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RESEARCH PAPER

Frailty status predicts futility of cardiopulmonary resuscitation in older adults

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Abstract

Aim: To determine if frailty is associated with poor outcome following in-hospital cardiac arrest; to find if there is a "frailty threshold" beyond which cardiopulmonary resuscitation (CPR) becomes futile.
Methods: Retrospective review of patients aged over 60 years who received CPR between May 2017 and December 2018, in a tertiary referral hospital, which does not provide primary coronary revascularisation. Clinical Frailty Scale (CFS) and Charlson Comorbidity Index were retrospectively assigned.
Results: Data for 90 patients were analysed, the median age was 77 (IQR 70-83); 71% were male; 44% were frail (CFS > 4). Frailty was predictive of in-hospital mortality independent of age, comorbidity and cardiac arrest rhythm (OR 2.789 95% CI 1.145–6.795). No frail patients (CFS > 4) survived to hospital discharge, regardless of cardiac arrest rhythm, whilst 13 (26%) of the non-frail (CFS ≤ 4) patients survived to hospital discharge. Of the 13 survivors (Age 72; range 61–86), 12 were alive at 1 year and had a good neurological outcome, the outcome for the remaining patient was unknown.
Conclusion: Frail patients are unlikely to survive to hospital discharge following in-hospital cardiac arrest, these results may facilitate clinical decision making regarding whether CPR may be considered futile. The Clinical Frailty Scale is a simple bedside assessment that can provide invaluable information when considering treatment escalation plans, as it becomes more widespread, larger scale observations using prospective assessments of frailty may become feasible.

Keywords: resuscitation, frailty, cardiopulmonary resuscitation, cardiac-arrest, older people

Key Points

- Frailty is associated with increased mortality following in-hospital cardiac arrest.
- A Clinical Frailty Scale (CFS) of 5 or more suggests futility of cardiopulmonary resuscitation (CPR).
- Frailty, as a feature of biological ageing, is more predictive of adverse outcome after cardiac arrest than age itself.

Introduction

Survival to discharge following in-hospital cardiac arrest is reported to be as high as 17–20% [1–3]. However, this is unlikely to be representative of outcomes in older people, where myriad studies have demonstrated that patients of advanced age [3] or comorbidity [4, 5] have significantly reduced survival following cardiac arrest. In recent months, frailty has also been linked to adverse outcomes following in-hospital cardiac arrest [6, 7].

Frailty is considered to be a syndrome of impaired physical function and reduced physiological reserve; it is associated with adverse outcomes including mortality, physical dependence and hospitalisation [8, 9]. In the frail, major surgery is associated with higher rates of complications and prolonged length-of-stay [10]; furthermore, admission to intensive care is linked to increased mortality in patients with established frailty [11]. Various scales and tools exist to identify frailty, and there is no universal consensus on which tool is superior. However, the Clinical Frailty Scale (CFS) is increasingly used in UK clinical practice [12]. It is easy to apply at the bedside and considers an individual's pre-existing level of function and mobility in a 9-point visual and descriptive scale (Figure 1).

Cardiopulmonary resuscitation (CPR) was originally developed to treat cardiac arrest after myocardial infarction [13]; it is now the default position for all in-patient cardiac arrest unless a 'Do Not Attempt CPR' (DNACPR) decision has been documented. Failure to discuss and document a DNACPR decision will, therefore, typically result in CPR being attempted on patients sustaining cardiac arrest, even if such patients are naturally dying from advanced or irreversible disease. In such cases, CPR is associated with low rates of success and the application of inappropriate and futile CPR treatment can deprive patients of a dignified and peaceful death at the end of their natural lives [14]. CPR, in this context, can therefore arguably be considered harmful. Furthermore, CPR is considered to be an aerosol-generating procedure and in the era of the 2020 global COVID-19 pandemic, the risks of CPR to healthcare staff are not insignificant [15]. It is therefore important that CPR should only be undertaken when there is a chance of successful outcome.

