

Diagnostic and Therapeutic Value of Echocardiography during the Acute Phase of Ischemic Stroke

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Background: Echocardiography is routinely used to identify potential cardiac sources of embolism (CSE) in the acute phase of ischemic stroke (IS). We know that transoesophageal echography (TEE) is superior to detect CSE than transthoracic echography (TTE). However, the indications of each technique remain controversial. We aimed to evaluate the diagnostic yield (DY) and the therapeutic impact (TI) of echocardiography (both techniques combined) in IS and to analyze impact of clinical factors on these values. *Methods:* We included consecutive IS patients over a period of 22 months. All patients underwent TTE, and selected patients (young or with a high suspicion of cardioembolic origin) then underwent TEE. DY (detection of CSE) and TI (introduction of oral anticoagulant, closure of patent foramen ovale and targeted cardiologic consultation) were systematically evaluated. *Results:* We analyzed 300 patients (mean age 61 years). All patients underwent TTE and 127 patients underwent TTE and TEE. Echocardiography overall detected CSE in 22% of patients with a TI in 11% of all cases. The TI was higher in patients less than or equal to 55 years of age. In contrast to other studies, the DY and TI of echocardiography were not associated with vascular risk factors. *Conclusions:* Echocardiography, as currently practiced in our stroke unit, allows detection of CSE in one patient in five, and leads to change in therapy in half of these cases. Our results suggest that TTE should be used for all patients admitted for IS, and to limit the use of TEE to younger patients. **Key Words:** Transthoracic echography—transoesophageal echography—echocardiography—stroke—diagnostic yield—therapeutic impact.
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Embolisms of cardiac origin are responsible for 15%-40% of ischemic strokes (ISs) and transient ischemic attacks (TIAs).¹ Atrial fibrillation (AF) is the most frequent etiology but there are many other cardiac factors that may

cause cerebral embolism. Most can be detected by transthoracic echocardiography (TTE) and/or transesophageal echocardiography (TEE). However, the indications for each of these techniques are not well defined in the literature. Some authors recommend TTE as the first-line investigation, arguing a high therapeutic impact (TI).^{2,3} However, TEE has been found to be superior to TTE but with a great variability in both the diagnostic yield (DY) and TI.^{4,5} Consequently, some authors propose that only TEE should be used,⁴ and others recommend the selective use of TEE.^{5,6} The heterogeneity and inaccuracies of guidelines contribute to the difficulty in determining the appropriate use of echocardiography during the acute phase of IS.

In this study, we aimed to evaluate the DY (defined as the detection of cardiac sources of embolism[CSE]) and the TI of echocardiography, both techniques combined,

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Received November 21, 2013; revision received March 11, 2014; accepted March 22, 2014.

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1052-3057/\$ - see front matter

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<http://dx.doi.org/10.1016/j.jstrokecerebrovasdis.2014.03.018>

in the acute phase of IS. We also analyzed the respective values (DY and TI) of the 2 techniques and we tried to determine the subgroups of patients for which echocardiography was the most useful, in terms of DY and TI.

Methods

Patients

From July 2009 to May 2011, consecutive patients admitted to our stroke center for an acute IS or TIA⁷ were prospectively enrolled.

Exclusion criteria included known AF treated with anticoagulants, consciousness disorder, or a previously identified etiology of IS (cervical artery dissection or surgical carotid stenosis).

Echocardiography

All patients underwent TTE, which was followed by TEE in the following cases: (1) suspicion of paradoxical embolism; (2) undetermined etiology in patients less than 55 years old; (3) multiple IS; or (4) abnormal TTE. Echocardiographic examinations were performed with a Philips IE33 cardiac ultrasound machine equipped with a 3-MHz phased-array transthoracic probe and a 5-7 MHz transesophageal probe. Contrast study with agitated saline, followed by the Valsalva maneuver, was performed for all TEE instances and exceptionally for the TTE instances.

Determination of CSE

In TTE, we screened the following CSE⁸: (1) intracardiac thrombus; (2) mitral valve stenosis; (3) left ventricular dyskinesia; (4) recent myocardial infarct (<1 month); (5) dilated cardiomyopathy; (6) left ventricular ejection fraction $\leq 35\%$; (7) interatrial anomalies (patent foramen ovale [PFO] only if the contrast study was done \pm atrial septal aneurysm [ASA] and atrial septal defect); (8) endocarditis; and (9) cardiac tumor.

In TEE, we screened the following CSE⁸: (1) intracardiac thrombus; (2) spontaneous echo contrast (SEC); (3) aortic arch atheroma (simple or complex); (4) interatrial anomalies (PFO \pm ASA and atrial septal defect); and (5) endocarditis.

PFO was considered after the appearance of at least 3 bubbles in left atrial, spontaneously or after the Valsalva maneuver, following 3 cardiac cycles and a complete opacification of right atrium.

ASA was defined as an excursion of the secundum septum with a base of at least 15 mm and an amplitude from the plane of the septum exceeding 10 mm in the right or left directions or both.

A thickness of atheroma protrusion greater than 4 mm with a mobile component and ulcerated plaque of at least 2 mm was classified as a complex aortic arch atheroma. Atheroma protrusions between 2 and 4 mm, without a

mobile component or ulcerated plaque, were scored as a simple aortic arch atheroma.⁸

Definitions of DY and TI

The DY was considered to be the number of patients who had at least 1 CSE.

The TI was defined as the proportion of patients for whom the CSE detection involved significant therapeutic modifications defined as follows: (1) introduction of oral anticoagulant (OA); (2) closure of a PFO; and (3) targeted cardiologic consultation (modification of the cardiotropic drug regimen).

Influence of Clinical Factors on DY and TI

To identify subgroups of patients in which echocardiography maybe particularly useful, we studied the potential associations of DY and TI with the following criteria: (1) age (young patients ≤ 55 years old vs. patients > 55 years old); (2) the presence and numbers of vascular risk factors; and (3) history of cardiac disease (angina or myocardial infarct).

Statistical Analysis

Descriptive statistics are presented as the means or medians \pm standard deviation or frequency (%). We used the Wilcoxon and McNemar tests and a logistic regression for the different analyses, with a significant P value of $P < .05$.

Results

Baseline Characteristics of Patients

A total of 431 patients were screened and 300 patients were finally enrolled (Fig 1). Their clinical characteristics are summarized in Table 1. At admission, AF was known but not anticoagulated in 12 patients and previously unknown AF was detected during hospitalization in 26 patients. TTE was performed in all patients and TEE in 127 patients, such that 127 patients underwent both examinations.

Results of Echocardiography

Echocardiography detected at least 1 CSE in 67 patients (22.3%) (Table 2). Other cardiac anomalies (not recognized as potentially cardioembolic) were found in 31.0% of patients: LA enlargement in 8.0% of cases and simple aortic atheroma in 6.7%. The findings had a therapeutic impact in 33 patients (11.0%) including introduction of anticoagulant in 10 cases (3.3%) and PFO closure in 5 cases (1.7%).

Among the 300 patients who underwent TTE, 43 (14.3%) CSE were identified. These findings had a TI for 21 patients (7.0%) with the introduction of anticoagulant in 5 cases (1.7%) and PFO closure in 2 cases (.7%).

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