ORIGINAL ARTICLE

Comparison of the factors affecting neurological outcome in out-of vs in-hospital cardiac arrest cases

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Abstract

Objective: To determine the differences between the factors such as return of spontaneous circulation positivity, duration of cardiopulmonary resuscitation, and cardiac rhythm at first arrival affecting neurological outcomes in cardiac-arrest cases.

Methods: This study was conducted at the Malatya State Hospital, Malatya, Turkey, from January to December 2014, and comprised patients who had received cardiopulmonary resuscitation. Patients were divided into two groups; in-hospital cardiac arrest and out-of-hospital cardiac arrest. The groups were compared in terms of gender, age, initial rhythm, cardiopulmonary resuscitation durations, cardiopulmonary resuscitation results (exitus, return), return of spontaneous circulation rates observed after cardiopulmonary resuscitation, and neurological outcome responses of the cases in which return of spontaneous circulation was observed. SPSS 22 was used for data analysis.

Results: Of the 321 cases, 88(27.41%) were in-hospital and 233(72.59%) were out-of-hospital cardiac arrest cases. Besides, 189(58.9%) of the patients were men and 132(41.1%) were women with an overall mean age of 67.21±15.25 years (range: 18-98 years).

Moreover, 16(18.2%) in-hospital cases and 47(20.2%) out-of-hospital cases had shockable rhythms at the time of arrival. Cardiopulmonary resuscitation was applied to 74(23%) patients for less than 20 minutes and to 247(76.9%) for more than 20 minutes. Return of spontaneous circulation positivity was recorded in 134(41.7%) patients, of whom 62(70.5%) were in-hospital and 72(30.9%) were out-of-hospital cases. Moreover, 19(5.9%) patients were discharged with good neurological outcome. In cases where cardiopulmonary resuscitation was applied for less than 20 minutes, return of spontaneous circulation positivity was present in 43(100%) in-hospital and 31(100%) out-of-hospital cases. Return of spontaneous circulation positivity and good neurological outcome rate of the patients having shockable rhythms was 48(76.2%) and 8(12.7%), respectively.

Conclusions: Return of spontaneous circulation positivity, favourable neurological outcome response and survival rates were significantly higher among in-hospital cardiac arrest cases.

Keywords: Cardiac arrest, Resuscitation, Neurological outcome, Survival. (JPMA 66: 1412; 2016)

Introduction

Cardiac arrest is the abrupt loss of respiration and consciousness occurring in consequence of the failure of cardiac functions.[1] The 'chain of survival' which consists of the factors such as early admission, early cardiopulmonary resuscitation (CPR) application, and early defibrillation constitutes the most important step to ensure the survival of the patient subsequent to the cardiac arrest.[2] Cardiac arrests are described in two terms, namely in-hospital cardiac arrest (IHCA) and out-of-hospital arrest (OHCA). OHCA comprises patients who are taken to the emergency room (ER) by others or rescue teams with the complaint of cardiac arrest, and who are treated in the ER. On the other hand, the patients who suffer from cardiac arrest while being followed up and treated in the ER are called as IHCAs. When the survival rates of OHCA are compared with the survival rates of IHCA, it is seen that IHCA cases have a higher chance of survival.[3]

The return of the pulse, which is referred to as the Return of Spontaneous Circulation (ROSC), can be obtained in response to CPR and/or electrical defibrillation in the patients to whom CPR is applied subsequent to cardiac arrest.[4] There are certain studies indicating that high-qualified CPR is related to ROSC positivity.[5] Systematic post-cardiac arrest care after ROSC may enhance survival and neurological outcome.[6]

The current study was planned to compare the factors affecting neurological outcome such as ROSC positivity, CPR duration and arrival cardiac rhythm according to the arrest localisations in cardiac arrest cases.

Patients and Methods

This study was conducted at the Malatya State

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Hospital, Malatya, Turkey, from January to December 2014, and comprised patients to whom CPR had been applied by emergency medicine specialists. The participants were divided into IHCA and OHCA groups. The groups were compared in terms of gender, age, arrival rhythm in the first application, CPR durations, CPR results (exitus, return), ROSC rates observed after CPR, and neurological outcome responses of the cases in which ROSC was observed.

Pulse return occurring after CPR and/or defibrillation was accepted as ROSC positivity. Neurological outcome at the moment of discharge was examined for the patients having ROSC positivity who were admitted to intensive care units (ICUs) or who were transferred to a higher level of hospital. Neurological outcomes at the moment of discharge were classified in accordance with cerebral performance category (CPC). The CPC score classifies patients into 5 categories: CPC 1 (no neurological disability); CPC 2 (minor neurological deficit); CPC 3 (severe neurological impairment, dependent in everyday life); CPC 4 (coma); and CPC 5 (brain death).[7] According to this classification, the outcomes of the patients in the 1st and 2nd groups were considered as good neurological outcome, the outcomes in the 3rd and 4th groups as poor neurological outcome, and the outcomes in the 5th group as no neurological outcome.

