Archives of Gerontology and Geriatrics 61 (2015) 458–463

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

Short- and longer-term predictive capacity of the Multidimensional Prognostic Index: The timing of the assessment is of no consequence

Elisabetta De Luca [a,*], Egle Perissinotto [b], Laura Fabris [a], Valentina Pengo [a], Anna Zurlo [a], Pietro De Toni [a], Francesca De Zaiacomo [a], Enzo Manzato [a], Valter Giantin [a]

[a] Geriatric Clinic, Department of Medical Science, University of Padova, Via Giustiniani 2, 35128 Padova, Italy
[b] Unit of Biostatistics, Epidemiology and Public Health, Department of Cardiac, Thoracic and Vascular Sciences, University of Padova, Italy

ARTICLE INFO

Article history:
Received 10 June 2015
Received in revised form 13 July 2015
Accepted 31 July 2015
Available online 7 August 2015

Keywords:
Outcome
Elderly patients
MPI

ABSTRACT

Background: Several studies have tested the ability of the Multidimensional Prognostic Index (MPI) to predict mortality for acute elderly patients admitted to hospital. We compared the reliability of MPI scores obtained both on admission to, and at discharge from hospital. We tested MPI performance in predicting short- and longer-term mortality grouped into three risk groups and according to single MPI scores.

Methods: A longitudinal prospective study was conducted on 699 elderly patients admitted to the Geriatric Unit at Padua General Hospital. MPI scores were obtained on admission and at discharge. In-hospital and one-year mortality was recorded. Adjusted Cox's regression models were used to assess the prognostic value of the MPI scores.

Results: 691 were included in the study: 459 (66.4%) women and 232 (33.6%) men, mean age = 85.2 ± 7.0 years. Patients were grouped as: low risk MPI 12.5%; moderate risk MPI 28.6%; severe risk MPI 58.9%.

The cumulative in-hospital mortality rate was 7.4%. In the adjusted model, only MPI score (not MPI risk group) was significantly associated with in-hospital death ([HR] = 1.22, 95%CI 1.07–1.39).

1-Year crude mortality rate: 39.2%. The patients' MPI scores at admission and at discharge were equally predictive of death (adjusted HR of MPI on admission 1.20 [1.15–1.27], $p < 0.0001$; at discharge 1.24 [1.18–1.30], $p < 0.0001$). The performance (AUC) of the MPI score on admission and at discharge proved much the same.

Conclusions: This study confirmed the value of the MPI in predicting mortality for acute elderly patients. Grouping MPI scores into risk levels may not be appropriate when applied to hospitalized acute geriatric patients. The prognostic value of MPI scores was confirmed only for MPI value ≥0.68. Judging from our study, the timing of the assessment during a patient's hospital stay (on admission or at discharge) may be irrelevant for longer-term prognostic purposes.

1. Introduction

When frail older adults develop an acute condition, their best management is a great challenge for both relatives and clinicians (Evans, Sayers, Mitnitski, & Rockwood, 2014; Pijpers, Ferreira, Stehouwer, & Nieuwenhuijzen Kruseman, 2012; Rubenstein et al., 1984).

A geriatric assessment can help clinicians customize their global care and identify their risk of an adverse prognosis (Sourial, Wolfson, Bergman, Zhu, & Karanananthan, 2010). A systematic review was recently conducted to compare the capacity of several published indexes to predict mortality (Yourman, 2012) among the 12 indexes considered, the Multidimensional Prognostic Index (MPI) emerged as a powerful tool (Pilotto et al., 2008) and was judged to be well calibrated and to have a good discriminatory power (Yourman, 2012).

The MPI was developed and validated in a setting of hospitalized elderly patients consecutively admitted to an acute geriatric ward (Pilotto et al., 2008). The prognostic value of MPI scores has been confirmed in different acute and chronic disease scenarios (Giantin, Valentini, & Iasevoli, 2013; Pilotto et al., 2007, 2009a, 2009b; Volpato, Bazzano, Fontana, Ferrucci, & Pilotto,

* Corresponding author.
E-mail address: elisabetta121283@libero.it (E. De Luca).

http://dx.doi.org/10.1016/j.archger.2015.07.004
0167-4943/

2014). The MPI is generally used as part of the clinical work-up for assessing a patient on admission. Given the amount of information needed to calculate the MPI, an acute patient's emergency care often makes it difficult to complete all the MPI-related tests already on the first hours after admission. In addition, little is known about how patients' MPI scores change during their hospital stay, and less still about what their scores might be at the time of their discharge. The main purpose of the present study was to see how MPI scores change during a hospital stay, and to compare the prognostic reliability of MPI scores obtained on admission and at discharge. The value of the MPI as a predictor of in-hospital and one-year mortality among elderly patients hospitalized for acute conditions was assessed both for individual MPI scores, and for patients grouped as low, moderate or severe risk according to their MPI scores (Pilotto et al., 2008).

2. Methods

A longitudinal prospective study was developed at the Geriatric Unit of Padua General Hospital. The sample included patients admitted from 1st January 2012 to 31st December 2012.

