ΣΤΡΟΓΥΛΟ ΤΡΑΠΕΖΙ
Καρδιά & Εγκέφαλος

ΔΙΑΓΝΩΣΤΙΚΗ ΠΡΟΣΕΓΓΙΣΗ ΑΕΕ

Χατζηελευθερίου Χρήστος
Διευθυντής ΕΣΥ
ΓΝ Δράμας
significant uncertainty

- 5% of emergency department (ED) patients present with neurological symptoms
- In 19.1% of cases, there was disagreement
- Misdiagnosis of headache focuses on subarachnoid hemorrhage (SAH) rate from 12–25%
- Common issue is distinguishing syncope, seizure, psychogenic seizures
- Transient paralysis
  Hypoglycemia / Labyrinth disorders
  Syncope episodes
  Anxious disorder
  Organic psychosyndrome
  Hypertensive Encephalopathy
  Subdural hematoma
  CNS tumors
  Cerebral amyloidosis
  Angiopathy
STROKE DIAGNOSTIC APPROACH

OBJECTIVES

<table>
<thead>
<tr>
<th>Stroke-like presentation</th>
<th>Atypical stroke-like presentation</th>
</tr>
</thead>
<tbody>
<tr>
<td>True stroke</td>
<td>Stroke “chameleons”^2</td>
</tr>
<tr>
<td>Not a stroke</td>
<td>Non-stroke</td>
</tr>
</tbody>
</table>

*Table: Diagnosis of patients presenting with acute neurological symptoms*

Non-localising symptoms
- Neuropsychiatric symptoms
- Acute confusional state
- Altered level of consciousness

Abnormal movements or seizures
- Abnormal movements
- Limb-shaking transient ischaemic attacks
- Seizures
- Alien hand syndrome
- Localised asterixis
- Isolated hemifacial spasms
- Disappearance of previous essential tremor

Peripheral nervous system symptoms
- Acute vestibular syndrome
- Other cranial nerve palsies (especially third and seventh cranial nerves)
- Acute monoparesis
  - Cortical hand syndrome
  - Cortical foot syndrome
- Isolated sensory symptoms

Atypical symptoms
- Isolated dysarthria
- Isolated dysarthria-facial paresis syndrome
- Isolated visual symptoms
  - Anton’s syndrome (cortical blindness with denial of deficit)
  - Balint’s syndrome
  - Isolated visual field disturbances
- Foreign accent syndrome
- Isolated dysphagia or stridor
5 main subtypes of stroke

• Atherotrombotic
• **cardioembolic**: emboli from a cardiac or aortic source
• **lacunar**: lipohyalinosis of terminal penetrant arteries, small vessel disease
• **uncommon**: arterial dissection, coagulopathy, immune disorders, drug abuse
• **cryptogenic stroke**
Causative diagnosis of stroke

- Aortic arch atherosclerosis: statins
- PFO and venous thrombosis: anticoagulants
- Paroxysmal atrial fibrillation: anticoagulants
- Endocardial thrombus: anticoagulants
- Hypercoagulation due to malignancy: LMWH
- Endocarditis: antibiotics
- Myxoma: cardiac surgery
- Symptomatic carotid stenosis: stent
- Angiitis - Antiphospholipidemic syndrome
- Symptomatic intracranial stenosis: dapt
- Lacunar infract: apt
- Reversible corneal vasculitis syndrome: cabl
- Sickle cell anemia: transfusions
Diagnostic steps

• rule out a brain hemorrhage
• confirmation of an ischemic stroke
• find out the cause of the stroke
• medical history, risk factor profile, physical exploration, and basic explorations
• identify arterial causes of embolism using ultra-sound techniques, transcranial Doppler (TCD) and cervical arteries Doppler (CD), color coded transcranial or cervical arteries duplex (TCCD, CCD) or angiography, usually MRI or CT
• start cardiac explorations to identify a cardiac source of stroke.
## Features Suggestive of Cardioembolic Stroke

