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Management and outcomes of cardiac arrests at nursing homes: A French nationwide cohort study

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Abstract

Background: The incidence of cardiac arrest (CA) in nursing homes is rising. Our objective was to compare nursing home CAs with at-home CAs in patients aged 65 and over with regard to the CAs' characteristics, the use and characteristics of cardiopulmonary resuscitation (CPR), and the outcome.

Methods: We performed an ancillary analysis of a French nationwide cohort of over-65 patients having experienced an out-of-hospital CA (at home or in a nursing home) treated by a physician-manned mobile intensive care unit (MICU) between July 2011 and September 2015.

Results: Out of 21,720 CAs, 1907 (9%) occurred in a nursing home. The presence of a witness was more frequent in the nursing home than at home (77% vs. 62%, respectively; p < 0.001) and bystander-initiated CPR was more frequent (62% vs. 34%, respectively; p < 0.001). CPR by a MICU was less likely in the nursing home than at home — even after adjustment for the patients' and CAs' characteristics (adjusted odds ratio (aOR) [95% confidence interval] = 0.49 [0.42–0.57]). A return of spontaneous circulation was less frequent in the nursing home than at home (14% vs. 16%, respectively; OR = 0.86 [0.75–0.99]; p = 0.03) except when CPR was performed by the MICU (31% vs. 26%, respectively; OR = 1.25 [1.07–1.47]; p = 0.005). There was no intergroup difference in the CA outcome at day 30.

Conclusions: Nursing home residents who experience a CA are less likely to receive CPR from a MICU. If CPR is performed, however, the residents' prognosis is no worse than that of patients treated at home.

Keywords: Cardiac arrest, Nursing home, Emergency medical services, Cardiopulmonary resuscitation, Medical practices

Introduction

Out-of-hospital cardiac arrest (OHCA) accounts for 50,000 deaths in France annually, and almost half of the victims are aged 65 or over.[1] As the population ages, the proportion of elderly people living in nursing homes is growing. Over the past two decades, the proportion of people aged 75 or over who die in a nursing home has risen to 16%.[2] Consequently, cardiac arrest (CA) in a nursing home has become a common incident.

Few studies have investigated the prognosis for nursing home residents with OHCA.[3] Most of the available data were gathered in the 1980s.[4–6] On one hand, living in a nursing home may be a negative prognostic factor for CA because the residents are usually older and are more likely to have chronic conditions than elderly people who still live at home[7,8] On the other hand, nursing home residence may be a positive prognostic factor: the more frequent presence of trained caregivers and witnesses means that cardiopulmonary resuscitation (CPR) is more likely for residents, relative to elderly people living in the community.

Although the current guidelines state that age should not be the sole factor considered when deciding whether or not to perform CPR,[9] older people are less likely than younger people to receive CPR.[10] The presence of another factor that might impact the patient's management – nursing home residence – has not previously been studied. Nevertheless, an association between the patient's place of residence and the physician's medical decision has already been reported: in the intensive care unit (ICU), physicians are less inclined to admit patients from nursing homes, which constitutes a limitation on active treatment.[11,12] Hence, we hypothesized that the likelihood of CPR by a physician-manned mobile intensive care unit (MICU) team would be lower for nursing home residents than for elderly people living in the community, independently of the patients' other characteristics and the CAs' presentations.

The objectives of the present study were therefore to compare nursing home CAs with at-home CAs in patients aged 65 and over with regard to the MICU's medical practice (the decision to perform CPR or not and, when appropriate, the characteristics of the CPR) and to investigate the putative association between the place of residence and the patient's post-CA prognosis.

Methods

Setting

The emergency medical service system in France is a two-tiered system. The first level is composed of basic life support (BLS) fire department ambulances (FDA), including automatic external defibrillators. The second level is composed of advanced life support (ALS) MICUs. In case of CA identified by dispatching center, FDA and MICU are both sent to the patient. In contrast to MICU, FDA can not refrain from initiating CPR unless the patient present obvious signs of death.