In the UK, the General Medical Council (GMC) is the independent regulator of doctors and publishes guidance on various subjects including CPR. On this topic, GMC guidance indicates that when patients are at foreseeable risk of cardiac arrest, a judgement about the likely benefits, burdens and risks of CPR should be made as early as possible [16]. Discussions about CPR should be had with patients, or if they lack capacity with their relatives or caregivers. However, the evidential basis for DNACPR is sometimes inadequately understood by clinicians who can struggle to determine when CPR may be considered futile, and therefore should not be offered to the patient [17]. Legal cases pertaining to DNACPR orders have achieved high-profile coverage in the mainstream media and have generated anxiety surrounding the issue of DNACPR [18]. As a result of these issues, some doctors feel increasingly dis-incentivised to address the challenging issue of DNACPR [19]. The evidence currently indicates that CPR is attempted in many patients in whom successful resuscitation is highly unlikely, and therefore possibly inappropriate [20].

A number of scoring tools have been proposed to predict survival after in-hospital cardiac arrest. These include the pre-arrest morbidity score [21], and subsequent modifications [22, 23]. These scores include multiple clinical characteristics that are weighted according to importance to generate a final score. Although theoretically feasible in routine clinical practice, calculation at the bedside can be cumbersome. Furthermore, some components are rapidly dynamic and related to acute illness. Whilst it is clear that they are of adverse prognostic value in an acute illness, these parameters are easily reversible and therefore of limited value in making long-term resuscitation decisions. Although these scores have an acceptable level of accuracy in predicting outcomes of CPR, their complexity makes them difficult to use in real-life clinical practice. This is reflected in the paucity of their use in clinical decision-making despite being formulated >20 years ago [24].

In clinical practice, we have observed that frailty is often cited as an indicator that resuscitation is unlikely to be successful and documented as a justification that resuscitation should not be attempted. However, at the time of commencing this study, there was no published research in UK populations describing the association between frailty and mortality following in-hospital cardiac arrest.

We aimed to determine whether frailty is associated with in-hospital mortality following cardiac arrest in older patients (aged >60 years), independently of age and comorbidity. To support clinical decision-making, we considered whether a 'frailty threshold' exists at which CPR is likely to be futile. We hypothesised that such a threshold might inform clinicians of when CPR is unlikely to change the outcome, and therefore at what point it should not be offered to patients.

Methods

This study was conducted in a tertiary referral hospital, Major Trauma Centre in South West England. Notably, the institution did not have a Primary Percutaneous Coronary Intervention (PPCI) service.

Patients aged >60 years of age who received CPR between May 2017 and December 2018 were identified using the National Cardiac Arrest Audit database. Age, initial arrest rhythm and in-hospital mortality were obtained from the database. CFS and Charlson Comorbidity Index (CCI) were calculated retrospectively from review of electronic medical records by the authors. The resuscitation event was also reviewed; where an alternative diagnosis to genuine cardiac arrest was documented by the treating team (e.g. syncope) patients were excluded from analyses.

The CFS (Figure 1) was selected as our frailty scale as it has been validated for hospitalised older adults, is easy to use and has good inter-rater reliability [12, 25]. Importantly, it has also been shown to retain validity when retrospectively applied [25].

Data were analysed in IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Patients were stratified by in-hospital mortality; $P < 0.05$ was considered statistically significant. Wilcoxon test and Mann–Whitney test were undertaken on non-normally distributed variables, and Fisher's exact two-sided tests for dichotomous categorical variables. Multivariate analyses were performed using logistic regression; results are shown as odds ratios (OR) with 95% confidence intervals (CIs).