<table>
<thead>
<tr>
<th></th>
<th>Clinical</th>
<th>MRI or CT</th>
<th>Ultrasound</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical</strong></td>
<td>1. Sudden onset to maximal deficit</td>
<td>Simultaneous or sequential infarcts in different arterial territories</td>
<td>Occlusion of the carotid artery by a mobile thrombus</td>
<td>Elevation of troponins or cardiac enzymes</td>
</tr>
<tr>
<td></td>
<td>2. Rapid regression of symptoms</td>
<td>Hemorrhagic transformation</td>
<td>Early recanalisation of an arterial occlusion</td>
<td>Brain natriuretic peptide</td>
</tr>
<tr>
<td></td>
<td>3. Visual field defect, neglect or aphasia</td>
<td>Hyperdense artery sign in absence of arterial pathology</td>
<td>Microembolism (HITS) in both middle cerebral arteries</td>
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<td></td>
<td>4. Concomitant palpitations or oppressive chest pain</td>
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<td></td>
<td>5. Oppressive chest pain</td>
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</tbody>
</table>
Fig. (3). Diagnostic algorithm for cardiac workup of ischemic stroke.
<table>
<thead>
<tr>
<th>2.2. Brain Imaging</th>
<th>COR</th>
<th>LOE</th>
<th>New, Revised, or Unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. All patients admitted to hospital with suspected acute stroke should receive brain imaging evaluation on arrival to hospital. In most cases, noncontrast CT (NCCT) will provide the necessary information to make decisions about acute management.</td>
<td>I</td>
<td>B-NR</td>
<td>Recommendation revised from 2013 AIS Guidelines.</td>
</tr>
</tbody>
</table>
NEUROIMAGING
### 6.1. Brain Imaging

<table>
<thead>
<tr>
<th>Description</th>
<th>COR</th>
<th>LOE</th>
<th>New, Revised, or Unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Routine use of brain MRI in all patients with AIS is not cost-effective and is not recommended for initial diagnosis or to plan subsequent treatment.</td>
<td>III: No Benefit</td>
<td>B-NR</td>
<td>New recommendation.</td>
</tr>
<tr>
<td>2. In some patients with AIS, the use of MRI might be considered to provide additional information for initial diagnosis or to plan subsequent treatment, although the effect on outcomes is uncertain.</td>
<td>IIb</td>
<td>C EO</td>
<td>New recommendation.</td>
</tr>
</tbody>
</table>
## Carotid vascular imaging

<table>
<thead>
<tr>
<th>6.2. Vascular Imaging</th>
<th>COR</th>
<th>LOE</th>
<th>New, Revised, or Unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. For patients with nondisabling (mRS score 0–2) AIS in the carotid territory who are candidates for CEA or stenting, noninvasive imaging of the cervical vessels should be performed routinely within 24 hours of admission.</td>
<td>I</td>
<td>B-NR</td>
<td>New recommendation.</td>
</tr>
</tbody>
</table>

American Heart Association
American Stroke Association
8. For patients who otherwise meet criteria for EVT, a noninvasive intracranial vascular study is recommended during the initial imaging evaluation of the acute stroke patient, but should not delay IV alteplase if indicated. For patients who qualify for IV alteplase according to guidelines from professional medical societies, initiating IV alteplase before noninvasive vascular imaging is recommended for patients who have not had noninvasive vascular imaging as part of their initial imaging assessment for stroke. Noninvasive intracranial vascular imaging should then be obtained as quickly as possible.

Recommendation reworded for clarity from 2015 Endovascular. Class and LOE unchanged.
See Table LXXXIII in online Data Supplement 1 for original wording.
Elevated troponin in patients with acute stroke

- Ischemic Heart Disease (IHD) and cerebrovascular disease (CVD) frequently co-exist
- Ejection fraction of less than 50% did not predict adverse outcomes
- Possibly due to sympathetic nervous system surge that occurs during an acute stroke.
- Neurogenic Heart Syndrome (NHS)
- Cells die in a hyper-contracted state with prominent contraction bands
- Catecholamine levels may account for the cardiac arrhythmias and ECG changes
decisions should be made based on the expertise of both the cardiologist and neurologist.

