Tracheal intubation by paramedics under limited indication criteria may improve the short-term outcome of out-of-hospital cardiac arrests with noncardiac origin.

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Tracheal intubation by paramedics under limited indication criteria improves the short-term outcome of out-of-hospital cardiac arrests with non-cardiac origin.

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ABSTRACT

Purpose: It is not clear whether advanced airway management (AAM) with endotracheal tube (ET) by well-trained paramedics provides a better outcome in cases of out-of-hospital cardiac arrest (OHCA) compared with a bag-valve-mask device (BVMD) and other AAM devices. **Methods:** We analysed adult 2586 cases of OHCA without administration of adrenaline, witnessed or recognised by citizens and transported to hospital by paramedics between 1 July 2004 and 31 March 2008 in Ishikawa, Japan, to determine whether the AAM with ET under limited indication criteria may improve the outcome of OHCA. **Results:** The airway was managed with ET in 263 cases, other AAM devices in 660 cases and BVMD in 1,539 cases. The AAM was failed or discontinued in 124 cases, which were excluded from the analysis. The incidence of sustained return of spontaneous circulation (ROSC) was significantly higher in cases of AAM with ET (30%) than in AAM with other devices (20.2%) and in the standard procedure with BVMD (21.3%). The AAM with ET did not significantly affect 1-year survival. Multiple regression analysis indicated that tracheal intubation but not patient management by the certified paramedics is an independent factor associated with sustained ROSC (odds ratio=1.503, 95% confidence interval 1.081–2078). **Conclusion:** Tracheal intubation according to limited indication criteria and well-organised protocol in Japan may improve the short-term outcome of OHCA with non-cardiac origin. The large prospective study is needed to determine universal effects of tracheal intubation on the long-term outcome of OHCA with disturbed ventilation.

INTRODUCTION

Advanced cardiac life support (ACLS), including advanced airway management (AAM) and intravenous drug therapy, may have some benefits on the outcome of out-of-hospital cardiac arrest (OHCA) [1]. It is not clear whether AAM with an endotracheal tube (ET) in the emergency medical service (EMS) provides a better outcome on OHCA than other airway management devices [2, 3]. One controlled study in children showed that tracheal intubation does not improve clinical outcome [4]. Outcome was reported to be worsened when AAM with ET was performed in cases of OHCA with shockable rhythms [5, 6]. Recently, Garza et al. reported that avoidance of tracheal intubation as an early airway management and an increase in the ratio of chest compression to ventilation improved survival rate in OHCA of cardiac origin [6].

In Japan, certified paramedics who have completed training programs for tracheal intubation have used ET in patients with OHCA since July 2004. The program includes 180 hours of lectures and exercises in schools as well as experience with 30 cases in hospital operating rooms. When ET is indicated as an AAM device, the paramedics obtain instruction regarding tracheal intubation from an emergency physician in accordance with a protocol defined by the regional medical control council (MCC).

The present population-based cohort study was performed to determine whether airway management with ET according to the indication criteria may affect the outcome of OHCA in comparison with other AAM devices or BVMD and whether patient management by paramedics certified for ET may affect the prognosis in comparison with uncertified paramedics. Furthermore, we investigated whether the origin of OHCA (cardiac or non-cardiac in the Utstein style) modifies the effects.

MATERIALS AND METHODS

Data were collected in accordance to the national guideline of ethics for the epidemiological survey (The Ministry of Health, Labor and Welfare in Japan : http://www.mhlw.go.jp/general/seido/kousei/i-kenkyu/index.html). The study was approved by an institutional review board (#843).

Populations and setting

Ishikawa prefecture encompasses an area of 4,185 km^2 on the Sea of Japan coast, and has a resident population of 1,160,000. The prefecture is divided into four administrative regions: one central or urban, and three semi-rural or rural regions. Sixty-two percent of the residents are located in the Central (urban) region with an area of 1,432 km^2. An estimated 22% of the residents are over the age of 65. The prefecture has 704 ambulance crews, including 215 paramedics who can perform AAM with esophageal obturator airways and laryngeal masks. The numbers of paramedics certified for ET use (number of total paramedics) were 4 (174) in 2004, 23 (185) in 2005, 67 (195) in 2006, 95 (204) in 2007 and 127 (215) in 2008.

