

Outcomes of Nonagenarians Admitted to the Cardiac Intensive Care Unit by the Elders Risk Assessment Score for Long-Term Mortality Risk Stratification



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There are limited data on outcomes of older adults admitted to cardiac intensive care units (CICU), and there are no data on outcomes after admission to the CICU in nonagenarians. Our purpose was to identify whether the Elders Risk Assessment (ERA) index could risk stratify older adults after CICU admission. We retrospectively identified 453 nonagenarians admitted to the CICU between 2004 and 2013. End points included mortality, length of stay, incidence of delirium, and discharge disposition. Average age of the cohort was 92 ± 2 years, and the average ERA score was 13 ± 6 . A total of 258 patients were female (57%). Most common admission indication was acute decompensated heart failure (57%) followed by acute myocardial infarction (49%). Loss of independence was observed after CICU admission, with 66% of patients living independently before admission, decreasing to 47% at discharge. Overall length of stay was 6 ± 5 days and CICU stay was 2 ± 2 days. Fifteen percent of patients died before hospital discharge. Median survival was 452 (interquartile range 40 to 1,371) days. ERA score effectively predicted survival (log-rank test, $p = 0.002$). ERA score of 16 or greater and ERA score of 9 to 15 were both associated with increased risk of mortality compared with the reference (score 4 to 8): hazard ratio 2.00, 95% confidence interval 1.37 to 2.90, $p = 0.003$, and hazard ratio 1.48, 95% confidence interval 1.06 to 2.08, $p = 0.02$, respectively. In conclusion, nonagenarians admitted to CICU experience reasonable outcomes. The ERA score effectively risk stratifies nonagenarians admitted to the CICU and may help with identification of vulnerable patients at risk of adverse outcomes. © 2017 Elsevier Inc. All rights reserved. (Am J Cardiol 2017;120:1421–1426)

Because of co-morbidities, increasing severity of illness at presentation, and change in admission policy, admissions of older adults to the intensive care unit are increasing.¹ Data have shown that the aggressiveness of the care desired rests heavily on the likelihood, not only of positive survival outcome, but the potential resulting functional or cognitive impairment.^{2,3} Complicating the decision-making is that the number of co-morbidities increases with age, survival is already limited because of advanced age, and there are increasing therapies targeted at elderly patients.⁴ To risk stratify older adults, previous studies have used the Elders Risk Assessment (ERA) index, which was derived from a large population of geriatric primary care patients, to predict hospitalizations and emergency department (ED) visits in ambulatory geriatric patients.⁵ This risk prediction tool was validated in another cohort of older adults undergoing coronary revascularization to predict survival.⁶ Thus far, this index has not been validated in hospitalized patients, including those admitted to the intensive care unit.

Cardiovascular disease morbidity and mortality in older adults is high.⁷ There are few data on outcomes of older adults, especially in the most vulnerable, nonagenarian group, admitted to the cardiac intensive care unit (CICU).⁸ Our purpose was to examine clinical outcomes, including hospital length of stay (LOS), hospital disposition, and 3-year mortality, in nonagenarians admitted to the CICU and determine the applicability of an ambulatory care instrument to an ICU population.

Methods

The current study is a retrospective cohort study approved by the Mayo Clinic Institutional Review Board. The requirement for individual consent was waived for this study. The current study is a single-center retrospective observational cohort study of patients admitted to the CICU at the Mayo Clinic in Rochester, Minnesota. Inclusion criteria for the present study included consecutive patients who were admitted to or transferred to the CICU between January 1, 2004, and December 31, 2013. Patients over the age of 90 years of age were included in the present study as this was felt to be a vastly understudied cohort. Patients were excluded only if they did not constitute a full admission to the CICU (spent less than 1 night in the CICU) or if they were not over the age of 90 years old. Patient follow-up was completed to 3 years. The primary end point of the present study was all-cause mortality. Secondary end points included in-hospital,

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Table 1
Demographics of the nonagenarian cohort