Measurements of serial troponins are a key element in detecting acute coronary syndrome (ACS) in association with an acute stroke.
Neurogenic heart syndrome.

Jan F. Scheitz et al. Stroke. 2015;46:1132-1140
Possible mechanisms of acute troponin elevation in patients with ischemic stroke.

Jan F. Scheitz et al. Stroke. 2015;46:1132-1140
Possible algorithm for classification of elevated cardiac troponin (cTn) in acute ischemic stroke.

Jan F. Scheitz et al. Stroke. 2015;46:1132-1140
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<tbody>
<tr>
<td><strong>2. Baseline ECG assessment is recommended in patients presenting with AIS, but should not delay initiation of IV alteplase.</strong></td>
<td>Recommendation reworded for clarity from 2013 AIS Guidelines. Class unchanged. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System. See Table LXXXIII in online Data Supplement 1 for original wording.</td>
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<td><strong>3. Baseline troponin assessment is recommended in patients presenting with AIS, but should not delay initiation of IV alteplase.</strong></td>
<td>Recommendation reworded for clarity from 2013 AIS Guidelines. Class unchanged. LOE revised. See Table LXXXIII in online Data Supplement 1 for original wording.</td>
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</tbody>
</table>
ECG changes in stroke

- ECG abnormalities are reported in 75-90% The most common findings include repolarization and ischemic-like ECG changes.
- prolonged QTc 36.0%
- ST depression 24.5%
- T wave inversion 17.8%
- ST depression and Q waves were significantly associated with a rise in TnT
- identifying AF, coexisting acute myocardial infarction (MI) or chronic cardiac disease that may predispose to embolic sources.
- specificity to detect acute myocardial infarction is very low
ECG in stroke

• Initial ECG has a detection rate for AF varying from 5 to 25%. Detection of new-onset AF is 4.8%.
• Serial ECG within the first 72 hours.
• Holter monitoring.
• Telemetry monitoring during 48 hours in acute ischemic stroke patients detects between 4 to 8.4% of new AF.
• 60-65% of patients will develop conduction or rhythm abnormalities. Predict 3 month mortality independent of stroke severity.
Cryptogenic Stroke and Underlying Atrial Fibrillation

Ischemic stroke is among the leading causes of death and disability. The cause remains unexplained after routine evaluation in 20 to 40% of cases, resulting in the classification, by exclusion, of cryptogenic stroke. Atrial fibrillation is a well-recognized cause of ischemic stroke, though the risk is markedly reduced by anticoagulation. Documentation of atrial fibrillation is required to initiate anticoagulant therapy after ischemic stroke. In the absence of documented atrial fibrillation, antiplatelet agents are recommended. Given the often paroxysmal and asymptomatic nature of atrial fibrillation, it may not be detected with the use of traditional monitoring techniques. Strategies for detection of atrial fibrillation have included in-hospital monitoring, serial electrocardiography (ECG), Holter monitoring, monitoring with the use of external event or loop recorders, long-term outpatient monitoring, and monitoring by means of insertable cardiac monitors (ICMs), yielding detection rates ranging from 0 to 25%. However, differences among studies with respect to eligibility criteria, end points, and duration of monitoring make it difficult to translate these findings into changes in clinical practice. Current guidelines suggest performing 24 or more hours of ECG monitoring to rule out atrial fibrillation in patients with an ischemic stroke but acknowledge that the most effective duration of monitoring has not been determined. The use of additional ECG monitoring beyond 24 hours after cryptogenic stroke is currently left to physician discretion. We conducted a randomized, controlled study to assess whether a long-term ECG monitoring strategy with an ICM is superior to conventional follow-up for the detection of atrial fibrillation in patients with cryptogenic stroke.
Key Inclusion/Exclusion Criteria