There are 11 fire departments and 55 registered ambulances in Ishikawa prefecture. There is one MCC. Ambulance crews act according to MCC protocols when patients have cardiopulmonary arrest or serious trauma. The indications and contraindications for tracheal intubation are listed in Table 1. All the paramedics begin ventilation with the BVMD. In cases in which ventilation is predicted to be difficult with a standard procedure using BVMD, they are encouraged to obtain permission for use of AAM devices. When ventilation is inadequate or expected to be difficult with AAM devices other than ET, the certified paramedics are allowed to perform tracheal intubation with the approval of emergency medical physicians. The paramedics are requested to minimally interrupt cardiopulmonary resuscitation (CPR) during the intubation procedure (< 30 s prior to November 2006, and < 10 s thereafter). In cases in which AAM with ET failed or was difficult (Cormack grade [7] = 2 or more), the paramedics are instructed to ventilate the patients with BVMD. After successful placement of ET or other AAM device, chest compression and ventilation are performed in a non-synchronized manner. The paramedics are instructed to perform tracheal suction if needed.

Patient data (Fig. 1)

Basal data were collected prospectively from 2759 OHCAs that were witnessed or recognized by citizens, confirmed by emergency medical technician (EMTs) on arrival at patient from 1 July 2004 to 31 March 2008. The collected data were based on the Utstein template [8.9] and included region, patient's age, patient's sex, arrest witness, cause of arrest, bystander CPR, initial cardiac rhythm, airway management by paramedics, interval between call and arrival at patient, interval between arrival at patient and completion of AAM, any return of spontaneous circulation (any ROSC), sustained ROSC, 1-month survival and 1-year survival. Sustained ROSC is defined as the continuous presence of palpable pulses for more than 20 min [9]. Survival rates at 1 year were determined either when the patient was alive in hospital at 1 year or when they were discharged alive from hospital to home or care and rehabilitation facilities within 1 year. The primary end point was 1-year survival. The secondary end points were any ROSC, sustained ROSC and 1-month survival.

EMTs other than paramedics are allowed to ventilate the patients only with BVM. One hundred and eleven cases were transported by other EMTs than paramedics and excluded from analysis.

Thirty-three cases with age of less than 8 y were also excluded from analysis since children were included in exclusion criteria for tracheal intubation. Furthermore, we excluded the data from 27 cases in which adrenaline was administered by a limited number of paramedics to exclude a possible interaction between tracheal intubation and adrenaline administration. The AAM was attempted in 1,047 of the remaining 2,586 cases. However, the attempted AAM failed or was discontinued in 124 arrests, which were excluded from the analysis as paramedics were obliged to insufficiently ventilate this group of patients with BVMD resulting in a very poor prognosis (survival 0% at 1 month). Finally, ventilation was maintained with ET in 263 cases, other AAM devices in 660 cases and BVMD in 1,539 cases. These 3 groups were analyzed to clarify the effects of tracheal intubation. The total 2462 cases in these 3 groups were divided into 2 groups according to the patient management by certified and uncertified paramedics for ET, when the effect of the certification of ET was analysis.

Statistical methods

Continuous variables are expressed as medians with interquartile ranges. Continuous variables were compared using non-parametric tests including Kruskal-Wallis one-way analysis of variance on ranks test and the Mann-Whitney rank sum test. For comparison of dichotomous variables, we used chi-square analysis with Pearson's correction. When significant differences were found among the 3 groups, multiple comparisons between 2 groups were made using Tukey's method [10]. Multiple logistic regression analyses were used to disclose independent predictors in dichotomous or trichotomous dependent variables. Results are expressed as odds ratio (OR) and 95% confidence interval (CI). All statistical analyses were performed using the JMP software version 7 (SAS Institute, Inc., Cary, NC, USA).

RESULTS

Patient characteristics

The characteristics of patients in relation to airway management are shown in Table 2. There were significant differences in age, interval between call and arrival at patient, interval between arrival at patient and admission to ambulance, duration of ambulance transportation to hospital, region, causes of arrest and CPR by citizens among the 3 groups. Multiple comparisons among the 3 groups were made using Tukey's method. Patient age, interval between arrival at patient and admission to ambulance and causes of arrest were significantly different between ET and other AAM devices. Patient age, interval between arrival at patient and admission to ambulance, duration of ambulance transportation to hospital and region were significantly different between ET and BVMD. The interval between call and arrival at patient, the interval between arrival at patient and admission to ambulance, duration of ambulance transportation to hospital and the incidence of CPR by citizens were significantly different between other

AAM devices and BVMD.