Patients under the age of 18, with traumatic cardiac arrest, and those suffering from drug intoxication were excluded. The arrest cases resulting from suffocation, electric shock or originating from central nervous system were also excluded. Similarly, patients whose medical records and system records were not complete were also excluded.

Approval was obtained from the institutional review board.

Qualitative data was presented with numbers and percentages while qualitative data was given in arithmetic mean ± standard deviation (SD). SPSS 22 was used for data analysis. Statistical analyses of Pearson's chi-squared test, Fisher's exact test, and chi-squared trend were used for the comparison between the groups. $P<0.05$ was considered significant.

Results

Of the 321 cases, 88(27.41%) were IHCA and 233(72.59%) were OHCA cases. Besides, 189(58.9%) of the patients were men and 132(41.1%) were women. The overall mean age was 67.21±15.25 years (range: 18-98 years).

Moreover, 16(18.2%) IHCA cases and 47(20.2%) OHCA cases had shockable rhythms at the time of arrival. CPR was applied to 74(23%) patients for less than 20 minutes and to 247(76.9%) patients for more than 20 minutes. It was observed that 43(48.9%) of the IHCA patients responded to CPR in less than 20 minutes while this number was 31(13.3%) in OHCA cases. ROSC positivity was recorded on 134(41.7%) patients, of which 62(70.5%) were IHCA and 72(30.9%) were OHCA cases. Moreover, 26(8.1%) patients had neurological

Table-1: Demographic and clinical characteristics of the groups.

		IHCA / OHCA	Total	
		n (%) / n (%)	n	%
Gender	Male	45 (51,1) / 144 (61,8)	189	58,9
	Female	43 (48,9) / 89 (38,2)	132	41,1
Initial Rhythm	Shockable	16 (18,2) / 47 (20,2)	63	19,6
	Non-Shockable	13 (14,8) / 182 (78,1)	195	60,7
	Other	59 (67) / 4 (1,7)	63	19,6
ROSC	ROSC (+)	62 (70,5) / 72 (30,9)	134	41,7
	ROSC (-)	26 (29,5) / 161 (69,1)	187	58,3
CPR	<20 min	43 (48,9) / 31 (13,3)	74	23,1
	>=20 min	45 (51,1) / 202 (86,7)	247	76,9
Diagnosis	Cardiac	35 (39,8) / 143 (61,4)	178	55,5
	Non-Cardiac	53 (60,2) / 90 (38,6)	143	44,5
Outcome	No	71 (80,7) / 224 (96,1)	295	91,9
	GoodOutcome	12 (13,6) / 7 (3)	19	5,9
	PoorOutcome	5 (5,7) / 2 (0,9)	7	2,2
Age	AVG.±SD (Min.-Max.)	67,99±16,71(18-96) / 66,92±14,69(18-98)	67,21±15,25	18-98
CPR durations (min)	AVG.±SD (Min.-Max.)	25,44±20,66(3-110) / 33,27±13,41(5-75)	31,12±16,08	3-110

IHCA: InHospitalCardiacArrest, OHCA: Out Of HospitalCardiacArrest, ROSC : Return Of SpontanCirculation CPR: CardiopulmonaryResuscitation, AVG: Average, min.:minute, SD: Standard Deviation.

Table-2: ROSC positivity of cases and their distribution according to outcome results.

		CA				Total		p
		IHCA		OHCA				
		n	%	n	%	n	%	
ROSC	ROSC (+)	62	70,5	72	30,9	134	41,7	0,000
	ROSC (-)	26	29,5	161	69,1	187	58,3	
Outcome	No	71	80,7	224	96,1	295	91,9	0,000
	Good Outcome	12	13,6	7	3	19	5,9	
	Poor Outcome	5	5,7	2	0,9	7	2,2	
Outcome	(+)	17	19,3	9	3,9	26	8,1	0,000
	(-)	71	80,7	224	96,1	295	91,9	
CardiacEtiology								
ROSC	ROSC (+)	27	77,1	54	37,8	81	45,5	0,000
	ROSC (-)	8	22,9	89	62,2	97	54,5	
Outcome	No	28	80	135	94,4	163	91,6	0,017
	Good Outcome	6	17,1	6	4,2	12	6,7	
	Poor Outcome	1	2,9	2	1,4	3	1,7	
Outcome	(+)	7	20	8	5,6	15	8,4	0,012

CA: Cardiac Arrest, IHCA: In Hospital Cardiac Arrest, OHCA: Out Of Hospital Cardiac Arrest, ROSC: Return of Spontan Circulation.

