Out-of-hospital Cardiac Arrest in the Elderly

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SUMMARY

Background: To investigate the characteristics of out-of-hospital cardiac arrest (OHCA) in the elderly, we retrospectively studied a 6-month series of cases in an emergency department (ED) of a medical center in northern Taiwan.

Methods: There were 145 OHCA cases sent to our ED from January 1, 2007 to June 30, 2007. Of these, 28 trauma-related and five pediatric cases were excluded, and 112 cases were eventually enrolled into our study. The 112 cases were divided into an elderly group (≥65 years) of 81 cases and a non-elderly group of 31 cases. There were 64 males and 48 females (male/female ratio, 1.33:1) aged 24–99 years. We collected the laboratory data and made comparisons between the elderly and non-elderly group in arterial blood gas, hemoglobin, potassium, glucose, and troponin I. We used the statistical software SPSS version 11.5.0 (SPSS Inc., Chicago, IL, USA) with *t* test analysis. The clinical significance was set at $p < 0.05$.

Results: Return of spontaneous circulation (ROSC) occurred in 46 cases (41%) after standard resuscitation by advanced cardiac life support. The elderly group had a higher ROSC rate than the non-elderly group, but this was not significant (44% vs. 32%; $p = 0.335$). The elderly group had less acidosis, less hypercapnia, less hyperkalemia, less hyperglycemia and a higher rate of elevated troponin I than the non-elderly group, but the differences were not significant. The elderly group had significantly lower hemoglobin levels than the non-elderly group (10.52 ± 3.04 vs. 12.6 ± 3.32 g/dL; $p = 0.003$). The glucose levels of the ROSC group were significantly higher than the non-ROSC group in the elderly (230.14 ± 130.4 vs. 195.1 ± 147.7 mg/dL; $p = 0.049$). In the group of acute coronary syndrome (ACS)-related OHCA, the ROSC rate in the elderly group was significantly higher than that of the non-elderly (54.2% vs. 40%; $p = 0.014$). The elderly group had a slightly lower rate of survival than the non-elderly group (7.4% vs. 9.7%; $p = 0.159$).

Conclusion: The elderly OHCA cases had an anemic status. The elderly had a higher ROSC rate in cases with relative hyperglycemia and ACS-related OHCA. This finding provides us with the theory of trialing administration of glucose water during resuscitation in OHCA cases. [International Journal of Gerontology 2008; 2(2): 67–71]

Key Words: anemia, elderly, glucose, sudden cardiac arrest

Introduction

Despite a large amount of data evaluating outcomes of out-of-hospital cardiac arrests (OHCAs), little information is available about the characteristics of elderly OHCA patients. Herlitz et al.[1] reported a successive decline in survival with increasing age of OHCA patients. In past OHCA studies analyzing the pre-hospital resuscitation such as early phone call for the ambulance, pilot study of medication, and formal and structured emergency resuscitation teams, better outcomes for victims of cardiac arrest were strongly associated with the initial shockable rhythms and early bystander cardiopulmonary resuscitation (CPR)[2]. This study analyzed the laboratory tests of OHCA cases in elderly and non-elderly groups that have never been reported up to now.

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Materials and Methods

Materials

The Mackay Memorial Hospital in Taiwan is a 2,000-bed teaching medical center that employs approximately 4,500 doctors, nurses and allied health professionals. The total number of annual visits to the emergency department (ED) was approximately 157,000. We retrospectively collected the data of OHCA cases sent by either the emergency medical services (EMS) or families from January 1, 2007 to June 30, 2007. During the 6 months, there were a total of 65,639 visits to the ED. Of these, 145 OHCA cases were sent to our ED for resuscitation. Of these, 28 trauma-related and five pediatric cases were excluded, and eventually 112 cases were enrolled into our study. There were 64 males and 48 females (male/female ratio, 1.33:1) aged from 24–99 years, and 41.1% experienced ROSC after resuscitation.

