Role of Emergency Physicians Stationed in Mass-Gathering Area

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Objective: Our tertiary emergency medical center is located near an amusement park, with an emergency physician from our emergency room (ER) being positioned at the first-aid station in the park. In this study, we examined patients transported from the amusement park to our ER facility, in order to clarify the role and efficiency of emergency physicians stationed at mass-gathering locations.

Materials: Patients that were transported from an amusement park to our ER facility between April 2008 and March 2013 were included.

Methods: We retrospectively investigated the pathophysiology, pre-hospital care, and prognosis of patients.

Results: During the 5-year study period, 1,601 visitors transported by ambulance from the park to a hospital. Among these park visitors, 1,107 were transported to our ER facility, with 189 being immediately hospitalized, including 66 critical cases that admitted to the intensive care unit (ICU). No mass-casualty accidents occurred at this amusement park during the study period. Nine patients had initial cardiopulmonary arrest (CPA) at the amusement park. All the patients suffering from CPA showed a return of spontaneous circulation (ROSC), but 2 of these patients eventually died. The 1-month survival rate was 77.8%. When limited to cardiogenic CPA, the 1-month survival rate was 85.7%.

Conclusion: Mass-gathering areas, such as amusement parks, have the risk of medical emergencies that require critical care. Emergency physicians stationed onsite could promptly respond to medical events and offer pre-hospital care. To establish a ‘chain of survival’ that involves the emergency physicians may contribute to good prognosis for critical patients.

Key words: mass-gathering, amusement park, pre-hospital, emergency physicians

Introduction

Although definitions of mass-gatherings vary greatly, they all consist of large numbers of people (>25,000) attending an event at a specific site, for a finite time1). Mass-gatherings can potentially generate greater health risks than those considered normally acceptable for a natural gathering of similar size. The risks associated with mass-gathering events may be concerned with specific environmental characteristics, including limited access to the locality, enthusiasm of the participants, weather conditions, and effects of alcohol and/or drugs. Generally, mass-gatherings of a larger scale have a higher risk of sporadic emergency patients with critical illness or trauma2, 3). Moreover, mass-gatherings have been associated with significant morbidity and death, although this is a relatively rare occurrence. For example, in 2001 human stampedes at the Akashi fireworks event in Japan resulted in 11 deaths and more than 200 people injured people4). One important lesson learned from this tragedy was the importance of the initial triage of causalities. Poor initial communication with emergency medical
services was repeatedly recognized in previous disasters at mass-gatherings. The key to preparedness for medical services at mass-gatherings is early involvement of health professionals who have knowledge and skill in pre-hospital care, primary care, critical care, and disaster response, including triage and incident command at the disaster site. Therefore, emergency physicians are expected to be effective responders and leaders at disasters during mass-gatherings. However, there currently is a lack of available evidence concerning the provision of medical care by emergency physicians in mass gathering circumstances.

Our tertiary emergency medical center is located near an amusement park, with an emergency physician from our emergency room (ER) being positioned at the first-aid station in the park every day. In case of mass casualty accidents or critical incidences, the physician is charged with arranging pre-hospital care with our emergency medical center. The amusement park has more than 25 million visitors annually. Therefore, our stationed emergency physician is critical to providing medical services at any incident during a mass-gathering.

In this study, we examined patients transported from the amusement park to our ER facility during 5-year period, in order to clarify the role and efficiency of emergency physicians stationed at mass-gathering locations.

Patients and Methods

In this retrospective study, we investigated the pathophysiology, pre-hospital care, and prognosis of patients that were transported from an amusement park to our ER facility between April 2008 and March 2013. In particular, we examined the number of patients, who used first-aid, needed transportation to medical facility, needed emergency transportation, transported to our ER, needed immediate hospitalization to inpatient floor and ICU, the characteristics of patients that were admitted to our emergency medical center and to our ICU. Our facility is located in an urban area near Tokyo in Japan, with an in-patient capacity of 659 beds. Annually, our emergency medical center services approximately 23,000 emergency patients, including more than 5,000 patients transported by ambulance. The amusement park is approximately 2.5 km away from our medical center. In the amusement park with 100 ha of the area, there are 8 first-aid stations with total of 20 nursing staff including one central first-aid station near the entrance. Central first-aid station has an emergency physician stationed. The park also has a total of 140 automated external defibrillators (AED) and 2 private ambulances operated by an original transporting system. All amusement park staff are obliged to go through the training program for the life saving at the time they are employed. This training program is repeatedly conducted for the workers in each department.

