

Functional abilities of elderly survivors of intensive care

GREGORY E. BROSLAWSKI, DO
MICHELE ELKINS, MD
MICHAEL ALGUS, MD

In a prospective, randomized study undertaken to determine if age, length of hospital stay, or severity of illness are predictors of future functional status after intensive care unit (ICU) admission, 45 patients were evaluated. Pre-ICU functional status was determined by using Activities of Daily Living (ADL), Instrumental Activities of Daily Living (IADL), Geriatric Depression Scale (GDS), and Mini-Mental State (MMS) examinations. Severity of illness was assessed by using the Acute Physiology Assessment and Chronic Health Evaluation (APACHE-II) system. There were no significant differences in age or APACHE-II score at 6-month follow-up. However, in those patients who had decreased ADL and IADL scores, ICU and total hospital length of stay were two and three times longer, respectively. Functional status at 6-months was unrelated to age or severity of illness, but correlated with the length of ICU and total hospital stay. Advanced age and severity of illness should not be used to predict future functional ability.

(Key words: Activities of daily living, age factors, geriatric assessment, health status indicators, intensive care units, length of stay, severity of illness index)

Advanced age and severity of illness are well-recognized determinants of mortality after inten-

From the Department of Medical Education (Dr Broslawski) and the Department of Internal Medicine (Drs Elkins and Albus), Overlook Hospital, Summit, NJ. At the time this article was written, Dr Broslawski was a third-year internal medicine resident, and Drs Elkins and Albus were both associate directors of internal medicine. Currently, Dr Broslawski is in internal medicine private practice, Flemington, NJ; Dr Elkins is medical director of geriatrics, St Barnabas Hospital, Livingston, NJ; and Dr Albus is in pulmonary medicine/critical care private practice, Bennington, Vt.

Correspondence to Gregory E. Broslawski, DO, Hunterdon Internal Medicine Associates, 31 North Office Centre, 121 Route 31, Suite 1100, Flemington, NJ 08822.

sive care unit (ICU) admission,¹⁻³ and the length of intensive care and total hospital stay for elderly patients have been shown to predict both in-hospital and long-term mortality.^{4,5} In a review of the literature from 1980 to date, no prospective studies comparing preadmission and postmorbidity functional capacity of elderly patients were found. It is not known if these characteristics are indicators of future functional status. This study was conducted to investigate the extent that advanced age, severity of illness, and the length of ICU or total hospital stay predict future functional abilities in patients of advanced age (≥ 65 years). Premorbidity functional abilities and 6-month outcomes were evaluated.

Materials and methods

The study was approved by the Overlook Hospital (Summit, NJ) Institutional Review Board before patient selection. We obtained signed informed consent from the patient or the patient's durable power of medical care and verbal consent of the patient's attending physician.

Initial hospitalization

Patients admitted to the ICU between July 1, 1991, and September 2, 1992, were eligible for the study. Patients were selected at random in three 1-month intervals during this period. Exclusion criteria included age younger than 65 years, a primary surgical or neurosurgical diagnosis, postoperative medical complication, coronary care unit admission, or myocardial infarction as the primary ICU admission diagnosis. Sixty-eight patients were asked to participate in the study. Twenty-three refused and were excluded, leaving 45 study patients.

The interview process required approximately 20 to 30 minutes per patient and was performed within 24 hours of ICU admission. Patients completed both the Katz-Downs Activities of Daily Living (ADL) Scale and the Lawton-Brody Instrumental Activities of Daily Living (IADL) Scale to quantify functional abilities for 1 month before hospital or ICU admission.⁶⁻⁸ Briefly, ADL items include toileting, feeding, dressing, grooming, ambulation, and bathing. IADL items consist of ability to use a telephone, shop, prepare meals, do routine housekeeping and laundry, means of transportation, and responsibility to take medications and handle finances.

Table 1
Demographic Data of Patients
Admitted to Intensive Care Unit (ICU)

	No.	%
Patients		
Men	24	53
Women	21	47
Total	45	
Origin		
Home	41	91
Nursing home	4	9
ICU readmission*		
No	42	93
Yes	3	7
Survivors†	27	60
Nonsurvivors‡	18	40

*Readmitted to ICU after transfer to a medical bed, then returned to ICU.
†Survivors are defined as patients alive at 6 months.
‡Nonsurvivors are defined as patients who died before follow-up evaluation.

