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Out-of-hospital cardiac arrests in nursing homes and primary care facilities in Pirkanmaa, Finland

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Conflicts of interest

The authors confirm there are no conflicts of interest to report.

ABSTRACT

Background: Dispatching Emergency Medical Services to treat patients with deteriorating health in nursing homes and primary care facilities is common in Finland. We examined the cardiac arrest patients to describe this phenomenon. We had a special interest in patients for whom cardiopulmonary resuscitation was considered futile.

Methods: We conducted an observational study between 1 June 2013 and 31 May 2014 in the Pirkanmaa area. We included cases in which Emergency Medical Services participated in the treatment of cardiac arrest patients in nursing homes and primary care facilities.

Results: Emergency Medical Services attended to a total of 355 cardiac arrest patients, and 65 patients (18%) met the inclusion criteria. The included patients were generally older than 65 years, but otherwise heterogeneous. Nineteen patients (29%) had a valid do-not-attempt-resuscitation order, but paramedics were not informed about it in ten (53%) of those cases. Eight (12%) of the 65 patients survived to hospital admission and three (5%) survived to hospital discharge with a neurologically favourable outcome. Two patients were alive 90 days after the cardiac arrest; both were younger than 70 years of age and had ventricular fibrillation as primary rhythm. There were no survivors in nursing homes.

Conclusions: The do-not-attempt-resuscitation orders were often unavailable during a cardiopulmonary resuscitation attempt. Although resuscitation attempts were futile for patients in nursing homes, some patients in primary care facilities demonstrated a favourable outcome after cardiac arrest. Emergency Medical Services seem to be able to recognise potential survivors and focus resources on their treatment.

Introduction

Sudden cardiac arrest (CA) generally results in poor outcomes, as the survival to hospital discharge has been reported as only 7–8 %[1]. Recently, some encouraging studies on out-of-hospital cardiac arrest (OHCA) have been published, that report increasing survival over time due to improvements in CA management[2-5]. Yet the survival rate among patients older than 80 years of age has not improved as much over time when compared to the rate among younger CA patients[6]. Better survival after CA is associated with cardiopulmonary resuscitation (CPR) factors such as a shockable initial rhythm, witnessed arrest, bystander CPR, a shorter Emergency Medical Services (EMS) response and a public location of CA[1,7,8]. Survival from CA decreases among aged persons after the age of 65-70. Nevertheless, age is a poor independent prognostic factor of survival with good neurological outcome[2,5,8-14]. Many studies show the increasing burden of pre-arrest comorbidities to be associated with decreasing survival after CA[8,15-19], while in many recent studies this association has not been found[5,11,13,14]. Studies concerning the impact of nursing home (NH) residence and functional status of the patients are even more scarce and controversial[2,4,9,12,14,20-22].

EMS respond equally to all medical emergencies in Finland, including those of patients in health care facilities and aged NH residents with comorbidities. In cases of acute critical illness or emergency, patients in smaller health care facilities and NHs need to be transferred to a hospital. Occasionally, EMS is inappropriately dispatched to treat patients in health care facilities and NHs due to deficient treatment plans or lack of advance directives concerning end-of-life care[23]. The purpose of our study was to describe the CA patients treated by EMS in health care facilities and NHs, a subgroup that is usually excluded from either Utstein-style OHCA or in-hospital cardiac arrest (IHCA) reports. We focused specifically on patients with pre-existing do-not-attempt-resuscitation (DNAR) orders and on those patients with whom cardiopulmonary resuscitation was attempted but with efforts being promptly ceased due to evidence of medical futility[24].

Materials and methods

Ethics

We conducted an observational study with prospective data collection and post-hoc analysis. The Ethics Committee of Tampere University Hospital reviewed the study protocol (Approval no: R15048). The study was approved by Tampere University Hospital, the National Institute for Health and Welfare and the Finnish Population Register Centre. The need for patient consent was waived due to the observational nature of the study.

