

## AMIODARONE AS COMPARED WITH LIDOCAINE FOR SHOCK-RESISTANT VENTRICULAR FIBRILLATION

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### ABSTRACT

**Background** Lidocaine has been the initial antiarrhythmic drug treatment recommended for patients with ventricular fibrillation that is resistant to conversion by defibrillator shocks. We performed a randomized trial comparing intravenous lidocaine with intravenous amiodarone as an adjunct to defibrillation in victims of out-of-hospital cardiac arrest.

**Methods** Patients were enrolled if they had out-of-hospital ventricular fibrillation resistant to three shocks, intravenous epinephrine, and a further shock; or if they had recurrent ventricular fibrillation after initially successful defibrillation. They were randomly assigned in a double-blind manner to receive intravenous amiodarone plus lidocaine placebo or intravenous lidocaine plus amiodarone placebo. The primary end point was the proportion of patients who survived to be admitted to the hospital.

**Results** In total, 347 patients (mean [ $\pm$ SD] age,  $67\pm 14$  years) were enrolled. The mean interval between the time at which paramedics were dispatched to the scene of the cardiac arrest and the time of their arrival was  $7\pm 3$  minutes, and the mean interval from dispatch to drug administration was  $25\pm 8$  minutes. After treatment with amiodarone, 22.8 percent of 180 patients survived to hospital admission, as compared with 12.0 percent of 167 patients treated with lidocaine ( $P=0.009$ ; odds ratio, 2.17; 95 percent confidence interval, 1.21 to 3.83). Among patients for whom the time from dispatch to the administration of the drug was equal to or less than the median time (24 minutes), 27.7 percent of those given amiodarone and 15.3 percent of those given lidocaine survived to hospital admission ( $P=0.05$ ).

**Conclusions** As compared with lidocaine, amiodarone leads to substantially higher rates of survival to hospital admission in patients with shock-resistant out-of-hospital ventricular fibrillation. (N Engl J Med 2002;346:884-90.)

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**V**ENTRICULAR fibrillation is the most common cause of out-of-hospital cardiac arrest.<sup>1</sup> An estimated 250,000 out-of-hospital cardiac arrests occur each year in the United States; the case fatality rate remains very high, generally more than 95 percent.<sup>1</sup>

Antiarrhythmic therapy is often administered to patients with ventricular fibrillation; the "Guidelines 2000 for Cardiopulmonary Resuscitation and Emer-

gency Cardiovascular Care" of the American Heart Association and the International Liaison Committee on Resuscitation recommend antiarrhythmic drugs as "acceptable" and "probably helpful" in the treatment of ventricular fibrillation that persists after three or more external defibrillation shocks.<sup>2</sup> Lidocaine has traditionally been used in such cases, as well as for the prevention of recurrent ventricular fibrillation.<sup>3</sup> However, no randomized clinical trial has demonstrated the efficacy of lidocaine for these indications. The current guidelines recommend considering the use of either amiodarone or lidocaine for shock-resistant ventricular fibrillation.<sup>2</sup>

The Amiodarone versus Lidocaine in Prehospital Ventricular Fibrillation Evaluation (ALIVE) was a double-blind, controlled clinical trial comparing amiodarone with lidocaine in patients with out-of-hospital ventricular fibrillation in Toronto.

### METHODS

#### Patients

Patients were eligible if they were adults with electrocardiographically documented out-of-hospital ventricular fibrillation, not due to trauma, or with other cardiac rhythms that converted to ventricular fibrillation; if the ventricular fibrillation was resistant to three shocks from an external defibrillator, at least one dose of intravenous epinephrine, and a fourth defibrillator shock; and if they continued to have ventricular fibrillation or had recurrent ventricular fibrillation after successful initial defibrillation.

#### Protocol

The study was conducted under the auspices of the Toronto Emergency Medical Services system, a multitiered out-of-hospital emergency-response system that follows treatment protocols in accordance with the American Heart Association guidelines for advanced cardiac life support.<sup>2</sup> The human-subjects review committee of the University of Toronto approved the study, including its provisions for waiver of informed consent. The investigator-initiated protocol was designed, drafted, and executed, and the results were analyzed, without any contribution from the study sponsors (Wyeth-Ayerst Laboratories). The manuscript was written entirely by the study authors and was not sent to the sponsors for review. All the authors contributed to the planning and execution of the trial, as well as to the analysis of the results and the drafting of the manuscript.

