



## Original research

## Frailty and poor functional status are common in arterial vascular surgical patients and affect postoperative outcomes



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## HIGHLIGHTS

- Frailty is common in older patients undergoing arterial vascular surgery.
- The Edmonton Frail Scale (EFS) was a feasible tool for the preoperative assessment of frailty.
- The EFS in older vascular surgical patients was high compared with other elective surgical groups.
- An EFS of  $\geq 6.5$  was predictive of longer length of hospital stay.

## ARTICLE INFO

## Article history:

Received 16 June 2014

Received in revised form

23 March 2015

Accepted 11 April 2015

Available online 20 April 2015

## Keywords:

Frailty

Functional status

Older people

Arterial vascular surgery

Outcomes

## ABSTRACT

**Objectives:** Increasing numbers of older people are undergoing emergency and elective arterial vascular procedures. Many older patients are frail which is a recognised predictor of adverse postoperative outcomes in other surgical specialties. This study in older patients undergoing arterial vascular surgery examined; the prevalence of preoperative frailty; the clinical feasibility of preoperatively measuring frailty and functional status; the association between these characteristics and adverse postoperative outcome.

**Methods:** Prospective observational study in patients aged over 60 years undergoing elective and emergency arterial vascular surgery. Baseline measures of frailty (Edmonton Frail Scale), functional status (gait velocity, timed up and go, hand grip strength) and cognitive function (Montreal Cognitive Assessment) were obtained preoperatively. The primary outcome measure Length of Stay (LOS) and secondary outcome measures of postoperative morbidity (medical and surgical complications), functional status and postoperative in-hospital mortality were recorded.

**Results:** 125 patients were recruited. Frailty was common in this older surgical population (52% EFS score of  $\geq 6.5$ ) with high frailty scores observed (mean EFS 6.6, SD 3.05) and poor functional status (60% had TUG >15 s, 45% had gait velocity of <0.6 m/s). Higher preoperative EFS (>6.5) was univariately associated with longer LOS ( $\geq 12$  days), composite measures of postoperative infections, postoperative medical complications and adverse functional outcomes. EFS  $\geq 6.5$  was predictive of LOS  $\geq 12$  days, adjusted for age (AUC 0.660, CI 0.541–0.779,  $p = 0.010$ ). This association between EFS  $\geq 6.5$  and LOS  $\geq 12$  days was strengthened with the addition of MoCA < 24 (AUC 0.695, CI 0.584–0.806,  $p = 0.002$ ).

**Conclusions:** Patients aged over 60 years admitted for arterial vascular surgery were frail, had impaired functional status and were cognitively impaired. This combination of preoperative characteristics was predictive of longer hospital length of stay and associated with adverse postoperative outcome.

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## 1. Introduction

Vascular services are managing increasing numbers of older patients as the population ages and evidence accrues of the benefit from arterial vascular surgery in older people [1]. This poses a challenge as increasing age is associated with physiological changes, multi-morbidity and specific geriatric syndromes which increase the risk of adverse postoperative outcomes [2–4]. Risk factors (including hypertension, hypercholesterolemia and cigarette smoking) which predispose to the development of peripheral vascular disease and aortic aneurysms, also predispose to frailty [5,6]. Frailty is defined as physiological decline across multiple organ systems, making the patient vulnerable to even relatively minor external stressors [7–9]. It is an independent predictor of postoperative morbidity, postoperative mortality, length of stay (LOS) and institutionalisation at discharge [10–16]. However, although functional status has been reported as a predictor of adverse postoperative outcome in those with lower limb arterial disease undergoing revascularisation [17,18], the prevalence of frailty and its impact on postoperative outcomes has not been studied more widely in older patients undergoing planned and unplanned aortic and lower limb surgery.

Numerous measures of frailty exist, from scales, scores and indices to functional measures such as “timed up and go” (TUG) and gait velocity. These have prognostic value in various clinical settings. The Edmonton Frailty Scale (EFS) [19] is validated when used in the preoperative setting for elective surgical patients [14], high EFS scores being associated with both postoperative complications and prolonged LOS. It is a short tool based on 11 questions covering nine domains, scored from zero to 17, the maximum frailty score [19]. Thus the EFS may be useful to identify risk profiles preoperatively, potentially enabling modification of risk and better postoperative outcomes.