We used Folstein's Mini-Mental State (MMS) to evaluate cognitive function.⁹ This grading method has a maximum total score of 30 and includes orientation, attention, recall, language, and ability to follow commands. Depression was screened by using the Geriatric Depression Scale (GDS).¹⁰ This is a 15-item yes-or-no-type questionnaire, with a score of 6 or more indicating depression. In patients who were obtunded, comatose, sedated, or otherwise unable to respond, the spouse, relative, or durable power of medical care provided information to complete the ADL and IADL scales.

After the interview, we reviewed the hospital chart for sociodemographic information. The patient's ICU flow sheet provided laboratory data, vital signs, and admission diagnosis. We determined severity of illness by using the Acute Physiology And Chronic Health Evaluation (APACHE-II) scoring system.^{11,12}

Follow-up evaluation

Postmorbidity functional ability was assessed by telephone interview 6 months after ICU discharge. Patients completed each component of the ADL, IADL, and GDS, and the corresponding scores were recorded. If caregivers provided the initial evaluation of functional abilities, they gave follow-up information on

subsequent ADL and IADL evaluations, to assure that the person who initially responded was the same individual who provided follow-up data. The GDS was omitted at initial and follow-up evaluations when a caregiver (not patient) responded.

Data analysis

We examined the potential relationship between age, severity of illness, diagnosis at ICU admission, and length of ICU and total hospital stay by using multivariate analysis. In particular, we were interested in comparing ADL and IADL scores before ICU admission and after discharge to determine which factors would predict diminished functional abilities.

We performed bivariate analysis for age and APACHE-II scores by using χ^2 , Student's *t*, and Wilcoxon tests for patients alive at follow-up (survivors) and deceased at 6 months (nonsurvivors). Diagnoses at ICU admission were grouped into four categories: gastrointestinal, pulmonary, infectious disease, and miscellaneous. Duncan's multiple range test was then applied to analyze these categories. Functional abilities of ICU survivors were compared with age, length of stay, and APACHE-II scores by using Spearman correlation analysis.

Results

The 23 excluded patients did not differ significantly from the study group in regard to demographic data or medical diagnosis. All attending physicians agreed to include their individual patients, and none were lost to follow-up.

The characteristics of the 45 patients are shown in Table 1. Genders were equally represented. Most patients were admitted to the hospital from the community, and only a small subset were ICU

Table 2
Age, Length of Stay, Cognitive Function, and
Severity of Illness for Patients and Survivors

Characteristic	Total (Mean $\pm$ SD*)	Survivors (Mean $\pm$ SD*)
Age, years	76.6 $\pm$ 7.5	77.3 $\pm$ 6.9
Length of stay, d		
Before ICU†	5.4 $\pm$ 12.9	3.3 $\pm$ 9.2
In ICU	6.9 $\pm$ 8.1	6.6 $\pm$ 8.1
After ICU	17.1 $\pm$ 19.5	17.2 $\pm$ 20.3
Total hospital stay, d	29.4 $\pm$ 28.4	27.0 $\pm$ 29.2
Mini Mental State‡	24.0 $\pm$ 6.2	...
APACHE-II	18.9 $\pm$ 8.1	16.3 $\pm$ 6.8

*SD = standard deviation.
†ICU = intensive care unit.
‡Derived from 38 patients able to complete the examination at admission; this was not repeated at follow-up evaluation.

Diagnosis	Survivors*		Nonsurvivors†		Total	
	No.	%‡	No.	%	No.	%
Gastrointestinal disease						
Patients	11	24.4	2	4.4	13	28.9
Row§		84.6		15.4		...
Pulmonary disease						
Patients	7	15.6	9	20.0	16	35.6
Row		43.7		56.3		...
Infectious diseases						
Patients	4	8.9	5	11.1	9	20.0
Row		44.4		55.6		...
Miscellaneous						
Patients	5	4.4	2	11.1	7	15.5
Row		71.4		28.6		...
*Survivors are defined as patients alive at 6 months. †Nonsurvivors are defined as patients who died before follow-up evaluation. ‡Percentages are based on group total of 45 patients. §Row percentages are based on total for each disease.						

readmissions. Of the nonsurvivors, five (28%) died in the ICU and seven (39%) died in the hospital after transfer from the ICU. Six (33%) patients survived initial hospitalization but died before follow-up.

The age, length of stay, and cognitive function of the patients and survivors are shown in *Table 2*. Ages ranged from 65 to 92 years. The survivors were slightly older and had less severe illnesses. These differences were not statistically significant. In the survivor group, the total length of hospital stay correlated negatively with the MMS score (-0.405 , $P < .05$). This suggests that the patients with shorter total hospital stays had higher cognitive function. The ages of the total and survivor group also correlated negatively with the MMS (-0.184 and -0.166 , respectively), but these correlations did not reach statistical significance.