Drug-administration kits were distributed to ambulances, one

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at a time, in balanced, randomized order in blocks of four. Each kit contained either active amiodarone (Cordarone, Wyeth-Ayerst Laboratories, Philadelphia) and lidocaine placebo or active lidocaine (supplied by Sanofi-Synthelabo, Paris) and amiodarone placebo. Amiodarone (5 mg per kilogram of estimated body weight) or its matching placebo containing the same diluent (polysorbate 80), diluted to 30 ml with 5 percent dextrose in water, and lidocaine (1.5 mg per kilogram at a concentration of 10 mg per milliliter) or its matching placebo were infused rapidly into a peripheral vein, and further defibrillator shocks were administered as necessary, along with further advanced cardiac life support.<sup>2,3</sup>

If ventricular fibrillation persisted after a further shock, a second dose of the study drug was administered (1.5 mg of lidocaine per kilogram or 2.5 mg of amiodarone per kilogram, together with placebo), and attempts at resuscitation were continued. Resuscitated patients were admitted to 1 of 17 community hospitals, without disclosure of their treatment assignment or any directives for further treatment.

#### Recording of Data

All data were analyzed without knowledge of the patients' treatment assignments. Data on the patient's course before hospitalization were obtained from the ambulance call report, which included documentation of the initial and all subsequent cardiac rhythms during treatment of the arrest, all drugs administered, the state of circulation (the presence or absence of a spontaneous palpable pulse), and the time, recorded in Utstein reference format. The time of dispatch was recorded as the time when the emergency-response dispatch center ordered emergency personnel to go to the scene. Data on admission to and discharge from the hospital were obtained from hospital charts.

#### End Points

The primary study end point was survival to admission to the hospital intensive care unit; patients who died in the emergency department were not considered to have been admitted. Secondary end points included survival to discharge from the hospital and adverse events, defined as the need to administer atropine or dopamine after administration of the study drug.

#### Statistical Analysis

On the basis of an estimated improvement in survival to hospital admission from 25 percent among patients receiving lidocaine to 40 percent among those receiving amiodarone, an alpha error of 0.05, and a power of 80 percent, a required sample size of 160 patients in each treatment group, or a total of 320 patients, was calculated; this figure was increased to 350 to allow for missing data. The study results were reviewed by an independent data and safety monitoring board, whose members could recommend termination of the study.

Summary statistics for continuous variables were recorded as means and standard deviations, as well as medians; comparisons between the two treatment groups were performed with the Wilcoxon rank-sum test. All *P* values are two-tailed. Categorical data were summarized as frequencies and percentages, and comparisons between the two treatment groups were performed with the Pearson chi-square test or Fisher's exact test. Multiple logistic regression with backward selection of variables and calculation of odds ratios was used to identify variables that predicted the rate of survival to hospital admission.

### RESULTS

Between November 1995 and April 2001, 347 patients (mean [ $\pm$ SD] age,  $67 \pm 14$  years) were randomly assigned to receive amiodarone (180 patients) or lidocaine (167 patients). During this period, car-

diac arrests occurred at the rate of approximately 1400 per year in the metropolitan Toronto Emergency Medical Services system; 78 percent of these arrests were treated by advanced life-support crews. Approximately 26 percent of the patients treated by the crews had ventricular fibrillation.

All patients in the study had ventricular fibrillation or pulseless ventricular tachycardia at some time during treatment of the cardiac arrest. The distribution of initial rhythms and rhythm at the time of administration of the study drug, intervals to procedures, and characteristics of patients is given in Table 1. The mean interval from the time at which paramedics were dispatched to the scene and their arrival at the patient's side was  $7 \pm 3$  minutes, and the mean interval from dispatch to the time of drug administration was  $25 \pm 8$  minutes. Except for the study drugs administered, there were no significant differences between the amiodarone and lidocaine groups in any treatment or procedure (Table 1). Eighty-seven patients in the amiodarone group and 86 patients in the lidocaine group received a second dose of the study drug.

