ORIGINAL ARTICLE

An Utstein-style Investigation into the Association between Prognoses and the Conditions of Patients with Out-of-hospital Cardiac Arrest

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ABSTRACT

Objective: *The goal of this study was to evaluate the association between the conditions of the patients at the time of the emergency calls (119) and their prognoses.*

Methods: *A total of 1511 cases from the records of the Emergency Medical Services from July 1, 2010 to September 30, 2012 were retrospectively investigated using the Utstein Style. The presence of consciousness, pulse and respiration were evaluated to confirm the clinical conditions of the patients. The conscious cases, at the time of the emergency calls, were further classified into groups based on their chief complaints. To evaluate the association between the conditions of the patients and their prognoses, each condition was compared with unconscious cases without respiration.*

Results: *The one-month survival rate was significantly higher in conscious cases with chest pain/back pain or dyspnoea, conscious cases with faint state, unconscious cases with respiration, unconscious cases with respiration unknown, and unconscious cases with seizure at the time of the emergency calls (*$p < 0.001$, $p = 0.004$, $p < 0.001$, $p = 0.042$ *and* $p = 0.001$, *respectively). In multivariate analysis, conscious cases with chest/back pain or dyspnoea (odds ratio (OR) = 9.298, 95% confidence level (95% CI) = 4.373, 19.768), unconscious cases with respiration (OR = 3.884, 95% CI = 2.166, 6.964), and unconscious cases with breathing unknown (OR = 1.915, 95% CI = 1.129, 3.247) were significant prognostic factors.*

Conclusion: *The subsequent survival rate was particularly high in cases with chest/back pain or dyspnoea, and cases in which the bystander could not confirm respiratory arrest. It is pivotal to provide appropriate instructions on resuscitation, without overlooking important signs that have an impact on survival in these cases.*

Keywords: Emergency medical dispatch, instructions for CPR, out-of-hospital cardiac arrest

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INTRODUCTION

The importance of emergency medical dispatch for out-of-hospital cardiac arrest (OHCA) cases was reported in the *2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care* (AHA-G2010) (1). Since instructions for cardiopulmonary resuscitation (CPR) by dispatchers are known to improve the bystander CPR rate as well as prognoses, bystanders should be provided with instructions of appropriate CPR for all suspected cardiopulmonary arrest (CPA) cases (1, 2). However, when obtaining information over the phone, it is often difficult to determine whether they are cases of CPA or cases of impending CPA. It is therefore crucial to be able to recognize critical signs so that a better prognosis can be made based on the content of the emergency call

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(119). If the condition of the patient can be associated with his or her prognosis at the time of the emergency call, it may be possible for dispatchers to focus more on collecting information and providing suitable CPR instructions in cases where the patient is already in, or may go into, CPA.

The goal of this study was to determine the association between the conditions of the patients at the time of the emergency calls and their prognoses in order to improve the outcome.

SUBJECTS AND METHODS

Since July 1, 2010, the authors' institution has been involved in the validation of the records from the Emergency Medical Services (EMS) as part of prefectural medical control and has confirmed all EMS records requiring hospitalization. In this study, 1511 EMS records in the Utstein Style submitted by prefectural fire departments were evaluated in an attempt to validate all of the cases requiring hospitalization during the period between July 1, 2010 and September 30, 2012.

The conditions of the patients at the time of the emergency calls were evaluated based on their consciousness, pulse and respiration as reported by the callers. The conscious cases were further classified into groups based on their chief complaints. Vomiting is commonly seen in patients experiencing OHCA, and it has been reported that it occurs in one-third of patients experiencing cardiac arrest (3). However, because there were cases in which the time of occurrence of vomiting was unclear (such as cases with insufficient descriptions and cases with CPR-induced vomiting), these cases were excluded, with the exception of cases in which vomiting was the only primary symptom. In addition, since dispatchers should consider that brief generalized seizure may be the earliest symptom of cardiac arrest (4, 5), it was a separate evaluation point. Because rescue efforts are first required prior to resuscitation for accidents in the bath tub, hanging, near-drowning and trauma, it was believed that it would be difficult to study any association with prognosis. Therefore, these cases were considered in a separate category.

In addition, cases being transferred from one hospital to another were also considered in a separate category. To reflect the exact contents of the emergency calls, even if the respiratory arrest was expected from the conditions of the patients and EMS records, these cases were classified into breathing cases. The conditions of the patients at the time of the emergency calls were also classified into: conscious with chest pain/back pain/respiratory discomfort, conscious with vomiting/haematemesis, conscious with faint, conscious with stupor, conscious with coughing/haemosputum, conscious with discomfort, conscious with abdominal pain, conscious with bleeding from a wounded area, unconscious without respiration, unconscious with respiration, unconscious with unknown respiration, unconscious with pulse, unconscious with seizure, unconscious in a bath tub, unconscious due to hanging, unconscious due to near-drowning, unconscious due to trauma, and request to send the patient to another hospital.