The characteristics of patients in relation to type of paramedics are shown in Table 3. There were significant differences in interval between arrival at patient and admission to ambulance and region between the 2 groups.

Comparisons of outcomes among ET, other AAM devices and BVMD

The results of monovariate analysis are shown in Table 4. There were significant differences in the incidences of any ROSC (P = 0.0151) and sustained ROSC (P = 0.0027) (chi-square analysis). Multiple comparisons of variables among the 3 groups were made by Tukey's method. The incidences of any ROSC and sustained ROSC were significantly higher in the patients managed with ET than in those with BVMD or other AAM devices.

When the outcomes were analyzed in OHCA patients with non-cardiac origin, the rates of any ROSC (P = 0.0286) and sustained ROSC (P = 0.0078) significantly differed among the 3 groups (chi-square analysis). Multiple comparisons of variables using Tukey's method disclosed that rate was significantly higher in patients managed with ET than in those managed with BVMD or other AAM devices.

To analyze the superiority of ET among the AAM devises, the comparison of outcomes only between ET and other AAM devices may be a more appropriate way. As a whole, the results of this simple chi-square analysis were similar to those of Tukey's multiple comparisons. However, it revealed that survival rate at 1 M in OHCA patients with non-cardiac origin is significantly higher in ET than in other AAM devices.

Comparisons of outcomes between paramedic groups

The results of monovariate analysis are shown in Table 5. There were significant differences in the incidences of any ROSC (P = 0.0308) and sustained ROSC (P = 0.0112) between the 2 groups (chi-square analysis). When the outcomes were compared in OHCA patients with cardiac origin and non-cardiac origin, there were no significant differences between the 2 groups.

Factors associated with sustained ROSC

The results of monovariate analysis are shown in Table 6. Patient age, interval between call and arrival at patient, region, cause of arrest, arrest witness, initial rhythms, incidences of tracheal intubation and management by paramedics certified for tracheal intubation were significantly different between patients with and without sustained ROSC.

Multiple logistic regression analysis was performed to confirm the effect of ET on sustained ROSC (Table 7). The results indicated that ET is an independent factor associated with sustained ROSC (OR: 1.5; 95%CI: 1.1 – 2.1) and identified arrest witness, origin of cardiac arrest (cardiac or non-cardiac), initial rhythm (shockable or non-shockable) and call – arrival interval as other significant factors related to sustained ROSC.

DISCUSSION

In the present study, we found a favorable effect of ET compared not only with BVMD but also with other AAM devices on the rate of sustained ROSC in adult (8-y or more) cases of OHCA witnessed by citizens and transported by paramedics. The favorable effects of ET were more prominent in OHCA with non-cardiac origins. The management by certified paramedics for tracheal intubation significantly influenced the sustained ROSC of all OHCAs when analyzed by monovariate analysis. However, multiple regression analysis revealed that ET as AAM but not the management by the certified paramedics is an independent factor associated with sustained ROSC. When tracheal suction is expected to be required, the ET may be recommended as the initial device for AAM. The superiority of ET in promoting a higher incidence rate of sustained ROSC suggests that ET may be a good initial choice for AAM in such cases.

However, ET did not improve the long-term outcomes including 1-month and 1-year survival in all OHCAs or OHCA with non-cardiac origin. Since the rate of long term survival in our community is low, a large prospective randomized control trial (RCT) study is required to clarify the effect of tracheal intubation on the long term outcome of OHCAs with non-cardiac origin.