Setting

In the Finnish health care system, there are five university hospitals, 14 central hospitals and in addition, every municipality has a public general practitioner-level primary health care facility (PCF). The PCFs have policlinics and wards that admit patients with low-risk acute conditions, such as infections requiring intravenous antibiotics, rehabilitation after surgery, patients with terminal conditions and patients who are waiting for residency at NHs. PCFs often have an on-call physician only for phone consultations only outside office hours. Finnish patients have the right to long-term care on the basis of chronic medical conditions or decreased functional status caused by comorbidities or advanced age (over 65 years of age). Long-term care denotes both social and medical aid as needed and mainly takes place at patients' homes, but nursing homes provide long-term care for the oldest, most morbidly ill, and functionally impaired patients. NHs usually do not have any on-call physician on duty.

All acute EMS units are alarmed via a centralised emergency dispatch centre. The dispatcher makes a risk assessment based on the symptoms of the patient and defines the appropriate response. All patients with similar symptoms and similar risk analyses receive the same EMS response, regardless of whether the patient is located in a health care facility or NH. In the case of a CA patient without a DNAR order, advanced life support units are dispatched simultaneously with an anaesthetist physician-staffed Helicopter Emergency Medical Services (HEMS) unit. The purpose of this arrangement is to begin the intensive care unit-level treatment as soon as possible. Although details on the EMS, anaesthetist physician-staffed HEMS, and acute hospitals in the Pirkanmaa area were described in our previous study[24], we provide a summary here. The EMS serves approximately 525,000 inhabitants. Alongside the EMS unit, the HEMS is always dispatched to a suspected CA

patient. One HEMS unit operates in the area 24 hours a day. Patients with return of spontaneous circulation (ROSC) are transported to Tampere University Hospital.

Data and definitions

We collected all data concerning OHCAs and cardiopulmonary resuscitation attempts in the Pirkanmaa area from 1 June 2013 to 31 May 2014, according to the Utstein template[25,26]. This study analyses a subgroup of CPR attempts in various nursing homes and the emergency departments and wards of primary care facilities. Exclusion criteria were locations in a private residence, work place, recreational place, public place or EMS transport.

The Utstein data were prospectively collected by paramedics. We collected the additional data on patients' backgrounds and outcomes from EMS datasheets and primary care and university hospital patient records retrospectively. To evaluate the patients' prior health, we used the weighted Charlson Comorbidity Index (CCI)[27], which is a validated index used to predict short-term mortality. In addition, we collected data on the presence of an existing DNAR order or limitations of medical treatment from all available patient records compiled by paramedics during CPR attempts. Limitations of medical treatment were defined as limitations in providing intensive care, intubation and/or ventilator treatment, invasive procedures such as dialysis or percutaneous coronary intervention, transportation to specialised medical care facilities or allowing natural death. One author (HK) completed the data retrospectively if additional information was found during a re-check of the medical records. The dates of deaths were collected from the Finnish Population Register Centre. To describe the survival of these patients, we reported survival to hospital admission, survival to hospital discharge and 90-day survival. We also reviewed the relevant patient records to determine the neurological status of the survivors before CA and at hospital discharge. The neurological status was characterised by Cerebral Performance Category (CPC) as either favourable (CPC 1–2, i.e., independent) or unfavourable (CPC 3–5, i.e. dependent, comatose, brain-dead)[25]. Futile resuscitation attempts were defined as those performed on patients with dismal chances of survival, including those with prolonged downtime, end-stage terminal illness, multiple traumas and unwitnessed asystole as the primary rhythm[24].

Statistics

Data are presented as frequencies and percentages or as median and interquartile ranges (Q_1-Q_3). When comparing survivors and non-survivors, we used the Chi-Square test and Fisher's exact test for categorical variables and the Mann-Whitney U-test for numerical variables. P values <0.05 were considered statistically significant, and all tests were two-sided. Statistical analyses were performed using SPSS applications (IBM SPSS Statistics for Macintosh, Version 24.0 Armonk, NY: IBM Corp).

Results

In total, *n*=355 CA patients were identified, and *n*=65 (18%) patients met the inclusion criteria (Figure 1). The patients included in our study were heterogeneous by their background characteristics, and mainly older than 65 with multiple comorbidities. We present the patient characteristics in Table 1. Twenty-one (32%) CAs occurred in NHs and *n*=44 (68%) in PCFs. Fifteen of *n*=23 (65%) NH residents had a DNAR order. Resuscitation was attempted on *n*=38 (86%) of PCF patients and *n*=14 (67%) of NH patients (p=0.10, Pearson Chi-Square) (Table 2).

