Short-term outcomes in older intensive care unit patients with dementia*

Margaret A. Pisani, MD, MPH; Carrie A. Redlich, MD, MPH; Lynn McNicoll, MD; E. Wesley Ely, MD, MPH; Rebecca J. Friedkin, PhD; Sharon K. Inouye, MD, MPH

Objective: **To determine the impact of dementia on the outcomes of intensive care unit (ICU) care and use of ICU interventions among older patients.**

Design: **Prospective observational cohort study.**

Setting: **Urban university teaching hospital.**

Patients: **Patients were 395 patients age ≥65 consecutively admitted to a medical ICU.**

Interventions: **None.**

Measurements and Main Results: **Dementia was determined by a previously validated proxy measure, the Modified Blessed Dementia Rating Scale. We chose cut points to focus on patients with moderate-severe dementia at baseline. Our primary outcomes included length of mechanical ventilation and ICU and hospital length of stay. Secondary outcomes included ICU readmission, changes in code status, discharge location, mortality, and use of ICU interventions. Medical record abstraction was performed to determine the rates of ICU outcomes, use of ICU interventions, and potential confounders. Our study documented a prevalence of moderate-severe dementia of 17% in patients age ≥65 admitted to the ICU. Patients with dementia were significantly older (80 vs. 76), more likely to be female (65% vs. 52%), and more likely to be admitted from a nursing home (46% vs. 11%). Patients with dementia had significantly higher Acute Physiology and Chronic Health Evaluation II scores on admission to the ICU (25 vs. 23). Patients with dementia were more likely to have their code status changed to less aggressive in the ICU (24% vs. 14%). There was no significant difference in readmission to the ICU, discharge location, ICU or hospital mortality rate, or use of ICU interventions between patients with and without dementia.**

Conclusions: **Our study documents no difference in outcomes from ICU care in older patients with and without dementia. There was no increased short-term mortality rate in older patients with dementia compared with those without dementia after admission to the ICU. Presumptions that outcomes from critical care are less favorable in patients with dementia should not drive treatment decisions in the ICU. (Crit Care Med 2005; 33:1371–1376)**

KEY WORDS: critical care; intensive care units; outcome assessments; dementia; aged

Given the limited availability, great demand, and high cost of intensive care unit (ICU) services, some health care policymakers have proposed that critical life-sustaining procedures should be severely restricted for older patients with dementia (1–3). The underlying assumption of those who would restrict ICU care is that dementia patients fare more poorly than patients without dementia in the ICU and at best achieve only marginal benefits from the high-technology procedures and treatments available in these settings. In fact, there are no data to support these assertions.

The problems presented by providing ICU care to the elderly, and thus to an increasing population of demented patients, will only grow as the population ages. Our previous work has evaluated methods to screen for dementia in older ICU patients and documented a high prevalence of dementia in this population and a lack of physician awareness (4). To our knowledge, no previous studies have addressed the role of dementia in ICU outcomes. For this reason, we sought to extend our previous work to examine the impact of dementia on outcomes of ICU care and the frequency of various interventions. We hypothesized that patients with dementia would have longer durations of intubation, prolonged ICU and total hospital stay, and delayed discharges for placement compared with those without dementia. Our results were surprising.

METHODS

Setting and Patients. Our study followed a prospective cohort design. The study participants were consecutive patients age ≥65 ad-

***See also p. 1457.**

From the Department of Internal Medicine, Yale University School of Medicine (MAP, CAR, SKI); Department of Internal Medicine, Brown University School of Medicine (LM); and Department of Medicine and Center for Health Services Research, Veterans Affairs Geriatric Research and Clinical Education Center, and the Vanderbilt University School of Medicine (EWE).

Supported, in part, by the American Lung Association; grant CG-002-N from the Connecticut Thoracic Society; grant P30AG21342 from the Claude D. Pepper Older Americans Independence Center at Yale University School of Medicine, and grant RO1 AG12551 from the National Institutes of Health. Dr. Pisani is a recipient of a Merck/AFAR Junior Investigator Award in Geriatric Clinical Pharmacology, American Lung Association Clinical Research Grant, Franklin T. Williams Geriatric Development Initiative through The CHEST Foundation, ASP, Hartford Foundation, Yale Pepper Center Early Career Development Award, Yale Mentored Clinical Scholar Program (K12) Award, and a NIH K23 (K23 AG 23023-01A1) Career Development Award. Dr. Inouye is a recipient of a Midcareer Award from the National Institute on Aging (K24AG00949). Dr. Ely is a recipient of the AFAR Pharmacology in Aging Grant and the Paul Beeson Faculty Scholar Award from the American Federation for Aging Research/Hartford Foundation. Dr. Redlich is a recipient of an NIH Midcareer Award (K24ES00355).

Address requests for reprints to: Margaret A. Pisani, MD, MPH, Yale University School of Medicine Pulmonary & Critical Care Medicine, 333 Cedar Street, P.O. Box 208057, New Haven, CT 06520-8057. E-mail: Margaret.Pisani@yale.edu

Copyright © 2005 by the Society of Critical Care Medicine and Lippincott Williams & Wilkins

DOI: 10.1097/01.CCM.0000165558.83676.48

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.

mitted to the medical intensive care unit at Yale-New Haven Hospital from September 1, 2000, to July 1, 2002. Yale-New Haven hospital is an 800-bed urban teaching hospital with a 14-bed medical intensive care unit, serving a large community as well as a referral population. A geriatric research nurse screened ICU admissions daily for eligibility. Age-eligible patients were excluded if there was no identifiable proxy to provide information about the patient, if they were transferred from any another ICU, or if they died before the proxy interview could be obtained. Patients were excluded if they were transferred from another ICU because the required baseline information might not have been consistently available and because the proxy interview was standardized to be administered within 48 hrs of ICU admission to minimize reporting and recall bias.

