvular strands</td>
</tr>
<tr>
<td>• Infective</td>
<td></td>
</tr>
<tr>
<td><strong>Prosthetic cardiac valve</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Complex aortic atheroma</strong></td>
<td></td>
</tr>
</tbody>
</table>

Doufekias E et al. J Am Coll Cardiol 2008;51:1049-59
CLINICAL AND IMAGING FINDINGS INDICATING CARDIOEMBOLIC STROKE MECHANISM

Abrupt onset of stroke symptoms, particularly in AF with lack of preceding TIA and severe first-ever stroke

Striking stroke severity in the elderly (NIH-Stroke Scale ≥10; age ≥70 years)

Previous infarctions in various arterial distributions

Multiplicity in space (1/4 infarct in both the anterior and posterior circulation, or bilateral)

Multiplicity in time (1/4 infarct of different age)

Other signs of systemic thromboembolism

Territorial distribution of the infarcts involving cortex, or subcortical ‘large lenticulostriate infarct’

Hyperdense MCA sign (as long as without severe ipsilateral internal carotid stenosis)

Rapid recanalization of occluded major brain artery
CARDIAC SOURCES OF EMBOLISM
LV THROMBUS

Prevalence 7-20%

Higher in anterior or apical infarction

Up to 50% with chronic LV aneurysm

Echo Sensitivity and specificity in the range of 95 and 86%, respectively

TOE has little to offer in the detection of LV thrombus
USE OF CONTRAST
CARDIAC SOURCES OF EMBOLISM
CARDIOMYOPATHY
CARDIAC SOURCES OF EMBOLISM
CARDIOMYOPATHY
(1) It is recommended that echocardiography should be performed as the first-line imaging test in patients with known or suspected cardiomyopathy to determine the extent of LV and/or RV dysfunction.

(2) Echocardiography must be used to identify LV thrombus and the use of contrast may increase its diagnostic accuracy.

(3) Patients with dilated, poorly contracting ventricles, AF, a previous thromboembolic event or LV thrombus should be anticoagulated.
Atrial fibrillation causes about **25% of strokes** and increases stroke rate by **five times**.

Over **90% of these embolic strokes** are from clots originating in the **left atrial appendage**.

“The Left Atrial Appendage: Our Most Lethal Human Attachment!”

*Johnson WD*
CARDIAC SOURCES OF EMBOLISM
AF + MITRAL STENOSIS

SEC
Spontaneous Echo Contrast
intracavitary swirling motion

LAA emptying velocity

- No SEC: > 64.3 cm/s
- "faint smoke": 37 cm/s
- "dense smoke": <20 cm/s

SPAF STUDY Ann Intern Med 1998; 128;639
CARDIAC SOURCES OF EMBOLISM
AF AND ATRIAL THROMBI
CARDIAC SOURCES OF EMBOLISM
LAA emptying peak velocities

High flow profile

Low flow profile

LAA peak velocity = 52 cm/s

LAA peak velocity = 18 cm/s

Strongest predictor for the occurrence of thrombus / SEC
Independent of the basic rhythm
Risk stratification

Handke et al., JASE 2005, 18; 1366
TTE is clinically indicated in patients with AF

(1) to detect an underlying pathology affecting management or therapeutic decisions (ischaemic heart disease, valvulopathy, cardiomyopathy, or reduced ventricular function)

(2) before cardioversion of atrial flutter

(3) to indicate, guide and follow-up invasive surgical procedures such as substrate AF ablation (RF or surgical) or LAA closure

The addition of TOE in patients with AF is indicated

(1) In guiding short-term anticoagulated cardioversion
(2) In clinical selected cases (pre-ablation of AF and pre-closure LAA, suspected aortic arch atherosclerosis, recurrence of embolism during correct anticoagulation)
(3) In determining the risk for future embolism - study of LAA function
CARDIAC SOURCES OF EMBOLISM
FOP
CARDIAC SOURCES OF EMBOLISM
FOP WITH ASA
Recommendations

(1) TOE is traditionally the gold standard for the detection of PFO, however in the presence of good image quality, transthoracic echo is sufficient to detect the presence of a PFO. Performance of a valid Valsalvamanoeuvre or strong cough must be ensured with both methods.