**Inclusion:**
- ≥40 years of age
- Cryptogenic stroke (or clinical TIA), with infarct seen on MRI or CT, within the previous 90 days; and no mechanism (including AF) determined after:
  - 12-lead ECG
  - 24-hour ECG monitoring (e.g. Holter)
  - Transesophageal echocardiography (TEE)
  - CTA or MRA of head and neck to rule out arterial source
  - Screening for hypercoagulable states in patients <55 years old

**Exclusion:**
- History of AF or Atrial Flutter
- Permanent indication or contraindication for anticoagulation
- Indication for pacemaker or implantable cardioverter defibrillator
Objectives of CRYSTAL-AF

• Prospective, randomized, multi-center, global, post-market study

• To assess whether a long-term cardiac monitoring strategy with an implantable cardiac monitor (ICM) is superior to standard monitoring for the detection AF in patients with cryptogenic stroke.

• **Primary endpoint: Detection of AF by six months**

• Determine the proportion of patients with cryptogenic stroke that have underlying AF.

• Determine actions taken after patient is diagnosed with AF
Patient Follow-up

- Patients in both arms received scheduled follow-up visits at:
  - 1 month
  - 6 months
  - 12 months
  - Every 6 months thereafter until study closure

- Follow-up visits recorded:
  - Cardiac symptoms
  - Treatment modifications
  - Recurrence of stroke or TIA
  - Modified Rankin Scale
  - Health status (EQ-5D)
Comparison of Monitoring Strategies

Continuous Monitoring Arm: Insertion of REVEAL® XT

- Minimally invasive outpatient procedure
- Local anesthetic and no leads or fluoroscopy
- 15-30 minute procedure
- Device can be followed remotely
- MRI conditional
- 3 year device longevity
- Automatic AF detection algorithm

Standard Monitoring Arm

- Cardiac monitoring performed according to local standards, after mandated testing completed
- Symptoms consistent with AF were evaluated by study physicians
Methods

• AF defined as an episode of irregular heart rhythm, without detectable p waves, greater than 30 seconds

• AF episodes were identified by patient’s physician and adjudicated by an independent committee
Primary Endpoint: DETECTION OF AF AT 6 MONTHS

- Rate of detection in ICM arm was 8.9% vs 1.4% in control arm.

Hazard Ratio (95% CI) = \(6.43\) (1.90, 21.74)
log-rank p-value = 0.0006
Atrial Fibrillation Duration in ICM Arm at 12 months (N=29)

92.3% of patients in ICM arm had a maximum one-day AF burden of > 6 minutes
Detection of AF at 3 years

Hazard Ratio (95% CI) = 8.78 (3.47, 22.19)
log-rank p-value < 0.0001

# at risk
Control 220 194 167 114 72 36 7
ICM 221 191 173 102 57 29 8
• Insertable Cardiac Monitor (ICM-ILR) is superior to standard monitoring in detection of AF at 6 months (HR = 6.43), 12 months (HR=7.32), and 36 months (HR=8.78) in patients with cryptogenic stroke

• In the ICM arm, AF was detected in 8.9%, 12.4%, and 30% of patients at 6 months, 12 months, and 36 months

• 92.3% of patients with AF in the ICM arm had a day with greater than 6 minutes of AF

• Detection of AF changed management to anticoagulation in 97% of patients

• AF was detected 3% of 220 control subjects (P<0.001), but the occurrence of TIA or ischemic stroke was 9% in the implantable cardiac monitor group and 11% in the control group (P=0.64)
<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class(^a)</th>
<th>Level(^b)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opportunistic screening for AF is recommended by pulse taking or ECG rhythm strip in patients &gt;65 years of age.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>In patients with TIA or ischaemic stroke, screening for AF is recommended by short-term ECG recording followed by continuous ECG monitoring for at least 72 hours.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>It is recommended to interrogate pacemakers and ICDs on a regular basis for atrial high rate episodes (AHRE). Patients with AHRE should undergo further ECG monitoring to document AF before initiating AF therapy.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>In stroke patients, additional ECG monitoring by long-term non-invasive ECG monitors or implanted loop recorders should be considered to document silent atrial fibrillation.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>Systematic ECG screening may be considered to detect AF in patients aged &gt;75 years, or those at high stroke risk.</td>
<td>IIb</td>
<td>B</td>
</tr>
</tbody>
</table>
Cardiac evaluation

