Outcomes of Rapid Defibrillation by Security Officers after Cardiac Arrest in Casinos

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Characteristics of Subjects with Cardiac Arrest in Casinos.Out-of-hospital cardiac arrest is a major cause of death in the United States.[1,2] Studies of cardiac arrest in the nation's largest cities have shown dismal rates of survival to hospital discharge (less than 5 percent for cases of ventricular fibrillation in which the collapse is witnessed).[3,4] By contrast, some mid-sized urban areas with excellent emergency medical systems have achieved survival rates of 15 to 35 percent.[5,6] The majority of cases of out-of-hospital cardiac arrest arise from ventricular fibrillation.[7,8] Survival after out-of-hospital cardiac arrest due to ventricular fibrillation is determined primarily by the length of time from the onset of ventricular fibrillation to electrical defibrillation.[9] Therefore, early in the 1990s, the American Heart Association initiated a program to ensure public access to defibrillation and reduce the delay between collapse and electrical defibrillation.[10] The keys to reducing the interval from collapse to defibrillation are increasing the availability of automated external defibrillators and increasing the number of people trained to use them. We conducted a prospective, observational study of cardiac arrest in casinos to determine whether training casino security officers in electrical defibrillation and manual cardiopulmonary resuscitation would increase the rate of survival to discharge from the hospital after cardiac arrest.

Methods

Subjects

We identified persons who had had cardiac arrest in casinos in Clark County, Nevada (in which Las Vegas, Henderson, and Laughlin are located); Lake Tahoe, Nevada; Philadelphia, Mississippi; and Tunica, Mississippi. The subjects had cardiac arrest within the property of the casinos, including the common areas where gambling occurred and the hotel rooms. Subjects who met the inclusion criteria had been unconscious and unresponsive, had no palpable carotid pulse, and had no spontaneous respiration. Subjects less than nine years of age or weighing 36 kg or less were excluded, according to the specifications of the defibrillator manufacturers. Age and weight were estimated visually by security officers. Data on cases of cardiac arrest were collected consecutively from participating casinos.

Training and Equipment of Responders

The security officers were required to have current American Heart Association basic-cardiopulmonary-resuscitation certification before training. Training was conducted by two of the investigators and lasted five to six hours. The curriculum consisted of the following: introduction to cardiac arrest and objectives of defibrillation training, basic anatomy and physiology of cardiac arrest, assessment of the patient, orientation to the automated external defibrillator, protocol for automated external defibrillation, small-group practice with the defibrillator, skills testing, written examination, and review. Two to three hours of the course consisted of hands-on practice and scenarios. The passing score for the written test was set at 75 percent.

An initial group of approximately 1350 security officers from 10 casinos was trained and equipped by March 1, 1997. Thereafter, security officers at casinos that requested participation in the program were trained as the time of the investigators allowed. All officers received the same course and testing. A prospectively set threshold for data analysis (100 cases of ventricular fibrillation) was reached on October 12, 1999. Data were collected from a total of 32 casinos over approximately 32 months.

The casinos were encouraged to place a sufficient number of defibrillators on their premises to meet a goal of no more than three minutes of elapsed time from collapse to defibrillation. Implementation of these recommendations was left to the management of the individual casinos. Casino security officers staged mock cardiac arrests at various locations to determine the length of time required to bring defibrillators to those locations from their storage places. The casinos were free to purchase any current-generation automated external defibrillator; several brands were in use by the end of the study.

Protocol

Security officers remain in designated areas of the casinos at all times. An officer is always visible from any point in the public area of the casino. In addition, security cameras mounted in the ceiling randomly scan the public areas, and security personnel can focus on unusual events. In our study, when the officers were notified by radio of the presence of a “sick person,” the nearest officer proceeded to the patient and assessed him or her for responsiveness, spontaneous respiration, and palpable carotid pulse. This officer initiated manual cardiopulmonary resuscitation if indicated. A second officer, who had also been informed by radio of the patient's location and who had prior knowledge of where the defibrillators were stored, brought the nearest defibrillator to the patient. The defibrillator was immediately attached and activated, and audible prompts (by a recorded voice) from the various devices were followed. Resuscitative efforts by the security officers continued until the patient regained pulse and spontaneous respiration or until the paramedics arrived.

Collection of Data

Data from the participating casinos were provided to the study investigators by the Clark County Fire Department. The casinos outside Nevada are owned by corporations with headquarters in Las Vegas and also reported through the Clark County Fire Department. The following data were collected: the subject's name, address, Social Security number (for collection of follow-up data from survivors), and date of birth; the location of the arrest in the casino; whether the subject was receiving cardiopulmonary resuscitation from either the first-responding security officer or from a bystander when the security officer equipped with a defibrillator arrived; and the presence or absence of a pulse, the subject's respiratory effort, and any change in level of consciousness at the time the subject left the casino with the paramedics. In addition, the security officers completed a one-page data form and an incident report specific to the casino.