Variable	Overall (n = 453)	Elder Risk Assessment Score		
		4–8 (n = 109)	9–15 (n = 227)	16+ (n = 117)
Age (years)	92 ± 2.4	92 ± 2.4	92 ± 2.4	92 ± 2.6
Women	57%	61%	55%	59%
Body mass index (kg/m ²)	26 ± 5.0	26 ± 4.5	25 ± 5.1	26 ± 5.0
Average Elder Risk Assessment score	12.6 ± 5.6			
Clinical Characteristics				
Charlson Comorbidity Index	2.7 ± 2.5	0.9 ± 1.4	2.5 ± 2.1	4.6 ± 2.5
Coronary artery disease	212 (47%)	0 (0%)	135 (59%)	77 (66%)
Prior myocardial infarction	110 (24%)	0 (0%)	64 (28%)	46 (39%)
Prior heart failure	114 (25%)	0 (0%)	59 (26%)	55 (47%)
Prior stroke	89 (20%)	0 (0%)	24 (11%)	65 (56%)
Peripheral artery disease	40 (9%)	1 (1%)	27 (12%)	12 (10%)
Chronic kidney disease	114 (25%)	15 (14%)	57 (25%)	42 (36%)
Hypertension	354 (78%)	68 (62%)	188 (83%)	98 (84%)
Diabetes mellitus	97 (21%)	4 (4%)	54 (24%)	39 (33%)
Chronic interstitial lung disease	12 (3%)	2 (2%)	3 (1%)	7 (6%)
Chronic obstructive lung disease	89 (20%)	0 (0%)	24 (11%)	65 (56%)
Autoimmune disease	20 (4%)	3 (3%)	7 (3%)	10 (9%)
Dementia	24 (5%)	0 (0%)	14 (6%)	10 (9%)
Metastatic solid tumor	8 (2%)	1 (1%)	4 (2%)	3 (3%)

30-day, and 1-year mortality; in-hospital delirium; hospital LOS; and new transition to nursing home.

Data were obtained from a large database established at our institution, which includes all patients admitted to the ICU, described previously.⁹ Data included in this database include admission indications and diagnoses, co-morbidities, laboratory studies, imaging studies, and outcomes. Much of the data were extracted using “Data Discovery and Query Builder,” including co-morbidities, which has been previously used successfully and accurately for extraction of clinical data.⁹ Additional data were extracted from the clinical documentation. Living situation at admission and discharge was determined from social history, discharge summaries, patient-provided information, or social services notes. LOS was determined from chart review and calculation of days in hospital. Delirium was diagnosed using a positive score on the Confusion Assessment Method for the ICU in addition to exhibiting acute onset or fluctuating course of inattention, with disorganized thinking or altered level of consciousness.¹⁰

The Acute Physiology, Age, and Chronic Health Evaluation (APACHE) III score was calculated as previously described.¹¹ The ERA index was calculated as previously described as well.⁵ Briefly, scoring is based on marriage status (–1), age (7 for 90 years or above), days of admission in the preceding 24 months (1 to 5 hospital days: 5 points; 6 or more hospital days: 11 points), history of each of diabetes (2), coronary disease or heart failure (3), stroke (2), chronic obstructive pulmonary disease (5), cancer (1), and dementia (3). Cutoffs for the ERA are derived from the previous studies using the ERA in a prognostic fashion with risk quintiles of –7 to –1, 0 to 3, 4 to 8, 9 to 15, and 16 and above.^{5,6} The Charlson index, a classification system composed of co-morbid illness primarily was quantified as previously described.¹²

The study patients were categorized in 3 groups based on the ERA score (i.e., ERA of 4 to 8, 9 to 15, and ≥16). Descriptive statistics are presented as mean ± standard deviation

if continuous variables, unless otherwise indicated. A 2-tailed Student *t* test was used to compare sets of continuous variables. Categorical variables are indicated by number of patients within the cohort followed by percentage of the corresponding grouping. These were compared using chi-square test of significance as appropriate. Association between continuous variables was compared using univariate linear regression analysis with correlation coefficient and analysis of variance test of statistical significance as indicated. Odds ratios for binary variables were computed using nominal logistic regression, and significance was determined using the chi-square test. Referent group was defined as the cohort of patients in the lowest ERA category. Given the non-normal distribution of cardiac troponin-T and N-terminal pro-brain natriuretic peptide, the log transformation was taken and regressed with outcomes.

Differences in mortality over time were compared using Kaplan-Meier estimated survival based on grouping and log-rank test of significance. Effect of risk scores on time-dependent variables, including survival, was compared using the Cox proportional hazards model, including a multivariate regression with relevant clinical covariates. Statistical analysis was performed using JMP Pro 10.0 (SAS Institute Inc., Cary, NC).

Results

Of a total of 452 study patients, the average age was 92 ± 2 years and 57% were female. The average ERA score was 13 ± 6. Other basic demographics and specifics of co-morbidities are presented in Table 1. Most common admission indication was acute decompensated heart failure (ADHF) (57%) followed by acute myocardial infarction (49%). Supplementary Table S1 shows indications for admissions, laboratory studies on admission, and utilization of inotropes and vasopressors. The overall LOS was 6 ± 5 days, and CICU

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