<table>
<thead>
<tr>
<th>6.3. Cardiac Evaluation</th>
<th>COR</th>
<th>LOE</th>
<th>New, Revised, or Unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cardiac monitoring is recommended to screen for atrial fibrillation and other potentially serious cardiac arrhythmias that would necessitate emergency cardiac interventions. Cardiac monitoring should be performed for at least the first 24 hours.</td>
<td>I</td>
<td>B-NR</td>
<td>Recommendation and Class unchanged from 2013 AIS Guidelines. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System.</td>
</tr>
<tr>
<td>2. The clinical benefit of prolonged cardiac monitoring to detect atrial fibrillation after AIS is uncertain.</td>
<td>IIb</td>
<td>B-R</td>
<td>New recommendation.</td>
</tr>
<tr>
<td>3. In some patients with AIS, prolonged cardiac monitoring to provide additional information to plan subsequent secondary preventive treatment may be reasonable, although the effect on outcomes is uncertain.</td>
<td>IIb</td>
<td>C-EO</td>
<td>New recommendation.</td>
</tr>
</tbody>
</table>
A clinical Score for the Targeting of Atrial Fibrillation (STAF)

- age >62 (2 points)
- National Institutes of Health Stroke Scale (NIHSS) >8 (1 point),
- Left atrial dilatation (2 points)
- absence of symptomatic intra or extracranial stenosis > 50% or clinic-radiological lacunar syndrome (3 points)

A STAF score >5 identified patients with AF with 89% sensitivity and 88% specificity

Suissa et al.
To detect cardiac sources of emboli originated by abnormalities of cardiac structure

- Risk of stroke after MI of 12.2 per 1000 MI at 30 days
- Dilated cardiomyopathy has an annual risk of embolisation of 1-3.5% rising to 9% after suffering a stroke
- Infective endocarditis has a 15-20% incidence of ischemic stroke
- Prosthetic valves either biological or mechanical have a 1 to 4%
- Complex aortic arch atheroma (CAA) protruding
- 4 mm has a relative risk of recurrent stroke of 1.6 to 4.3

<table>
<thead>
<tr>
<th>High risk</th>
<th>Low or uncertain risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial</td>
<td>Interatrial septal abnormalities</td>
</tr>
<tr>
<td>- Atrial fibrillation</td>
<td>- Patent Foramen Ovale</td>
</tr>
<tr>
<td>- Atrial flutter</td>
<td>- Atrial-septal aneurysm</td>
</tr>
<tr>
<td>- Sick sinus syndrome</td>
<td>Pulmonary arteriovenous malformation</td>
</tr>
<tr>
<td>- Left atrial thrombus</td>
<td>Spontaneous echo contrast (&quot;smoke&quot;)</td>
</tr>
<tr>
<td>Valvular</td>
<td>Mitral valve prolapse</td>
</tr>
<tr>
<td>- Mitral valve stenosis</td>
<td>Mitral annular calcification</td>
</tr>
<tr>
<td>- Prosthetic cardiac valve</td>
<td>Aortic valve sclerosis/stenosis</td>
</tr>
<tr>
<td>- Left ventricular thrombus</td>
<td>Valvular strands</td>
</tr>
<tr>
<td>- Acute myocardial infarction</td>
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<tr>
<td>- Dilated cardiomyopathy</td>
<td></td>
</tr>
<tr>
<td>Vegetations</td>
<td></td>
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<tr>
<td>- Infective endocarditis</td>
<td></td>
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<tr>
<td>- Marantic endocarditis</td>
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<tr>
<td>Complex aortic arch atheroma</td>
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<tr>
<td>Tumours</td>
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<tr>
<td>- Myxoma</td>
<td></td>
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<tr>
<td>- Papillary fibroellastoma</td>
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<tr>
<td>- Mestastasic tumours</td>
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</tbody>
</table>
UTILITY OF TTE-TEE