A comparison of survivors and nonsurvivors is shown in *Table 3*. Gastrointestinal disease includes upper and lower gastrointestinal bleeding that did not require surgical intervention. In most instances, this bleeding stemmed from peptic ulcer disease. The best survival odds were associated with gastrointestinal disorders. Predominant pulmonary diseases include pulmonary edema of any cause and respiratory failure, usually from end-stage emphysema. Pulmonary disorder was the most common diagnosis category overall and among nonsurvivors. Survival was not significantly affected by use of mechanical ventilation: 3 of 16 (19%) in whom it was

used survived and 4 of 16 (25%) did not. Infectious diseases were classified either as sepsis or septic shock. Miscellaneous disorders included ischemic stroke, diabetic ketoacidosis, myxedema, metabolic acidosis, and drug overdose.

Survivors' functional abilities are compared with regard to age, length of stay, and severity of illness in *Table 4*. For convenience, we placed survivors who had improved or had no interval change into one group. Neither age nor severity of illness was associated with diminished future functional capacity. The strongest predictors of function were the length of ICU stay and total hospital stay. These stays were approximately three times longer in the subsets with decreased ADL and IADL scores at 6 months.

The most common diagnosis (9 of 26 patients, 35%) associated with favorable future functional ability was upper gastrointestinal bleeding, whereas only 2 of 11 survivors (~18%) with this gastrointestinal disorder had decreased function at follow-up evaluation. The diagnosis with the worst prognosis was acute respiratory failure requiring intubation and mechanical ventilation; four patients (33%) had this illness, and none ended up with the same or improved function. Only one person had a score of depression on the GDS (score of 9), but this person had a diagnosis of major depression before ICU admission and had had a relapse at follow-up evaluation.

A correlation analysis of functional abilities

Table 4
Functional Abilities of Survivors in Relation to Length of Intensive Care Unit (ICU) Stay, Total Hospital Stay, and Severity of Illness

Scale* and outcome	No. of patients	Age, yr ($\pm$ SD†)	ICU stay, d ($\pm$ SD)	Total LOS,‡ d ($\pm$ SD)	APACHE-II score ($\pm$ SD)
ADL					
Decreased	6	74 $\pm$ 6.3	12.5 $\pm$ 14.1	60.2 $\pm$ 44.6	17.5 $\pm$ 8.0
Improved + same	21	78 $\pm$ 6.7	4.9 $\pm$ 3.2	17.5 $\pm$ 8.9	16.0 $\pm$ 6.3
IADL					
Decreased	6	76.8 $\pm$ 6.7	13.3 $\pm$ 13.6	62.3 $\pm$ 42.3	18.0 $\pm$ 7.5
Improved + same	21	77.4 $\pm$ 6.8	4.7 $\pm$ 3.2	16.9 $\pm$ 9.0	15.6 $\pm$ 6.4

*ADL = Activities of Daily Living; IADL = Instrumental Activities of Daily Living.
†SD = standard deviation.
‡LOS = length of stay.

Table 5
Correlation Analysis of Functional Abilities With Age, Length of Stay (LOS), and Severity of Illness

Scale*	Age	Before ICU	In ICU	After ICU	Total LOS†	APACHE-II‡
ADL-0						
Total patients	-0.344§	-0.035	-0.127	-0.038	-0.045	-0.037
Survivors¶	-0.193	+0.135	-0.241	-0.104	-0.115	-0.238
ADL-6						
Total patients	...	...	...	...	...	...
Survivors	-0.002	-0.109	-0.389§	-0.266	-0.270	-0.360
IADL-0						
Total patients	-0.305	-0.110	-0.141	+0.005	+0.001	-0.195
Survivors	-0.166	+0.062	-0.119	-0.160	-0.114	-0.337
IADL-6						
Total patients	...	...	...	...	...	...
Survivors	-0.008	-0.283	-0.265	-0.348	-0.410§	-0.265

*ADL-0 and ADL-6 are basic Activities of Daily Living scores at ICU admission and at follow-up evaluation, respectively; IADL-0 and IADL-6 are Instrumental Activities of Daily Living scores at ICU admission and at follow-up evaluation, respectively.

†Total LOS is the patient-days spent in the hospital before, during, and after intensive care admission.

‡Severity of illness is measured by APACHE-II score.

