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THE ACUTE TRIAL

Transesophageal echocardiography to guide electrical cardioversion in atrial fibrillation

ABSTRACT

The Assessment of Cardioversion Using Transesophageal Echocardiography (ACUTE) trial compared cardioversion following transesophageal echocardiography (TEE) against conventional management of atrial fibrillation (ie, cardioversion following 3 weeks of anticoagulation) in patients scheduled to undergo electrical cardioversion.

KEY POINTS

In the study, the chief advantages of TEE-guided cardioversion of atrial fibrillation compared with the conventional approach appeared to be the shorter course of anticoagulation required, earlier cardioversion, and fewer bleeding events.

The trial showed no advantage of a TEE-guided approach over conventional management in rates of embolic events (the primary end point), death, maintenance of sinus rhythm, or functional status.

Patients best suited for the TEE-guided approach include those with new-onset atrial fibrillation who require expedited (but not emergency) cardioversion due to ischemia, congestive heart failure, hemodynamic effects, or intolerable symptoms.

Patients best suited for the conventional strategy include those who do not require hospitalization, have only mild symptoms, and have no hemodynamic impairment.

ELECTRICAL CONVERSION of atrial fibrillation to sinus rhythm carries a risk of stroke or embolism, either because a preexisting left atrial thrombus dislodges or because a thrombus forms during "atrial stunning"—the time before a return to normal atrial function that typically follows electrical cardioversion.[1,2]

Two strategies have evolved to prevent stroke after cardioversion. In patients with atrial fibrillation for longer than 48 hours, the conventional approach is to give anticoagulants for at least 3 weeks before and for 4 weeks after cardioversion.[3–5] A newer approach, used for the past 10 years, is to use transesophageal echocardiography (TEE) to guide the decision about when to perform cardioversion: TEE is used to rule out the presence of left atrial thrombi before cardioversion, thus permitting cardioversion sooner and with a shorter period of anticoagulation before cardioversion.[6–9]

In this article, we review the results of the Assessment of Cardioversion Using Transesophageal Echocardiography (ACUTE) trial,[10] the first randomized, prospective clinical trial to compare the conventional approach with the TEE-guided approach.

THE CONVENTIONAL AND THE GUIDED APPROACH

The conventional approach has the support of the American College of Chest Physicians and has been used since the 1970s. Its use is associated with embolism rates of less than 3%.[3,4] Most of the data defending this approach are from observational studies, not from prospec-

FIGURE 1

tive, randomized trials.[5]

The TEE-guided strategy involves short-term anticoagulation (approximately 3 days vs 31 days with the conventional approach), TEE to rule out left atrial thrombi, then cardioversion, followed by the usual 4 weeks of anticoagulation.

Advances in multiplane technology enable TEE to detect small thrombi (a few millimeters in size), and as a result, left atrial thrombi can be excluded with greater than 95% accuracy.[11–13] Patients still require a month of anticoagulation after cardioversion because of atrial stunning. Pilot studies of the

TEE-guided approach showed it to be as safe as the conventional approach, with similarly low rates of embolic events.[7,9]

DESIGN OF THE ACUTE TRIAL

The ACUTE trial was an investigator-initiated (ie, no funding from industry), randomized, international, multicenter trial that enrolled patients from 1994 through 1999.[10] Seventy clinical sites enrolled 1,222 patients, randomly assigned to the TEE-guided approach (619 patients) or the conventional approach (603 patients). The study was originally designed to enroll 3,000 patients but was stopped early because of low rates of both recruitment and embolic events.

Inclusion criteria

According to the study protocol (FIGURE 1), all patients had atrial fibrillation lasting longer than 2 days and had received a prescription for electrical cardioversion from their primary physician. The conventional treatment group received warfarin for 3 weeks at therapeutic levels before undergoing cardioversion. In the TEE-guided group, hospitalized patients received intravenous heparin for 1 day and outpatients received warfarin for 5 days prior to cardioversion.

Exclusion criteria

Patients were excluded from the study if they:

- Had atrial flutter and no history of atrial fibrillation
- Were hemodynamically unstable
- Were on long-term warfarin therapy
- Had contraindications to warfarin or TEE.

These exclusion criteria were important, because patients on chronic anticoagulation were excluded.