Paramedics often attempt tracheal intubation in awkward situations, such as on the floor, in the moving ambulance and in restricted spaces. A more complex procedure may be required than in a hospital setting. It has been reported that incidence of ET misplacement is high when paramedics were insufficiently trained under poor medical control [11, 12]. Experienced paramedics regularly operating with physicians were reported to have a low tracheal intubation failure rate at OHCA [13]. Clinical experience of tracheal intubation has been identified as an independent factor to succeeded intubation [14]. The didactic curriculum for tracheal intubation in Japan is stricter than in other countries reported to date. The national paramedic curriculum in the USA requires students to perform 5 successful tracheal intubations to graduate [15]. In the San Diego Rapid Sequence Intubation Trial, paramedics received a 7-h educational session without supplemental live training [16]. The certifying paramedic curriculum in Japan generally includes 180 h of lectures and practice in school and experience in 30 successful cases in operation rooms under the instruction of anesthesiologists. It is assumed that experience with 15 to 20 cases in a clinical setting is necessary for paramedics to become proficient [17]. Thus, the training programs in Japan are considered appropriate.

One of major disadvantage of tracheal intubation is interruption of chest compression. Wang HE, et al reported that median duration of the first tracheal intubation–associated CPR interruption was 46.5 seconds and that paramedic tracheal intubation efforts were associated with multiple and prolonged CPR interruptions [18]. In our regional protocol for tracheal intubation, the interruption of chest compression was < 30 s before November 2006 and < 10 s thereafter. This rigorous protocol may diminish the disagreeable effects of procedure.

As shown in Table 2, tracheal intubation was performed in older patients. Elderly patients may have difficulty in managing their airway with a standard procedure using BVMD. Cardiac arrest may be more frequently caused by sunken cheeks, aspiration or choking, which are included in our regional indication criteria for tracheal intubation [19].

Adams et al. retrospectively analyzed the effects of ET on prognosis of the OHCA with cardiac origin [5]. They reported that the incidence of ET was highest in the patients who received the greatest number of shocks and that survival rates were lower in intubated patients among the subjects receiving similar numbers of shocks. Recently, Garza et al. reported that modification of the resuscitation protocol, including delaying intubation and increasing the ratio of chest compression to ventilation, improved the survival rate in OHCA with cardiac origin [6]. In accordance with these previous reports, we found no evidence that ET has beneficial effects on the outcome of OHCA with cardiac origin. In our regional protocol, routine application of ET is not recommended in cases of OHCA with cardiac origin. As shown in Table 4, ET was used less frequently in OHCA with cardiac origin that may be complicated with aspiration and other airway problems.

Ventilation becomes more important in cases of non-cardiac origin [20, 21]. Thus, more efficient airway management, including tracheal suction and ventilation, may be preferable if ventilation is inadequate or adequate ventilation is expected to be difficult with BVMD. OHCA with non-cardiac origin includes cardiac arrest due to numerous causes. We did not analyze the effects of tracheal intubation on the outcome in each subgroup with a different cause as the number of intubated patients was small. There may be a subgroup of patients in which ET use has a definitive effect on not only short-term outcome but also on long-term outcome.

As shown in Table 2, the interval between arrival at patient and admission to ambulance as well as the duration of transportation to hospital were prolonged when AAM with ET or other devices was performed. This implies that administration of adrenaline was delayed in patients with AAM as all of the patients analyzed received adrenaline only after arrival at the hospital emergency room. Although there were no significant differences in the interval between arrival at patients and admission to ambulance or the duration of transportation to hospital between patients with and without sustained ROSC, this delay should be corrected. Recently, certified paramedics were trained to administer adrenaline to OHCA patients in Japan. The increase in number of certified paramedics may correct the delay of adrenaline administration.

Limitations

Tracheal intubation was performed by certified paramedics in accordance to limited indication criteria. Both certified and non-certified paramedics treated the OHCA patients. We did not evaluate the quality and capability of paramedics. Therefore, the results of this cohort study may not show any universal effect of tracheal intubation on the outcome. However, it is suggested that tracheal intubation in accordance with limited indication criteria and well-organized protocol should not be discontinued, at least in part, in OHCA with non-cardiac origin.

Another issue to be resolved is the occurrence of patients in whom intubation or AAM is difficult. Patient anatomy is a primary factor in failed AAM. In a recent prospective cohort study [22], the two most common reasons subjectively reported by ALS providers for airway difficulty were anterior trachea (39%) and small mouth (30%). To perform tracheal intubation in this group of patients, further professional education programs will be required [13, 14]. Neither doctor car systems nor on-site assistance by emergency physicians or anesthesiologists in the ambulance are commonly available in Japan.

