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Frailty is associated with postoperative complications in older adults with medical problems

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ABSTRACT

We sought to test whether frailty may be predictive of operative risk in older adults with medical problems. One hundred and twenty-five patients at least 70 years of age had a previously developed frailty screen, the Edmonton Frail Scale (EFS), administered at a pre-surgical clinic, prior to elective non-cardiac surgery. A blinded chart audit assessed for postoperative medical complications, length of stay and inability to be discharged home. The mean age of patients was 77 (range 70–92) and most (82%) underwent orthopedic procedures. Increasing frailty was associated with postoperative complications ($p = 0.02$), increased length of hospitalization ($p = 0.004$) and inability to be discharged home ($p = 0.01$), independent of age. EFS scores of 3 or less were associated with a lower risk of having a complication (age-adjusted OR 0.27, 95% CI 0.09–0.80, likelihood ratio of 0.33) and a higher chance (80%) of being discharged home ($p < 0.02$). EFS scores exceeding 7 were associated with increased complications (OR 5.02, 95% CI 1.55–16.25, likelihood ratio of 3.9) and a lower chance of being discharged home (40%, $p < 0.02$). This study suggests that a frailty screen can refine risk estimates of postoperative complications in older adults undergoing elective non-cardiac surgery.

1. Introduction

Despite recent advances in surgical and anaesthetic techniques, elderly patients are at increased risk for major perioperative complications, longer hospital stays, and postoperative institutionalization (Goldman et al., 1977; Detsky et al., 1986; Marcantonio et al., 1994; Arozullah et al., 2000, 2001; Polanczyk et al., 2001; Alibhai et al., 2005; Smetana et al., 2006). Even after controlling for co-morbid illnesses and functional impairment, age remains an independent risk factor for adverse postoperative events (Marcantonio et al., 1994; Arozullah et al., 2000, 2001; Polanczyk et al., 2001; Alibhai et al., 2005).

Frailty is an increasingly used concept in the geriatric medicine literature. Various definitions have been proposed (Winograd et al., 1991; Rockwood et al., 1994, 1996, 1999; Jarrett et al., 1995; Chin et al., 1999; Fried et al., 2001; Gill et al., 2002), but there is no universally accepted definition or measure of frailty (Rockwood et al., 1996; Hammerman, 1999; Fried et al., 2001; Hogan et al., 2003). However defined, there is consensus that frail individuals are at increased risk for sustaining adverse outcomes such as functional disability, institutionalization or death (Winograd et al., 1991; Rockwood et al., 1994, 1996, 1999; Jarrett et al., 1995; Chin et al., 1999; Hammerman, 1999; Fried et al., 2001; Gill et al., 2002).

In the operative setting various components of frailty have been associated with postoperative adverse events. Studies have linked loneliness (Herlitz et al., 1998), cognitive impairment (Marcantonio et al., 1994; Arozullah et al., 2001; Galanakis et al., 2001; Schneider et al., 2002; Fukuse et al., 2005), functional limitations (Arozullah et al., 2000, 2001; Polanczyk et al., 2001; Fukuse et al., 2005), poor nutritional status (Arozullah et al., 2000, 2001; Maurer et al., 2002) and depression (Berggren et al., 1987; Galanakis et al., 2001) to various postoperative complications. Poor exercise

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tolerance, a characteristic of some frailty models (Chin et al., 1999; Fried et al., 2001), has been linked to postoperative institutionalization (Legner et al., 2004), cardiac complications (Gerson et al., 1990; Reilly et al., 1999) and delirium (Reilly et al., 1999). Hence, those same components of frailty seen in non-surgical populations can be viewed as important risk factors for postoperative complications, supporting the hypothesis that frailty may be a unifying concept to help refine risk estimate in addition to other factors such as age.

A measure of frailty, which identifies the "at risk" individual, could therefore also be used for global operative risk assessment. The occurrence of postoperative complications could be another consequence of being "frail". This exploratory study examined whether frailty is associated with an increased risk of postoperative complications in older adults with medical illness undergoing non-cardiac, major elective surgery. It also addresses whether formally assessing for frailty, in a clinical preoperative setting, would add additional information on operative risk beyond that obtainable from a standard preoperative risk assessment.

2. Subjects and methods

This study was approved by the Health Sciences Research Ethics Board of the University of Western Ontario. Study participants were recruited at a preadmission clinic for preoperative assessment, at a tertiary care teaching hospital, between June 2002 and April 2003. Inclusion criteria were: (i) age 70 years or older; (ii) referred for medical preoperative assessment for medical clearance; (iii) undergoing a single elective non-cardiac operation. Exclusion criteria were: (i) day surgical procedures; (ii) active cancer (defined as having surgery for a possible malignancy or receiving treatment for cancer); (iii) undecided as to whether they would have surgery; (iv) no working understanding of English; (v) not cleared for surgery for unstable medical reasons; (vi) enrolled in randomized controlled trials of new (i.e. investigational) pharmacologic agents.