#### Effect of Clinical Variables on Survival

Shorter intervals from the dispatch of the crew to the administration of the study drug were associated with increased survival to hospital admission. The 50 percent of patients with such intervals at or below the median of 24 minutes had an overall survival to hospital admission of 21.4 percent, as compared with 12.7 percent for the patients with intervals above the median (*P*=0.04). Unadjusted analysis found no association between survival to hospital admission and whether or not the first shock was administered by a basic-life-support crew (which was not equipped for advanced cardiac life-support treatment or administration of the study drug), the interval from dispatch to the first attempt at defibrillation (for patients with ventricular fibrillation as the initial rhythm), or whether or not a bystander performed cardiopulmonary resuscitation (Table 2). However, among patients whose initial rhythm was ventricular fibrillation, the interval from the first shock to the administration of the drug was a significant predictor of survival (odds ratio for survival for each minute of delay, 0.87; 95 percent confidence interval, 0.80 to 0.96; *P*=0.003).

Patients in whom cardiac arrest was due to ventricular fibrillation were more likely to survive to hospital admission than those whose initial rhythm was asystole or pulseless electrical activity (19.6 percent vs. 8.2 percent; *P*<0.05; odds ratio for survival, 2.27; 95 percent confidence interval, 0.99 to 5.23). Of the 35 patients who had a transient return of spontaneous circulation before the administration of the study drug (10 percent of the entire study group), 15 (42.9

**TABLE 1. CLINICAL CHARACTERISTICS OF THE PATIENTS AND COURSE OF RESUSCITATION BEFORE THE ADMINISTRATION OF AMIODARONE OR LIDOCAINE.\***

CHARACTERISTIC	AMIODARONE (N=180)	LIDOCAINE (N=167)
Male sex — no. (%)	136 (76)	136 (81)
Age — yr	68±14	66±13
History of cardiac disease — no. (%)†	110 (61)	99 (59)
Witnessed arrest — no. (%)‡	136 (76)	130 (78)
CPR by bystander — no. (%)‡	47 (26)	47 (28)
Initial cardiac rhythm — no. (%)		
Ventricular fibrillation	140 (78)	132 (79)
Pulseless ventricular tachycardia	1 (1)	2 (1)
Asystole converting to ventricular fibrillation	20 (11)	16 (10)
Pulseless electrical activity converting to ventricular fibrillation	14 (8)	11 (7)
Rhythm at the time of drug administration — no. (%)		
Ventricular fibrillation	163 (91)	156 (93)
Pulseless ventricular tachycardia	3 (2)	4 (2)
Other pulseless rhythm	11 (6)	7 (4)
Supraventricular rhythm	3 (2)	1 (1)
Time from dispatch to response or procedure — min		
First shock§		
Mean ±SD	8±3	9±4
Median	8	9
Intubation		
Mean ±SD	11±4	11±4
Median	11	11
Intravenous access		
Mean ±SD	13±4	14±4
Median	13	13
Administration of study drug¶		
Mean ±SD	25±8	24±7
Median	24	24

\*Plus-minus values are means ±SD. There were no significant differences between the amiodarone and lidocaine groups. CPR denotes cardiopulmonary resuscitation.

†Data were available for 148 amiodarone recipients and 131 lidocaine recipients.

‡Data were available for 179 amiodarone recipients and 164 lidocaine recipients.

§The data are from patients whose initial rhythm was ventricular fibrillation or pulseless ventricular tachycardia and do not include data from patients who received a shock only from a basic life-support crew (69 treated with amiodarone and 72 treated with lidocaine).

¶Data were available for 162 amiodarone recipients and 148 lidocaine recipients.

percent) survived to hospital admission, as compared with 46 of the 312 patients (14.7 percent) without transient return of spontaneous circulation ( $P \leq 0.001$ ). The characteristics of resuscitation and treatment before and after the administration of amiodarone or lidocaine are listed in Table 3.

