Location of Out-of-Hospital Cardiac Arrests in Takatsuki City
—— Where Should Automated External Defibrillator be Placed? ——

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Background Public access defibrillation has been introduced to improve the outcome of patients experiencing out-of-hospital cardiac arrest (OHCA). The aim of this study was to examine the best location for automated external defibrillators (AED).

Methods and Results All patients who were resuscitated after OHCA by emergency medical technicians in Takatsuki City over 6 years were enrolled. The annual incidence of OHCA and the number of 1-year survivors with good neurological outcome in each of 21 sub-location categories were investigated, as well as the ratio of ventricular fibrillation (VF) as the initial rhythm to the total OHCA in each of 5 location categories. In total, there were 1,112 patients with OHCA, 62 (5.6%) with VF and 14 (1.3%) with good neurological outcome. The annual incidence of cardiac arrest (CA) per site was the highest in railway stations (0.3000), followed by hospitals (0.1802), homes for the aged (0.1115), playgrounds (0.0769) and golf courses (0.0667). However, none of the patients experiencing CA at railway stations, homes for the aged and golf courses had a good neurological outcome. The ratio of VF to total CA was the highest in the workplace (35.3%).

Conclusions The 6 locations, including workplace, are recommended as appropriate locations for AED. (Circ J 2006; 70: 827 – 831)

Key Words: Automated external defibrillator; Out-of-hospital cardiac arrest; Public access defibrillation; Ventricular fibrillation

Table 1 Location and Sub-Location Categories of Out-of-Hospital Cardiac Arrests

<table>
<thead>
<tr>
<th>Location</th>
<th>Sub-location</th>
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<tbody>
<tr>
<td>Home</td>
<td>Home</td>
</tr>
<tr>
<td>Public space</td>
<td>Restaurant, department store/market/store, hotel, hospital, clinic, home for the aged/welfare facility, school, public bath, railway station, temple/church, parking/garage, playground/ground, pool and others</td>
</tr>
<tr>
<td>Workplace</td>
<td>Factory/office and storehouse</td>
</tr>
<tr>
<td>Street</td>
<td>Street</td>
</tr>
<tr>
<td>Others</td>
<td>Forest/field, golf course, and vacant lot/river</td>
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</table>

Although ventricular fibrillation (VF) as the initial rhythm has been recognized as one of the factors related to good outcome in patients presenting with out-of-hospital cardiac arrest (OHCA), early defibrillation is always necessary to achieve this. In Japan, emergency medical technicians (EMTs) have recently been authorized to use defibrillators in accordance with standing orders to shorten the time from collapse to defibrillation. However, the improvement of survival rate is limited if only EMTs are responsible for the rapid defibrillation in patients with VF, because the time to EMT arrival is generally 4–7 min, but occasionally longer, in a large city in Japan. The survival rate from cardiac arrest (CA) with VF declines from 7% to 10% per minute delay in the time from collapse to defibrillation and none of the patients with CA survive to hospital discharge if the delay is more than 12 min. According to “The employment of automated external defibrillator (AED) by non-physicians” guideline announced by the Health Policy Bureau of the Japanese Ministry of Health, Labour and Welfare on July 1, 2004, the use of AED by general citizens is legal because the situation is unexpected and the use is unrepeated. Moreover, it is recommended that the training courses are available to general citizens for the safe use of AED and achievement of rapid defibrillation. However, it remains uncertain where the AED should be placed, so the aim of this study was to examine the locations and incidence of OHCA in Takatsuki City to determine the most suitable locations for AED.
Methods

All of the patients who experienced an OHCA and were resuscitated by EMTs in Takatsuki City (area: 105.3 km², population: 360,000, number of Fire Department stations: 8), from January 1, 1999 to December 31, 2004, were enrolled in this retrospective study. We investigated the total number of patients with OHCA, witnesses, cases of bystander cardiopulmonary resuscitation (CPR), VF as the initial rhythm on EMT arrival, 1-year survival and good neurological outcome according to 5 location categories or 21 sub-location categories (Table 1), based on the Enforce-
Location of OHCA and AED in Takatsuki City

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ment Order of the Fire Service Law. Although it was contrary to the concept of OHCA, “hospital” was included in the location list because in a few of the hospitals included in this study EMTs worked exclusively to resuscitate patients with CA who were then referred to tertiary emergency or related hospitals. On the other hand, “ambulance” was excluded from location because patients experiencing OHCA in an ambulance were not targets of Public Access Defibrillation (PAD). Good neurological outcome was estimated by the Glasgow-Pittsburgh Cerebral Performance and Overall Performance Categories9,10 (CPC and OPC), and patients with both CPC1 and OPC1 were defined as good neurological outcome.

We calculated the annual incidence of OHCA in each of the sub-location categories and the ratio of witnesses, bystander CPR, VF as the initial rhythm on EMT arrival, 1-year survival and good neurological outcome to the total OHCA in each of the location categories.

The data of the total number of OHCAs and institutions were collected from active emergency records, in cooperation with Takatsuki Fire Department. The data of the total number of patients with witnesses, bystander CPR, VF as the initial rhythm on EMT arrival, 1-year survival and good neurological outcome were collected using the Utstein Style11 as the international standard. This study was approved by the institutional Human Research Committee.