Medical charts of patients attending the preadmission clinic were screened depending on the availability of the main investigator (MD). During the study period, charts from 0 to 3 half-day clinics per week were screened. All consecutive and eligible patients attending the clinic on these days were invited to participate by the main investigator and enrolled after obtaining informed consent. Patients underwent a standard medical work-up including a history and physical exam, laboratory tests, other investigational studies (as ordered by the internist working at the clinic) and application of the Detsky criteria (Detsky et al., 1986). Information on demographics, co-morbidity, using the Cumulative Illness rating Scale (CIRS, Parmalee et al., 1995), and Body Mass Index (BMI, patient weight (kg)/height (m) $\times$ height (m)) were collected.

In addition, the EFS was administered by the main investigator (MD). The EFS is a recently developed and validated multifactorial scale, which is easy and quick to administer (Rolfson et al., 2006). No prior geriatric assessment is required to administer the test. It was tested on older adults undergoing comprehensive geriatric assessment at a different site (Edmonton, Canada), and found to be reliable and valid compared to a geriatrician's clinical impression of frailty (Rolfson et al., 2006). The EFS screens for cognitive impairment, dependence in instrumental activities of daily living, recent burden of illness, self-perceived health, depression, weight loss, medication issues, incontinence, inadequate social support, and mobility difficulties. Scores range from 0 (not frail) to 17 (very frail).

Outcomes were determined through a standardized chart audit by a research assistant who was experienced in chart audits and reading EKGs. Postoperative management was not altered by the study and the clinicians who managed and documented patients' postoperative course were not part of the study protocol. They, and the chart auditor, were blinded to the study hypotheses and preoperative EFS scores.

The primary outcome of interest was the occurrence of an in-hospital, postoperative complication felt to be unrelated to surgical technique (e.g., wound infection or excessive bleeding into the surgical site). Since frailty generally refers to an increased vulnerability to different adverse outcomes, and is not specific to a particular disease process, the primary outcome was broadly defined to encompass the three most commonly cited post-operative complications (Seymour and Vaz, 1989; Liu and Leung, 2000; Polanczyk et al., 2001), namely cardiac or pulmonary complications (defined using pre-specified definitions as outlined in Appendix A) or delirium. Delirium symptoms were abstracted from the hospital record using a tool, which identified key words or themes. A similar method was used in a study on postoperative delirium in coronary bypass patients (Rolfson et al., 1999). In addition, other less common complications including death, stroke, or gastrointestinal bleeding requiring work-up were recorded. A patient was considered to have had an adverse postoperative outcome if he/she had either a cardiac or pulmonary complication, delirium, or one of the above-mentioned less common adverse events. Other outcomes of interest included length of postoperative stay (LOS) and inability to be discharged home for previously non-institutionalized patients.

Data were analyzed using SPSS, version 9.0 for Windows. For the primary question the dependent variable was the occurrence of any postoperative complication as defined above. Fisher's exact test and Mann–Whitney tests were used to examine associations between categorical or continuous variables and the occurrence of a complication. Variables with an association ($p < 0.1$) in the univariate analyses were put into a multiple logistic regression model and then consecutively removed in a backwards elimination model (for $p > 0.05$) to arrive at the final model. Age-adjusted logistic regression was used for the secondary outcome, inability to be discharged home. LOS was analyzed in an age-adjusted time constant Cox regression model with time until discharge as the dependent variable, with in-hospital deaths censored at the date of death.

To address whether the EFS may be clinically useful, two analyses were done. Firstly likelihood ratios associated with the EFS were calculated to determine whether clinical risk assessment would be altered to a significant extent (Jaeschke et al., 2002). Secondly the area under the Receiver Operating characteristic (ROC) curve of the EFS was compared to ROC curve area for the Detsky criteria (the standard measure of risk chosen for the study) using the method of Hanley and McNeil (1983).

3. Results

Out of 161 eligible patients, nine had their surgeries cancelled because of medical instability as determined by the clinic internist. Fourteen patients refused, two did not have a working understanding of English, two were involved in randomized controlled trials, and one was undecided about whether to have surgery. One hundred and thirty-three patients were enrolled but seven did not undergo surgery for unknown reasons, and one patient underwent three procedures, one emergently, and was therefore excluded (multiple or emergency surgeries being exclusionary criteria). The patients who were excluded did not differ in their mean age, gender or Detsky score (Mann–Whitney test). The final sample comprised 125 patients.