The time of collapse and the time of initiation of manual cardiopulmonary resuscitation for witnessed arrests were obtained from security videos if the subject collapsed in a common area. If the cardiac arrest was witnessed in a hotel room, the security officer asked the witness or witnesses about the interval between the collapse and the call for help. The time of the call for help was documented on the officer's incident report.

The defibrillation times were recorded automatically by the defibrillator devices. Two types of devices were used. In the case of one type, each device's internal clock is synchronized when contact with the main computer is made to transmit data after an event or each month if the automated electrical defibrillator is not used. The computer's clock is synchronized daily with an atomic clock in Boulder, Colorado. For the other type of device, whose internal clock could not be synchronized remotely, the machine was reset every day to match the casino's security-center clock.

The defibrillators recorded a detailed sequence of events during resuscitation that provided tracings of the cardiac wave form with real clock times and, if the device had audio recording, an audio recording of the resuscitation effort. The time of arrival of the paramedics at the arrest scene was obtained from audio recordings, dispatch records, reports from the emergency medical service, and security videotapes. Data on the subjects' outcomes and their hospital course were obtained by the paramedics of the Clark County Fire Department from the hospitals to which the subjects were transported. Study data forms and electronic data from the defibrillators were collected from all participating casinos by the Clark County Fire Department and forwarded to investigators at the University of Arizona for review and analysis.

Outcome Variables

The time of collapse, time of initiation of manual cardiopulmonary resuscitation, and time of first electrical defibrillation were used to calculate the predictor intervals from collapse to cardiopulmonary resuscitation and from collapse to defibrillation. The primary outcome variable was survival to discharge from the hospital. Consent for review of hospital records was obtained from surviving subjects and from family members of those who did not survive. The study was approved by the institutional review board of the University of Arizona.

Statistical Analysis

Descriptive statistics such as proportions, means, and standard deviations were used to summarize the results. A sample size of 100 subjects with cardiac arrest due to ventricular fibrillation was prospectively established to ensure that the accuracy of the model of survival after cardiac arrest could be estimated with a standard error of no more than 5 percent. The rate of survival among subjects undergoing defibrillation no more than three minutes after collapse was compared with that among subjects undergoing defibrillation more than three minutes after collapse by a chi-square test, and the 95 percent confidence interval was computed for the difference between the rates of survival. Differences between the results for the subjects in our study and previously reported results for patients in Tucson, Arizona, and King County, Washington,[9] were examined with use of chi-square tests for categorical variables and Kruskal–Wallis tests for continuous variables. All P values are two-sided.

Results

The sample contained 148 subjects with confirmed cardiac arrest. None of them were children, and therefore no cases were excluded because of the age and weight criteria. One hundred five subjects had an initial cardiac rhythm of ventricular fibrillation, 17 had pulseless electrical activity, and 26 had asystole. No subjects whose initial cardiac rhythm was not ventricular fibrillation survived to discharge from the hospital. Of the 148 subjects in the total group, 17 (11 percent) were pronounced dead at the scene, 60 (41 percent) were pronounced dead in the hospital emergency department, 15 (10 percent) were admitted to the hospital and died before discharge, and 56 (38 percent) survived to discharge from the hospital.

Ventricular fibrillation accounted for 105 of the 148 cases (71 percent). Fifteen subjects who had ventricular fibrillation collapsed unobserved; three of them survived to hospital discharge (20 percent). Of the 105 patients with ventricular fibrillation, 4 (4 percent) were pronounced dead at the scene, 35 (33 percent) were pronounced dead in the hospital emergency department, 10 (10 percent) were admitted to the hospital and died before discharge, and 56 (53 percent) survived to discharge from the hospital.

We performed subgroup analysis on data from the 90 subjects with witnessed cardiac arrest due to ventricular fibrillation. They were predominantly male (84 percent), with a mean (±SD) age of 65±11 years. The demographic characteristics of this subgroup did not differ significantly from those of the entire group of subjects. Fifty-four percent of the subjects with witnessed arrests received cardiopulmonary resuscitation before the arrival of the guard with the defibrillator: 61 percent of them from security officers, 16 percent from strangers, 14 percent from family members, and 8 percent from friends or coworkers. The mean intervals from collapse to various interventions were 2.9±2.8 minutes for cardiopulmonary resuscitation, 3.5±2.9 minutes for attachment of the defibrillator, 4.4±2.9 minutes for the first defibrillation shock, and 9.8±4.3 minutes for arrival of the paramedics. Fifty-three of those with witnessed cardiac arrest due to ventricular fibrillation (59 percent) survived to discharge from the hospital; those who did not survive died at the casino (2 percent), in the emergency department of the hospital (29 percent), or after hospital admission (10 percent). Among subjects whose collapse was witnessed, the survival rate was 74 percent (26 of 35) for those who received their first defibrillation no later than three minutes after collapse and 49 percent (27 of 55) for those who received their first defibrillation more than three minutes after collapse. This difference (25 percentage points) was statistically significant ($P=0.02$), with a 95 percent confidence interval of 5.6 to 44.8 percentage points.