Considered futility

An EMS unit was dispatched to treat a CA victim with a DNAR order in *n*=19 (29%) cases. The EMS received information about the existing DNAR order in nine of these cases (47%), but in ten cases (53%), the EMS did not receive this information and started CPR. Eight of the ten patients were in long-term care.

In addition to the nine patients with known DNARs, CPR attempts were discontinued due to considered futility in *n*=20 cases. The reasons for futility designation were prolonged downtime (*n*=9), DNAR-order revealed during the resuscitation attempt (*n*=5) or an end-state terminal disease (*n*=6). The six (9%) patients with diagnosed terminal illness did not have any limitations of medical treatment. HEMS physicians recognised the futility in these cases within a median of 16 minutes from dispatch (Q_1–Q_3 10–23) and ordered the EMS unit to terminate the resuscitation attempt. All these patients were over 87 years old except one patient, who had an old brain injury. Two of these patients did not receive bystander CPR (Table 1).

Return of spontaneous circulation (ROSC) and survival after CA

Ten patients (*n*=10; 15%) achieved permanent ROSC. The treatment of two patients was limited after ROSC due to a dismal prognosis, and they were transferred to palliative care. Eight patients (12%) survived to the hospital and none of them was a NH patient. The survivors were younger, were more often resuscitated at a PCF emergency department, and had had a shorter admission period in the unit where CA occurred and a shorter EMS response time (Table 1). The HEMS unit was more often present on the resuscitation attempt (i.e., not cancelled) in cases where the patient survived to hospital

admission (75% for survivors vs. 12% for non-survivors, $p<0.001$), hospital discharge (100% vs. 15%, $p=0.001$) and 90 days after CA (100% vs. 17%, $p=0.038$).

Four patients admitted to the university hospital survived to hospital discharge (6% of all 65 patients). Three patients were discharged with the same neurological status as prior to CA, and one patient remained comatose. Only two patients (3%) were alive 90 days after CA, both with CPC 1–2. They were males under 70 years old, had ventricular fibrillation as the first monitored rhythm, and were in PCF due to an acute illness at the time of CA.

Discussion

In this Utstein-style study, we report the results of cases in which Emergency Medical Services were dispatched to nursing homes or primary care facilities to address patients with cardiac arrest. These heterogeneous cases are normally excluded from OHCA or IHCA reports but – in this material – represent 18% of EMS-treated cardiac arrests. In this study, the rate of survival after CA with a neurologically favourable outcome was 5%. In addition, we found deficiencies in the nursing homes' and primary care facilities' resuscitation protocols[28], the most striking of which was the high proportion of patients with DNARs who received cardiopulmonary resuscitation. However, the EMS system and Helicopter Emergency Medical Services physicians seemed to recognise patients with an assumed favourable prognosis.

None of the NH residents survived in this study. Interestingly, the survival rate in our study was generally worse than survival rates reported in other recent studies investigating elderly CA patients or those living in NHs[9,10,12-14,22]. This could be explained by our wide inclusion criteria, as some previous studies have excluded patients with DNAR decisions or cases with unattempted resuscitation from their survival analysis[6,11-14,21,22]. Also, the patients in this study were older compared to the patients studied in previous reports[1], which reflects the characteristics of Finnish NH residents[29]. As EMS responded promptly to CAs in this study, the poor survival rate can be explained mainly by the demographics of the studied patient group, although the deficiencies in the resuscitation protocol may also have had an impact on survival rates.

The most important deficiency in resuscitation protocols found in our study was that information on DNAR orders was not readily available during the resuscitation attempt. It is alarming that EMS received the DNAR information in fewer than half of the cases. Interestingly, while many of the patients with a pre-existing DNAR order underwent an inappropriate resuscitation attempt, some of the patients without a DNAR order did not receive bystander CPR, even if the CA was witnessed by a NH/PCF nurse. The proportion of DNAR patients receiving CPR was higher compared to a recent French study (53% vs. 24%)[30]. We also included those cases where data on DNAR orders were accessed from medical records retrospectively, while the French study only reported the number of advance directives that EMS accessed during the CPR attempts.