#### Effect of the Study Drug on Survival

Forty-one patients (22.8 percent) in the amiodarone group survived to hospital admission, as compared with 20 patients (12.0 percent) in the lidocaine group ( $P=0.009$ ; unadjusted odds ratio for survival,

2.17; 95 percent confidence interval, 1.21 to 3.83) (Table 2). This change represents a relative improvement of 90 percent (Fig. 1). After adjustment for other factors that may influence the likelihood of survival, the only factors that significantly influenced the primary outcome were the study-drug assignment, the length of time to the administration of the drug (odds ratio for survival for each minute of delay, 0.88; 95 percent confidence interval, 0.83 to 0.93;  $P < 0.001$ ), and the presence or absence of a transient return of spontaneous circulation before the administration of the study drug (odds ratio for survival with transient return, 5.93; 95 percent confidence interval, 2.46 to 14.26;  $P < 0.001$ ). The adjusted odds ratio for survival to hospital admission in recipients of amiodarone as compared with recipients of lidocaine was 2.49 (95 percent confidence interval, 1.28 to 4.85;  $P=0.007$ ).

A minority of patients had a transient return of spontaneous circulation before the administration of the study drug: 24 patients in the amiodarone group (13.3 percent) and 11 patients in the lidocaine group (6.6 percent,  $P=0.04$ ) (Table 3). Ten of the 24 amiodarone-treated patients (41.7 percent) survived to hospital admission, and 4 of these 10 (16.7 percent) survived to discharge from the hospital. Three of the 11 lidocaine-treated patients (27.3 percent) survived to admission, and none survived to discharge ( $P=0.48$  and  $P=0.28$ , respectively). Among the patients in whom there was no transient return of spontaneous circulation, 31 of 156 treated with amiodarone (19.9 percent) survived to hospital admission, as compared with 17 of 156 treated with lidocaine (10.9 percent,  $P=0.04$ ) (Fig. 1).

Among patients who had ventricular fibrillation or pulseless ventricular tachycardia as their initial rhythm, 35 of 141 given amiodarone (24.8 percent) survived to hospital admission, as compared with 19 of 134 given lidocaine (14.2 percent,  $P=0.03$ ). Among 69 patients with an initial rhythm other than ventricular fibrillation or pulseless ventricular tachycardia, 6 of 38 given amiodarone (15.8 percent) survived to hospital admission, as compared with 1 of 31 given lidocaine (3.2 percent,  $P=0.08$ ) (Fig. 1).

Figure 2 illustrates the effect of length of time between the dispatch of the crew and the administration of the study drug on the proportion of amiodarone-treated and lidocaine-treated patients who survived to hospital admission. Among both patients treated at or before the median interval (24 minutes) and those treated after the median interval, the proportion surviving until admission was significantly higher after treatment with amiodarone than after treatment with lidocaine (time effect,  $P < 0.001$ ; drug effect,  $P=0.005$ ; interaction between time and drug,  $P=0.26$ ).

**TABLE 2.** ODDS RATIOS FOR SURVIVAL TO HOSPITAL ADMISSION ACCORDING TO SELECTED FACTORS, FROM THE UNADJUSTED AND ADJUSTED ANALYSES.\*

FACTOR	ODDS RATIO FOR SURVIVAL (95% CI)	P VALUE
<b>Unadjusted analysis</b>		
Treatment assignment (amiodarone vs. lidocaine)	2.17 (1.21–3.83)	0.009
Time from dispatch to drug administration (per 1-min increase)	0.91 (0.86–0.96)	<0.001
Transient return of spontaneous circulation before drug administration (yes vs. no)	3.6 (1.7–7.3)	<0.001
Initial rhythm (VF or pulseless ventricular tachycardia vs. asystole or pulseless electrical activity)	2.27 (0.99–5.23)	0.05
Witnessed arrest (yes vs. no)	2.10 (0.95–4.63)	0.07
Age (per additional yr)	0.999 (0.978–1.019)	0.90
Sex (male vs. female)	0.73 (0.39–1.38)	0.34
History of heart disease (yes vs. no)	1.23 (0.59–2.56)	0.58
No. of shocks (per additional shock)	0.86 (0.73–1.02)	0.08
CPR by bystander (yes vs. no)	1.41 (0.78–2.56)	0.26
Defibrillation by basic life-support crew (yes vs. no)	1.34 (0.51–3.57)	0.55
Time to first defibrillation (per 1-min increase)†	1.02 (0.91–1.16)	0.71
<b>Adjusted analysis‡</b>		
Treatment assignment (amiodarone vs. lidocaine)	2.49 (1.28–4.85)	0.007
Time from dispatch to drug administration (per 1-min increase)	0.88 (0.83–0.93)	<0.001
Transient return of spontaneous circulation before drug administration (yes vs. no)	5.93 (2.46–14.26)	<0.001

\*CI denotes confidence interval, VF ventricular fibrillation, and CPR cardiopulmonary resuscitation.

