Hotline Editorial

Transoesophageal echocardiography for immediate and safe cardioversion in patients with atrial fibrillation

Atrial fibrillation is the most commonly sustained arrhythmia: it has a considerable prevalence (0.4%) which must be expected to increase in the near future because of rising life expectancy[1]. Thus it is imperative to make cardioversion, for the adequate treatment of atrial fibrillation, as safe as possible.

In order to prevent stroke and other embolic events, anticoagulation with a target INR of 2.5 (range 2 to 3) for 3 weeks before and 4 weeks after cardioversion has been widely accepted[2] for patients presenting with atrial fibrillation of more than 48 h, or of unknown duration, although this treatment strategy has never been evaluated in a large prospective study[3]. Obviously, this approach has a number of drawbacks, including a potentially increased risk of bleeding and the inevitable delay before cardioversion — factors which may generally decrease the success of conversion therapy. In addition, this regimen requires repeat visits, INR measurements, and is expensive. Moreover, embolic events can occur despite therapeutic anticoagulation[3], because patients with thrombi in the left atrial appendage, who should possibly receive more intensive anticoagulation, are not identified prior to cardioversion.

Transoesophageal echocardiography opened a new window to the heart[5] and particularly to the left atrial appendage, where it can detect thrombi in 12% of patients with atrial fibrillation[6,7]. In order to reduce the number of embolic events — reported to occur in 3–4% of patients after cardioversion[3] — several investigators proposed performing transoesophageal echocardiography instead of prescribing a 3-week course of anticoagulation[3,6–9] instead of prescribing a 3-week course of anticoagulation. Only patients with atrial thrombi should receive conventional anticoagulation treatment and have their cardioversion postponed.

After cardioversion, left atrial mechanical function remains reduced[10], so that embolic events may occur after cardioversion, despite a restored sinus rhythm. The Assessment of Cardioversion Using Transoesophageal Echocardiography (ACUTE) multicentre study was therefore designed to resolve the controversies associated with the management of patients with atrial fibrillation.

The ACUTE multicentre study

The ACUTE multicentre study was a randomized clinical trial which prospectively compared a transoesophageal echocardiography-guided approach plus short-term anticoagulation to the conventional anticoagulation strategy. Patients who were to undergo elective cardioversion of atrial fibrillation lasting longer than 48 h[11] were enrolled. The trial was investigator-initiated by Alan Klein, MD (Cleveland Clinic) and without principal sponsorship. Primary end-points were stroke, transitory ischaemic attack, or peripheral embolism. All-cause mortality, major and minor bleeding, functional status, success of cardioversion, and maintenance of sinus rhythm were considered secondary end-points. Patients older than 18 years with atrial fibrillation of >48 h duration or atrial flutter with a documented history of atrial fibrillation were included. Exclusion criteria were chronic (>7 days) anticoagulation, haemodynamic instability, contraindications to warfarin or transoesophageal echocardiography, and any anticipated need to discontinue anticoagulation. The intended sample size had been 3000 patients; which would have resulted in a statistical power of >90%. The Data Safety and Monitoring Board and the ACUTE Steering Committee terminated the study before enrolling the target 3000 patients because of low event rates and slow recruitment[11,12].

First enrolment was carried out in 1994 and the study completed in 2000. Of 1222 randomized patients, 619 were assigned to the transoesophageal echocardiography-guided arm, whereas 603 were assigned to the conventional arm. Atrial cavity and appendage thrombi were detected by transoesophageal echocardiography in 76 patients (14%) — a higher percentage than expected from previously reported data[6,7] and surprising in view of the previously reported much lower frequency of embolic events in patients not receiving anticoagulation therapy[13]. When thrombi were detected, a 3-week course of anticoagulation with warfarin was started, and consequently, another transoesophageal echocardiography performed. Exclusion of atrial thrombi allowed early successful cardioversion in 81% of patients.
The total number of embolic events including stroke, transitory ischaemic attack, and peripheral embolism was very low in both groups: five (0.81%) in the transoesophageal echocardiography-group vs three (0.50%) in the conventional-treatment group; \( P = 0.501 \). In parallel, there was no statistically significant difference with respect to major embolic events: four (0.65%) vs two (0.33%); \( P = 0.432 \). In contrast, the transoesophageal echocardiography group experienced a significantly smaller number of bleeding episodes: 19 (3.11%) vs 33 (5.50%); \( P = 0.025 \). All cause mortality was shown to be higher in the transoesophageal echocardiography group (15 (2.42%) vs six (1.00%); \( P = 0.055 \), but cardiac-related death was not (eight (1.29%) vs four (0.66%); \( P = 0.265 \). With respect to the secondary end-points, no significant differences were found. Sinus rhythm could be maintained in 326 (52.7%) vs 304 (50.4%) patients; \( P = 0.431 \). In addition, functional capacity at 8 weeks was similar in both groups: 27.4 ± 18.3 vs 26.7 ± 18.6; \( P = 0.500 \). The long period of enrollment, the longer post-cardioversion follow-up in the transoesophageal echocardiography group compared to the conventional-treatment group, and the fact that the study was statistically underpowered must be considered limitations[13].