§Significant difference ($P < .05$).

¶Survivors are defined as patients alive at 6 months.

with age, length of stay, and severity of illness is shown in *Table 5*. Despite the low number of patients available for analysis, several intriguing trends were observed. Neither age nor severity of illness correlated with decreased functional ability. The ADL and IADL scores correlated negatively with age, that is, older patients did not have lower functional abilities. In particular, there was a statistically

negative correlation between ADL scores at ICU admission and advanced age. Also, there was an inverse relationship between increased days spent in both hospital and critical care and decreased functional abilities at follow-up, demonstrated by the negative correlation between ADL and IADL scores and the length of ICU and hospital stays. Conversely, patients with shorter hospital courses

had higher ADL and IADL scores at 6 months, for a positive correlation between ADL score, IADL score, and total length of stay. Severity of illness did not correlate with decreased functional abilities either at admission or follow-up evaluation.

Discussion

Several prognostic scoring systems can be used to predict mortality after ICU admission,¹³ but no similar prognostic scale exists to identify indicators of future functional abilities of the survivors. Even fewer studies have examined post-ICU function in elderly people, even though this segment of the population has a disproportionately high utilization of hospital and ICU resources.^{14,15} Amid rising healthcare costs and availability of intensive care at a premium, scrutiny of these areas is warranted.

Our initial hypothesis was that advanced age does not make a difference in future functional abilities. We found no statistical difference between the ages of all patients before hospital admission and of survivors of intensive care. These findings are compatible with those of Wu and associates,¹⁶ who found that age did not predict mortality when older patients were compared with middle-aged patients with the same severity of illness. Also, we found no significant age difference between survivors who had improved functional abilities and those who did not. In view of these data, age cannot be deemed a justifiable barrier to access or utilization of critical care resources.

We also examined to what extent the length of intensive care and total hospital stay contributed to functional decline. In a study by Goldstein and colleagues,¹⁷ patients who had more preadmission functional limitation had more major interventions and significantly higher mortality. However, 71% of a "severely impaired" subset of survivors of intensive care had achieved a higher functional level than before admission. Activity levels before admission were not associated with increased ICU or total hospital lengths of stay. In contrast, we found both the length of critical care and total hospital stay to be negative predictors of future basic and instrumental activities of daily living. For the two groups who demonstrated decreases in functional scores, the total ICU and hospital stays were 2 and 3 times longer, respectively. Decreased ADL and IADL scores were inversely related to ICU stay as well as total hospital stay.

Finally, we attempted to determine if severity of illness was associated with decreased functional ability. As expected, severity of illness (as gauged by APACHE-II scores) was associated with decreased survival. Because of this, it would be anticipated that elderly patients who have a serious illness requiring ICU admission would have a diminished func-

tional level if they survived. In our study, severity of illness of the survivors did not correspond with or predict future functional ability. Increased severity of illness (higher APACHE-II scores) was associated with longer stays in the ICU and in the hospital, but there was no significant correlation between ADL and IADL scores at admission to ICU or at follow-up evaluation.

It is interesting to note that most survivors in our study had gastrointestinal disorders. These data may be skewed in the favorable direction, however, because many elderly patients with gastrointestinal bleeding are admitted to our ICU on a "precautionary" basis. In a larger institution, where critical care beds are at a premium, many of these patients probably would not gain admission to the ICU but would be monitored either on "step-down" units or on general medical floors. Pulmonary disorder was the most common diagnosis category overall as well as among nonsurvivors. We found no statistical difference in survival statistics for patients requiring intubation with mechanical ventilation, but this might not be the case if adequate numbers of patients within this subset were available for analysis.

Comment

Because of the modest sample size of our patient group, the results of our study are only preliminary. We found that increased length of stay in either critical care or in the hospital predicts poor prognosis for regaining prior or increased levels of functional abilities. We can speculate that longer stays were associated with factors such as more severe illness, coincident diseases, and invasive procedures. The hypothesis that advanced age and severity of illness do not portend poor function among those who survive ICU admission and subsequent hospitalization should be confirmed with a larger, prospective study, perhaps one that combines data from critical care units in different hospitals. The design would include a mechanism to identify factors that result in decreased function independent of severity of illness, such as ICU interventions, diagnosis, a stroke program or physical rehabilitation after critical care stay, and use of home-care nursing. Our results indicate a need for the development of a prognostic scoring system to estimate the functional abilities of elderly survivors of intensive care. In this manner, it would be possible to identify and potentially remediate heretofore unrecognized factors leading to functional decline.

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