Study design

We retrospectively reviewed the data, including age, gender, pH and carbon dioxide (CO_2) pressure of arterial blood gas and blood tests (hemoglobin, glucose, potassium, troponin I), and analyzed these with the *t* test using SPSS version 11.5.0 (SPSS Inc., Chicago, IL, USA). All blood samples were taken as soon as possible on arrival to the ED. We divided patients into two groups, i.e., an elderly group with ages 65 years or older and a non-elderly group with ages younger than 65 years. We defined an abnormal troponin I level as > 1 ng/mL in our study and assumed that as a heart attack-related OHCA. We compared the mean values of blood tests collected to find out the characteristic aspects of elderly OHCA and non-elderly OHCA.

Results

Forty-six cases (41%) had ROSC after standard resuscitation by advanced cardiac life support. Nine of 112 OHCA cases (8%) were alive to discharge. The non-elderly group were aged from 28–64 years with a mean ± standard deviation of 49.58 ± 10.99 years, and the elderly group were aged from 65–99 years with a mean ± standard deviation of 80.64 ± 8.18 years. Of the 46 with ROSC (Figure 1), the non-elderly group accounted for 32% and the elderly group for 44% ($p = 0.335$; Table 1).

On arrival at our ED, the elderly group had slightly less acidosis than the non-elderly group (6.94 ± 0.19 vs. 6.89 ± 0.27; $p = 0.067$), and the CO_2 pressure of the elderly group was slightly lower than that of the non-elderly group (76.94 ± 37.92 vs. 77.36 ± 44.5 mmHg; $p = 0.397$). The non-elderly had a relatively high potassium level, but it was not significantly greater than that

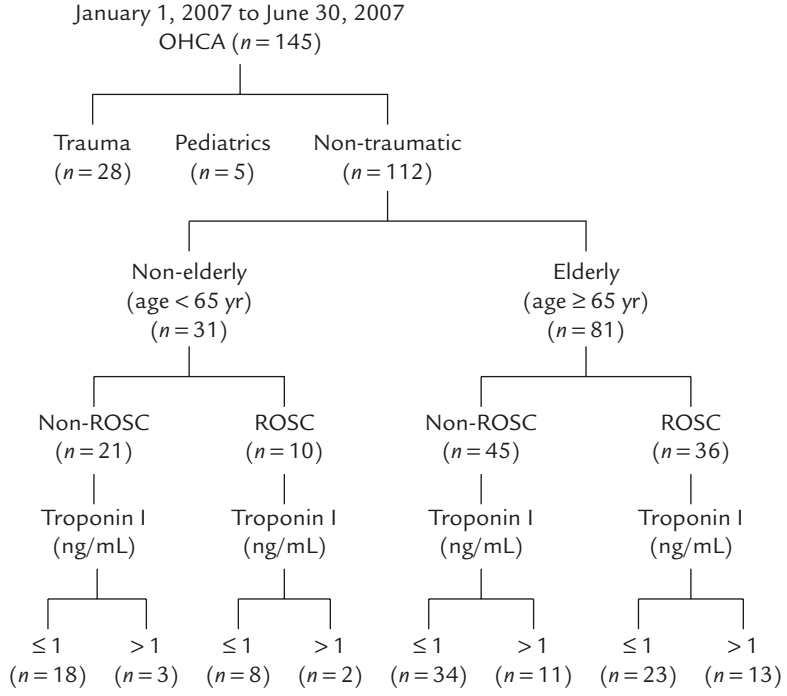

Figure 1. The 112 enrolled out-of-hospital cardiac arrest (OHCA) cases were divided into an elderly group and non-elderly group.

in the elderly group (6.57 ± 2.38 vs. 7.24 ± 3.04 mEq/L; $p = 0.174$). The elderly group had a significantly lower hemoglobin level than the non-elderly group (10.52 ± 3.04 vs. 12.6 ± 3.32 g/dL; $p = 0.003$; Figure 2). The elderly group had a higher rate of elevated troponin I than the non-elderly group (29.63% vs. 16.13%; $p = 0.251$). Furthermore, in patients with elevated troponin I, the elderly had a significantly higher ROSC rate than the non-elderly group (54.17% vs. 40%; $p = 0.014$). The non-elderly group had a slightly higher rate for survival to discharge (9.7% vs. 7.4%; $p = 0.159$).