Results

In total there were 1,112 patients who had an OHCA and were resuscitated by EMTs during the study period as shown in Table 2, which also shows the annual incidence of OHCA in each of the sub-location categories. The incidence of OHCA was the highest in railway stations (0.3000), followed by hospitals (0.1802), homes for the aged/welfare facilities (0.1115), playgrounds/grounds (0.0769) and golf courses (0.0667). Twelve of the 20 patients with an OHCA in a hospital occurred in hospitals that had only departments of psychiatry. Although the number of OHCA was the highest at home, the overall incidence of OHCA was relatively low.

The number of witnesses and cases of bystander CPR were 423 (38.0%) and 104 (9.4%), respectively, and 62 patients (5.6%) had VF as the initial rhythm upon arrival of the EMTs (Table 3). The ratio of witnesses to total OHCA in each of the location categories was the highest in the workplace (70.6%), followed by the street (61.8%), public spaces (48.3%), home (34.0%) and others (28.6%). The ratio of bystander CPR to total OHCA was highest in public spaces (17.5%), followed by workplaces (11.8%), home (8.3%), others (7.1%) and the street (5.9%). The ratio of VF as the initial rhythm on EMT arrival to total OHCA was highest in the workplace (35.3%), followed by the street (14.7%), public spaces (8.4%), home (3.9%) and others (0.0%).

The number of 1-year survivors after OHCA was 55 (4.9%), and 14 (1.3%) showed good neurological outcome (Table 4). The ratio of both 1-year survivors and good neurological outcome to the total OHCA was highest in the workplace, consistent with the ratio of witness or VF to the total OHCA. None of the patients experiencing CA in railway stations, homes for the aged/welfare facilities and golf courses, which all had a relatively high incidence of OHCA, had a good neurological outcome.

Discussion

Recent reports concerning the beneficial effects of early
defibrillation with AED by non-physicians have been increasing worldwide. Rea et al have revealed that the rate of survival to hospital discharge in patients suffering from VF was approximately 40% in areas where the PAD program of early resuscitation and defibrillation performed by laypersons had been introduced. Moreover, the effectiveness of the PAD program and the advantage of optimal emergency medical services for rapid defibrillation over advanced cardiac life support on the scene has been demonstrated. The introduction of the PAD program in Takatsuki city is expected to further improve the survival rate after OHCA, which is why we investigated the location and the incidence of OHCA to determine the most effective locations of the AED.

Cobb et al established that an annual incidence of OHCA per year per site >0.03 is high and <0.01 is low. Therefore, based on our results we recommend railway stations, hospitals, homes for the aged/welfare facilities, playgrounds/grounds and golf courses as the most appropriate locations for AED, as well as in workplaces.

Railway Stations

In Takatsuki City there are 2 railway stations of the Japan Railway Company and 3 railway stations belonging to a private railroad company, but none of them have AEDs, although AEDs have already been placed in 16 public institutions in Takatsuki City up to October, 2005 (6 in homes for the aged/welfare facilities, 4 in swimming pools, 2 in playgrounds/grounds, 4 in other sites), in accordance with the notification of the Ministry of Health, Labour and Welfare of 2004. The present investigation demonstrated that OHCA occur frequently in railway stations, but these patients do not achieve a good neurological outcome, even 1 year later, so it is essential that AED are placed in each of the railway stations as soon as possible.

Hospitals

In the present study if a CA occurred while a patient was in hospital and was resuscitated by EMTs, we considered such patients as OHCA and included that data in the incidence of OHCA in hospitals. From this, a serious issue emerged: the incidence of OHCA in hospitals was higher than anticipated and moreover, most cases occurred in hospitals that possessed only departments of psychiatry. Therefore, we expect that such hospitals will restore their emergency systems and that their medical staff will attend advanced or immediate cardiac life support courses.

Other Locations

The present study also indicated that homes for the aged/welfare facilities, playgrounds/grounds and golf courses were appropriate locations for AED. Moreover, workplaces should have AED because the highest incidence of witnesses and VF as the initial rhythm occurred in that location. As already mentioned, AED are already being placed in public institutions, but not yet in private institutions. Detailed further investigation is necessary to establish the importance of AED in such institutions.

Moreover, the number of cases of bystander CPR was relatively low, compared with the number of witnesses in the workplace. Therefore, the importance of bystander CPR must be vigorously promoted. To date, various organizations, such as the Medical Association, non-profit organizations, such as the Life Support Association, the Pharmaceutical Association and the Chamber of Commerce and Industry, have endeavored to increase the awareness and training in the use of AED in Takatsuki City. We anticipate further development of these activities and collaborations.

Study Limitations

Our study was retrospective and involved a relatively small number of patients. In particular, the number of patients with VF was very small. Therefore, the incidence of VF must be carefully interpreted, although we recommended the workplace as a suitable location for AED, based on our data for patients with VF as the initial rhythm. We did not estimate the time from collapse to the evaluation of the initial rhythm. At present, EMTs most commonly assess the initial rhythm, but general citizens will eventually evaluate this with the AED, as the PAD program is initiated. The incidence of VF as the initial rhythm decreases as the time from the collapse increases, so with greater use of AED, the incidence of VF by location may change in the future.

Conclusions

The incidence of OHCA was more frequent in railway stations, hospitals, homes for the aged/welfare facilities, playgrounds/grounds and golf courses, and VF as the initial rhythm in OHCA was most frequent in the workplace. Public education in the use of AED and their placement in these places is necessary.

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References


