Short paper

Frailty is associated with adverse outcome from in-hospital cardiopulmonary resuscitation

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Abstract

Aim: To assess whether frailty was associated with cardio-pulmonary resuscitation (CPR) outcome in a UK setting.

Method: Retrospective review of prospectively collected data on in-hospital cardio-respiratory arrests between 1/1/17 and 31/12/17. Clinical Frailty Scale (CFS) scores were assigned from notes review, patients with CFS scores ≥ 6 signified moderate or greater frailty.

Results: There were 179 in-hospital cardiac arrest cases where the CFS could be calculated. The median age on admission was 74 (mean 71, range 27–102), 110 patients were male and 69 female. The initial rhythm was non-shockable in 64% of cases. In 49% of cases return of spontaneous circulation (ROSC) was achieved, 22% of the study population survived to hospital discharge. Moderate or greater frailty was present in 31.3% of patients. Return of spontaneous circulation (ROSC) was achieved in 56.1% of patients with a CFS score of 1–5 and 32.1% with scores 6–9 ($p < 0.001$). Survival to hospital discharge was also associated with frailty, being seen in 31.7% of CFS 1–5 patients but only in 1.8% of CFS 6–9 patients ($p < 0.001$). In multivariable analysis adjusting for age, presenting rhythm and admitting specialty the effect of frailty on survival to discharge remained significant ($p = 0.044$).

Conclusion: Patients with moderate or greater frailty as determined by CFS score are unlikely to survive to hospital discharge even if ROSC occurs following CPR. This should be considered when making resuscitation status and ceiling of care decisions in this patient group.

Keywords: Cardiopulmonary resuscitation (CPR), Outcome

Introduction

Frailty is a state of increased vulnerability to poor resolution of homeostasis after a stressor event.[1] This has been described as a phenotype featuring at least three of: unintentional weight loss, self-reported exhaustion, weakness, slow walking speed, and low physical activity.[2] Frailty assessment tools include the Clinical Frailty Scale (CFS), Hospital Frailty Risk Score (HFRS) and the Frailty Index.[3–5] The CFS is a validated tool that can easily be applied without specialist training and does not rely on coding data. Information on cognition, function, mobility and co-morbidities gathered from the medical history is used to determine a patient's frailty status on a 9-point ordinal scale (Fig. 1).

Frailty is associated with adverse outcomes including falls, worsening disability, hospitalisation, care home admission and mortality in community studies.[2,6] Patients with frailty have increased risk of complications and mortality after surgery, reduced likelihood of discharge home and increased mortality after ICU admission.[7,8]

Survival after out-of-hospital cardiac arrest has been shown to be adversely affected by the presence of frailty.[9] When this study was conceived in 2018 there was no comparable data examining an association between frailty and in-hospital cardiac arrests. A recent Australian study of in-hospital cardiac arrests concluded that frailty was associated with reduced likelihood of discharge home, but not with mortality.[10]

The aim of our study was to assess whether frailty was associated with cardio-pulmonary resuscitation (CPR) outcome in a UK setting.

Clinical Frailty Scale*

1 **Very Fit** – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.

2 **Well** – People who have **no active disease symptoms** but are less fit than category 1. Often, they exercise or are very **active occasionally**, e.g. seasonally.

3 **Managing Well** – People whose **medical problems are well controlled,** but are **not regularly active** beyond routine walking.

4 **Vulnerable** – While **not dependent** on others for daily help, often **symptoms limit activities.** A common complaint is being "slowed up", and/or being tired during the day.

5 **Mildly Frail** – These people often have **more evident slowing,** and need help in **high order IADLs** (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.

6 **Moderately Frail** – People need help with **all outside activities** and with **keeping house.** Inside, they often have problems with stairs and need **help with bathing** and might need minimal assistance (cuing, standby) with dressing.

7 **Severely Frail** – **Completely dependent for personal care,** from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).

8 **Very Severely Frail** – Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.

9. **Terminally Ill** - Approaching the end of life. This category applies to people with **a life expectancy <6 months,** who are **not otherwise** evidently frail.

Scoring frailty in people with dementia

The degree of frailty corresponds to the degree of dementia. Common **symptoms in mild dementia** include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.

In **moderate dementia**, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.

In **severe dementia**, they cannot do personal care without help.