In conclusion, the transoesophageal echocardiography-guided strategy for cardioversion is as safe as the conventional one. It decreases bleeding complications and reduces the overall treatment time without increasing the risk of embolism. Thus, the newly developed management is a powerful alternative to long-term anticoagulation prior to cardioversion. Transoesophageal echocardiography-guided cardioversion, however, is not capable of improving the maintenance of sinus rhythm or functional capacity at 8 weeks, but it is more convenient for patients and probably lowers the average costs of atrial fibrillation treatment.

**Development of a transoesophageal echocardiography-guided strategy for cardioversion**

Transoesophageal echocardiography is a very safe diagnostic approach[14] and has markedly increased the diagnostic power of cardiovascular ultrasound in patients with atrial thrombi[15]. Nevertheless, embolism may occur after cardioversion of atrial fibrillation, even if pre-existing atrial thrombus has seemingly been ruled out by transoesophageal echocardiography. This suggests that transoesophageal echocardiography is not sensitive enough to detect atrial thrombi or delayed thrombus formation[16]. This lack of sensitivity, albeit minor, was confirmed by the outcome of the ACUTE multicentre trial[13]. One reason for this minor imperfection may be a certain inter-observer variability for left atrial and appendage thrombi as well as for left atrial spontaneous echo contrast[16]. Musculi pectinati and lobulated appendages, in particular, may prevent detection of thrombi in specific cases.

Undoubtedly, a reliable echocardiographic diagnosis requires the examiner to be sufficiently trained and experienced; this holds particularly true with respect to the detection of appendage thrombi. This limitation may be overcome by additional use of tissue Doppler transoesophageal echocardiography because the detection and documentation of both left atrial thrombi and spontaneous echo contrast is improved by visualizing specific motion patterns[17,18]. Thrombi in the left atrium are characterized by incoherent motion (Fig. 1), which is defined as passive and different in velocity and direction of motion compared with the surrounding tissue for a time interval >50 ms. In contrast, thrombi confined to the left atrial appendage cannot oscillate freely. However, colour-coding different from that of normal tissue is caused by an effectively damped oscillation and consecutive coherent motion with a phase difference[17]. Spontaneous echo contrast can also be better detected and documented when tissue Doppler is used instead of fundamental imaging, since colour-coding facilitates differentiation between the revolving motion of spontaneous echo contrast and artefacts or noise[18].

**Transoesophageal echocardiography-guided strategy in the clinical practice**

In our department, the transoesophageal echocardiography-guided strategy has been used for the last 6 years to manage patients with atrial fibrillation. We surveyed 220 patients with atrial fibrillation who underwent short-term anticoagulation and in whom intracardiac thrombi were ruled out by transoesophageal echocardiography performed directly prior to cardioversion. Neither embolic events nor any transoesophageal echocardiography-related complication occurred. Thus, the transoesophageal echocardiography-guided strategy can be recommended for all patients with atrial fibrillation undergoing elective cardioversion (Fig. 2). Extensive experience in transoesophageal echocardiography is required to safely rule out thrombi, especially those in the left atrial appendage. In this respect, tissue Doppler echocardiography may be helpful in order to identify thrombi and spontaneous echo contrast.
Therefore, this technique may further benefit from this strategy. Cardiac and non-cardiac diseases possibly responsible for atrial fibrillation should always be effectively treated prior to cardioversion. An accurate diagnosis is therefore imperative.

**Summary**

The recently published outcomes of the ACUTE multicentre trial give evidence that echocardiographic exclusion of cardiac thrombi in combination with short-term anticoagulation represents an effective strategy to overcome the drawbacks of conventional long-term anticoagulation prior to elective cardioversion, without increasing the risk of embolism. Thus, the transoesophageal echocardiography-guided strategy can be recommended as an excellent alternative to the conventional approach. As an additional tool, tissue Doppler may be helpful because it supports visualization of cardiac thrombi. Nevertheless, sufficient experience in transoesophageal echocardiography is necessary to fully utilize this approach.

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**Figure 1** Incoherent motion of a left atrial thrombus depicted by transoesophageal tissue Doppler echocardiography. LA=left atrium; LV=left ventricle; AO=aorta; = thrombus showing different colour-coding compared to native tissue.

**Figure 2** Diagnostic and therapeutic strategy derived from the results of the ACUTE study in patients with atrial fibrillation prior to and after cardioversion.
echocardiography is mandatory to derive benefits from this strategy.

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References