To evaluate the association between the condition of the patient and his or her prognosis, each condition was compared with unconscious cases without respiration since these were definitive CPA cases. The one-month survival rate was used to assess the prognosis. Statistical analysis was performed using the student two-tailed test, the Chi-square test and a Fisher's exact test with SPSS Statistics version 19 (IBM®). A value of $p < 0.05$ was determined to be statistically significant.

In addition, multivariate analysis was performed to identify prognostic factors in relation to patient status at the time of the emergency call.

This study was approved by the Institutional Review Board of the Advanced Emergency Care Centre, Faculty of Medicine, Saga University, Japan.

RESULTS

The percentages based on the conditions of the patients at the time of the emergency calls were as follows: conscious cases with chest pain/back pain/respiratory discomfort accounted for 3.2% (48/1511), conscious cases and others 1.9% (vomiting/haematemesis 0.3% (5/1511), faint 0.2% (3/1511), stupor 1.1% (16/1511), coughing/haemosputum 0.1% (2/1511), feeling discomfort 0.1% (1/1511), abdominal pain 0.1% (1/1511), bleeding from the wounded area 0.1% (1/1511)), unconscious cases without respiration 25.8% (390/1511), unconscious cases with respiration 11.9% (180/1511), unconscious cases with unclear respiration 31.2% (472/1511), unconscious cases with a pulse 1.0% (15/1511), unconscious cases with seizure 0.9% (13/1511), unconscious cases with face submerged in the bath tub 9.5% (144/1511), unconscious cases involving hanging 5.7% (86/1511), unconscious cases drowned in water passage/river/sea etc 2.2% (33/1511), cases involving external injuries such as traffic accidents 6.0% (90/1511), and cases with the request to be transferred to another hospital 0.7% [11/1511] (Table 1).

Table 1: The relationship between the status of the sick and wounded at the time of the emergency call and the prognosis

Conditions at the time of emergency calls	Case		One-month survival		*p*
	n	%	n	%	
Conscious cases					
Chest pain/back pain/respiratory discomfort	48	3.2	12	25.0	< 0.001
Vomiting/haematemesis	5	0.3	1	20.0	0.166
Faint	3	0.2	2	66.7	0.004
Stupor	16	1.1	1	6.7	0.416
Coughing/haemosputum	2	0.1	0	0	1.000
Feeling discomfort	1	0.1	0	0	1.000
Abdominal pain	1	0.1	0	0	1.000
Bleeding from the wounded area	1	0.1	1	100	0.036
Unconscious cases					
Without respiration	390	25.8	13	3.3	–
With respiration	180	11.9	22	12.2	< 0.001
With respiration unknown	472	31.2	30	6.4	0.042
With a pulse	15	1.0	1	6.7	0.416
With seizure	13	0.9	4	30.8	0.001
Bath tub	144	9.5	0	0	0.024
Hanging	86	5.7	2	2.3	1.000
Drowning	33	2.2	3	9.1	0.121
Trauma	90	6.0	0	0	0.141
Hospital transfer	11	0.7	0	0	1.000

Moreover, cases with consciousness accounted for 5.1% of the total (77/1511). Of these, cases involving chest pain/back pain/respiratory discomfort accounted for the largest group at 62.3% (48/77), followed by vomiting/haematemesis 6.5% (5/77), faint 3.9% (3/77), stupor 20.8% (16/77), coughing/haemosputum 2.6% (2/77), and feeling discomfort/abdominal pain/bleeding in the wounded area 1.3% (1/77).

Next, an association between the conditions of the patients at the time of the emergency calls and their prognoses was evaluated. Since we were unable to obtain information regarding one-month survival for seven cases (one conscious case with stupor, one unconscious case without respiration and five unconscious cases with respiration unknown), those cases were excluded in this analysis. When compared with unconscious cases with no respiration (3.3% (13/389)), which were definitive CPA cases, conscious cases with chest pain/back pain/respiratory discomfort (25.0% (12/48), $p < 0.001$), conscious cases with faint (66.7% (2/3), $p = 0.004$), conscious cases with bleeding from a wounded area (100% (1/1), $p = 0.036$), unconscious cases with respiration (12.2% (22/180), $p < 0.001$), unconscious cases with unclear respiration (6.4% (30/467), $p = 0.042$), and unconscious cases with seizure (30.8% (4/13), $p = 0.001$) showed significantly higher one-month survival rates, while unconscious cases with face submerged in the bath tub (0% (0/144): $p = 0.024$) showed a significantly lower one-month survival rate (Table 1).

In multivariate analysis, consciousness with chest/back pain or dyspnoea (odds ratio (OR): 9.298, 95% confidence level (95% CI): 4.373, 19.768), unconsciousness with respiration (OR: 3.884, 95% CI: 2.166, 6.964), and unconsciousness with breathing unknown (OR: 1.915, 95% CI: 1.129, 3.247) were significant prognostic factors to predict one-month survival (Table 2).