During the opening hours of the park, an emergency physician is dispatched from our ER is stationed at the central first-aid room of the park. Immediately after an emergency call from park staff, the physician and nursing staff move to the site or the nearest first-aid room with trauma bags by car, or on foot, and assess the urgency and severity of the medical event, while managing pre-hospital care. When the physician decides that the case requires further examinations or special treatment, they can directly contact our ER. And also, we determined how to transport the patient to a hospital from the choice of private ambulance or public ambulance. But the use of public emergency car basically depends on citizen’s emergency call or patient’s request. When manpower is required for treatment such as cardiopulmonary resuscitation (CPR), we choose public emergency car.

This study was approved by the Ethics Committee of Juntendo University (approval no. 30-002).

Results

The average number of annual visitors in the studied amusement park was 26.2 million (25.3–27.5) during 2008–2012. Among the 27.2 million visitors in 2008, 64,606 visitors (0.24%) used one of the first-aid stations in the park, with 3,447 visitors (0.013%) subsequently visiting an adjacent medical facility for further treatment, including 326 visitors transported by ambulance. During the 5-year study period, 14,344 visitors consulted a physician, with 1,601 visitors being transported by public ambulance. During the 5-year study period, 14,344 visitors consulted a physician, with 1,601 visitors being transported by ambulance from the park to a hospital. Among these park visitors, 1,107 (69.1%) were transported to our ER facility, with 189 being immediately hospitalized, including 66 critical cases that admitted to the
intensive care unit (ICU). For transportation from the park to our ER, 264 of 1,107 patients (23.8%) used a public ambulance and the other 843 patients (76.2%) used the previously described private ambulance stationed at the park. No mass-casualty accidents occurred at this amusement park during the study period.

The characteristics of 189 patients that were admitted to our emergency medical center are summarized in Table-1. Of the 123 patients (65.1%) that were admitted to the general ward, their pathophysiology features included trauma, convulsions, asthma attack, and acute abdomen pain. The majority of the treated patients were children or young females, with an average age of 20-years-old. All patients were discharged after receiving medical care, with an average hospitalization duration of 4 days. Although trauma patients tended to require longer hospitalization, most of the other patients were discharged after for 1–2 days of observation. Meanwhile, the pathophysiology features of the 66 patients that were admitted to the ICU included 20 cases of cerebrovascular disease, 12 cardiovascular disease, 9 convulsions, 7 infectious disease, 7 trauma, 3 acute poisoning, 2 gastrointestinal bleeding, 2 heatstroke, 1 airway obstruction, 1 pneumothorax and 1 respiratory insufficiency by ALS. Nine patients (13.6%) had initial cardiopulmonary arrest (CPA) at the amusement park. The average age of an ICU patient was 40–years-old, which was significantly higher than that of the patients in the general ward. The outcome of the 66 patients consisted of 50 discharges, 12 transfers, and 4 deaths. The average hospitalization duration of these patients was 21 days. The details of the 9 patients with initial CPA are shown in Table-2. The patient ages ranged from 6 to 86-years-old. There were 5 male and 4 female patients. The primary disease of these patients consisted of cardiovascular diseases (n=7), cerebrovascular disease (n=1), and airway obstruction (n=1). All of these cases had cardiac arrest witnessed, with a bystander performing cardiopulmonary resuscitation (CPR) at the incident site. An AED was applied in all the patients, except one. The case without AED was 4-years-old girl. We assume that AED was not used in that case because it was obvious from the situation that the cause of cardiac arrest was hypoxia due to the airway obstruction. In fact, that patient showed ROSC immediately after the airway was cleared.

All the patients suffering from CPA showed a return of spontaneous circulation (ROSC), but 2 of these patients eventually died. Survival to discharge

| Table-1 Patient characteristics |
|-------------------------------|
| Age | 40 year-old (0-86) | Used transportation system |
| Sex (male : female) | 26 : 40 | Public ambulance 32 |
| | | Original ambulance 34 |
| Final diagnosis | Number of case |
| Cerebrovascular disease | 20 (CPA: 1) |
| Cardiovascular disease | 12 (CPA: 7) |
| Epilepsy | 9 |
| Infectious disease | 7 |
| Trauma | 7 |
| Acute intoxication (Drug. Alcohol) | 3 |
| Gastrointestinal hemorrhage | 2 |
| Heatstroke | 2 |
| Anaphylaxis | 1 |
| Airway obstruction | 1 (CPA: 1) |
| Pneumothorax | 1 |
| Respiratory insufficiency by ALS | 1 |
| Total 66 | Including 9 CPA patients |
including 2 cases that transferred hospitals was 77.8%. The 1-month survival rate was same. Cerebral Performance Category (hereinafter called CPC) of 7 people who were able to discharge from the hospital was that 6 cases were discharge CPC1 and 1 case was unknown. When limited to cardiogenic CPA, Survival to discharge including 1 case that transferred hospitals was 85.7%. The 1-month survival rate was same. Cerebral Performance Category of 6 people who were able to discharge from the hospital was that 5 cases were discharge CPC1 and 1 case was unknown (Figure-1).