The aims of this observational study were to examine in elective and emergency arterial vascular surgical patients;

1. The clinical feasibility of pre and postoperative assessment of frailty and functional status using EFS, TUG, gait velocity and hand grip strength.
2. The prevalence of preoperative frailty.
3. The association between preoperative frailty, preoperative physical function and adverse postoperative outcome

## 2. Methods

Approval for the study was given in February 2011 by the South East Research Ethics Committee (11/H1102/10). This study has been described previously [20].

### 2.1. Setting

The study was conducted at a single institution; an inner city teaching hospital which operates as a hub centre providing care to both the local population and with a large tertiary referral practice for vascular surgery as is increasingly the practice in the UK.

### 2.2. Subjects

#### 2.2.1. Criteria for eligibility

1. Aged 60 years or more.
2. Presenting for proposed elective or emergency aortic or lower limb arterial intervention.

#### 2.2.2. Exclusion criteria

1. Patients receiving palliative treatment for a terminal condition.
2. Patients admitted and discharged over the weekend (research team capacity).
3. Patients too unwell to complete the preoperative assessments.

#### 2.2.3. Recruitment and consent

The study was open to recruitment from May until August 2011. Patients were consecutively recruited within 48 h of admission to the vascular surgical unit. Written informed consent was sought. Participation of those without capacity to consent was managed according to sections 30–34 of the Mental Capacity Act (2005) employing the use of a personal consultee to give assent to study participation on behalf of the patient. Flow chart (Fig. 1) shows details of patient recruitment. A sample size of 120 was required based on the statistical necessity of 7–10 cases per variable anticipated for the regression modelling.

#### 2.2.4. Preoperative data collection

Baseline demographic data were collected through a combination of patient interview and review of medical records. Comorbidities including falls history, medications and social history were recorded. Clinical assessment of frailty and cognition (Montreal Cognitive Assessment, MoCA) [21] were undertaken preoperatively by a trained clinical researcher. The Hospital Anxiety and Depression Scale (HADS) [22] was also completed preoperatively.

#### 2.2.5. Frailty and functional assessments

**2.2.5.1. Edmonton Frail Scale (EFS).** The EFS assesses nine domains of frailty (cognition, general health status, functional independence, social support, medication usage, nutrition, mood, continence, functional performance) and provides a score from 0 to 17 where 17 represents the maximum level of frailty [19] (appendix 1). It incorporates the “timed up and go” test (TUG), with the option of a maximum domain score of 2 for participants unwilling or unable to perform it. Frail and non-frail participants were defined according to dichotomising the EFS score at 0–6 and 7–17.

**2.2.5.2. Grip strength.** Hand grip strength was assessed preoperatively using a Jamar dynamometer adhering to the standardised protocol recommended by the American Society of Hand Therapists [23]. The result was compared with accepted age and gender norms [24].

**2.2.5.3. Gait velocity & TUG.** A physiotherapist preoperatively recorded gait velocity and TUG. Gait velocity is walking velocity over four metres. TUG asks a seated subject to rise from a chair, walk a distance of three metres, turn round and return to sit in the chair. TUG was dichotomised at 20 s [25,26] and gait velocity at 0.6 m/s [25–28].

#### 2.2.6. Postoperative data collection

Outcomes including the primary outcome measure LOS and secondary measures of postoperative morbidity (medical, surgical and functional complications), functional status at discharge (TUG and gait velocity) and postoperative in-hospital mortality were recorded contemporaneously from the medical record until the patient was discharged from hospital or died in hospital. Complications were predefined prior to study commencement and involved objective measures coupled with clinical findings. For example postoperative acute coronary syndrome was defined as clinical features coupled with ECG and troponin changes for which low molecular weight heparin was given, and postoperative wound

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