Total Echocardiograms n = 439

Patients with Afiib in ER; n=69

Potential Clinically Relevant Echo Findings; n = 28/370 (7.6%)

Echo Findings on TTE only; n = 21/307 (6.8%)
- New Anticoagulation added; n = 11/307 (3.6%)
- Suspicious Vegetation; n = 8/307 (2.6%)
- Neither; n=2/307 (0.7%)

Echo Findings on TTE & TOE; n = 7/63 (11.1%)
- New Anticoagulation added; n = 5/63 (7.9%)
- Vegetation; n = 2/63 (3.2%)
When to perform cardiac diagnostic tests in stroke

<table>
<thead>
<tr>
<th>Diagnostic test</th>
<th>In which patient</th>
<th>When applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>12-lead ECG</td>
<td>Every stroke</td>
<td>Upon hospital admission</td>
</tr>
<tr>
<td>ECG monitoring short term</td>
<td>Every stroke</td>
<td>At least 24 h</td>
</tr>
<tr>
<td>ECG monitoring long term</td>
<td>ESUS with functional recovery</td>
<td>After (or prior to) discharge</td>
</tr>
<tr>
<td>Echocardiography transthoracic</td>
<td>Ischaemic stroke with ECG or auscultation pathology</td>
<td>Within 72 h after admission</td>
</tr>
<tr>
<td>Echocardiography transoesophageal</td>
<td>Suspicion for patent foramen ovale, intracardiac thrombi, infective endocarditis, valve disease</td>
<td>Any time</td>
</tr>
<tr>
<td>Coronary angiography</td>
<td>Selected patients with clinical or ECG suspicion to acute coronary syndrome</td>
<td>Individual timing based on stroke severity and cardiac symptoms</td>
</tr>
</tbody>
</table>

ECG, electrocardiogram.
## Cardiac evaluation

<table>
<thead>
<tr>
<th></th>
<th></th>
<th>III: No Benefit</th>
<th>B-NR</th>
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</thead>
<tbody>
<tr>
<td>4.</td>
<td>Routine use of echocardiography in all patients with AIS to plan subsequent secondary preventive treatment is not cost-effective and is not recommended.</td>
<td></td>
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<tr>
<td>5.</td>
<td>In selected patients with AIS, echocardiography to provide additional information to plan subsequent secondary preventive treatment may be reasonable.</td>
<td>IIb</td>
<td>B-R</td>
</tr>
</tbody>
</table>

New recommendation.
Recurrence stroke and cardiac risks after first ischemic stroke
The Northern Manhattan Study
M.S. Dhamoon, MD, MPH; R.R. Sciacca, EngScD; T. Rundek, MD, PhD; R.L. Sacco, MD, MS; and M.S.V. Elkind, MD, MS

• 2 to 6% of all stroke patients die from cardiac causes in the first three months after ischemic stroke.

• Whereas in the first 6 months after a first-ever stroke the cause of death is mostly stroke related, this changes within the subsequent 4–5 years in the sense that cardiovascular disorders assume the role of a major killer, particularly due to myocardial infarction and congestive heart failure!
Figure 2. Dhamoon M S et al. Neurology 2006;66:641-646
Multicomponent quality improvement programs to improve stroke care

<table>
<thead>
<tr>
<th>4. Designation of an acute stroke team that includes physicians, nurses, and laboratory/radiology personnel is recommended. Patients with stroke should have a careful clinical assessment, including neurological examination.</th>
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<tbody>
<tr>
<td>I</td>
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<tr>
<td>Recommendation wording modified from 2013 AIS Guidelines to match Class I stratifications. Class unchanged. LOE added to conform with ACC/AHA 2015 Recommendation Classification System.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. Multicomponent quality improvement initiatives, which include ED education and multidisciplinary teams with access to neurological expertise, are recommended to safely increase IV thrombolytic treatment.</th>
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<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>New recommendation.</td>
</tr>
</tbody>
</table>
the Heart-Brain Team—Towards an Optimal Team-Based Coordinated Care