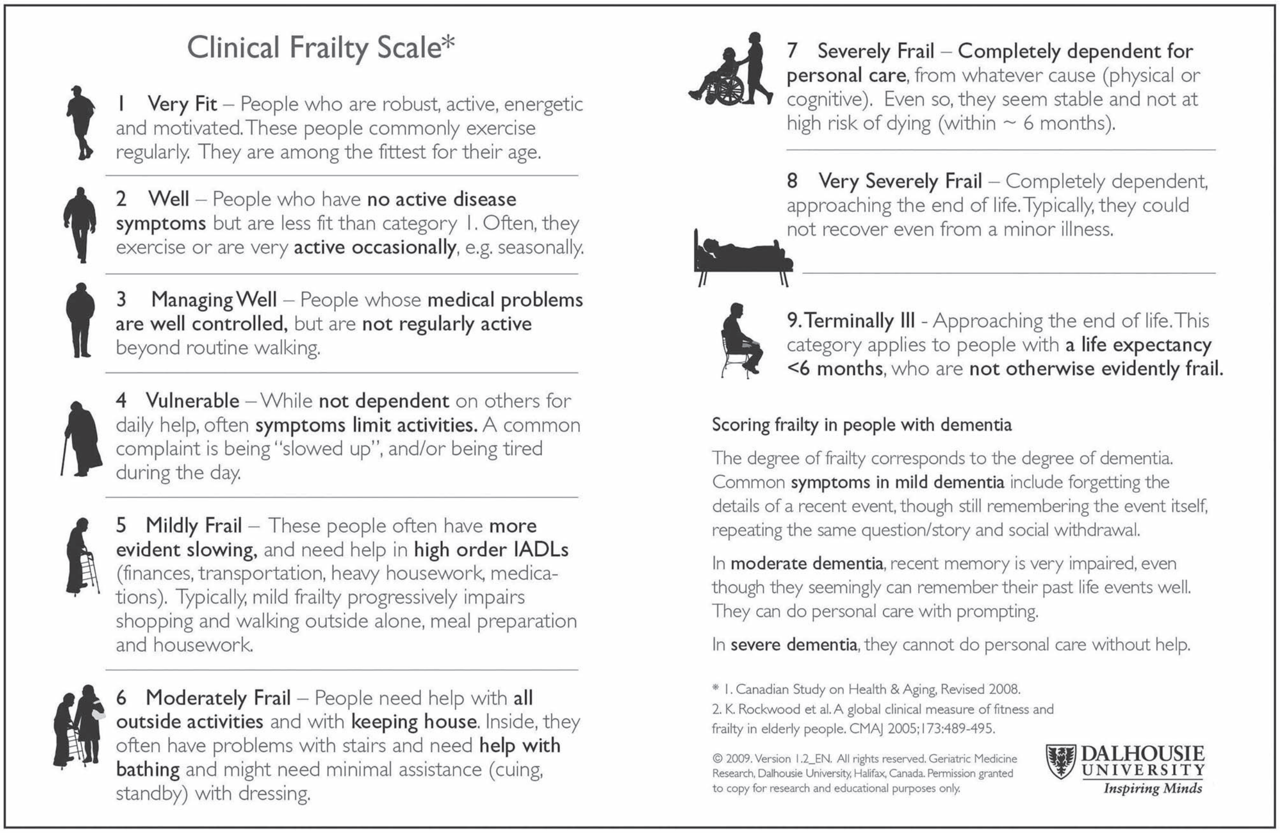

Figure 1. The CFS.

Our organisation's Quality Improvement and Audit Board reviewed the project and determined formal ethical approval for this retrospective study was not required.

Results

One hundred and twelve in-patients aged >60 years received CPR in the study period. Twenty-two cases were excluded: one was a repeat cardiac arrest in a patient already included in the study; 11 cases were excluded where CPR was discontinued early when a DNACPR document was discovered; 4 where a CFS score could not be inferred given the paucity of clinical records; 6 where an alternative diagnosis (i.e. syncope) was made. Ninety cases were therefore included in the analysis.

The median age was 77 (interquartile range (IQR) 70–83); 71% were male; 82% of initial cardiac arrest rhythms were non-shockable. Most (86%) recipients of CPR died in hospital. The median CFS was 4 (IQR 3–5); 44% of patients were frail (CFS > 4), and the median CCI was 5 (IQR 4–7).