The elderly group had slightly lower glucose levels than the non-elderly group (211.68 ± 139.2 vs. 261.35 ± 145.1 mg/dL; $p = 0.184$; Table 2 and Figure 3). In the ROSC cases, the elderly group had significantly lower glucose levels than the non-elderly group (230.14 ± 130.35 vs. 329.1 ± 183.46 mg/dL; $p = 0.075$; Figure 4). In the non-ROSC cases, the elderly group had slightly lower glucose levels than the non-elderly group (195.1 ± 147.7 vs. 229.1 ± 114.27 mg/dL; $p = 0.487$; Table 3 and Figure 5). In the non-elderly group, ROSC cases had higher glucose levels than the non-ROSC cases (329.1 ± 183.5 vs. 229.1 ± 114.3 mg/dL; $p = 0.05$). In the elderly group, ROSC cases also had significantly higher glucose levels than the non-ROSC cases (230.14 ± 130.4 vs. 195.1 ± 147.7 mg/dL; $p = 0.049$; Table 4). Thus, we found that OHCA in the elderly had significantly lower hemoglobin levels and significantly higher glucose levels in the ROSC cases. In heart attack-related OHCA cases, the elderly group also had a higher ROSC rate than the non-elderly group.

Table 1. *Basic data of the enrolled 112 out-of-hospital cardiac arrest cases in the two age groups*

Group	Non-elderly (aged < 65 years)	Elderly (aged ≥ 65 years)
Male (*n*)	15	49
Female (*n*)	16	32
Male/female ratio	0.94	1.53
Age range (yr)	28–64	65–99
Age, mean ± SD (yr)	49.58 ± 10.99	80.64 ± 8.18
ROSC ($p = 0.335$), *n* (%)	10 (32)	36 (44)
Survival to discharge ($p = 0.159$), *n* (%)	3 (9.7)	6 (7.4)

SD = standard deviation; ROSC = return of spontaneous circulation.

Discussion

OHCA continues to have a high mortality rate, and only 5–12.6% of OHCA cases can survive to discharge[2–4].

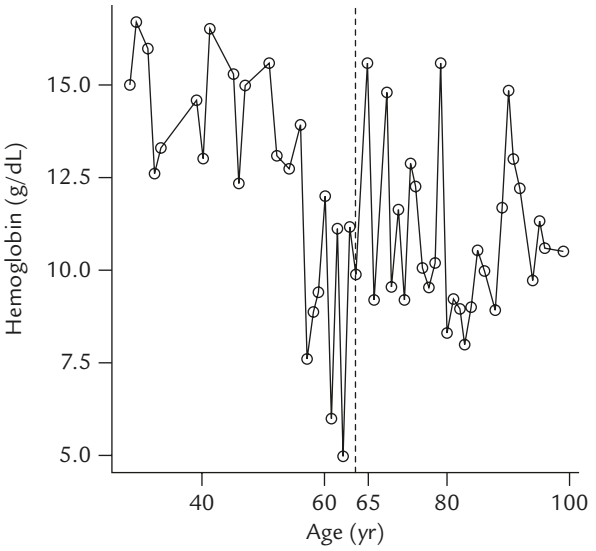

Figure 2. Curve of hemoglobin level against age shows that the elderly group had a significantly lower hemoglobin level in out-of-hospital cardiac arrest cases.