CONCLUSION

Performance of tracheal intubation according to limited indication criteria and well-organized protocol in Japan may improve the short-term outcome of OHCA with non-cardiac origin, compared not only with BVMD but also with other AAM devices. Since the 1 month or 1 year prognosis is very low, a large randomized control trial is required to determine the universal effects of tracheal intubation on the outcome of OHCA in which ventilation is inadequate with a standard procedure using BVMD, and to identify the subgroup of OHCA with non-cardiac origin, in which tracheal intubation may exert a definitive effect.

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Figure legends

Fig. Study profile

Table 1. Indications and contraindications for tracheal intubation in OHCA by paramedics in Ishikawa prefecture

Indications
1. Ventilation is inadequate or adequate ventilation is expected to be difficult with other airway management devices
a. Aspiration
b. Backflow of stomach contents
c. Inhalation burn
d. Serious injury of face or cervix
e. Bronchial asthma
f. Transportation takes more than 20 min
2. The paramedic judges that tracheal intubation is needed
3. The medical director judges that tracheal intubation is required
Contraindications
1. Patients less than 8 years old
2. Suspected cervical spine injury
3. Difficulty of head tilt
4. Trismus
5. Difficulty of laryngoscope insertion
6. Cormack grade ≥2
7. Too much time is taken to complete intubation (Interruption of CPR for more than 30 s prior to November 2006 and 10 s thereafter)
8. The paramedic judges that tracheal intubation is inappropriate

Table 2. Patient characteristics and time factors in relation to type of airway managements

Characteristics	AAM devices		BVMD (n=1,539)	P-value	Multiple comparisons
	ET (n=263)	Other AAM devices (n=660)			
Patient age, y, median (25%–75%)	79(68–86)	76(64–83)	76(64–85)	0.0060†	ET *vs*. BVMD, ET *vs*. Other AAM †
Patient sex, male (%)	154(58.6)	418(63.3)	890(57.8)	0.0528‡	
Interval between call and arrival at patient, median (25%–75%)	6.3(4.8–9)	6.6(5–9)	6 (4.4–8.4)	0.0114†	Other AAM *vs*. BVMD †
Interval between arrival at patient and admission to ambulance, median (25%–75%)	17(13–20)	13(10–17)	10(8–13)	<0.0001†	ET *vs*. BVMD, ET *vs*. Other AAM Other AAM *vs*. BVMD†
Duration of ambulance transportation to hospital, median (25%–75%)	11(7–16)	10(6.5–14)	7(4.7–11)	<0.0001†	ET *vs*. BVMD, Other AAM *vs*. BVMD†
Region: Central (urban) (%)	167(63.5)	384(58.2)	619(40.2)	<0.0001‡	ET *vs*. BVMD, Other AAM *vs*. BVMD §
Cause of arrest: Cardiac (%)	121(46.0)	365(55.3)	792(51.5)	0.0327‡	ET *vs*. Other AAM §
Not witnessed by citizen (%)	158(60.1)	414(62.7)	992(64.5)	0.3484‡	
CPR by citizen (%)	130(49.4)	328(49.7)	661(43.0)	0.0056‡	Other AAM *vs*. BVMD §
Initial rhythms: Shockable (%)	18(6.8)	53(8.0)	139(9.0)	0.4347‡	
Interval between arrival at patient and establishment of AAM, median (25%–75%)	9.1(5.8–12)	8(5.4–11.3)	–	0.102†	

ET: endotracheal tube; AAM: advanced airway management; BVMD: bag valve mask devices

† Kruskal-Wallis one way analysis of variance on Ranks test

‡ The χ^2 test

§ P<0.05 (Tukey's multiple comparison method).

Table 3. Patient characteristics and time factors in relation to type of paramedics