Of those who died in hospital, there was a tendency to older age (median 78 vs. 72; $P < 0.07$ years) and increased comorbidity (CCI 6 vs. 4; $P < 0.09$). Those who died were significantly more frail (CFS 5 vs. 3; $P < 0.002$). Non-shockable cardiac arrest rhythms were also significantly associated with in-hospital mortality (92.2% vs. 23.1%; $P < 0.001$) (Table 1).

No frail patients (CFS > 4) survived to discharge after in-hospital cardiac arrest, whilst 13 (26%) of the non-frail (CFS ≤ 4) patients survived to hospital discharge. No patients with a CCI >6 survived to discharge after in-hospital cardiac arrest; CCI > 6 is the level at which predicted 10-year survival tends to 0% [26].

CFS is independently associated with in-hospital mortality when adjusted for age, comorbidity and arrest rhythm in multivariate logistic regression (OR 2.789; 95% CI 1.145–6.795).

Of the 13 patients who survived to discharge (age 72; range 61–86), all had a cardiac cause of arrest: either myocardial infarction, heart block, complication of coronary angiography or cardiac medication. Twelve had a good outcome with Cerebral Performance Category [27] 1 or 2 and were discharged home. The remaining patient had additional complications and was repatriated to their local hospital for ongoing care. All 12 local patients was still alive at 1 year; outcome data were not available for the non-local patient.

Fifteen percent of frail patients had a shockable rhythm, but even in this context, none survived to discharge.

Discussion

These data are amongst the first to specifically report outcomes of CPR following in-patient cardiac arrest in

Table 1. Characteristics by survival to discharge.

	Survived to discharge ($n = 13$)	Died in hospital ($n = 77$)	P	Odds ratio (95% CI)
Age (IQR)	72 (65–80)	78 (72–83)	0.07	1.08 (1.00–1.16)
Male (%)	11 (85%)	53 (69)	0.33	
Clinical Frailty Scale (IQR)	3 (2–3.5)	5 (4–5.5)	0.002	2.85 (1.58–5.13)
Charlson Comorbidity Index (IQR)	4 (3–5)	6 (4–7)	0.09	2.04 (1.26–3.33)
Initial cardiac arrest rhythm was non-shockable (%)	3 (23)	71 (92)	<0.001	39.44 (8.49–183.24)

IQR, interquartile range.

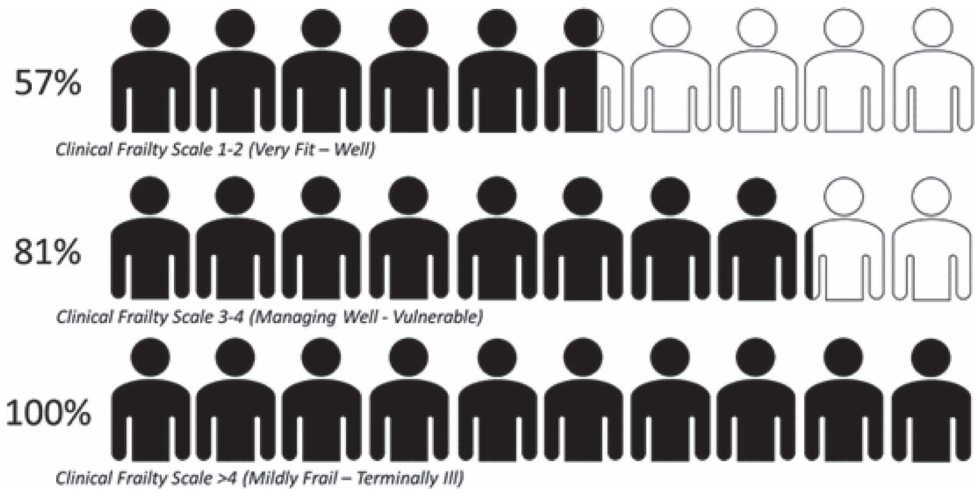

Figure 2. Percentage of patients who died in hospital following CPR for cardiac arrest, stratified by CFS. Deaths are shown in black.

older populations in the UK in the context of frailty. Frailty was associated with in-hospital death following cardiac arrest, independently of age, comorbidity and cardiac rhythm. It is important to note that none of our patients aged >60 years with CFS > 4 survived (Figure 2), and therefore could suggest futility of CPR in this group.