Table 2. *Comparisons of blood tests between the non-elderly and elderly groups. The elderly group had significantly lower hemoglobin levels and a significantly higher return of spontaneous circulation (ROSC) rate in heart attack-related out-of-hospital cardiac arrest*

Blood test	Non-elderly	Elderly	*p*
pH of arterial blood gas	6.89 ± 0.27	6.94 ± 0.19	0.067
CO_2 pressure (mmHg)	77.36 ± 44.5	76.94 ± 37.92	0.397
Potassium level (mEq/L)	7.24 ± 3.04	6.57 ± 2.38	0.174
Hemoglobin level (g/dL)	12.6 ± 3.3	10.5 ± 3	0.003*
Elevated troponin I (%)	16.1	29.6	0.251
ROSC in elevated troponin I (%)	40.0	54.2	0.014*
Glucose (mg/dL)	261.35 ± 145.1	211.68 ± 139.2	0.184

**Statistical significance.*

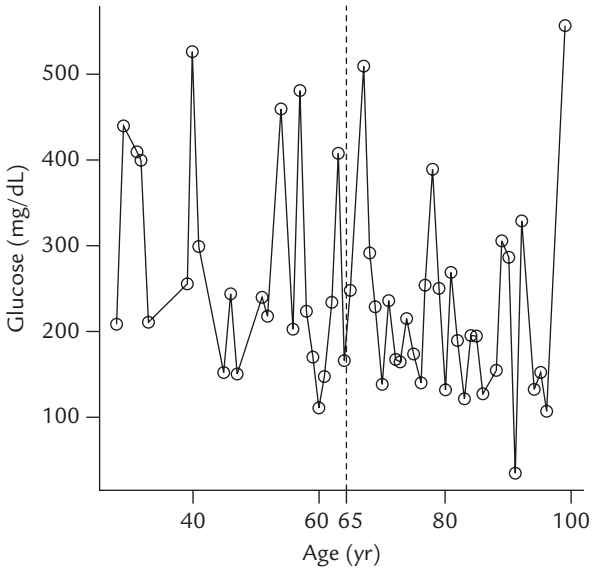

Figure 3. Curve of glucose level against age shows that the elderly group had an insignificantly lower glucose level in out-of-hospital cardiac arrest cases.

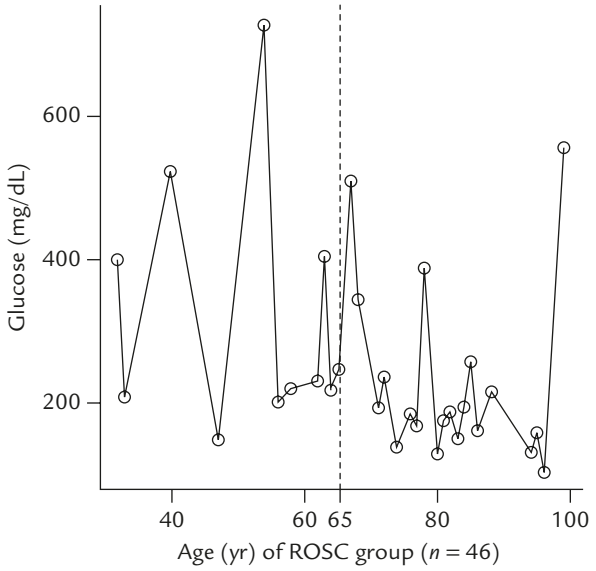

Figure 4. In the 46 cases with return of spontaneous circulation (ROSC), the curve shows that the elderly group had an insignificantly lower glucose level than the non-elderly group.

Table 3. *The elderly group had slightly less hyperglycemia than the non-elderly group*

	Non-elderly	Elderly	*p*
Glucose (mg/dL)			
ROSC (*n* = 46)	329.1 ± 183.5	230.1 ± 130.4	0.075
Non-ROSC (*n* = 66)	229.1 ± 114.3	195.1 ± 147.7	0.487

ROSC = return of spontaneous circulation.