The inclusion criteria were: (a) age ≥65 years; (b) feasibility of obtaining a complete geriatric assessment; (c) availability of details on periods spent in a nursing home (if any); (d) vital status after 12 months of follow-up; (e) patients' and/or caregivers' cooperation in answering questions.

Each patient underwent a geriatric assessment within 48 h of admission and at the time of discharge from hospital, focusing on the items included in the Multidimensional Prognostic Index (MPI) (Pilotto et al., 2008; Katz, Downs, Cash, & Grotz, 1970; Lawton & Brody, 1969, Guigoz & Vellas, 1999, Conwell, Forbes, Cox, & Caine, 1993, Bliss, McLaren, & Exton Smith, 1966; Pfeiffer, 1975).

For each patient, the MPI score was calculated in accordance with the literature, in 2 steps: first a score of 0, 0.5 or 1 was awarded for each domain (Pilotto et al., 2008) then the sum of these scores was divided by 8 to obtain a final score in the range of 0–1. Patients were divided into three prognostic risk groups according to their final MPI scores: low risk, 0.0–0.33; moderate risk, 0.34–0.66; and severe risk, 0.67–1.0.

The MPI was analyzed as a discontinuous quantitative value (score) or stratified by risk group (low, moderate or severe). To take in-hospital changes in MPI score into account, an additional variable (called 'transition') was computed considering the following classification: 'worsened' meant an increase in MPI score of at least 2 levels; 'stable' meant an MPI score that changed by no more than 1 level; and 'improved' meant a drop in MPI score of 2 or more levels.

Length of hospital stay and mortality in hospital or up to one year after discharge (by consulting the Regional Health Registry) were also recorded. For patients still alive, additional information on health status and subsequent hospitalizations was obtained by telephone from patients and/or their relatives.

The study was approved by the Padua Hospital Ethics Committee and conducted in accordance with the Declaration of Helsinki and the Good Clinical Practice guidelines. Written informed consent was obtained from patients, or the relatives of demented or critically ill patients, prior to their enrollment in the study.

2.1. Statistical analysis

The sample's demographic and clinical characteristics were described as: mean ± standard deviation (SD) for normally distributed variables:

The data analysis was conducted in three steps.

1) In-hospital mortality. The general and clinical characteristics of patients who died in hospitalization were compared with those who were discharged using parametric or non-parametric ANOVA for continuous variables, or chi-squared statistics for categorical variables. Survival analysis was performed by applying the Kaplan–Meier method, while the log-rank test was applied to verify the difference in survival probability between post hoc MPI groups based on patients' scores on admission. Simple and adjusted HRs for death were obtained by means of (stepwise) Cox's regression models, including potential predictors of death. In the Cox's regression models, the MPI score was treated as a ranked variable.
2) Transition of MPI scores during the hospital stay. For patients discharged from hospital, the distributions of the MPI scores calculated on admission and at discharge were compared using the Kolmogorov–Smirnov test. Individual changes in MPI score were assessed with the Wilcoxon signed ranked test.
3) One-year mortality after discharge. Survival analysis was performed and stepwise Cox regression models were constructed to examine the potential predictors of death. The goodness of fit of the models was judged from the value of the AIC (Akaike information criterion). The predictive capacity of the MPI score was also tested by comparing the AUC of the ROC curve obtained with the separate, unadjusted and adjusted models, including the MPI score obtained at the two time points (admission and discharge).

3. Results

3.1. General characteristic of the study population and in-hospital mortality

By the end of the enrolment period, 699 patients had entered the study; 8 of them did not satisfy all the inclusion criteria. The final study population included 691 patients, 459 (66.4%) women and 232 (33.6%) men, mean age of 85.2 ± 7.0 years. The median hospital stay was 8 days (Q1–Q3 = 5–12 days). During their hospital stay, 51 patients died (cumulative in-hospital mortality rate = 7.4%; 7.6‰ person-days). Covariates significantly associated to in-hospital death are shown in unadjusted statistical analyses (Table 1). The cumulative mortality rate was 1.2% among patients with low MPI scores, 3.5% for those with moderate MPI scores, and 10.6% for cases with high MPI scores.

Survival analysis are shown in unadjusted regression models for in-hospital mortality (Table 2); in the multivariate stepwise Cox's regression model, only the MPI score was confirmed as being significantly associated with death in hospital.

3.2. Transition in MPI scores from admission to discharge

For all patients still alive at discharge ($n = 640$), the MPI was calculated twice, on admission and before discharge, and the median MPI score was 0.68 (Q1–Q3 = 0.50–0.84) at both time points. The two distributions differed only slightly ($p = 0.48$), as shown in Fig. 1.

In the sample as a whole, few patients' MPI scores changed during their hospital stay: about 84% of the patients had the same MPI score on admission and at discharge; the score dropped (improved) in about 10%; and it increased (worsened) in 7%.

3.3. One-year mortality rate

Among the 640 patients discharged after their hospital stay, 251 died within 12 months (one-year crude mortality rate = 39.2%). Covariates significantly associated to 1 year mortality are shown in Table 3.

The one-year crude mortality rate was 18.8% among the patients in the low-risk MPI group on admission, 24.6% for those with a moderate risk, and 51.7% for those at high risk (Fig. 2A).