†The calculation was based on the interval from dispatch to first defibrillation by an advanced life-support crew in patients whose initial rhythm was ventricular fibrillation.

‡In the adjusted analysis, the odds ratios were adjusted for all factors that could potentially affect survival to hospital admission for which P<0.02 in the unadjusted analysis.

**TABLE 3.** CHARACTERISTICS OF RESUSCITATION AND TREATMENT BEFORE AND AFTER THE ADMINISTRATION OF AMIODARONE OR LIDOCAINE.

CHARACTERISTIC	AMIODARONE (N = 180)	LIDOCAINE (N = 167)
<b>Before study drug</b>		
No. of shocks		
Mean ±SD	5 ± 1.9	5 ± 2.2
Median	4	4
Transient return of spontaneous circulation — no. (%)	24 (13)	11 (7)*
Treatment for bradycardia (atropine) — no. (%)	98 (54)	96 (57)
Pressor treatment (dopamine) — no. (%)	2 (1)	0
Antiarrhythmic drug treatment (open-label lidocaine) — no. (%)	4 (2)	1 (1)
<b>After study drug</b>		
Treatment for bradycardia (atropine) — no. (%)	43 (24)	38 (23)
Pressor treatment (dopamine) — no. (%)	13 (7)	6 (4)
Antiarrhythmic drug treatment (open-label lidocaine) — no. (%)	11 (6)	10 (6)

\*P=0.04 for the comparison with the amiodarone group. All other differences were nonsignificant.

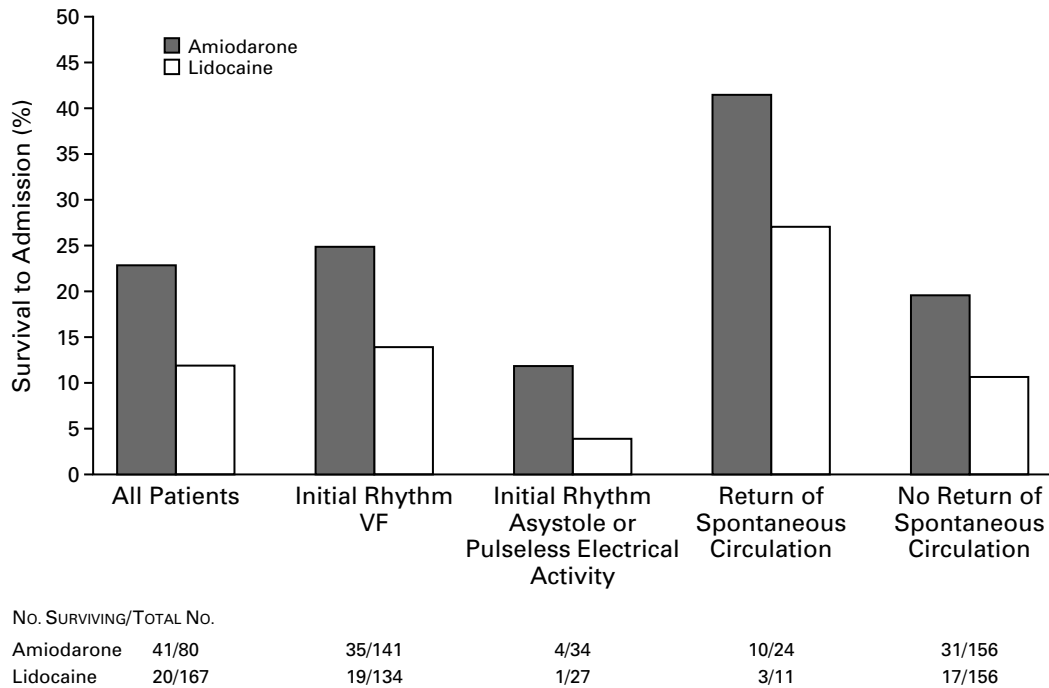
There were no differences between the treatment groups in the proportions of patients who needed treatment of bradycardia with atropine or pressor treatment with dopamine or in the proportions receiving open-label lidocaine (Table 3).