Cardiologists
- Primary and secondary CVD prevention
- Anticoagulation handling in AF
- Percutaneous closure of PFO and LAA
- Prevention of procedural strokes
- Poststroke myocardial infarction
- Stress-induced cardiomyopathies
- Muscular dystrophies
- Syncope

Neurologists
- Primary and secondary CVD prevention
- Management of hemorrhagic stroke
- Risk stratification of cryptogenic stroke
- Management of procedural strokes
- Poststroke myocardial infarction
- Stress-induced cardiomyopathies
- Muscular dystrophies
- Syncope

Heart-Brain Team
- CVD prevention
- Cardioembolic stroke
- Procedure-related stroke
- Poststroke myocardial infarction
- Stress-induced cardiomyopathies
- Muscular dystrophies
- Syncope
- Heart-brain connection
ΕΥΧΑΡΙΣΤΩ
# The role of cardiologists and cardiac diagnostic methods in stroke diagnosis

<table>
<thead>
<tr>
<th>Phase</th>
<th>Activities</th>
</tr>
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<tbody>
<tr>
<td><strong>Acute phase</strong></td>
<td>Interpretation of ECG (arrhythmias, myocardial infarction) and monitoring clinical abnormalities of the cardiac function (e.g. heart failure, acute hypertension, etc.)</td>
</tr>
<tr>
<td></td>
<td>Clinical diagnosis of heart failure, endocarditis, valve disease, aortic aneurysm, or other cardiac diseases which may require emergent treatment</td>
</tr>
<tr>
<td><strong>During early hospital stay</strong></td>
<td>Evaluation and titration of hypertension</td>
</tr>
<tr>
<td></td>
<td>Detection of acute cardiac comorbidities</td>
</tr>
<tr>
<td></td>
<td>ECG detection of atrial fibrillation or other arrhythmias (ICU monitoring, Holter ECG, loop recorders, implantable recorders)</td>
</tr>
<tr>
<td></td>
<td>Auscultation, echocardiography (detection of structural heart disease)</td>
</tr>
<tr>
<td><strong>After discharge</strong></td>
<td>Complete cardiologic workup—search for cardiovascular comorbidities, treatment adjustment, risk factors correction</td>
</tr>
</tbody>
</table>
NEUROIMAGING

characteristics related to cardiac embolisms

- Cardiac emboli often occlude middle-large size arteries and multiple vascular territories.
- Hemorrhagic transformation of an ischemic infarct and early recanalisation of an arterial occlusion
- Cortical involvement
- Hyperdense cerebral artery sign on non-contrast CT scanning
- The detection of oscillating, homogenous, elastic mass-echos by CCD
- TCD allows a first line non-invasive diagnosis of a right-to-left shunt (RLS) caused by a patent foramen ovale (PFO) by detecting bubble signals in the middle cerebral artery
- TCD can detect high intensity transient signals (HITS) indicating microembolism from an embolic condition
## TABLE 1: Some reasons for misdiagnosis

<table>
<thead>
<tr>
<th></th>
<th>Headache</th>
<th>Dizziness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History</strong></td>
<td>Patients use words like “migraine” and “sinus infection” that may mislead the physician. Beware previous diagnoses; they might be wrong.</td>
<td>The use of the word “vertigo” versus other dizziness descriptors is not etiologically useful.</td>
</tr>
<tr>
<td><strong>Physical exam</strong></td>
<td>Patients with SAH may be well appearing and neurologically intact.</td>
<td>Patients with small posterior circulation strokes can mimic a peripheral vestibular presentation.</td>
</tr>
<tr>
<td><strong>Diagnostic testing</strong></td>
<td>For SAH, CT sensitivity is good but decays with time. CT has poor sensitivity for CVST and dissection.</td>
<td>CT is a poor test for cerebellar and brainstem infarction</td>
</tr>
<tr>
<td><strong>Preconceived notions</strong></td>
<td>Headache improved with triptans so is not a serious secondary cause.</td>
<td>Posterior circulation strokes are obvious or devastating events</td>
</tr>
</tbody>
</table>