Our findings are consistent with two other recently published studies evaluating the role of frailty in predicting adverse outcome of CPR: one in an Australian population [6], and one from the UK [7]. Our study importantly differs in several ways: we focussed specifically on an older population (aged >60 years) who are likely to consequently suffer from a greater burden of frailty and comorbidity than younger patients sustaining cardiac arrest. Compared to the only other study conducted in the UK [7], our population has an important difference: like ∼70% of UK hospitals [28, 29], we conducted our study in a centre without a primary coronary revascularisation service; we therefore treated fewer patients with shockable cardiac arrest rhythms and potentially reversible cardiac pathology. It is well established that patients suffering from shockable rhythms have more favourable outcomes from CPR; this may explain greater survival of frail patients at the other UK centre with a PPCI service [7].

Non-shockable rhythm was most strongly predictive of adverse cardiac arrest outcome in our study. Though informative, this is not useful for pre-arrest clinical decision-making about the appropriateness of CPR, because such information is only available in a cardiac arrest situation, once resuscitation has commenced. Fixed predictors of unsuccessful outcome are therefore needed to guide decision-making prior to cardiac arrest.

Comorbidity has previously been shown to be useful in this regard. In our study, we demonstrated a non-significant trend between greater comorbidity (CCI) and adverse outcome. Lack of significance may relate to small single-centre sample size or higher baseline comorbidity in our older population.

Chronological age has also historically been used to guide decision-making regarding CPR. We add to the expanding body of evidence by showing that frailty, as a feature of biological ageing, is more predictive of adverse outcome than age per se, and in older patients may be the major determinant (Box 1) [8]. Our results suggest that patients who do not show evidence of frailty may have good neurological outcomes, and survival beyond a year. This suggests that frailty is more informative than age in directing advanced care plans and determining suitability for CPR.

Box 1: Case Examples: Is frailty more important than age in determining survival from in-hospital cardiac arrest?
An 83-year-old male who was not frail, CFS 3, but had some comorbidity (CCI 5), had a cardiac arrest with a non-shockable arrest rhythm. He, survived, was discharged home and was still alive 1 year later.
A 75-year-old female who was frail, CFS 5, with some comorbidity (CCI 5), had a cardiac arrest with a shockable arrest rhythm and died in hospital.

Our most significant finding is that all patients who were frail with a CFS of >4 died in hospital. Although we acknowledge that these are retrospective data from a single centre, which may reflect local populations or uncontrolled factors, these results suggest CPR in older patients with established frailty may be futile. This differs from other studies, which found survival following CPR in a small number of frail patients [6, 7]. Notably, these two other studies did not seemingly exclude from their analyses patients whose resuscitation diagnosis was not true cardiac arrest (i.e. syncope). This may explain the small numbers of patients with established frailty who reportedly survived ‘cardiac arrest’ in other studies.

However, it is important to acknowledge the limitations of this single-centre, observational study. Notably, it was conducted with retrospective design, and thus the determination of frailty scores was made from existing records, and the outcome of resuscitation attempts was known, which may have resulted in bias when allocating the CFS. Further work is needed to determine whether these data can be reproduced on a larger scale and in other centres. As frailty assessment becomes more widespread, larger scale observational studies using prospective assessments of clinical frailty may become feasible.

Conclusion

These data are amongst the first correlating frailty measured by CFS with mortality following in-hospital cardiac arrest in patients >60 years, independently of age and comorbidity. Frail patients are unlikely to survive to hospital discharge following in-hospital cardiac arrest; these results may facilitate clinical decision-making regarding whether CPR may be considered futile. It may also inform discussion with patients and their caregivers about the realistic outcomes of resuscitation in the context of established frailty.

Declaration of Conflicts of Interest: None.

Declaration of Sources of Funding: None.

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