Data source and population

The *Registre Électronique des Arrêts Cardiaques* (RéAC) registry is a French, nationwide, prospective OHCA registry that has been described in detail elsewhere.[1] Briefly, RéAC was initiated in 2009 and deployed nationally in June 2012. Almost 90 percent of French emergency medical aid services participate in RéAC. The registry prospectively includes OHCA victims of any age managed by a physician-manned MICU team, regardless of the CA's aetiology and whether or not CPR was performed. The RéAC's report form is structured according to the Utstein reporting framework. It collects sociodemographic data, time intervals, details of the CA, descriptions of BLS and ALS procedures, and the immediate post-CA outcomes. These data are collected on site. An additional form is used to report on the 30-day follow-up for discharged survivors. The RéAC registry was approved by the French National Consultative Committee on Information Processing in Medical Research (*Comité consultatif sur le traitement de l'information en matière de recherche dans le domaine de la santé*) and the French National Data Protection Commission (*Commission nationale de l'informatique et des libertés;* authorization number: 910,946). It was approved as a medical assessment registry, and so patient consent was not requested in the present study.

Study sample

For the present study, we included all patients aged 65 and over registered in the RéAC registry between July 1st 2011 and September 30th 2015. We excluded CAs in which trauma was the suspected cause, CAs that did not occur in a nursing home or in a private residence, and CAs whose location was unknown.

Outcomes

Our analyses focused on two types of event: those related to the patient's management in the MICU (i.e. an analysis of medical practice), and those related to the patient's prognosis (i.e. an analysis of clinical events). With regard to medical practice, the primary outcome was the MICU physician's decision to perform on-site CPR or not. The secondary events were all resuscitation procedures: chest compressions, use of a cardiac compression machine, artificial ventilation, endotracheal intubation, insertion of an intravenous line, the administration of adrenaline (and the dose, when administered), the administration of amiodarone, and the duration of resuscitation by the MICU when there was no return of spontaneous circulation (ROSC).

With regard to the patient's prognosis, the main outcome was prehospital ROSC. Two secondary outcomes were evaluated at day 30 or on discharge from the ICU: survival and the absence of severe neurological disability (i.e. a Cerebral Performance Category score of 1 or 2).

Variables

We extracted a number of patient- and CA-related variables from the RéAC registry. The patient-related variables included age, sex, medical history, end-of-life state, and the provision (or not) of advance directives. The CA-related variables included the place where the CA occurred, the presumed cause, the presence or absence of a witness, the type of witness, bystander initiation of CPR, the performance of CRP by the FDA before the MICU's arrival, defibrillation before the MICU's arrival, the cardiac rhythm on the electrocardiogram, agonal breathing on the MICU's arrival, the time interval between the emergency call and the FDA's arrival, the time interval between the emergency call and the MICU's arrival, and the time interval between

the patient's collapse and CPR. We considered the location of the CA to be a close approximation of the patient's place of residence.

Statistical analyses

We described the patient- and CA-related variables and other study parameters for the study population as a whole and for "nursing home" and "at-home" groups. Quantitative variables were quoted as the median (interquartile range), and qualitative variables were quoted as the number (percentage). The quantitative and qualitative character-istics of the nursing home and at-home groups were compared using Student's t-test and Pearson's chi-square test, respectively.

Furthermore, we studied the putative association between the place of residence and each of the study's main outcomes: the provision of CPR by the MICU team, and prehospital ROSC. The possible associations between provision of CPR by the MICU team and each of the patient- and CA-related variables were tested in univariate analyses. All variables found to be statistically significant ($p < 0.2$) in a univariate analysis were included in a multivariate logistic regression model. Next, backward stepwise selection was used to keep variables with $p < 0.10$. The quantitative variables were checked for linearity and incorporated into the regression model as either linear or indicator (dummy) variables. In the latter case, quantitative variables were categorised into the quartiles observed for the study population as a whole.

The same analytical strategy was applied for prehospital ROSC. The multivariate analysis included the patient- and CA-related variables (giving model A), to which performance of CPR by the MICU team was added (giving model B).

In secondary analysis, we matched nursing home group to at-home group for age and sex with and 1:4 ratio for maximizing power. Associations were tested using mixed logistic regression model taken into account the matched nature of the data.

