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Original Contributions

EVOLUTION OF SURVIVAL IN CARDIAC ARREST WITH AGE IN ELDERLY PATIENTS: IS RESUSCITATION A DEAD END?

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☐ **Abstract—Background: Even if age is not considered the key prognostic factor for survival in cardiac arrest (CA), some studies question whether cardiopulmonary resuscitation (CPR) in the elderly could be futile. Objective: The aim of this study was to describe differences in out-of-hospital CA survival rates according to age stratification based on the French National CA registry (RéAC). The second objective was to analyze the differences in resuscitation interventions according to age. Methods: We performed a retrospective cohort study based on data extracted from the RéAC. All 18,249 elderly patients (>65 years old) with non-traumatic CA recorded between July 2011 and March 2015 were included. Patients' ages were stratified into 5-year increments. Results: Cardiopulmonary resuscitation (CPR) was started significantly more often in younger patients ($p = 0.019$). Ventilation and automated external defibrillation by bystanders were started without any difference between age subgroups ($p = 0.147$ and $p = 0.123$, respectively). No difference in terms of rate of external chest compressions or ventilation initiation was found between the subgroups ($p = 0.357$ and $p = 0.131$, respectively). Advanced cardiac life support was started significantly more often in younger patients ($p = 0.023$). Total CPR duration, return of spontaneous circulation, and survival at hospital admission and at 30 days or hospital discharge decreased significantly with age ($p < 10^{-3}$). The survival decrease was linear, with a loss of 3% survival chances each 5-year interval. Conclusions: This study found that survival in older persons decreased linearly by 3% every 5 years. However, this diminished rate of survival could be the consequence of a shorter duration and less advanced life support.**

☐ **Keywords—cardiac arrest; resuscitation; elderly; aged; aged 80 and over; cardiopulmonary resuscitation**

INTRODUCTION

In the United States, more than 250,000 people die of cardiac arrest (CA) each year (1). In France, we estimate this rate to be 50,000 deaths per year (2). Worldwide survival rates in out-of-hospital cardiac arrest (OHCA) hover between 5% and 30% (2–6). In France, the last published data showed a survival rate about 5% (2,7). The major elements influencing the survival of patients are the no-flow duration (i.e., delay between the onset of CA and the first cardiopulmonary resuscitation [CPR]), low-flow duration (i.e., delay between the first CPR and the return of spontaneous circulation), and initial cardiac rhythm. In a 2003 French study on cardiac arrest, 20%

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of patients belonged in the young elderly group (65–74 years old), 21% were in the middle elderly group (75–84 years old), and 13% in the oldest elderly group (>84 years old) (8). Survival rates after CA in older adults vary widely in recent literature (9–13). Although resuscitation in older adults OHCA can save lives, the futility of CPR in older patients is still under debate (11,14–18). One of the main challenges concerning CPR in older adults is to differentiate between patients in whom resuscitation should be attempted and those who should not be resuscitated.

The aim of this study was to describe differences in OHCA survival rates according to age stratification on data extracted from the French National CA Registry (RéAC) (2). The second objective of this study is to analyze the differences in resuscitation procedure according to age.

MATERIALS AND METHODS

Study Design and Setting

We performed a retrospective cohort study based on data extracted from the RéAC. In France, the prehospital emergency medical services system is a two-tiered, physician-based system with fire department ambulance for basic life support (BLS) and mobile emergency and resuscitation services (MERS, *Service Mobile d'Urgence et de Réanimation*) for advanced cardiac life support (ACLS) (2,19,20). Each MERS includes one or more mobile medical teams (MMTs). Each MMT is composed of at least an emergency physician, a nurse, and an emergency medical technician.

We included all older people (>65 years old) with non-traumatic CA on whom MMT was triggered on scene. Where there was at least a resuscitation attempt (i.e., BLS, ACLS, or both), we stratified patients' ages into 5-year increments (65–69, 70–74, 75–79, 80–84, 85–89, 90–94, and 95 years and older). We extracted data on 20,233 CA recorded between July 2011 and March 2015 from the RéAC database.

The RéAC form met the requirements of French emergency medical services (EMS) organizations and was structured according to the Utstein universal style (1,21). All participating MERS used this form during the intervention. The data were reported in the RéAC secured database (www.registreac.org). If the patient was alive at hospital admission, a 30-day follow-up record sheet was filled in (2).

Ethical Approval

The French Advisory Committee on Information Processing in Health 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 910946) reviewed and approved this study; it was approved as a medical assessment registry without request for patient consent.

Statistical Analysis

We tested the quantitative variables distribution using the Kolmogorov–Smirnov test and described the baseline population characteristics using medians and the quartiles (first quartile and third quartile) for quantitative variables or frequencies for qualitative variables. We handled the age subgroups' comparisons using χ^2 test or Fisher's exact test for qualitative variables and the Kruskal–Wallis test for quantitative variables. We used simple linear regression to test the relationship between age and survival. The difference was considered significant when the p value was <0.05. We performed the analyses using IBM SPSS Statistics, version 19.0 (IBM Corp, Armonk, NY).

RESULTS

We studied 18,249 patients, 90.2% of the total database (Figure 1); 79 [first quartile; third quartile 72; 85] years was the median age. The more the patients get older, the lower the proportion of men in the corresponding 5-year-wide age group. Thus, men die younger. CA occurred at home in 78.4% of cases, in nursing homes or other similar institutions in 11.6% of cases, and 9.9% at workplace or in a public place. The CA-onset location varied with age stratification ($p < 10^{-3}$). For example, more CA occurred in nursing homes in the group 95 years and older compared to the group 65–69 years.

CA was witnessed in 71.8% of cases without any statistically significant difference between groups. In 47.3% of patients, external chest compressions were started by a bystander. CPR was started significantly more often in younger patients ($p = 0.019$). Ventilation by a bystander was started in 19.4% of patients, without any difference ($p = 0.147$) among age subgroups. We did not find any statistically significant difference in terms of automated external defibrillation (performed in 14.2% of patients) between age subgroups ($p = 0.123$). Fire brigade ambulances (BLS teams) were dispatched on scene in 90.5% of cases. Median time from SAMU call (dispatch center) to BLS teams' arrival on site was 10 min (first quartile; third quartile 5 min; 14 min), and no differences were reported between age subgroups. External chest compressions by BLS teams were started in 94.6% of patients. Ventilation by BLS teams was started in 86.9% of