(2) The aetiological role of paradoxical embolism through a PFO in unexplained stroke should be assumed with great caution and discussed with the neurologist.

Factors that argue in favour of this mechanism and that would suggest an indication for either anticoagulation or PFO closure are:

(a) temporal relationship of the neurological event with venous thrombosis
(b) young age (typically 55 years) and absence of other potential causes
(c) presence of an atrial septal aneurysm
(d) presence of a large spontaneous or provokable right-to-left shunt
CARDIAC SOURCES OF EMBOLISM
MYXOMA
CARDIAC SOURCES OF EMBOLISM

PAPILLARY FIBROELASTOMA
NORMAL VARIANTS

CHIARI NETWORK

LAMBL’S EXCRESCENCES
CARDIAC SOURCES OF EMBOLISM
ENDOCARDITIS
CARDIAC SOURCES OF EMBOLISM

PROSTHETIC VALVES
(1) TTE must be performed first in suspected IE
(2) Given to its better sensitivity, TOE must be performed in cases of initially negative TTE with a high level of clinical suspicion, in suspected prothetic valve endocarditis, and when TTE provides inadequate imaging
(3) The risk of embolism is related to the size, and mobility of vegetation, risk is increased in large (>10 mm) vegetations and particularly high with very mobile and large (>15 mm) vegetations
(4) The risk of new embolism is highest during the first days following initiation of antibiotic therapy and decreases after 2 weeks
### RECOMMENDATIONS: INDICATIONS FOR SURGERY

<table>
<thead>
<tr>
<th>PREVENTION OF EMBOLISM</th>
<th>TIMING</th>
<th>CLASS</th>
<th>LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic or mitral IE with large vegetations (&gt;10 mm) following one or more embolic episodes despite appropriate antibiotic therapy</td>
<td>Urgent</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Aortic or mitral IE with large vegetations (&gt;10 mm) and other predictors of complicated course (HF, persistent infection, abcess)</td>
<td>Urgent</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Isolated very large vegetations (&gt;15 mm)*</td>
<td>Urgent</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>

* Surgery may be preferred if procedure preserving the native valve feasible
Prevalence 21-27 %

same magnitude as the prevalence of Atrial Fibrillation - 18-30 %
carotid disease - 10-13 %

Related to the presence and grade of carotid stenosis
Independent Risk of Future Embolic Stroke - 12% - 1 year
( odds ratio for risk future events - 4.3 )

“SEC” + Complex Plaque
marker of destabilizing local hemodynamics

Tunick et al, JACC 2000;35:545
FinKelhor et al, Am Heart J, 1999; 137
CARDIAC SOURCES OF EMBOLISM
AORTIC COMPLEX PLAQUES

Protuding- plaque thickness >4 mm
Ulcration
Mobile lesions – any size
No certain casual relationships between minor conditions and stroke have been established. In patients with embolic events, the coexistence of MVP, MAC, or aortic stenosis may be an incidental finding on echocardiography. Echocardiography is recommended in patients with known MVP, MAC, or aortic stenosis and an embolic event.
A POTENTIAL CARDIAC SOURCE OF EMBOLISM SHOULD BE CONSIDERED IN ALL PATIENTS WITH STROKE, TIA OR PERIPHERAL EMBOLISM

ECHOCARDIOGRAPHY (TTE AND TOE) IS NOT ONLY A POWERFUL TOOL FOR THE EVALUATION OF CARDIOEMBOLIC SOURCES OF STROKE, BUT ALSO TO ESTABLISH RECOMMENDATIONS FOR THE PRIMARY AND SECONDARY PREVENTION OF CARDIOEMBOLIC EVENTS