Associations were estimated using crude and adjusted odds ratios (cORs and aORs, respectively) and their 95% confidence intervals (CIs). Missing data were not imputed. Unless otherwise stated, the threshold for statistical significance was set to $p < 0.05$.

All tests were two-tailed, and were performed using Stata/MP software (version 13.0, StataCorp. LLC, College Station, TX, USA).

Results

At the time of our study, a total of 26,969 people aged 65 or over had been included in the RéAC registry. We excluded CAs due to trauma (n = 1373), CAs whose location was not recorded, and CAs that had occurred at locations other than a nursing home or the patient's own home (n = 3876). Ultimately, we analysed 21,720 CAs, of which 19,813 (91%) occurred at the patient's own home, and 1907 (9%) occurred in a nursing home.

The "nursing home" group was older than the "at-home" group, and had a higher proportion of female patients (Table 1). The proportion of patients with previous and concomitant medical conditions (especially cardiovascular disease) was higher in the nursing home group than in the at-home group. However, a history of respiratory disease or diabetes was more frequent in the at-home group. The provision of advance directives and an end-of-life state were more frequent in the nursing home group. The presumed cause of the CAs was more likely to be a cardiac event in the at-home group; conversely, foreign body obstruction as a cause was more frequent in the nursing home group.

Several positive prognostic factors for CA were reported more frequently for the nursing home group than for the at-home group (e.g. the presence of a witness, and bystander-initiated CPR, a shorter time interval between the CA and CPR initiation). Lastly, at the time of the MICU's arrival, asystole was significantly more frequent in the at-home group.

Overall, the MICU had performed CPR on 56% of the patients (58% in the at-home group and 40% in the nursing home, $p < 0.001$) (Table 2). A lower likelihood of CPR was associated with very old age, the presence of advance directives, an end-of-life state, a long time interval between the emergency call and the MICU's arrival, and a long time interval between the CA and the initiation of CPR. In contrast, the performance of CPR by the MICU team was associated with male sex, a history of cardiovascular disease, respiratory disease, diabetes, a CA with a presumed cardiac cause, the presence of a witness, bystander-initiated CPR, defibrillation before the MICU's arrival, ventricular fibrillation, and agonal breathing upon the MICU's arrival.

In a multivariate analysis, the association between the place of residence and performance of CPR by the MICU remained statistically significant after adjusting for the other patient- and CA-related variables. The other variables independently associated with a lower likelihood of CPR by the MICU were older age, an end-of-life state, a long time interval between the emergency call and the MICU's arrival, and a long time interval between the CA and the initiation of CPR. Conversely, several variables were independently associated with a higher likelihood of CPR by the MICU: male sex, a history of cardiovascular disease or diabetes, a CA presumed to have been caused by a cardiac event or foreign body obstruction, the presence of a witness, bystander-initiated CPR, ventricular fibrillation, and agonal breathing.

Even when the MICU team decided to perform CPR on a patient in a nursing home, the procedure was less likely to include chest compression, use of a chest compression machine, tracheal intubation, placement of an IV line, and adrenaline or amiodarone administration than CPR in the at-home group (Table 3). When adrenaline was administered, the total dose was lower in the nursing home group. Lastly, the duration of CPR in the absence of ROSC was shorter for patients in the nursing home group.

The overall frequency of ROSC was 15.4% (Table 4). This frequency was significantly lower in the nursing home group than in the at-home group (13.7% vs. 15.5%, respectively; cOR [95% CI] = 0.86 [0.75–0.99]; $p = 0.03$). In patients who were resuscitated by the MICU team, the frequency of ROSC was higher in the nursing home group than in the at-home group (30.7% vs. 26.1%, respectively; cOR [95% CI] = 1.25 [1.07–1.47]; $p = 0.005$). When the CA- and patient-related variables were included in the logistic model (model A), our multivariate analysis highlighted an indepen-dent association between the occurrence of CA in a nursing home and a lower probability of ROSC. This association was no longer significant after the inclusion of MICU-performed CPR (model B). At day 30, the overall survival rate and the proportion of patients with a good neurological outcome were low (<2%) and were not associated with the type of residence. When CPR was performed by the MICU team, the overall survival at day 30 was 2.8%, and the proportion of patients with a good neurological outcome was 2.1%. There were no intergroup differences in these two variables.