Study end points

The primary end point of the study was an embolic event such as stroke, transient ischemic attack, or peripheral embolism. Secondary end points assessed included hemorrhage, functional status, achievement of sinus rhythm, and death. Relative costs[14] were also assessed but were not reported in the principal manuscript. Outcomes were determined based on 8 weeks from the time of randomization.

Similarities and differences of the two study groups

Most patients in each group had similar clinical and echocardiographic characteristics:

- The mean age was 64 years
- 66% were men
- The mean left ventricular ejection fraction was 50%
- 85% were in New York Heart Association (NYHA) functional class I or II
- The estimated median duration of atrial fibrillation was 13 days.

Patients in the conventional treatment group had a higher prevalence of antiarrhythmic therapy compared with the TEE-guided group (92.8 vs 82.2%, $P < .001$).

RESULTS OF THE ACUTE TRIAL

Of the 619 patients randomized to the TEE group, 425 (69%) had early electrical cardioversion at a mean of 3 days; and in 344 (81%) of these, the cardioversion was successful. Among the 124 patients who had TEE but not early electrical cardioversion (20%), cardioversion was postponed in 76 (61%) due to thrombi. These 76 patients (13.8%) were identified among the 549 patients who actually had the TEE examination.

TEE guidance allows cardioversion after only 3 days of anticoagulation

Of the 603 patients in the conventional treatment arm, 333 (55%) underwent electrical cardioversion at a mean of 31 days; and in 266 (80%) of these, cardioversion was immediately successful. Of the 45% (270) who did not undergo cardioversion, 47% reverted to sinus rhythm spontaneously or with chemical therapy. The remaining 53% of patients did not undergo cardioversion within the 8-week study period due to patient refusal, death, surgery, physician decision against cardioversion, subtherapeutic international normalized ratio (INR), bleeding, or loss to follow-up.

Number of embolic events

The number of embolic events in the two study groups was five in the TEE group (0.8%) vs three in the conventional group (0.5%; $P = .50$) (TABLE 1). Sample size estimates based on prior, mostly nonrandomized studies had pre-

TABLE 1

dicted a higher embolism rate of 1% to 3%.[4] The relatively short duration of atrial fibrillation and the early initiation of anticoagulation in the ACUTE trial may have contributed to the low rate of embolic events.

Shorter anticoagulation meant less bleeding

Bleeding events

Due to the longer period of anticoagulation used in the conventional treatment group, bleeding occurred more often (TABLE 1): major and minor hemorrhage occurred in 2.9% of patients in the TEE group, but in 5.5% of those in the conventional treatment group (relative risk 0.53, 95% confidence interval 0.30–0.93, $P = .03$). Of the 14 major bleeding events, 10 were due to gastrointestinal causes. Fifty-seven percent of patients with a major bleeding event had an INR greater than 3.0 at the time of bleeding, and most patients who had an embolic event had a low INR.[15]

Death from all causes

The rate of death from all causes was not statistically different between the two groups, although the TEE group had a notable trend toward a higher death rate (TABLE 1). However, the investigators provided a detailed account of the cause of death for each patient, revealing that only one patient (in the conventional treatment group) died as a result of a stroke, whereas the other deaths were not due to thromboembolic events. The rate of cardiac-related deaths was similar between the two groups.

Shorter time to electrical cardioversion

Patients undergoing TEE had electrical cardioversion earlier: 3.0 days from enrollment for the TEE-guided group vs 31 days from enrollment for the conventional treatment group. The initial success of electrical cardioversion was 80% for both groups, but there was a greater rate of successful restoration of sinus rhythm in the TEE group (71% vs 65%, $P = .03$). However, the maintenance of sinus rhythm at 8 weeks after randomization was similar for the two groups (52.7% with TEE vs 50.4% with conventional treatment, $P = .43$), despite the greater use of antiarrhythmic agents in the conventional treatment group.

Functional status

Assessment of functional status using the Duke Activity Status Index revealed no differences between the groups at baseline and at 8-week follow-up.