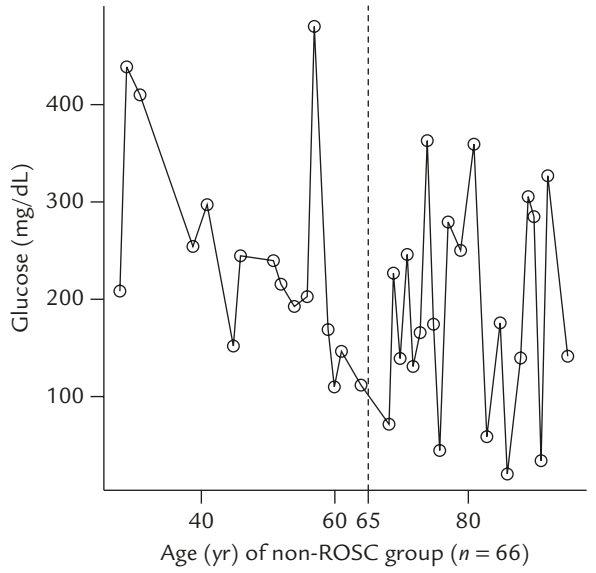

Figure 5. In the 66 cases without return of spontaneous circulation (ROSC), the curve shows that the elderly group had an insignificantly lower glucose level than the non-elderly group.

Table 4. *In the elderly of out-of-hospital cardiac arrest cases, the group with return of spontaneous circulation (ROSC) had significantly higher glucose levels than the non-ROSC group*

	ROSC	Non-ROSC	*p*
Glucose (mg/dL)			
Non-elderly	329.1 ± 183.5	229.1 ± 114.3	0.05
Elderly	230.1 ± 130.4	195.1 ± 147.7	0.049*

**Statistically significant. ROSC = return of spontaneous circulation.*

In our study, there was 8% survival to discharge, similar to the data worldwide. With regard to gender, males accounted for 57.1% of the 112 cases. Females were predominant over males in the non-elderly group (male/female ratio, 0.94:1), but males predominated in the elderly group (male/female ratio, 1.53:1). The age ranged from 28 to 99 years old (73.5 ± 15.3 years), and this is older than that in the 2007 US report and 2003 Singapore report of OHCA cases (61.5 to 67 years old)[4–6].

The elderly group had an insignificantly higher ROSC rate than the non-elderly group (44% vs. 32%; $p = 0.335$). In the survival to discharge, the elderly group had a slightly lower rate than the non-elderly group (7.4% vs. 9.7%; $p = 0.159$). This is compatible with the report of Cheung et al.[3] that analyzed a 1-year series of OHCA and found that patients aged 80 or older had lower survival rates. Herlitz et al.[1] also reported a successive decline in survival with increasing age in OHCA cases

in an analysis of the Swedish Cardiac Arrest Registry. We found that although the elderly had a higher ROSC rate during resuscitation initially, they had a lower rate for survival to discharge eventually.

In the laboratory tests, the elderly group had less acidosis, less hypercapnia, less hyperkalemia, less hyperglycemia, and more acute coronary syndrome (ACS)-related OHCA, but all of these did not show any statistical significance. In the ACS-related OHCA, the elderly group had a significantly higher ROSC rate than the non-elderly group (54.2% vs. 40%; $p=0.014$). Markusohn et al.[7] reported that for ST-elevation myocardial infarction patients after OHCA, primary percutaneous coronary intervention can be performed with a high success rate (88%) and provides a reasonably good outcome. Additionally, the elderly group was more anemic than the non-elderly group (hemoglobin, 10.5 ± 3 vs. 12.6 ± 3.3 g/dL; $p=0.003$). In the general population, anemia in the elderly usually relates to chronic disease and can lead to weakness, fatigue, limitations in activity, and may increase cardiovascular risk. Recent studies of the effect of erythropoietin in an aging population supports the hypothesis that anemia is associated with pathologic factors and not with normal aging[8,9].