In matched analysis, 1522 nursing home patients were matched with 6088 at-home patients (see supplementary data). Intergroup differences were no longer significant for many baseline character-istics, including age, sex, history of cardiovascular or respiratory

Table 1 – Baseline characteristics of the study population as a whole, and according to the type of residence.

	Overall n = 21,720	Type of residence		p[*]
		Own home n = 19,813	Nursing home n = 1907	
Age, years, median (IQR)	80 (73–86)	80 (73–85)	86 (81–90)	<0.001
Male sex, n (%)	12,379 (56.99)	11,693 (59.02)	686 (35.97)	<0.001
Medical history, n (%)				
Cardiovascular disease	12,487 (57.49)	11,325 (57.16)	1162 (60.93)	0.001
Respiratory disease	3,599 (16.57)	3338 (16.85)	261 (13.66)	<0.001
Diabetes mellitus	3,641 (16.76)	3371 (17.01)	270 (14.16)	0.001
Other disease	9,829 (45.25)	8607 (43.44)	1222 (64.08)	<0.001
None	1,818 (8.37)	1741 (8.79)	77 (4.04)	<0.001
End-of-life state, n (%)	1275 (5.87)	1122 (5.66)	153 (8.02)	<0.001
Advance directives, n (%)	1500 (6.91)	1337 (6.75)	163 (8.55)	0.003
Presumed cause of CA, n (%)				
Cardiogenic	3,976 (18.31)	3839 (19.38)	137 (7.18)	<0.001
Respiratory	5,385 (24.79)	4877 (24.62)	508 (26.64)	0.051
Neurological	122 (0.56)	113 (0.57)	9 (0.47)	0.583
Foreign body airway obstruction	1,248 (5.75)	907 (4.58)	341 (17.88)	<0.001
Other or unknown	12,093 (55.68)	11,085 (55.95)	1008 (52.86)	0.009
Witness to the CA, n (%)	13,817 (63.62)	12,340 (62.29)	1477 (77.45)	<0.001
CA witnessed by EMS[a], n (%)	1589 (7.84)	1391 (7.56)	198 (10.67)	<0.001
Bystander-initiated CPR, n (%)	7816 (35.99)	6637 (33.50)	1179 (61.82)	<0.001
CPR by the FDA before the MICU's arrival, n (%)	17,704 (81.51)	16,161 (81.57)	1543 (80.91)	0.481
Defibrillation before the MICU's arrival, n (%)	541 (2.49)	499 (2.52)	42 (2.20)	0.398
Electrocardiographic rhythm on the MICU's arrival[a], n (%)				
Asystole	17,231 (86.40)	15,798 (86.60)	1433 (84.20)	<0.001
Pulseless electrical activity	1,007 (5.05)	889 (4.87)	118 (6.93)	
VF/VT	887 (4.45)	850 (4.66)	37 (2.17)	
Spontaneous circulation	819 (4.11)	705 (3.86)	114 (6.70)	
Agonal breathing on the MICU's arrival, n (%)	795 (3.66)	687 (3.47)	108 (5.66)	<0.001
Intervals, min, median (IQR)				
Call to arrival of the FDA[a]	10 (7–15)	10 (7–15)	10 (7–14)	0.639
Call to arrival of the MICU	20 (14–29)	20 (14–29)	20 (14–28)	0.023
Collapse to CPR[a]	10 (1–20)	10 (2–20)	1 (0–10)	<0.001

IQR: interquartile range; CA cardiac arrest; EMS emergency medical service; CPR cardiopulmonary resuscitation; FDA fire department ambulance; MICU mobile intensive care unit; VF/VT ventricular fibrillation or tachycardia.

[a] The percentages of patients with missing data for these variables were as follows: CA witnessed by EMSs: 6.7%; electrocardiographic rhythm on the MICU's arrival: 8.1%; time interval between the call and the FDA's arrival: 29.7%; time interval between collapse and the initiation of CPR: 35.6%.