The physician could reach any site in the park within about five minutes. Moreover, we obtained information about the patients on the way to the site, thus we could provide instructions for the early

| No. | Age/Gender | Primary disease       | Witness/Bystander CPR/AED | ROSC or not | Location of ROSC | Prognosis CPC at discharge |
|-----|------------|-----------------------|---------------------------|-------------|------------------|--------------------------|
| ①  | 6  M       | Cardiovascular disease| ◯ ◯ ◯                     | ROSC        | Site             | Transfer CPC : unknown    |
| ②  | 26 M       | Cardiovascular disease| ◯ ◯ ◯                     | ROSC        | Site             | Discharge CPC1            |
| ③  | 26 F       | Cardiovascular disease| ◯ ◯ ◯                     | ROSC        | Site             | Discharge CPC1            |
| ④  | 45 F       | Cardiovascular disease| ◯ ◯ ◯                     | ROSC        | Site             | Discharge CPC1            |
| ⑤  | 58 M       | Cardiovascular disease| ◯ ◯ ◯                     | ROSC        | Site             | Discharge CPC1            |
| ⑥  | 65 M       | Cardiovascular disease| ◯ ◯ ◯                     | ROSC        | ER               | Dead                      |
| ⑦  | 86 M       | Cardiovascular disease| ◯ ◯ ◯                     | ROSC        | Site             | Transfer CPC1             |
| ⑧  | 47 F       | Cerebrovascular disease| ◯ ◯ ◯                     | ROSC        | ER               | Dead                      |
| ⑨  | 4  F       | Airway obstruction    | ◯ ◯ ×                     | ROSC        | Site             | Discharge CPC1            |

**Table-2**

**Figure-1** Diagram of medical course

Abbreviations: emergency room, ER; intensive care unit, ICU; cardiopulmonary arrest, CPA

Transportation from the amusement park to medical facilities  
\( n=1,601 \)

Transportation to our ER  
\( n=1,107 \)

Addmission to ICU  
\( n=66 \)

CPA  
\( n=9 \)

Cardiogenic CPA  
\( n=7 \)

Survival  
\( n=6 \)
care by personal handy- phone system (PHS) or radio communication system. The interventions that could be performed on the site are oxygenation, AED, administration of the fluids and drugs such as epinephrine and midazolam, and tracheal intubation.

Example case

An example case of an amusement park visitor being treated by an emergency physician onsite is presented in Table-3. A 45-year-old female suddenly collapsed at 11:00 a.m. when she stood with her family in a queue for an attraction at the park. Nearby park staff witnessed the incident and assisted the patient. The staff checked the patient’s vital signs and contacted the central first-aid station, where an emergency physician was located. Then, the park staff recognized the patient was unconsciousness with apnea, and immediately administered CPR of basic life support (BLS). Another park staff member called a public ambulance at the same time.

The emergency physician ran to the incident site with 2 nurses, and arrived there within 5 minutes after the emergency call. At the site, an AED was attached to the patient. At 11:06 a.m., the first defibrillation was administered by the AED. A second defibrillation was administered at 11:09 a.m. Finally, ROSC was confirmed at 11:11 a.m. The physician re-checked the patient’s vital signs and determined that her spontaneous respiration was sufficient with no need of tracheal intubation. The emergency physician placed an intravenous fluid line, contacted our ER, reported the patient’s condition, and asked the ER staff to summon a cardiologist and prepare for ICU admission.

At 11:21 a.m., an ambulance arrived and transported the patient to our ER with the emergency physician. The patient had stable hemodynamics during transportation and arrived at our ER at 11:36 a.m.

After admission, the findings of a quasi-emergency coronary angiography were consistent with vasospastic angina. The patient was making steady progress and she fully regained consciousness. A cardioverter defibrillator was implanted with a final diagnosis of long QT syndrome. After two weeks of hospitalization, the patient was discharged with no sequelae.

Discussion

This study examined how occurrences of emergency medical events in patients from an area of mass gathering in an amusement park, including the sporadic occurrence of critically ill patients in the park. According to our results, in an amusement park that accommodates 30 million people annually.

Table-3 Case example of a patient

| Time  | Event Description                              |
|-------|-----------------------------------------------|
| 11:00 | She fell suddenly in front of her family.     |
| 11:00 | Emergency physician started heading to the site after the emergency call. |
| 11:06 | 1st defibrillation by AED.                    |
| 11:09 | 2nd defibrillation by AED.                    |
| 11:11 | Return of spontaneous circulation.            |
| 11:21 | Ambulance arrived                             |
| 11:36 | Arrived at our hospital                       |
|       | Hemodynamics: stable / Cons: clear            |
|       | Emergency coronary angiogram                  |
|       | Diagnosis: vasospastic angina                 |
|       | Admission to ICU                              |
| PHD1  | Moved to general wards                        |
| PHD6  | Implanted cardioverter defibrillator (ICD)    |
| PHD14 | Discharged                                    |

Abbreviations: automated external defibrillator, AED; intensive care unit, ICU; post-hospitalization day, PHD.
3,000 people will require consultation with a physician, 300 people will require ambulance transportation, and 10-15 people will require ICU management.