Another deficiency in resuscitation protocols seen in this study was a delay in emergency dispatch calls and in the initiation of resuscitation. The longest emergency dispatch call delays (>10 min.)

occurred in PCFs with a physician working around the clock, and the primary call to the on-call physician most likely delayed the emergency call. The longer EMS response time for non-survivors may partly explain their more dismal survival rates in our study. In contrast, the EMS system and HEMS physicians seem to recognise those patients with a favourable prognosis, as the HEMS unit was present in those CPR attempts that led to the patients' survival. Primarily, the HEMS unit is dispatched to all cardiac arrest cases, but if the physician recognises the case as futile, the physician submits a cancellation for the HEMS unit. In this study, the EMS response in the resuscitation protocol was good in general.

In addition, we found that advance directives concerning end-of-life care[31,32] were often not documented. This was most obvious for patients with terminal illness. It is evident that the end-of-life-care of these patients should have been planned earlier. Finnish health care regulation states that treatment plans must be easily available and must contain patient's wishes and his/her physician's statement on intensity of treatments in case of acute illness or acceding death.[23] If the end-of-life care planning fails, this leads not only to futile resuscitation attempts, but also to the absence of good palliative care when death is inevitable.

This is the first study on CA patients in NHs and PCFs treated by EMS in Finland. The study sample was small, but due to prospective recording, this study contains detailed data on all patients and the situations that occurred during the study period. Because of the small cohort, the statistical power to demonstrate differences was restricted and the results cannot be generalised without further research. Yet, the total number of beds in all locations meeting the inclusion criteria remains unknown, and we were unable to estimate the incidence of CA in this population. Our study is also limited in explaining whether the low survival rate was due to the patients' overall poor prognosis or to deficiencies in treatment. The HEMS unit was cancelled in most of the cases, which may cause selection bias, as the same reasons that lead to the poor survival of the patients often lead to the HEMS cancellation.

We conclude that CA patients in nursing homes and primary care facilities are a heterogeneous patient group. In this study, there were no CA survivors in nursing homes. Most patients with a futile prognosis could be recognised in advance. However, there were patients in primary care facilities with a good prognosis who were also well recognised by EMS. Although the prevalence of DNAR orders was reasonable, more attention should be paid to operational procedures in cases of acute deterioration of old patients with comorbidities.

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Conflict of interest

The authors declare that they have no conflict of interest regarding this study.

Legends to figures

Figure 1. The inclusion and survival of patients in our study. EMS is Emergency Medical Services, ROSC is return of spontaneous circulation, DNAR is do-not-attempt-resuscitation order, and LOMT is limitations of medical treatment.

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Table 1. EMS units encountered cardiac arrest patients in nursing homes and primary care facilities during one year in the Pirkanmaa area. The table shows detailed information on demographics of patients and resuscitation attempts.