[*] p-Value for the comparison between the nursing home group and the at-home group, using Student's t-test and Pearson chi-squared test for quantitative and qualitative variables, respectively.

disease, diabetes, CA with presumed respiratory cause, provision of advance directives and end-of-live state. The association between nursing home and less likely performance of CPR by the MICU was confirmed. Insertion of an IV line, and adrenaline or amiodarone administration were not associated with the type of residence. Regarding the patients' prognosis, nursing home residence was associated with higher likelihood of prehospital ROSC and one-month survival in univariate analysis. Nevertheless, those associations were no longer significant in multivariate analysis.

Discussion

In the present French nationwide cohort study of CAs in patients aged 65 and over, victims in a nursing home were less likely to receive CPR from the MICU team than victims at their own home were; this

association was independent of patient- and CA-related characteristics. Moreover, when a patient in a nursing home did receive CPR from the MICU team, it was non-optimal (relative to CPR performed in a patient's own home) but was nevertheless associated with a greater likelihood of ROSC. There were no intergroup differences in the overall survival rate and the proportion of patients with a good neurologic outcome at day 30.

Deciding to or not to resuscitate a patient after a CA is difficult, especially in an out-of-hospital context.[13] Time pressure and the difficulty of obtaining precise, reliable information on the patient's wishes, comorbidities and medical history and on the circumstances of the CA hinder the accurate evaluation of a patient's likelihood of survival and his/her post-CA quality of life.[14] Under these conditions, it is hard to predict whether or not attempting to resuscitate a patient is futile. In this study, the MICU team decided not to resuscitate 60% of patients in the nursing home group – even though fewer than 10% of

Table 2 – Associations between CPR by the MICU and patient- or CA-related variables.

	Crude OR [95%CI][a]	Adjusted OR [95%CI][a,b]
CA in a nursing home	0.49 [0.45–0.54]	0.49 [0.42–0.57]
Victim's age (years)		
≤73	1.00	1.00
>73 et ≤80	0.71 [0.66–0.77]	0.63 [0.56–0.71]
>80 et ≤86	0.44 [0.40–0.47]	0.39 [0.34–0.44]
>86	0.19 [0.17–0.20]	0.15 [0.13–0.17]
Male sex	1.52 [1.44–1.60]	1.15 [1.06–1.26]
Cardiovascular disease	1.55 [1.46–1.63]	1.29 [1.18–1.41]
Respiratory disease	1.18 [1.10–1.27]	–
Diabetes mellitus	1.54 [1.43–1.66]	1.13 [1.01–1.27]
Other disease	0.68 [0.64–0.72]	0.63 [0.58–0.69]
End-of-life state	0.14 [0.12–0.16]	0.15 [0.12–0.19]
Advance directives	0.40 [0.36–0.45]	0.49 [0.42–0.57]
Presumed cardiogenic cause	1.96 [1.82–2.11]	1.29 [1.15–1.44]
Witnessed CA	2.64 [2.49–2.79]	1.49 [1.35–1.65]
CA witnessed by EMS	2.03 [1.81–2.27]	–
Bystander-initiated CPR	2.48 [2.34–2.63]	1.78 [1.59–1.99]
Defibrillation administered before the MICU's arrival	2.20 [1.77–2.73]	–
Electrocardiographic rhythm on the MICU's arrival		
Asystole	1.00	1.00
Pulseless electrical activity	2.64 [2.28–3.06]	2.07 [1.69–2.52]
VF/VT	27.32 [18.61–40.12]	13.26 [8.52–20.63]
Spontaneous circulation	2.46 [2.09–2.88]	1.73 [1.39–2.15]
Agonal breathing at arrival of MICU	2.50 [2.12–2.95]	1.69 [1.29–2.18]
Interval from call to arrival of MICU (min)		
≤14	1.00	1.00
>14 et ≤20	0.94 [0.87–1.01]	0.99 [0.88–1.12]
>20 et ≤29	0.90 [0.83–0.97]	0.85 [0.76–0.96]
>29	0.72 [0.67–0.78]	0.61 [0.51–0.69]
Interval from collapse to CPR (min)		
≤1	1.00	1.00
>1 et ≤10	0.93 [0.85–1.03]	1.03 [0.90–1.17]
>10 et ≤20	0.59 [0.53–0.65]	0.79 [0.68–0.91]
>20	0.23 [0.21–0.25]	0.32 [0.28–0.38]