Characteristics	Certified for endotracheal intubation yes (*n*=1183)	no (n=1279)	*P*-value	Odds ratio (95% CI)
Airway management				
ET	263(22.2)	-	-	
other AAM devices	292(24.7)	368(28.8)	<0.0001*	0.869(0.723-1.045)
BVM	628(53.1)	911(71.2)		
Patient age, y, median (25%–75%)	77(64-85)	76(64-84)	0.3880	Undefined
Patient sex, male (%)	695(58.8)	767(59.9)	0.5381	0.951(0.810-1.117)
Interval between call and arrival at patient, median (25%–75%)	6.2(4.6-8.6)	6 (4.9-9)	0.7441	Undefined
Interval between arrival at patient and admission to ambulance, median (25%–75%)	12(9-16)	11(9-14)	<0.0001	Undefined
Duration of ambulance transportation to hospital, median (25%–75%)	8.4(5.2-12.1)	8(5-13)	0.9493	Undefined
Region: Central (urban) (%)	589(49.8)	581(45.4)	0.0303	1.193(1.019-1.399)
Cause of arrest: Cardiac (%)	607(51.3)	671(52.5)	0.5674	0.946(0.808-1.109)
Not witnessed by citizen (%)	740(62.6)	824(64.4)	0.3349	0.932(0.791-1.098)
CPR by citizen (%)	549(46.4)	570(44.6)	0.3729	1.072(0.914-1.256)
Initial rhythms: Shockable (%)	103(8.7)	107(8.4)	0.7623	1.058(0.797-1.404)
Interval between arrival at patient and establishment of AAM, median (25%–75%)	8.4(5.4-11.6)	8(5.3-11.2)	0.3957	Undefined

ET: endotracheal tube; AAM: advanced airway management; BVMD: bag valve mask devices

† Kruskal-Wallis One Way Analysis of Variance on Ranks test.

‡ The χ^2 test.

§ P<0.05 was considered statistically significant.

* BVM vs AAM including ET and other devices

CI: confidence interval

Table 4. Comparison of outcomes among airway management groups

Outcomes	AAM devices		BVMD	*P*-value	Multiple comparisons †
	ET	Other AAM			
	All OHCA patients				
	n=263	*n*=660	*n*=1,539		
Any ROSC (%)	83(31.6)*	152(23.0)*	366(23.8)	0.0158	ET *vs*. other AAM, ET *vs*. BVMD
Sustained ROSC (%)	79(30.0)*	133(20.2)*	327(21.3)	0.0028	ET *vs*. other AAM, ET *vs*. BVMD
Alive or discharged alive at 1 month (%)	15(5.7)	21(3.2)	85(5.5)	0.0547	
Alive or discharged alive at 1 year (%)	9(3.4)	17(2.6)	65(4.2)	0.1665	
	OHCA patients with cardiac origin				
	n=121	*n*=365	*n*=792		
Any ROSC (%)	32(26.5)	80(21.9)	169(21.3)	0.4498	
Sustained ROSC (%)	29(24.0)	67(18.4)	148(18.7)	0.3546	
Alive or discharged alive at 1 month (%)	7(5.8)	16(4.4)	52(6.6)	0.3404	
Alive or discharged alive at 1 year (%)	5(4.1)	13(3.6)	44(5.6)	0.3164	
	OHCA patients with non-cardiac origin				
	n=142	*n*=295	*n*=747		
Any ROSC (%)	51(35.9)*	72(24.4)*	197(26.4)	0.0321	ET *vs*. other AAM, ET *vs*. BVMD
Sustained ROSC (%)	50(35.2)*	66(22.4)*	179(24.0)	0.0090	ET *vs*. other AAM, ET *vs*. BVMD
Alive or discharged alive at 1 month (%)	8(5.6)*	5(1.7)*	33(4.4)	0.0633	
Alive or discharged alive at 1 year (%)	4(2.8)	4(1.4)	21(2.8)	0.3742	

† $P<0.05$ (Tukey's method)

* $P < 0.05$ (sub-analysis by chi-square with or without Pearson's correction between ET and other AAM devices)