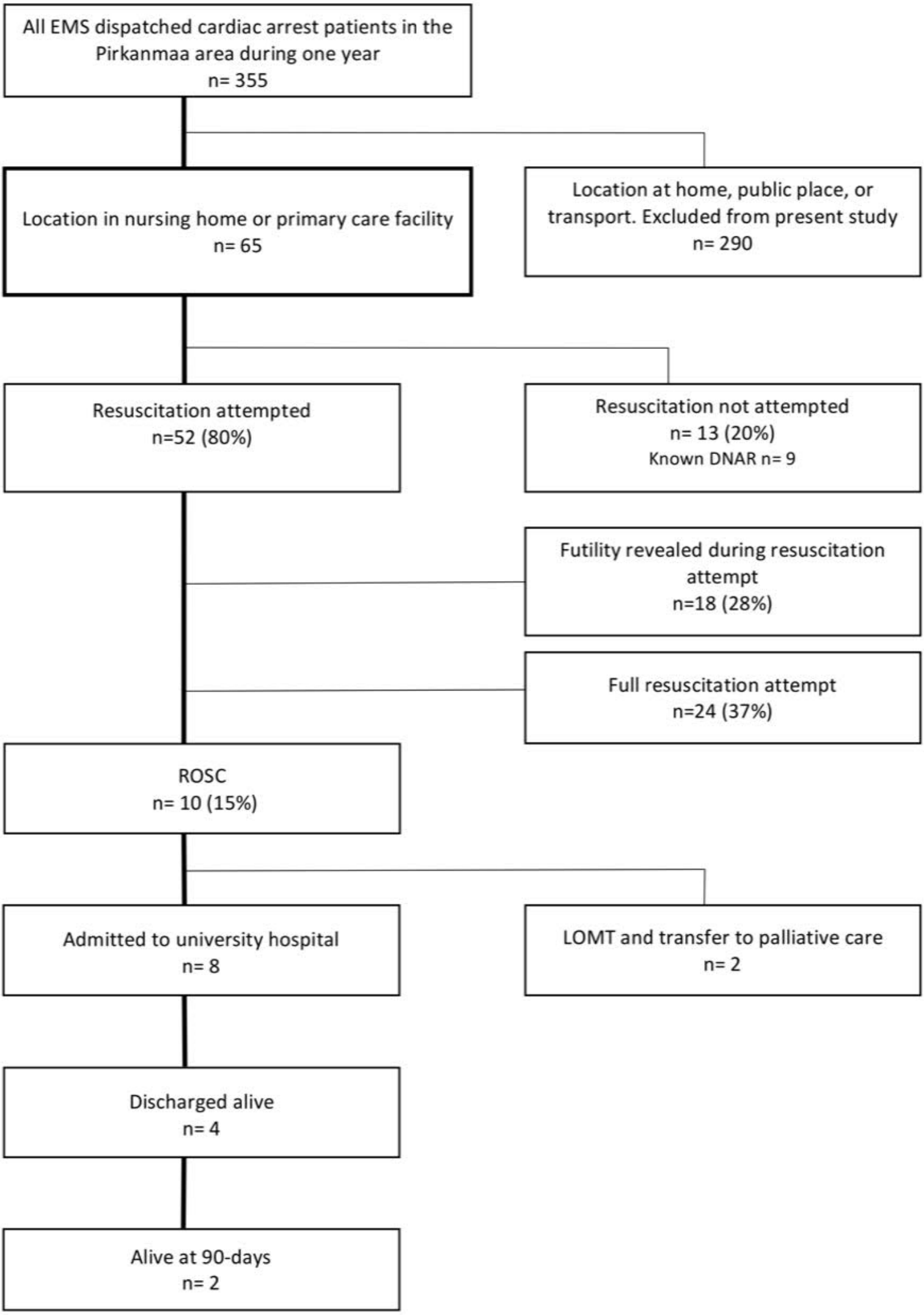
Patient demographics, detailed information on CA[a] situation and CPR[b].	All		Survived to hospital		Deceased on scene		
	n=65		n= 8		n=57		p
Age, years							
Median (Q1-Q3)	82	(68–90)	70	(62–82)	84	(70–90)	**0.03
Male median (Q1-Q3)	77	(67–87)	64	(52–76)	80	(70–88)	**0.03
Female median (Q1-Q3)	88	(75–91)	83	–	88	(72–91)	**0.49
Male gender n (%)	36	(55)	6	(75)	30	(53)	*0.28
Physical performance[c] n (%)							0.33
Outdoor independence	16	(29)	1	(13)	15	(32)	
In-house independence	26	(47)	6	(75)	20	(43)	
Dependent on assistance	13	(24)	1	(13)	12	(26)	
Impaired Cognition n (%) (missing n=10)	28	(51)	4	(57)	24	(50)	1.00
CCI score[d], median, (Q1-Q3)	4	(3 – 6)	3	(2 – 4.8)	4	(3 – 6)	**0.25
CCI ≥ 3 n (%)	46	(78)	5	(63)	41	(80)	*0.36
Independent living n (%) (missing n=3)	21	(34)	2	(25)	19	(35)	0.71
In institutional LTC[e] n (%)	23	(37)	0	(0)	23	(43)	0.02
Days spent at current location prior CA[f]							0.04
0-1	15	(28)	5	(63)	10	(22)	
2-7	16	(30)	3	(38)	13	(28)	
8-90	10	(19)	0	(0)	10	(22)	
over 90	13	(24)	0	(0)	13	(28)	
Arrest location n (%)							0.002
Primary care emergency department	7	(11)	4	(50)	3	(5)	
Primary care hospital ward	37	(57)	4	(50)	33	(58)	
Nursing home	21	(32)	0	(0)	21	(37)	
Existing DNAR[g] n (%)	19	(29)	0	(0)	19	(33)	0.09
DNAR, resuscitation attempted	10	(53)	0	(0)	10	(53)	
Witnessed arrest n (%)	53	(82)	8	(100)	45	(79)	*0.33
Arrest after arrival of EMS n (%)	12	(18)	3	(38)	9	(16)	0.16
Bystander CPR[h], n (%)	43	(81)	5	(100)	38	(79)	*0.57
No existing DNAR, no bystander CPR	2	(4)	0	(0)	2	(5)	
Presumed cardiac aetiology n (%)	53	(82)	5	(63)	48	(84)	*0.16
First monitored rhythm n (%)							0.16
VF/pulseless VT/AED-shockable	13	(20)	3	(38)	10	(18)	
PEA/AED non-shockable	22	(34)	3	(38)	19	(33)	
Asystole	26	(40)	1	(13)	25	(44)	
Other	4	(6)	1	(13)	3	(5)	
Time intervals, median, minutes (Q1-Q3)							
Collapse-to-call[i]	2	(0–8)	2	(0.5–15.5)	2	(0–8)	**0.46
Call-to-EMS arrival	7	(5–10.5)	4	(1.75–7)	7	(5–11.5)	**0.006
Collapse-to-ROSC[j]	15	(7–33.5)	17	(7–39.8)	13	(13–13)	**0.89
Beginning-of -to-end-of EMS CPR	9	(1–19)	9	(3.3–22.8)	9	(0–19)	**0.82
Any ROSC n (%)	23	(35)	8	(100)	15	(26)	*<0.001
HEMS[k] on scene n (%)	13	(20)	6	(75)	7	(12)	*<0.001
Treatment withdrawn n (%)							<0.001
On field	31	(48)	1	(13)	30	(53)	
In hospital emergency department	3	(5)	3	(38)	0	(0)	
No limitation of medical treatment	31	(48)	4	(50)	27	(47)	