The proportion of patients in whom asystole occurred following defibrillation shock after administration of the initial study drug was significantly higher

in the lidocaine group (41 of 142 patients, 28.9 percent) than in the amiodarone group (28 of 152, 18.4 percent; P=0.04).

**Survival after Hospital Admission**

Among the 41 patients who survived to hospital admission after receiving amiodarone, 9 (5 percent of the entire group) survived to hospital discharge,



**Figure 1.** Effect of Treatment with Amiodarone or Lidocaine on the Rate of Survival to Hospital Admission in All Patients and in Selected Subgroups.

VF denotes ventricular fibrillation. Return of spontaneous circulation refers to transient return before the administration of the study drug.

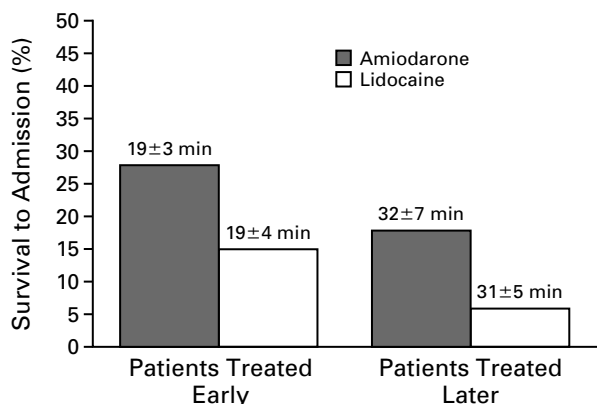
as compared with 5 of the 20 initial survivors in the lidocaine group (3 percent of the entire group,  $P=0.34$ ). The initial rhythm was ventricular fibrillation in all the long-term survivors; among those in whom the initial rhythm was ventricular fibrillation, 9 of 140 treated with amiodarone (6.4 percent) and 5 of 132 treated with lidocaine (3.8 percent) were discharged from the hospital alive ( $P=0.32$ ).

### DISCUSSION

Although antiarrhythmic drug therapy is often administered during the course of cardiac arrest due to ventricular fibrillation or pulseless ventricular tachycardia, there has been no agreement on the preferred drug in such situations.<sup>1</sup> According to the “Guidelines 2000 for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care,” amiodarone and lidocaine should be considered for patients with persistent or recurrent ventricular fibrillation or pulseless ventricular tachycardia after three unsuccessful defibrillator shocks, administration of epinephrine or vasopressin, and one or more subsequent attempts at defibrillation.<sup>2</sup> The evidence in favor of amiodarone

is classified as 2b (i.e., its use is based on “fair to good evidence,” and it is “acceptable, safe, and useful”) and the evidence in favor of lidocaine as “indeterminate” (i.e., it is “recommended for use, but where the research quantity/quality falls short of supporting a final class decision”).

Lidocaine has traditionally been the antiarrhythmic drug of choice for the treatment of shock-resistant ventricular fibrillation, as well as for the prevention of recurrence of ventricular fibrillation after out-of-hospital cardiac arrest.<sup>1,2,4</sup> Despite its long history of use, ease and simplicity of administration, and well-understood pharmacologic and adverse-effect profiles, there is no evidence from randomized, clinical trials in the out-of-hospital setting that lidocaine is superior to other drugs or to placebo in terms of any end point related to out-of-hospital resuscitation, including the rates of survival to hospital admission and survival to hospital discharge.<sup>2</sup> In small randomized trials comparing lidocaine with bretylium, there were no significant differences between the treatment groups in the proportion surviving until admission to the hospital.<sup>5,6</sup> A small randomized comparison of



**Figure 2.** Rate of Survival to Hospital Admission in All Patients, According to the Length of Time from the Dispatch of the Emergency-Medical-Services Crew to the Administration of Study Drug.

