Original Article

Shock Index and Decreased Level of Consciousness as Terminal Cancer Patients' Survival Time Predictors: A Retrospective Cohort Study

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Abstract

Context. Predicting prognosis using noninvasive and objective tools may facilitate end-of-life decisions for terminal cancer patients, their families, and other health care professionals.

Objectives. To investigate if the shock index (SI), along with decreased level of consciousness (DLOC), is a reliable tool for predicting short-term survival time in terminal cancer patients.

Methods. A two-part retrospective cohort study was performed on 670 consecutive adult hospice patients. Part 1 of the study was performed to investigate the reliability of SI and DLOC on admission and to make a simple tool for predicting survival time. Part 2 of the study was to validate the tool's reproducibility and analyze the correlation between SI, DLOC, and survival time.

Results. In Part 1, multivariate Cox proportional hazards analyses for all study patients revealed that SI $\geq$ 1.0 in patients with DLOC was a significant risk factor of death (hazard ratio 3.08; 95% CI 1.72−5.53; $P = 0.000$). Generalized additive models confirmed that DLOC patients with SI = 1.0 had 9.58 days of mean survival time (MST). Receiver operating characteristic curve analyses of SI in patients with DLOC revealed that a survival time of less than three days was most reliably predicted. In Part 2, an increase in SI statistically decreased survival time. The upper 95% CIs of the calculated mean survival time for DLOC patients with SI $\geq$ 1.0 were less than one week. Bootstrap analyses revealed that the 95% CIs of the predicted survival time were 4.54−6.18 days in DLOC patients with SI = 1.0.

Conclusion. An SI $\geq$ 1.0 along with DLOC is a highly reliable tool for predicting short-term survival time in terminal cancer patients. J Pain Symptom Manage 2016;51:220−231

Key Words

Palliative care, prognosis, neoplasms, vital signs, health status indicators

Introduction

Terminal cancer patients and their families often ask their physicians to predict prognosis.[1−3] In this context, the development of a simple, noninvasive, and objective prognostic tool could support end-of-life decision making.[4] Numerous tools have been developed and validated for prognostication in terminal cancer patients[5−9]; however, these tools have notable limitations. Some tools require laboratory data such as complete blood counts and/or blood chemistry tests to estimate prognosis.[5,7,8] Others require computer software to calculate prognostic scores,[7,8] whereas another relies on physicians' subjective clinical judgments.[5] In a few studies focusing on short-term prognosis,[8,9] the

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Accepted for publication: October 1, 2015.

0885-3924/$ - see front matter
http://dx.doi.org/10.1016/j.jpainsymman.2015.09.012

accuracy of a physician's subjective clinical judgment for a less than one-week survival time has been reported to be just over 25%.[10] In this study, we focused on physiological parameters routinely measured in daily medical care, shock index (SI) and level of consciousness (LOC), both of which significantly change as death approaches.[4,11–15]

SI, defined as the heart rate divided by the systolic blood pressure (SBP),[16] is an easy-to-use clinical tool that can rapidly identify patients at risk of hemodynamic decompensation; particularly, an SI ≥ 1.0 has been reported to be associated with poor outcomes.[17–19] In addition, an abnormal LOC also has been reported to be associated with a worse prognosis.[14,20,21] However, little is known about the reciprocal relationship between SI, decreased LOC (DLOC), and survival time. We hypothesized that an SI ≥ 1.0 along with DLOC would be a useful tool for predicting short-term survival time of terminal cancer patients. Therefore, we investigated the correlation between SI, DLOC, and survival time in detail and assessed usefulness as a prognostic tool for short-term survival time.

Methods

Study Design and Population

The institutional review board of Yakushiyama Hospital in Kyoto, Japan waived obtaining informed consent from the study patients. We performed a retrospective medical record review of 670 consecutive patients admitted to a 50-bed inpatient hospice unit from January 1, 2010 to December 31, 2012. We included patients aged 18 years or older with terminal cancer who were receiving neither active treatment for cancer nor further disease-modifying treatment, although the patients received supportive and palliative care including artificial hydration and nutrition during the study period. Eighty-one patients who met the six exclusion criteria were excluded from the study, and 589 patients were studied until their death (Fig. 1).

The study was performed in two parts. Part 1 was aimed at determining whether both SI and DLOC on admission were reliable prognostic factors of short-term survival time and at developing the prognostic tool. In Part 2, we used the generalized estimating equation (GEE) method to 1) validate the reproducibility of the tool's accuracy for survival time prediction using the data set repeatedly measured until death and 2) investigate the correlation between SI, DLOC, and survival time. Patients were categorized by LOC into alert versus DLOC as subgroups.[14,20,21]

Data Collection and Variable Definitions

For all study patients, baseline characteristics were recorded on admission, including age, sex, admission

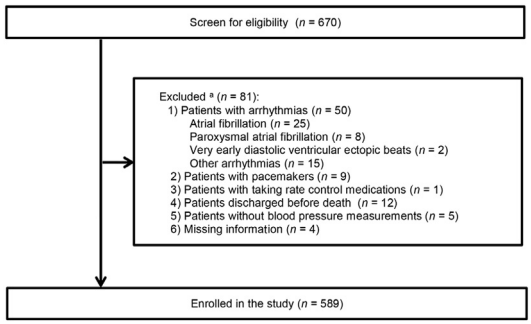

Fig. 1. Flowchart of study design. [a]Patients with arrhythmias or pacemakers or those taking rate-control medications that could cause pulse deficits were excluded.

date, primary tumor site, presence of metastases, use of opioids/sedatives, use of artificial hydration and nutrition, and presence of comorbidities. A number of variables were measured thrice daily and recorded from time of admission to death (Table 1). In addition, data on activities of daily living (ADLs) and oral intake also were obtained. ADLs were categorized as independent, partially dependent, or totally dependent. Oral intake was categorized as normal, reduced, minimal to sips, or mouth care only.[22] LOC was categorized as either alert or DLOC. Patients with confusion, drowsiness, no response, or coma were included in the DLOC cohort.

Study End Point

The outcome of interest was survival time, defined as the time between each measuring point of SI and death. Medical records and/or death certificates were used to confirm the time of death.

Statistical Analysis

All data were analyzed using SPSS, version 22 (IBM Japan, Ltd., Tokyo, Japan) and R program, version 3.2.1 (R Foundation for Statistical Computing, Vienna, Austria.). For all analyses, a probability (P) value of <0.05 was considered statistically significant. SI was assessed by increments of 0.1 in both Parts 1 and 2 of the study. In Part 1, variables of all study patients were obtained on admission, and SI was classified into five categories to identify whether SI ≥ 1.0 was sufficient to predict survival time (Tables 2 and 3; Supplementary Fig. 1, available at jpsmjournal.com). First, univariate Cox proportional hazards models were used to determine the significance of SI and DLOC as risk factors of death in all study patients (Supplementary Fig. 1). Second, we performed subgroup analyses with univariate and multivariate Cox proportional hazards models to identify the independent risk factors of death. The assumption of the model was confirmed using log-log survival plots for LOC and SI; furthermore, hazard ratios (HRs) and their 95% CI were calculated. The univariate data