DISCUSSION

The creation of guidelines (1, 6), the importance of the 'Chain of Survival' (7), a recommendation of automated external defibrillator (8), and efficacy of hypothermia therapy have been previously reported to improve the prognoses of cases of OHCA (9, 10). Early CPR by bystanders is known to be profoundly important for

Table 2: Multivariate analysis of the status of the sick and wounded at the time of the emergency call and their prognosis

Conditions at the time of emergency calls	Partial regression coefficient	Significance probability (*p*)	Odds ratio (95% CI)
Consciousness with chest pain/back pain/respiratory discomfort	2.230	< 0.001	9.298 (4.373, 19.768)
Unconsciousness with respiration	1.357	< 0.001	3.884 (2.166, 6.964)
Unconsciousness with breathing unknown	0.650	0.016	1.915 (1.129, 3.247)

increased survival rates of patients. However, it is also true that there were many cases that did not undergo bystander CPR (11).

One of the reasons for this is that the caller often falsely interprets agonal respiration and abnormal respiration as normal respiration when he or she checks for the presence of respiration (1). Therefore, in AHA-G2010, early recognition of cardiac arrest is a primary focus and requires that a dispatcher ask about the presence of consciousness and the quality of respiration (whether it is normal respiration), so that a bystander can recognize cardiac arrest (1). Because the instructions for CPR over the phone for patients who are not conscious and whose respiration is not normal increase the rate of bystander CPR and substantially improve survival rates for cardiac arrest, it is described that all dispatchers should be trained to provide bystanders with proper CPR instructions (1, 2).

It is important that both the caller and the dispatcher do not fail to recognize cardiac arrest in the following situations: when the caller mistakenly judges that there is consciousness, respiration and a pulse, and when cardiac arrest is reached after the emergency call. However, there are only a few specific reports regarding what symptoms should require specific attention during emergency calls. If dispatchers could recognize critical signs that may result in cardiac arrest, the prognosis of the patient may be better if treated properly at the time of the emergency call. More careful and higher-quality CPR instructions over the telephone could be provided to bystanders from EMS personnel.

Müller *et al* reported that in cases of cardiogenic cardiac arrest that were witnessed, patients with respiratory distress and dizziness/faint were prone to go into cardiac arrest 10 minutes after the onset of initial symptoms (12). They further reported that initial symptoms of the patients with subsequent cardiac arrest within one hour of onset included anginal pain (33%), respiratory discomfort (30%), dizziness/faint (15%), nausea/vomiting (10%) and others (12%). Moreover, it has been reported that prodromal symptoms of cases with witnessed CPA included anginal pain (43%), severe respiratory discomfort (7%), dizziness/palpitation (4%), nausea/feeling discomfort (21%) and no complaints (25%) (13). In the present study, conscious cases at the time of emergency calls accounted for 5.1% *ie* at least approximately 5% of the patients reached a state of cardiac arrest after the emergency calls and by the time the emergency medical technicians arrived at the scene.

Consistent with previous reports, the data obtained in the present study showed that cases involving chest pain/back pain/respiratory distress accounted for 62.3%, followed by stupor (20.8%), vomiting/haematemesis (6.5%) and faint (3.9%). Thus, it is necessary to pay attention to the transition to cardiac arrest in such cases. However, there was no statistical significance in terms of one-month survival rates between patients with CPA and stupor. It is considered that the caller may recognize the patient with CPA as being in stupor. Therefore, it is necessary to treat a patient in stupor as a possible CPA case.

Additionally, it is expected that cases with reportedly normal respiration or unclear respiration at the time of the emergency calls might include cases with agonal respiration or an impending cardiac arrest. Such cases are certainly good candidates in which patient survival can be expected with appropriate bystander CPR administered. Since the present study showed that the prognosis of unconscious cases with unclear respiration could be significantly better than in unconscious cases with no respiration, the AHA-G2010 instructions would definitely be adequate for cases where it is difficult to determine the patient's respiratory status due to the caller's inarticulacy and confusion.

According to the study results on the prognostic factors, a high subsequent survival rate was observed particularly in conscious cases with chest pain/back pain/respiratory distress, despite being at high risk of having

a cardiac arrest after the emergency call. This suggested that it would be necessary to provide proper instructions and resuscitation for these patients. Specifically, it is recommended that dispatchers should be educated in advance to be able to recognize these critical signs that may cause cardiac arrest. Furthermore, callers should be educated to make an immediate additional emergency call if conscious patients lose their consciousness. Additionally, it is important and necessary for EMS personnel to communicate with the caller from the ambulance while *en route* to the scene to reconfirm the condition of the patient (14).

There are some limitations to this study. First of all, as might be expected, many of the callers who discovered the patients with cardiac arrest tended to be overwhelmed. Therefore, it might have been very difficult for them to evaluate the patients' breathing and consciousness. Secondly, since the prognosis in this study was based on one-month survival rates, an evaluation of the long-term prognosis including favourable neurological status by expanding sample sizes will be needed in the future. Finally, the data in this study were obtained from only one prefecture. However, it might be possible that the data could vary according to the region. Thus, further investigation including more data from all over Japan is warranted.

In addition, it is imperative to evaluate what symptoms dispatchers should pay more specific attention to when they receive emergency calls.

CONCLUSION

The subsequent survival rate was high particularly in conscious cases with chest pain/back pain/respiratory distress at the time of the emergency call. Where the caller cannot affirm respiratory arrest, it is necessary to provide proper instructions and resuscitation for successful outcomes.

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