Table 5. Comparison of outcomes between paramedic groups

outcomes	qualified for endotracheal intubation		*P*-value	Odds ratio (95% CI)
	yes	no		
	All OHCA patients			
	n=1183	n=1279		
Any ROSC (%)	312(26.4)	289(22.6)	0.0308	1.227(1.021-1.475)
Sustained ROSC (%)	285(24.1)	254(19.9)	0.0112	1.281(1.058-1.551)
Alive or discharged alive at 1 month (%)	67(5.7)	54(4.2)	0.0983	1.362(0.943-1.967)
Alive or discharged alive at 1 year (%)	48(4.1)	43(3.4)	0.3930	1.216(0.799-1.849)
	OHCA patients with cardiac origin			
	n =607	n =671		
Any ROSC (%)	145(23.9)	136(20.3)	0.1187	1.235(0.947-1.610)
Sustained ROSC (%)	127(20.9)	117(17.4)	0.1133	1.253(0.948-1.657)
Alive or discharged alive at 1 month (%)	42(6.9)	33(4.9)	0.1285	1.437(0.898-2.299)
Alive or discharged alive at 1 year (%)	34(5.6)	28(4.2)	0.2353	1.363(0.816-2.275)
	OHCA patients with non-cardiac origin			
	n =576	n =608		
Any ROSC (%)	167(29.0)	153(25.2)	0.1382	1.214(0.939-1.570)
Sustained ROSC (%)	158(27.4)	137(22.5)	0.0515	1.300(0.998-1.692)
Alive or discharged alive at 1 month (%)	25(4.3)	21(3.5)	0.4302	1.268(0.702-2.292)
Alive or discharged alive at 1 year (%)	14(2.4)	15(2.5)	0.9676	0.985(0.471-2.059)

$P<0.05$ was considered statistically significant.

CI: confidence interval

Table 6. Factors associated with sustained ROSC by monovariate analysis

	Survival (*n*=545)	Non-survival (*n*=1947)	*P*-value	*95%CI*
Patient age, y, median (25%–75%)	75(62–83)	77(65–85)	<0.0001†	Undefined
Patient sex, male (%)	328(60.9)	1,134(59.0)	0.4314‡	0.925(0.761-1.124)
Interval between Call and arrival, Median (25%–75%)	6(4–8)	6.2(4.9–9)	<0.0001†	Undefined
Interval between arrival at patient and admission to ambulance, median (25%–75%)	11(9–14.6)	11(9–15)	0.4997	Undefined
Duration of ambulance transportation to hospital, median (25%–75%)	8(5–12)	8(5–12.8)	0.1557	Undefined
Region: Central (urban) (%)	293(54.4)	877(45.6)	0.0003‡	0.704(0.581-0.853)
Cause of arrest: Cardiac (%)	244(45.3)	1,034(53.8)	0.0005‡	1.406(1.161-1.703)
Not witnessed by citizen (%)	224(41.6)	1,340(69.7)	<0.0001‡	3.232(2.655-3.935)
CPR by citizen (%)	232(43.0)	887(46.1)	0.2039‡	1.133(0.934-1.374)
Initial rhythms: Shockable (%)	101(18.7)	109(5.7)	<0.0001‡	0.261(0.195-0.348)
Use of ET (%)	79(14.7)	184(9.6)	0.0007‡	0.616(0.464-0.818)
Use of other AAM devices (%)	133(24.7)	527(27.4)	0.2061‡	1.152(0.925-1.436)
Management by paramedics qualified for tracheal intubation	285(52.9)	898(46.7)	0.0112‡	1.281(1.058-1.551)