* 1. Canadian Study on Health & Aging, Revised 2008.
2. K. Rockwood et al. A global clinical measure of fitness and frailty in elderly people. CMAJ 2005;173:489-495.

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Fig. 1 – Clinical frailty scale.

This has the potential to provide critical data to help clinicians and patients when making advanced care planning decisions, as there is evidence that some patients receive CPR inappropriately, and patients may overestimate their likelihood of survival after a resuscitation attempt.[11,12]

Methods

The study was carried out at a large UK District General Hospital. The hospital cardiac arrest team consists of a medical registrar, two medical junior doctors, an advanced nurse practitioner and a critical care outreach practitioner. Resuscitation and on-going management is performed in accordance with Resuscitation Council guidelines reflecting UK practice.

The details of cardiac arrest calls are collected prospectively by the hospital resuscitation department and maintained in a database. We analysed all adult (age over 16) in-patient cardiac arrests from 1/1/17 to 31/12/17. In cases with more than one cardiac arrest during admission, only the data relating to the first arrest was reviewed. Admitting speciality was recorded. In our institution Cardiology provides a direct admission service predominantly for Primary Percutaneous Coronary intervention for Acute Coronary syndromes.

The case records were reviewed to obtain demographic data and details of the admission, cardiac arrest and resuscitation attempt. The outcomes of Return of Spontaneous Circulation (ROSC) and survival to hospital discharge were recorded. Using the medical records patients were categorised into groups using the nine-point Clinical Frailty Scale (CFS) score, as described in Fig. 1.[3,4] This was done by a single senior trainee geriatrician (CW) with an interest in frailty assessment.

Statistical analysis was performed using GraphPad Prism version 8 (GraphPad Software Incorporated San Diego California USA) and SPSS Statistics for Windows, Version 22.0. (Armonk, NY: IBM Corp). Outcome based on CFS groups was assessed by contingency tables analysed using the Chi-squared test. Differences between continuous variables were assessed by the Wilcoxon–Mann–Whitney U-test and multivariable logistic analysis performed, $p < 0.05$ was considered to be statistically significant.

The hospital Research and Development department deemed ethical approval was not required for this retrospective notes review.

Results

Admission demographics

There were a total of 220 cardiac arrest calls during the study period. After excluding 29 cases which included repeat cardiac arrest in patients already included in the study, non-inpatient or paediatric arrests, and 12 cases where the CFS could not be calculated, 179 cases were included in the study population.

The median age on admission was 74 (mean 71, range 27–102), 110 patients were male and 69 female. In 49% of cases ROSC was

achieved and 22% of the study population survived to hospital discharge.

Impact of frailty

The population was divided into groups of CFS 1–5 and 6–9, the latter indicates at least moderate frailty and 31.3% of patients were in this category. This represents a clinically important distinction between patients who are independent for self-care and those who require help with basic activities of daily living (ADLs). The data are summarised in Table 1. There were differences in age, gender and admitting specialty between the two categories.

ROSC was significantly associated with frailty, being achieved in 56.1% of patients with a CFS score of 1–5 and 32.1% in the 6–9 category ($p < 0.001$). Admission to critical care after ROSC occurred in 23 CFS 1–5 patients and 3 CFS 6–9 patients ($p = 0.168$), with none of the latter group surviving to discharge ($p = 0.0198$).

Survival to hospital discharge was significantly associated with frailty, being seen in 39 (31.7%) CFS 1–5 patients but only in 1 (1.8%) CFS 6–9 patient ($p < 0.001$). This association remained in multivariable analysis adjusting for age alone ($p = 0.003$) and when adjusting for age, shockable rhythm and admitting specialty ($p = 0.044$).

The time from admission to arrest was significantly longer in CFS 6–9 patients (median 3 [range 0–105 days]) than the CFS 1–5 group (median 2 [range 0–77 days] ($p = 0.044$). Time from ROSC to death in patients surviving cardiac arrest but not to discharge was similar between groups ($p = 0.439$).

Discussion

Main findings

We analysed the presence of frailty and outcomes of 179 in-hospital cardiac arrests. Moderate to severe frailty affected over 30% of patients, which is similar to previously reported prevalence in hospital populations.[8,10]

We found that moderate to severe frailty was associated with reduced likelihood of ROSC and with non-survival to discharge in patients receiving in-hospital CPR. This effect persists after adjusting for age, presenting rhythm and admitting specialty. Survival to hospital discharge in the moderate to severe frailty category was less than 2%.