CA: cardiac arrest; MICU: mobile intensive care unit; CPR: cardiopulmonary resuscitation; OR: odds ratio; CI: confidence interval; EMS; emergency medical service; VF/VT: ventricular fibrillation or tachycardia.
[a] ORs were estimated using a logistic regression model.
[b] Adjusted for all the variables listed below.

Table 3 – Characteristics of the resuscitation performed by the MICU, by type of residence.

	Overall n = 12,209	Type of residence		p[*]
		Own home n = 11,441	Nursing home n = 768	
Chest compressions[b], n (%)	10,687 (97.32)	10,031 (97.52)	656 (94.39)	<0.001
Mechanically assisted[b], n (%)	844 (10.95)	821 (11.29)	23 (5.30)	<0.001
Ventilation, n (%)	11,958 (97.94)	11,210 (97.98)	748 (97.40)	0.269
Endotracheal intubation, n (%)	11,065 (92.53)	10,406 (92.83)	659 (88.10)	<0.001
Perfusion, n (%)	11,575 (94.81)	10,865 (94.97)	710 (92.45)	0.002
Adrenaline administration, n (%)	10,255 (88.60)	9673 (89.03)	582 (81.97)	<0.001
Total dose, mg, median (IQR)	5 (3–8)	5 (3–8)	4 (2–5)	<0.001
Amiodarone administration[b], n (%)	1113 (23.70)	1074 (24.27)	39 (14.44)	<0.001
Duration of advanced resuscitation for patients without ROSC[a,b], min, median (IQR)	25 (17–33)	25 (18–33)	20 (15–30)	<0.001

MICU: mobile intensive care unit; CA: cardiac arrest; IQR: interquartile range; ROSC: return of spontaneous circulation.
[a] Number of patients without ROSC, despite advanced resuscitation = 8980.
[b] The percentages of patients with missing data for these variables were as follows: chest compressions: 10.1%; mechanically assisted compressions: 34.4%; amiodarone administration: 60.7%; duration of advanced resuscitation for patients without ROSC: 14.7%.
[*] p-Value for the comparison between the nursing home group and the at-home group, using Student's t-test and Pearson chi-squared test for quantitative and qualitative variables, respectively.

Table 4 – Outcomes of the CA, by type of residence.

| | Overall n = 21,720 | Type of residence | | Crude OR [95%CI][a] | Adjusted OR [95%CI][a,b] | |
| | | Own home n = 19,813 | Nursing home n = 1907 | | | |
	n (%)	n (%)	n (%)		Model A	Model B
Prehospital ROSC	3337 (15.36)	3076 (15.53)	261 (13.69)	0.86 [0.75–0.99]	0.66 [0.54–0.82]	0.93 [0.74–1.17]
One-month survival	401 (1.85)	363 (1.83)	38 (1.99)	1.09 [0.78–1.53]	–	–
One-month CPC score of 1 or 2	296 (1.36)	270 (1.36)	26 (1.36)	100 [0.67–1.50]	–	–

CA: cardiac arrest; OR: odds ratio; CI: confidence interval; ROSC: return of spontaneous circulation; CPC: Cerebral Performance Category.

[a] ORs were estimated using a logistic regression model.