Q1 – Q3 is the 25th – 75th percentile, [a]Cardiac arrest, [b]cardiopulmonary resuscitation [c]last week before CA, observed from patient records, missing n=10, [d]Charlson Comorbidity Index score, missing n=6, [e]Long-term care, missing n=3,

[f]Missing n=11, [g]Do-not-attempt-resuscitation order, [h]Among not EMS witnessed CA cases, [i]Witnessed cases, without EMS witnessed cases, n=32, [j]Return of spontaneous circulation, n=10, [k]Helicopter Emergency Medical Service. Impaired cognition: Patient with diagnosed dementia of any cause, Mini-Mental State Examination score < 24, moderate or severe intellectual disability or severe skitsofrenia with residence in NH. P values marked with * are calculated with Pearson Chi-square test and with ** are calculated with the Mann-Whitney U-test, and the others are calculated with the Fisher exact test.

Table 2. The survival rates of cardiac arrest patients with attempted cardiopulmonary resuscitation grouped by the location of the patient in primary health care facility (PCF) or in nursing home (NH). All patients were resuscitated by an EMS unit in the Pirkanmaa area during one year. LOMT is limitations of medical treatment. P-values are calculated with Fisher's test.

Survival rates of patients with cardiopulmonary resuscitation attempted	All patients n=52		PCF n=38		NH n=14	
	n	%	n	%	n	%
Any return of spontaneous circulation	22	42	21	55	1	7
Survival to hospital	8	15	8	22	0	0
LOMT in hospital Emergency Department	3	6	3	8	0	0
Survival to hospital discharge	4	8	4	11	0	0
90-day survival	2	4	2	5	0	0


All EMS dispatched cardiac arrest patients in the Pirkanmaa area during one year
n= 355
Location in nursing home or primary care facility
n= 65
Location at home, public place, or transport. Excluded from present study
n= 290
Resuscitation attempted
n=52 (80%)
Resuscitation not attempted
n= 13 (20%)
Known DNAR n= 9
Futility revealed during resuscitation attempt
n=18 (28%)
Full resuscitation attempt
n=24 (37%)
ROSC
n= 10 (15%)
Admitted to university hospital
n= 8
LOMT and transfer to palliative care
n= 2
Discharged alive
n= 4
Alive at 90-days
n= 2