ET: endotracheal tube; AAM: advanced airway management

OR: Odds ratio; CI: confidence interval

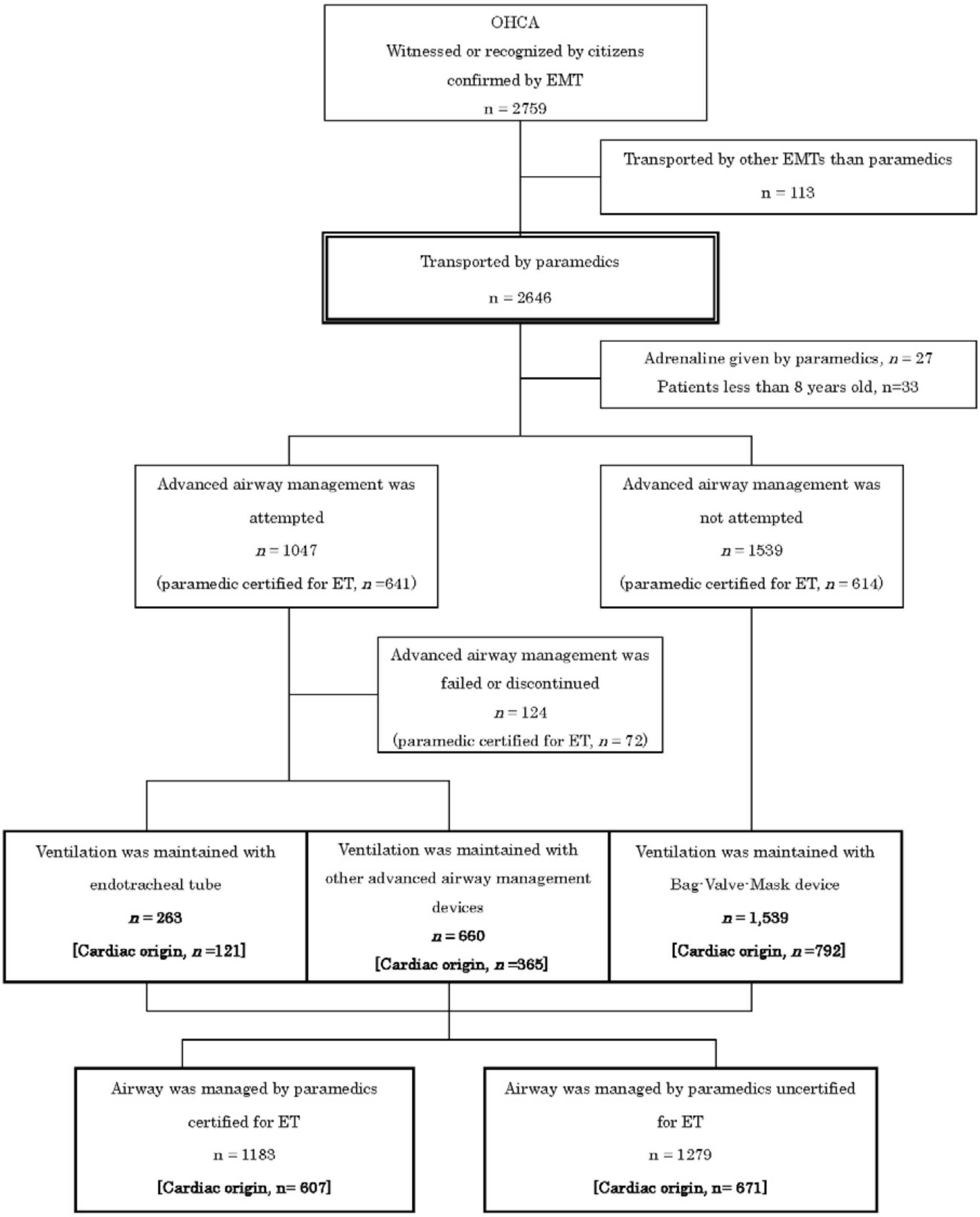
† The Mann-Whitney Rank Sum test

‡ The χ^2 test

Table 7. Factors associated with sustained ROSC by multiple logistic regression analysis.

	OR (Survival)	95% CI
Region: Central	1.137	0.923-1.400
Patient age	0.994	0.988-1.000
Not witnessed by citizen	0.355	0.289-0.437
Cause of arrest: Cardiac	0.571	0.459-0.708
Initial rhythms: Shockable	3.185	2.286-4.438
Tracheal intubation	1.503	1.081-2.078
Interval between call and arrival	0.958	0.930-0.986
management by paramedics qualified for tracheal intubation	1.141	0.917-1.419

OR: odds ratio; CI: confidence interval


OHCA
Witnessed or recognized by citizens
confirmed by EMT
n = 2759
Transported by other EMTs than paramedics
n = 113
Transported by paramedics
n = 2646
Adrenaline given by paramedics, n = 27
Patients less than 8 years old, n=33
Advanced airway management was attempted
n = 1047
(paramedic certified for ET, n =641)
Advanced airway management was not attempted
n = 1539
(paramedic certified for ET, n = 614)
Advanced airway management was failed or discontinued
n = 124
(paramedic certified for ET, n = 72)
Ventilation was maintained with endotracheal tube
n = 263
[Cardiac origin, n =121]
Ventilation was maintained with other advanced airway management devices
n = 660
[Cardiac origin, n =365]
Ventilation was maintained with Bag-Valve-Mask device
n = 1,539
[Cardiac origin, n =792]
Airway was managed by paramedics certified for ET
n = 1183
[Cardiac origin, n= 607]
Airway was managed by paramedics uncertified for ET
n = 1279
[Cardiac origin, n= 671]