Table-3: ROSC positivity and outcome distribution of arrest developing cases according to CPR duration and initial rhytm.

Cardiac Arrest			CPR				Total		p
			<20 min		>=20 min				
			n	%	n	%	n	%	
IHCA	ROSC	ROSC (+)	43	100	19	42,2	62	70,5	0,000
		ROSC (-)	0	0	26	57,8	26	29,5	
	Total		43	48,9	45	51,1	88	100	
OHCA	ROSC	ROSC (+)	31	100	41	20,3	72	30,9	0,000
		ROSC (-)	0	0	161	79,7	161	69,1	
	Total		31	13,3	202	86,7	233	100	
Total	ROSC	ROSC (+)	74	100	60	24,3	134	41,7	0,000
		ROSC (-)	0	0	187	75,7	187	58,3	
	Total		74	23,1	247	76,9	321	100	
IHCA	Outcome	No	29	67,4	42	93,3	71	80,7	0,007
		GoodOutcome	10	23,3	2	4,4	12	13,6	
		PoorOutcome	4	9,3	1	2,2	5	5,7	
	Total		43	48,9	45	51,1	88	100	
OHCA	Outcome	No	27	87,1	197	97,5	224	96,1	0,007
		GoodOutcome	2	6,5	5	2,5	7	3	
		PoorOutcome	2	6,5	0	0	2	0,9	
	Total		31	13,3	202	86,7	233	100	
Total	Outcome	No	56	75,7	239	96,8	295	91,9	0,000
		GoodOutcome	12	16,2	7	2,8	19	5,9	
		PoorOutcome	6	8,1	1	0,4	7	2,2	
	Total		74	23,1	247	76,9	321	100	
IHCA	Outcome	(+)	14	32,6	3	6,7	17	19,3	0,002
		(-)	29	67,4	42	93,3	71	80,7	
	Total		43	48,9	45	51,1	88	100	
OHCA	Outcome	(+)	4	12,9	5	2,5	9	3,9	0,020
		(-)	27	87,1	197	97,5	224	96,1	
	Total		31	13,3	202	86,7	233	100	
Total	Outcome	(+)	18	24,3	8	3,2	26	8,1	0,000
		(-)	56	75,7	239	96,8	295	91,9	

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	Total		74	23,1	247	76,9	321	100	
Cardiac Arrest			**Initial Rhytm**				**Total**		**p**
			Shockable		**Non- Shockable / Other**				
			n	**%**	**n**	**%**	**n**	**%**	
Total	ROSC	ROSC (+)	48	76,2	86	33,3	134	41,7	0,000
		ROSC (-)	15	23,8	172	66,7	187	58,3	
	Total		63	19,6	258	80,4	321	100	
Total	Outcome	No	53	84,1	242	93,8	295	91,9	0,026
		GoodOutcome	8	12,7	11	4,3	19	5,9	
		PoorOutcome	2	3,2	5	1,9	7	2,2	
	Total		63	19,6	258	80,4	321	100	
Total	Outcome	(+)	10	15,9	16	6,2	26	8,1	0,012
		(-)	53	84,1	242	93,8	295	91,9	
	Total		63	19,6	258	80,4	321	100	

IHCA: InHospitalCardiacArrest, OHCA: Out Of HospitalCardiacArrest, ROSC : Return of SpontanCirculation CPR: CardiopulmonaryResuscitation.

outcome while 295(91.9%) had no such outcome. Of the former, 19(5.9%) patients were discharged with good neurological outcome (CPC 1-2), and 7(2.2%) were discharged with poor neurological outcome (CPC 3-4). Favourable neurological outcome (CPC 1-2) of IHCA patients was found in 12(13.6%) cases while this rate was recorded at 7(3%) in OHCA patients. The mean CPR duration was 25.44±20.66 minutes (3-110) among IHCA and 33.27±13.41 minutes (5-75) among OHCA patients (Table-1).

Cardiac aetiology showed that ROSC positivity was found in 27(77.1%) IHCA and 54(37.8%) OHCA cases, whereas ROSC negativity was observed in 8(22.9%) and 89(62.2%) cases, respectively (p=0.000). Good neurological outcome was found in 6(17.1%) IHCA and 6(4.2%) OHCA cases while poor outcome was found in 1(2.9%) IHCA and 2(1.4%) OHCA cases (Table 2).