[b] Model A included age, sex, comorbidities, advance directives, presumed cardiac cause, witnessed arrest, witnessed by emergency medical services, bystander-initiated cardiopulmonary resuscitation (CPR), defibrillation administered before arrival of the mobile intensive care unit (MICU), electrocardiographic rhythm, agonal breathing, time interval between the emergency call and the MICU's arrival, the time interval between collapse and the initiation of CPR. Model B included the same variables and the initiation of CPR by the MICU.

the patients were known to have given advance directives. Most of the literature data on CAs at nursing homes relate to patients in whom CPR was actually performed by an out-of-hospital medical team. However, a study of decision-making and CPR found a high likelihood of failure to perform resuscitation (58%), which is close to the value observed here.[15] There are several possible explanations for this high frequency. Firstly, the presence of the victim's family (probably more common at private home) might prompt MICU physicians to attempt CPR for fear of being sued or out of sympathy.[16] Secondly, the physicians' decisions might be influenced by a belief that survival rates are low in nursing homes.[3]

In contrast, our results showed that when CPR was performed by the MICU team, the frequency of ROSC in a nursing home was higher to that at a patient's own home; this was despite the fact that on average, patients living in a nursing home were older and had more previous or concomitant medical conditions. On one hand, this might be due to the more favourable medical context in nursing homes, i.e. the more frequent presence of a witness and the greater likelihood of CPR initiation by bystanders. On the other hand, this difference might result from the selective resuscitation measures employed by the MICU team; for example, only patients with good prognostic factors might be resuscitated at nursing homes, whereas the criteria for initiating CPR at more lenient for an at-home CA. Finally, intergroup difference in presumed cause of CA could also have affected patients' prognosis.

In the subset of patients having received CPR from the MICU team, the frequency of ROSC was higher at in the nursing home group than in the at-home group. However, these two groups had similar outcomes at day 30. Given that performance of CPR by the MICU team is linked with the patient's place of residence, it is possible that the in-hospital care given to patients with ROSC is less effective for those living in a nursing home. A recently published study found a higher 30-day survival rate for private homes (4.9%) than for nursing homes (1.7%), which goes against our present results (1.8% and 2.0%, respectively).[17] However, the latter study was not restricted to elderly patients, and the median age of the patients living at home was lower than in our study population. We sought to minimize bias by considering a large number of patients and CAs' characteristics in a nationwide cohort, and by assessing the MICU's medical practices; these constitute study strengths.

Our study also had some limitations. Firstly, we had no information on the patients' level of personal autonomy; this an essential difference between patients living in their own home and patients living in a nursing home. The patient's autonomy is a cornerstone in

the decision tree, especially on admission to the ICU.[12] For CAs, the European guidelines suggest taking into consideration the person's degree of autonomy, quality of life, and cognitive level when deciding whether or not to resuscitate them.[9] In the present study, it is possible that the observed association between CPR by the MICU team and the type of residence was partly due to the high care dependency of nursing home residents, relative to elderly people living in the community. Indeed, the higher rate of "other disease" in nursing home is likely to correspond to a higher rate of dependency associated illnesses, neurocognitive disorders in particular. Secondly, the personal medical histories recorded in the RéAC register were not detailed, and so we were not able to calculate comorbidity scores (e.g. the Charlson index).[18] This might have narrowed the difference between nursing home residents and people living in their own home, since the latter usually have fewer comorbidities.[19] However, poor knowledge of a patient's level of autonomy or comorbidities corresponds to an uncertain situation that a MICU physician often faces in real life. Once on scene, he has a few seconds or minutes to collect information on the patient's characteristics and the circumstances of the CA. The patient's file is rarely at hand (whether at home or in a nursing home), and requesting information from relatives (who, if present, are often highly stressed) is often not of great value. The MICU physician often has a fragmented set of data, leaving age and the type of residence as the only solid facts to guide the patient's management.

In the present study, respiratory disease and diabetes were independently associated with prehospital ROSC; this contrasts with much of the literature data, where comorbidities are often associated with a poor prognosis.[8] However, the supporting evidence is not always strong.[20] The observed association might also be due to the exhaustive, careful recording of the patient's medical history by the MICU physician in cases of ROSC (before the patient is taken to hospital).

In conclusions, nursing home residents with CAs are less likely to receive CPR by a MICU team, regardless of the patient's profile and the characteristics of the CA. However, when CPR is performed in a nursing home setting, the patient's prognosis is no worse than that of a CA victim resuscitated in his/her own home.

Conflicts of interest

None.

Acknowledgements

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.resuscitation.2019.05.016.

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