In the ROSC and non-ROSC groups, the glucose levels in the elderly were slightly lower than the glucose level in the non-elderly group. In the elderly and non-elderly groups, the glucose levels of ROSC patients were significantly higher than the glucose levels of the non-ROSC group ($p=0.049$ vs. $p=0.05$). We presumed that individuals in the ROSC group released more catecholamines into the bloodstream than those in the non-ROSC group before the cardiopulmonary arrest. Catecholamines are associated with enhanced rates of aerobic glycolysis, glucose release (both from glycogenolysis and gluconeogenesis), and inhibition of insulin-mediated glycogenesis. Consequently, hyperglycemia and hyperlactatemia are the hallmarks of this metabolic response[10].

There are other factors which might have influenced the rate of ROSC and the statistical outcome, such as pre-hospital EMS, pre-hospital medication, initial rhythm, any bystander resuscitation, any cardioversion, and duration of the cardiac arrest, which we were concerned would inevitably confound this study. If the number of cases was larger, the true distribution might be determined from a multicenter study or national registry.

In conclusion, the elderly were anemic in the OHCA cases, but this did not influence the ROSC rate. The elderly had a higher ROSC rate in the relative hyperglycemia and ACS-related OHCA cases. This provides us with the theory of trialing administration of glucose water during resuscitation in OHCA cases. The elderly group had a higher ROSC rate but had a lower rate for survival to discharge than the non-elderly group, though the differences were not significant.

References

1. Herlitz J, Svensson L, Engdahl J, Gelberg J, Silfverstolpe J, Wisten A, et al. Characteristics of cardiac arrest and resuscitation by age group: an analysis from the Swedish Cardiac Arrest Registry. Am J Emerg Med 2007; 25: 1025–31.
2. Ma MH, Chiang WC, Ko PC, Huang JC, Lin CH, Wang HC, et al. Outcomes from out-of-hospital cardiac arrest in Metropolitan Taipei: does an advanced life support service make a difference? Resuscitation 2007; 74: 461–9.
3. Cheung W, Flynn M, Thanakrishnan G, Milliss DM, Fugaccia E. Survival after out-of-hospital cardiac arrest in Sydney, Australia. Crit Care Resusc 2006; 8: 321–7.
4. Fairbanks RJ, Shah MN, Lerner EB, Ilangovan K, Pennington EC, Schneider SM. Epidemiology and outcomes of out-of-hospital cardiac arrest in Rochester, New York. Resuscitation 2007; 72: 415–24.
5. Hess EP, Campbell RL, White RD. Epidemiology, trends, and outcome of out-of-hospital cardiac arrest of non-cardiac origin. Resuscitation 2007; 72: 200–6.
6. Eng Hock Ong M, Chan YH, Anantharaman V, Lau ST, Lim SH, Seldrup J. Cardiac arrest and resuscitation epidemiology in Singapore (CARE I study). Prehosp Emerg Care 2003; 7: 427–33.
7. Markusohn E, Roguin A, Sebbag A, Aronson D, Dragu R, Amikam S, et al. Primary percutaneous coronary intervention after out-of-hospital cardiac arrest: patients and outcomes. Isr Med Assoc J 2007; 9: 257–9.
8. Kirkeby OJ, Fossum S, Risøe C. Anaemia in elderly patients. Incidence and causes of low haemoglobin concentration in a city general practice. Scand J Prim Health Care 1991; 9: 167–71.
9. Aapro MS, Cella D, Zagari M. Age, anemia, and fatigue. Semin Oncol 2002; 29: 55–9.
10. Barth E, Albuszies G, Baumgart K, Matejovic M, Wachter U, Vogt J, et al. Glucose metabolism and catecholamines. Crit Care Med 2007; 35 (9 Suppl): S508–18.