Although some previous studies have indicated risks of a disaster at mass-gatherings and suggested the efficacy of physician involvement\(^8\)-\(^{10}\), few studies have reported any empirical evidence. There have been several published case reports linking roller coaster rides with neurologic complication\(^{11}\)\(^\text{-}\)\(^{12}\). However, we could not assess the relation between the ride and the diseases due to the lack of the information about what type of a ride the patients went on. We assume that visiting an amusement park itself makes visitors excited and therefore might cause the increase of the heart rate and blood pressure, resulting in the provoking factor of the diseases. Besides, some guests visit the amusement park from the far distance under the hard schedule. Insomnia and exhaustion might be a trigger for the onset of the diseases.

The mortality of out-of-hospital CPA patients greatly depends on whether or not pre-hospital CPR is successful. Therefore, in this study we focused on the survival rate of cardiogenic CPA patients to assess the efficacy of mass-gathering medical care. In a nationwide cohort study of out-of-hospital cardiac arrests, based on the standardized Utstein style of the Fire and Disaster Management Agency (FDMA) of Japan in 2005, the 1-month survival rate of bystander-witnessed cardiac arrests among patients who received ventricular fibrillation, was 11.4% and 1-month survival rate of patients administered an AED procedure by a bystander citizen is 44.4%\(^{13}\). The 1-month survival rate of cardiogenic CPA patients was 85.7% (6/7), which is worthy of attention despite the small number of patients.

In this report, we analyzed which factors could contribute to high-rate of survival. Firstly, the common feature with all survivors of cardiogenic CPA was ROSC at the incident site. Since many visitors and staff are dispersed throughout the amusement park, it is nearly impossible for any cardiac event to be non-witnessed. Moreover, all the park staff have been trained in BLS and CPR, with instruction to start CPR as soon as possible. The park has a total of 140 AED units, with all CPA patients except one case being administered AED in the study. Secondly, an emergency physician stationed at the park is suggested to have played an important role in patient survival. In the described case, the physician was notified of the medical emergency immediately after the event initiated. The physician managed the pre-hospital care and provided advanced life support, including fluid resuscitation and intubation. Simultaneously, the physician reported the patient’s clinical information to our ER, and this cooperation enabled the patient to have cardiac intervention upon arrival. The importance of having a physician stationed onsite not only offers prompt emergency medical intervention, but also lies in forming an instant medical team with park staff to direct pre-hospital care. Therefore, we suggest that the planning and establishment of comprehensive and contiguous management of emergency medical response to events at mass-gatherings, what we call ‘chain of survival’, contribute to higher survival rate of CPA patients in this study.

The 35 of 66 (53.0%) ICU patients were transported using a private ambulance with an emergency physician riding along. The application and availability of private transportation systems for mass-gathering medical care can free public ambulance services for other uses, which contributes to the effective utilization of limited regional medical resources. Furthermore, triage, medical advice, and first-aid treatment by the stationed physician can possibly result in the elimination of unnecessary consultations at, as well as transportation to, neighboring medical facilities. Medical demands of mass-gathering events largely affect regional medical resources, and preservation of these resources is an important responsibility of the onsite physician\(^{14}\).

The results of this study suggest that the type and scale of medical events at mass-gatherings could predict future onsite emergencies to a certain degree. Therefore, it is possible to properly plan and prepare for such events based on predicted data for mass-gathering medical emergencies.

It may not be particularly difficult to construct an emergency plan for mass-gathering medical care for the amusement park analyzed in this study, due to the abundant amount of medical care around the park, including our emergency medical center. However, every individual location that may
produce a mass-gathering does not necessarily have similar medical resources. Therefore, the strategic and operational framework for developing and implementing the initial medical response plans, receiving and allocating patients, and transportation to external medical facilities should be fully prepared for beforehand. Aggressive involvement of emergency physicians that are familiar with regional emergency medical conditions should be used as the initial step of planning for medical emergencies.

Some limitations of the present study should be considered. The numbers of transported patients in a single center study was small. During the study period, there were no mass causality incidents. Therefore, we could not examine the disaster response of the onsite physicians, which should be examined in a future study.

Conclusion

Mass-gathering areas, such as amusement parks, have the risk of medical emergencies that require critical care. Emergency physicians stationed onsite could promptly respond to medical events and offer pre–hospital care. To establish a ‘chain of survival’ that involves the emergency physicians may contribute to good prognosis for critical patients.

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