CVST: cerebral venous sinus thrombosis, SAH: subarachnoid hemorrhage, CT: CAT scan, MRI: n
## Misdiagnosis in Patients with Neurological Emergencies

<table>
<thead>
<tr>
<th>Back Pain</th>
<th>Weakness</th>
<th>Seizure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients use word “sciatica” which may lead physicians to diagnose sciatica.</td>
<td>Stroke patients may complain of “clumsiness” or “my arm felt like lead” rather than “weakness”.</td>
<td>Patient (or witness) says “seizure” after a faint. Seizure patients often present after the seizure with only an altered mental status or with a postictal “Todd’s” paralysis.</td>
</tr>
<tr>
<td>Patients with serious causes of back pain can present without neurological deficits.</td>
<td>Patients with stroke can present with just about any focal deficit depending upon the occluded vessel. Myasthenia patients’ symptoms wax and wane. GBS patients’ first symptoms may be purely sensory.</td>
<td>Patients may be lethargic, but neurologically intact.</td>
</tr>
<tr>
<td>No MRI available MRI must target the correct segment(s) of the spine.</td>
<td>False normal CT in early stroke</td>
<td>EEG often not available in the emergency department. Not performing LP in seizure patients who may have encephalitis or neurocysticercosis.</td>
</tr>
<tr>
<td>All patients with SEA have risk factors or fever, or neurological deficits</td>
<td>Young people do not get strokes</td>
<td>Seizures (or seizure-like movements) are sometimes seen with strokes. Convulsive movements are common in syncope.</td>
</tr>
</tbody>
</table>

MRI: Magnetic resonance imaging, SEA: Spinal epidemic abscess.
1.9. Stroke System Care Quality Improvement Process

1. Healthcare institutions should organize a multidisciplinary quality improvement committee to review and monitor stroke care quality benchmarks, indicators, evidence-based practices, and outcomes. The formation of a clinical process improvement team and the establishment of a stroke care data bank are helpful for such quality of care assurances. The data repository can be used to identify the gaps or disparities in quality stroke care. Once the gaps have been identified, specific interventions can be initiated to address these gaps or disparities.

<table>
<thead>
<tr>
<th>COR</th>
<th>LOE</th>
<th>New, Revised, or Unchanged</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>B-NR</td>
<td>Recommendation and Class unchanged from 2013 AIS Guidelines. LOE amended to conform with ACC/AHA 2015 Recommendation Classification System.</td>
</tr>
</tbody>
</table>
The value of transesophageal echocardiography for embolic strokes of undetermined source

Consecutive patients with acute IS (N=1,134)

Patients with cryptogenic IS (n=186)

Patients who fulfilled ESUS diagnostic criteria (n=68; 6% of all patients with IS)

ESUS patients who underwent TEE (n=61)

Patients without abnormal TEE findings (n=29; 48%)

Patients with abnormal TEE findings (n=32; 52%)

Patients without alterations in secondary prevention therapies based on TEE findings (n=51; 84%)

Patients with alterations in secondary prevention therapies based on TEE findings (n=10; 16%)

The flowchart presents the selection of included patients and the changes in therapeutic management after examination with TEE. ESUS = embolic stroke of undetermined source; IS = ischemic stroke; TEE = transesophageal echocardiography.
<table>
<thead>
<tr>
<th>Test</th>
<th>Rate %</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial ECG</td>
<td>4.8</td>
<td></td>
</tr>
<tr>
<td>Serial ECG</td>
<td>5.5</td>
<td>72h</td>
</tr>
<tr>
<td>Holter</td>
<td>4.6</td>
<td>24h</td>
</tr>
<tr>
<td>Telemetry</td>
<td>4- 8.4</td>
<td>48h</td>
</tr>
<tr>
<td>Event loop recorders or other ambulatory devices</td>
<td>5.7</td>
<td>24h</td>
</tr>
<tr>
<td></td>
<td>14.3</td>
<td>4 days</td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>21 days</td>
</tr>
</tbody>
</table>