A recent study did not show frailty to be a significant factor in predicting survival after cardiac arrest in multivariable analysis although it was associated with reduced likelihood of discharge to independent living.[10] The prevalence of frailty in that study was lower than in our study and excluded important groups of patients (geriatric, rehabilitation and palliative care) we included, as we were assessing standard UK hospital practice. Dependency for ADLs, a feature of frailty, has been shown to be associated with failure to survive to discharge following in-hospital CPR.[13] In patients suffering out of hospital cardiac arrest, frailty is directly associated with mortality, independent of age.[14]

Rates of ROSC and survival to discharge after CPR for our cohort as a whole were 49% and 22% respectively. The rate of ROSC is broadly similar to previous data [15] and the percentage of patients surviving to discharge is similar to other published figures which range

Table 1 – Characteristics and outcomes by CFS.			
	CFS		*p*
	1–5	6–9	
Age			
Median (range)	70 (27–102)	80 (40–97)	0.002
Gender *n* (%)			
M	88 (71.5)	22 (39.3)	<0.001
F	35 (28.5)	34 (60.7)	
Admitting specialty *n* (%)			
General medical	63 (51.2)	43 (76.8)	<0.001
Cardiology	47 (38.2)	3 (5.4)	
General surgical, orthopaedic, obstetrics and gynaecology	13 (10.6)	10 (17.8)	
Time admission to arrest (days)			
Median (range)	2 (0–77)	3 (0–105)	0.04
Rhythm *n* (%)			
Non-shockable/unknown	76 (61.8)	47 (83.9)	0.003
Shockable	47 (38.2)	9 (16.1)	
Outcome of CPR attempt (%)			
ROSC	69 (56.1)	18 (32.1)	<0.001
Unsuccessful	54 (43.9)	38 (67.9)	
Critical care admission after ROSC *n* (%)	23 (33.3)	3 (16.7)	0.17
Survival to discharge after critical care admission *n* (%)	16 (69.5)	0 (0)	0.02
Time from ROSC to non-survival (days) median (range)	0 (0–22)	1 (0–11)	0.439
Survival to discharge *n* (%)	39 (31.7)	1 (1.8)	<0.001

from 17.5 to 37.4%[10,13,15] suggesting that our data is representative of wider experience. Following ROSC patients with moderate frailty were less likely to be admitted to critical care, although this trend was not statistically significant. This low rate of admission (16.7%) likely demonstrates those with CFS 6–9 were felt to be poor candidates for critical care, given that frail patients are known to have increased ICU mortality.[8] This effect of frailty is seen in our study, with no CFS 6–9 patients surviving to discharge after critical care admission.

Patients with moderate to severe frailty had a significantly longer time from admission to cardiac arrest. We believe this may provide clinicians a window of opportunity to consider resuscitation status in this group. That these patients still had a resuscitation attempt yet many were not deemed candidates for critical care admission after ROSC could imply that chances of survival were over-estimated or resuscitation decision was deferred.

We believe that our data should prompt larger studies to confirm the prognostic value of identifying frailty so that clinicians and patients can make better informed decisions regarding the value of CPR for hospital in-patients.

Study limitations

A limitation of this study is its retrospective nature; however the CFS has been validated for retrospective use.[16] The CFS was chosen over other methods for measuring frailty such as the electronic frailty index and HFRS due to their reliance on clinical codes. A 2015 study of UK medical coding found that a significant proportion of case records had a change in comorbidity coding following review,[17] giving rise to the possibility that frailty scores based on coding may be underestimated.

Conclusion

In this retrospective study of in-hospital cardiac arrests we analysed survival to discharge and association with CFS score on admission. We have shown that for patients with a CFS score of greater than 5 there is a significant association with non-survival to discharge after adjusting for age, shockable rhythm and admitting specialty. For those with moderate and severe frailty, so few patients survive to discharge after CPR as to be approaching accepted definitions of futility.[18] This should prompt clinicians to strongly consider resuscitation status and ceiling of care when caring for this group of patients.

Conflict of interest

We, the authors, confirm we have no conflicts of interest, financial or otherwise, to disclose.

Acknowledgements

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