Patients treated early received the study drug at or before the median time from dispatch of the crew to the administration of drug (24 minutes); patients treated late received the drug after the median time. The mean ( $\pm$ SD) time from dispatch to drug administration is shown above each column. Among patients who received amiodarone, 28 percent of those treated early and 18 percent of those treated late survived; the corresponding figures for patients who received lidocaine were 15 percent and 6 percent. According to multiple logistic-regression analysis, amiodarone-treated patients had a better outcome than lidocaine-treated patients at all measured intervals, and the benefit was consistent whether the drug was administered early or late (treatment effect,  $P=0.005$ ; time effect,  $P<0.001$ ; interaction between time and treatment,  $P=0.26$ ).

amiodarone with lidocaine (involving 20 patients) found that more patients treated with amiodarone were successfully resuscitated.<sup>7</sup> A randomized study comparing lidocaine with epinephrine found that more patients treated with lidocaine had asystole and that there was no difference between the groups in the proportion with return of spontaneous circulation.<sup>8</sup> In a retrospective study of in-hospital cardiac arrest, there were more deaths among patients given lidocaine than among patients not given lidocaine,<sup>9</sup> and in an animal model of cardiac arrest, amiodarone was associated with significantly better resuscitation rates than lidocaine.<sup>10</sup> In animal models of myocardial ischemia, lidocaine, like other sodium-channel blockers, may be proarrhythmic.<sup>11</sup> However, lidocaine continues to be used in many emergency-medical-services systems as an adjunctive treatment for shock-resistant ventricular fibrillation and for the prevention of recurrent ventricular fibrillation after successful defibrillation.<sup>12</sup>

Intravenous amiodarone has been used in the treatment of frequent recurrences of destabilizing ventricular tachycardia or ventricular fibrillation in the

hospital.<sup>13-15</sup> Intravenous amiodarone appears effective in the prevention of recurrent ventricular fibrillation and unstable ventricular tachycardia that is resistant to lidocaine and procainamide.<sup>13,14</sup> The Amiodarone in Out-of-Hospital Resuscitation of Refractory Sustained Ventricular Tachycardia (ARREST) study compared amiodarone with placebo in a blinded, randomized trial in patients with shock-refractory out-of-hospital ventricular fibrillation or pulseless ventricular tachycardia; 44 percent of amiodarone-treated patients and 34 percent of placebo-treated patients survived to hospital admission ( $P=0.03$ ).<sup>16</sup> This was the first large, randomized study to show a benefit of any antiarrhythmic drug over placebo in patients with out-of-hospital cardiac arrest.

Uncertainties remain about the use of amiodarone outside the hospital. Intravenous amiodarone has adverse effects, including a tendency to cause hypotension and bradycardia; it also has complex electrophysiological properties, including adrenergic blockade, calcium-channel blockade, sodium-channel blockade, and at least some degree of prolongation of the action potential.<sup>13</sup> In its current formulation, amiodarone is not available in prefilled syringes and must be drawn up into a syringe for dilution and administration — a potentially time-consuming process, since the drug readily foams when the solution is agitated. The complexity of administration of amiodarone in its current formulation and its cost have been considered limitations to its out-of-hospital use.

Despite these potential limitations, amiodarone led to a statistically significant and relatively large improvement in the proportion of patients who survived to hospital admission in our study. Moreover, amiodarone led to a significant improvement in survival to admission in all patient subgroups — a finding consistent with the results in the whole study. The study did not have adequate statistical power, and was not expected, to show a significant improvement in survival to hospital discharge, and none was seen.

One cannot conclude from this study that intravenous amiodarone will necessarily increase the proportion of patients surviving to hospital discharge if it is administered to patients with shock-resistant ventricular fibrillation in the community. However, our findings are consistent with those of the ARREST trial in strongly suggesting that amiodarone has clinical effectiveness in the initial stages of resuscitation, and they indicate that amiodarone is superior to lidocaine for shock-resistant out-of-hospital ventricular fibrillation. Our findings also suggest that the earlier amiodarone can be administered in the course of a complicated cardiac arrest, the greater is the likelihood of at least short-term benefit. On the basis of these results and the accumulated evidence from previous clinical trials, there appears to be no indication

for the administration of lidocaine to patients with shock-resistant ventricular fibrillation in the out-of-hospital setting. We believe that if an antiarrhythmic drug is to be considered in this situation, intravenous amiodarone should be the drug of choice. The potential use of amiodarone earlier in the course of resuscitation from life-threatening out-of-hospital arrhythmias and its potential effect on survival to discharge from the hospital await clarification in future clinical trials.

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