TABLE 2

TEE or not TEE? Patient selection criteria in atrial fibrillation of longer than 48 hours' duration

Transesophageal echocardiography to guide when to perform electrical cardioversion may be appropriate if the patient:

- Has new-onset atrial fibrillation, uncertain anticoagulation status, subtherapeutic anticoagulation levels
- Has symptoms
- Has hemodynamic compromise, congestive heart failure, ischemia (except if unstable)
- Is hospitalized
- Is at high risk of bleeding
- Has difficulty complying with anticoagulation therapy regimen (needs short-term course)
- Is at high risk for stroke
  - Has valvular disease, left ventricular dysfunction, prior left atrial thrombus, history of stroke, advanced age, systolic hypertension

Conventional management may be appropriate if the patient:

- Is on chronic or therapeutic anticoagulation
- Has no symptoms or minimal symptoms
- Is hemodynamically stable
- Is not hospitalized
- Has a low risk of bleeding
- Can comply with anticoagulation regimen
- Is at low risk for stroke
  - Has normal left ventricular function and no valvular heart disease, no clinical risk factors as listed above
- Has a high likelihood of spontaneous or chemical conversion with inciting factors for atrial fibrillation
- Has contraindications to or cannot tolerate transesophageal echocardiography

PUTTING THE RESULTS INTO PRACTICE

The ACUTE trial, the first large randomized evaluation of patients with atrial fibrillation scheduled for electrical cardioversion, showed that a protocol of TEE-guided cardioversion was as safe as the conventional strategy. The advantages of TEE-guided cardioversion appeared to be a shorter course of anticoagulation before cardioversion, earlier cardioversion, and fewer bleeding events. Otherwise, the two approaches seemed similar with respect to death rates, maintenance of sinus rhythm, and functional status.

Thus, clinicians now have an alternative management strategy for atrial fibrillation and need to know which patients might benefit from this approach. We must keep in mind, however, that the patients in the ACUTE trial do not reflect all patients with atrial fibrillation.

Atrial fibrillation is categorized on a continuum from acute to chronic, depending on the duration of atrial fibrillation and the likelihood of successful reversion. Patients in the ACUTE trial generally had atrial fibrillation of shorter duration (median 13 days) and were not on long-term anticoagulation. Most were not in congestive heart failure (NYHA functional class III or IV), and many reverted to sinus rhythm before cardioversion.

Specific indications for the TEE-guided approach

Patients best suited for the TEE-guided approach are those with new-onset atrial fibrillation who require expedited but not emergency cardioversion due to ischemia, congestive heart failure, hemodynamic effects, or intolerable symptoms. Such patients are usually hospitalized, and the physician thus has the opportunity to observe the response to therapy and symptom relief.

Patients already on long-term anticoagulation but with an uncertain, subtherapeutic, or infrequently monitored INR may also benefit from earlier cardioversion via the TEE-

guided approach; patients not on anticoagulation because of a high risk of bleeding may benefit from the shorter course of anticoagulation with the TEE-guided approach. Finally, some patients are at significantly higher risk for left atrial thrombi and are—at least theoretically—at higher risk for embolic events with a conventional approach to cardioversion (TABLE 2).

Indications for the conventional approach

Patients best suited to the conventional strategy include those who do not require hospitalization, have only mild symptoms, and are not hemodynamically impaired. Patients on long-term anticoagulation with therapeutic levels and no history of bleeding can be managed by the conventional strategy. Also, patients who have transient atrial fibrillation due to factors such as alcohol or stimulant use or surgery and have a chance for spontaneous or chemical reversion may be spared TEE, which is a semi-invasive procedure (TABLE 2).

Factors influencing the decision

The decision to use the TEE-guided or the conventional approach must be individualized, depending on the following factors:

- Severity of symptoms and hemodynamic effect
- Level and duration of anticoagulation
- Risk of bleeding
- Duration of atrial fibrillation and likelihood of reversion
- Risk of left atrial thrombus formation.

ACUTE II is studying low-molecular-weight heparin in TEE-guided cardioversion

FURTHER EVOLUTION OF ATRIAL FIBRILLATION MANAGEMENT

The management of atrial fibrillation using a TEE-guided approach continues to evolve. The ACUTE II trial is a randomized study using low-molecular-weight heparin compared with intravenous unfractionated heparin in patients with atrial fibrillation who are started on warfarin. The low-molecular-weight heparin strategy has the potential to reduce the costs and the need for hospitalization for patients undergoing the TEE-guided approach. This study is under way, with 90 patients randomized.[16]

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