Discussion

The work of White and others demonstrated that people without other medical training could successfully resuscitate victims of out-of-hospital cardiac arrest due to ventricular fibrillation.[11,12] Investigators subsequently advocated strategies to shorten the delay from collapse to electrical defibrillation by training and equipping for defibrillation new classes of responders with a variety of backgrounds.[13] Device manufacturers responded to the American Heart Association's public-access defibrillation initiative by producing automated external defibrillators that are simpler and less expensive and that require less maintenance than previous portable defibrillators.

The challenge for the future is to decide where defibrillators should be available, place them there, and train appropriate groups of people to use them. Some airlines have already placed defibrillators on their aircraft and trained their attendants to use them.[14-16]

On the basis of their experience with cardiac arrests in casinos, officers of the Clark County Fire Department reasoned that casino security officers, whose job involves rapid response to emergencies but who have not previously received medical training other than basic cardiopulmonary resuscitation, would be ideal candidates for training in a rapid-defibrillation program. Our objective was to determine whether these officers could successfully resuscitate victims of cardiac arrest due to ventricular fibrillation through the use of automated external defibrillators. The survival rates achieved in this project were very high for persons with out-of-hospital cardiac arrest due to ventricular fibrillation.

What accounts for the apparent success of this project, and what are the implications for so-called public-access defibrillation? First, the majority of all arrests in this study occurred in the public areas of the casinos, not in the guests' rooms, and therefore were visible to security officers and video cameras. Studies of traditional emergency-medical-services systems indicate that less than 20 percent of cardiac arrests occur in public places.[17] The arrests in the casinos were therefore more frequently witnessed and recognized than those in other studies, and treatment was initiated sooner. Cardiac arrests are not likely to be detected as quickly in sites such as apartment buildings or gated communities, where residents do not spend extended periods in public areas. Second, the response intervals in the casinos were shorter than those reported with traditional emergency-response systems. The intervals from collapse to cardiopulmonary resuscitation were significantly shorter for the arrests that occurred in casinos (2.9 minutes) than for those that occurred in Tucson, Arizona (4.7 minutes), and King County, Washington (3.4 minutes), as were the intervals from collapse to defibrillation (4.4 minutes in the casinos, 5.1 minutes in King County, and 9.5 minutes in Tucson).[9]

These results have implications for the Public Access Defibrillation Study funded by the National Heart, Lung, and Blood Institute, a prospective, randomized study of rapid defibrillation by nonmedical providers. Survival rates in study sites where collapse-to-defibrillation intervals are not consistently in the range of three to four minutes may not be much higher than those with the best traditional emergency-medical-services systems; still, the results from these sites may be an improvement over those of emergency-medical-services systems with prolonged response times. Casinos also have an unusually high density of cardiac arrests in their public areas, in comparison with other types of public places.[18]

The limitations of this study include the lack of access to data on cardiac arrests that occurred in casinos other than the participating casinos during the study period. At the time the study was undertaken, uncertainty about potential legal liability limited the group of casinos willing to risk participation. A rolling implementation strategy, such as we used, was the only feasible option. In addition, there was no formal neurologic testing in survivors. However, the disposition of the subjects sheds light on their neurologic function at discharge. At the end of the study, no survivor was dependent on others for daily support. Therefore, it is unlikely that any survivor could be classified in cerebral-performance categories higher than 1 (good cerebral performance) or 2 (moderate cerebral disability) on the widely used Cerebral Performance scale.[19]

Our study has shown that rapid defibrillation by casino security officers is both feasible and effective; it also demonstrates that, to increase the survival rates over those obtained with standard emergency-services systems, the interval between collapse and the first defibrillation must be short.

We are indebted to the Clark County Fire Department, whose officers conceived the project; to the participating casinos, which had the courage to implement this program when their potential liability was unclear; to the medical directors of the casinos who, without financial compensation, provided the local medical oversight necessary for the project; and to Medtronic-PhysioControl for supplying the study computers.

Source Information

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