In cases where CPR was applied for less than 20 minutes, ROSC positivity was present in 43(100%) IHCA and 31(100%) OHCA cases, whereas none of the cases showed ROSC negativity. In case where CPR duration was equal to or above 20 minutes, 19(42.2%) IHCA and 41(20.3) OHCA cases were ROSC-positive while 26(57.8%) IHCA and 161(79.7%) OHCA cases were ROSC-negative.

ROSC positivity and good neurological outcome rate of the patients having shockable rhythms was 48(76.2%) and 8(12.7%), respectively (Table-3).

Discussion

Although certain improvements have been recorded for the treatment of cardiopulmonary arrest (CPA) cases, this disease is still the main cause of death in numerous places throughout the world.[8]

Differences are seen in the aetiologies, prognostic factors and discharge rates of arrest cases occurring in and out of hospital.[3] On this subject, various rates have been reported in the literature. For example, it was reported in a study carried out by Sosson et al. that only 7.1% of 5,505 OHCA cases were discharged from the hospital after medical interventions.[9] However, Chan et al. demonstrated in a recent study that discharge rate of CPA patients rose to 9.8% in 2012 while this percentage was 5.7% in 2005 and 2006.[10] Ehlenbach et al. remarked in their study performed on 433,985 IHCA cases that only 18.3% of the cases were discharged after treatment.[11] According to another study, discharge rate of out-of-hospital CPA cases were lower than the rate of in-hospital cases.[3] In our study, IHCA / OHCA discharge rates were found to be 19.3% and 3.9%, respectively. It was also recorded that survival rate of IHCA cases was higher than the rate of OHCA cases.

Differences are seen among arrival rhythms of arrest cases. Nevertheless, it was confirmed that effective interventions raised the survival rate from 21% to 38% in the arrest cases in which initial rhythms were determined as ventricular fibrillation (VF) or ventricular tachycardia (VT). Asystole was reported to be the lowest rhythm type for the return of circulation and discharge from hospital.[12]

Holmberg et al. demonstrated in their study that initial rhythm was VF (shockable rhythm) in approximately 60-80% of arrest cases. It was also reported in the same study that survival rate of CPA cases having shockable rhythms was higher than the rate of CPA cases having

non-shockable rhythms.[13] Herlitz et al. stated that discharge rate of CPA cases having shockablerhythms was higher than the rate of CPA cases having non-shockable rhythms.[14] According to another study, shockable rhythm incidence of IHCA cases was calculated to be higher than the incidence of OHCA cases.[3] When the initial rhythms were analysed in IHCA and OHCA cases by Fredriksson et al., survival rate of IHCA cases having shockable rhythm was found to be 18% while this rate was calculated as 61% in OHCA cases.[15] In our study, the initial rhythms of IHCA and OHCA cases were analysed, and 16 of IHCA cases (18.2%) and 47 of OHCA cases (20.2%) were seen to have shockable rhythms. It was also confirmed that there was a statistically significant relationship between shockable / non-shockable status of initial rhythms and ROSC positivity, existence of neurological outcome, and good neurological outcome. ROSC positivity and good neurological outcome of the cases having shockable rhythms were determined to be significantly higher in IHCA cases than OHCA cases ($p<0.05$).

Researches have demonstrated that there was a significant relationship between ROSC and the quality and duration of resuscitation applied to CPA cases.[16,17] Wibrandt I. et al. reported in a study that CPR duration was significant in terms of ROSC response and neurological outcome in the cases in which CPR was applied for less than 20 minutes.[18] Rehmani R et al. found that patients who performed for more than ten minutes CPR had more ROSC and outcome.[19] In our study, the relationship between ROSC positivity, neurological outcome and good neurological outcome was found to be statistically significant according to CPR duration of CPA cases in parallel with the literature ($p<0.05$).

Consequently, it was confirmed that ROSC positivity, existence of neurological outcome, and good neurological outcome response were higher in IHCA cases to which CPR was applied than OHCA cases. It can be considered that favourable results are obtained at higher rates in in-hospital arrest cases due to numerous reasons such as early diagnosis of the deterioration in physiological parameters, higher probability of prediction of possible arrests, readiness of experienced personnel, easy provision of necessary equipment, etc. On the other hand, ROSC positivity and obtainment of good neurological outcome were found to be higher in OHCA cases to which CPR was applied for more than 20 minutes. We consider that this situation arises from the difference of etiological factors between OHCA cases and IHCA cases.

Conclusion

ROSC positivity, good neurological outcome response and survival rates were significantly higher in IHCA cases.

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