Of the 531 patients screened, 100 patients were ineligible because of absence of an identifiable proxy (n = 58) or transfer from another ICU (n = 42). Of the 431 eligible patients, 400 (93%) were enrolled in the study. The 31 exclusions were due to proxy refusal (n = 8), death before proxy interview completed (n = 11), and research staff unavailability during holidays (n = 12). Of the 400 enrolled patients, the current study was restricted to 395 patients who had complete information available for the Modified Blessed Dementia Rating Scale (MBDRS) (5), which was our primary risk factor measure. Demographic factors, including age, gender, and race, did not differ significantly between enrolled and non-enrolled subjects. Informed consent for participation was obtained from the proxy respondents according to procedures approved by the Institutional Review Board of Yale University School of Medicine.

Study Procedures. Since the patients in this study were critically ill, proxy respondents were used as the primary source of information, as previously described (4, 6). To evaluate the prevalence of dementia in patients admitted to the ICU, we used the MBDRS (5), a measure specifically developed for proxy administration. Prior studies using this instrument evaluated validity against direct cognitive testing of patients (7, 8), and we have previously documented its usefulness in medical ICU patients (4). Given the critical illness of our patients and the high risk for delirium, which would make determinations of cognitive status on ICU admission invalid for determining the pre-illness baseline level, we did not perform cognitive testing directly with the patients. To minimize the impact due to delirium before hospitalization on the MBDRS, the proxy was instructed to report on cognitive status 1 month before the onset of the patient's current ICU illness. Proxies were then asked if these symptoms had been present for ≥6 months for the dementia assessment.

ICU physicians were interviewed about the presence of preexisting dementia, and the medical record was reviewed for any documentation of dementia in the physician's notes.

Study Variables. To determine the prevalence of dementia, a dichotomous variable was created for the MBDRS based on widely used, published cut points (9–11). Receiver operator characteristics of the MBDRS show good discrimination ability between subjects with and without dementia. The area under the curve for detecting patients with moderate to severe dementia is 0.95 (0.88–0.98) (11). Moderate to severe dementia was defined as an MBDRS >4 and cognitive symptoms that were present for ≥6 months before admission. This cut point was chosen to minimize false positives. To further examine the full impact of dementia across its full range of values (mild to severe ratings), we also repeated the analyses using the MBDRS as a continuous variable.

The proxy interview also contained marital status, educational level, activities of daily living (12), instrumental activities of daily living Scales (13), and resuscitation status on ICU admission.

Baseline data were obtained prospectively. The medical record was reviewed to score the Acute Physiology and Chronic Health Evaluation (APACHE) II (14), using the most deranged values, to determine the severity of illness within the first 24 hrs after admission to the ICU. Scores can range from 0 to 71, with higher scores indicating more severe illness. The research nurses recorded the ICD-9 code for admitting diagnosis on ICU admission. The Charlson Comorbidity Index (15), which is a widely used, validated comorbidity index, was determined for each study participant based on discharge diagnoses. Using daily medical record review, we tracked the use of standard ICU interventions including intubation, reintubation, noninvasive ventilation (bilevel positive airway pressure/continuous positive airway pressure), pulmonary artery catheterization, enteral feeding, total parental nutrition, hemodialysis, continuous venovenous hemofiltration, and tracheostomy. Both ICU and hospital mortality were recorded from the medical record. ICU physician knowledge of preexisting dementia was documented by interview and chart review.

Outcomes. The primary outcome was ICU length of stay. Secondary outcome variables included readmission to the ICU, change in code status, length of mechanical ventilation, length of hospital stay, discharge to a nursing home, and mortality. The frequency of use of ICU interventions was recorded daily.

Statistical Analysis. The sample size was determined *a priori* to have >80% power to detect a 1-day difference in length of ICU stay. Baseline characteristics between patients with and without dementia were summarized with appropriate descriptive statistics (means and standard deviations for continuous variables and proportions for categorical variables) and compared using appropriate bivariate statistics (Student's *t*-tests for continuous variables and chi-square and Fisher's exact test for categorical variables). The prevalence of dementia was determined by univariate analysis. ICU admitting diagnoses in patients with and without dementia were compared with chi-square and Fisher's exact tests, as appropriate. The impact of dementia on the use of ICU outcomes and interventions was evaluated using appropriate bivariate methods. Since the distributions of the length-of-stay variables were skewed, median values were used. The median lengths of stay were compared between groups using nonparametric testing, specifically the Wilcoxon rank sum. We also repeated all analyses using the MBDRS as a continuous variable.

To evaluate the impact of dementia on length of ICU stay, multiple linear regression was employed. For these models, the outcome was the transformed log-length of stay variable. In addition to dementia, covariates considered for the analyses were chosen among health measures and comorbidities based on clinical judgment and previous studies; these included age, gender, race, marital status, APACHE II score, admitting diagnoses, history of chronic pulmonary disease, activities of daily living, instrumental activities of daily living, and Charlson Comorbidity Index score of ≥2. Additionally, resuscitation status was evaluated. Both code status on ICU admission and change in code status to less aggressive were examined. Variables were assessed for collinearity. Models were examined for goodness of fit, and the fit of final model was assessed by r^2 and examination of residuals. Stepwise regression was used to determine the most parsimonious model, and entry and exit criteria for the model were $p \leq .15$.

All analyses were performed using the SAS statistical program, version 8 (SAS Institute, Cary, NC). All hypothesis tests were two-tailed, and significance was determined by alpha <.05.

RESULTS

Baseline characteristics of the study population (n = 395) are presented in Table 1. Seventy-six percent of our study population were white, non-Hispanic, 17% were black, and 7% were from other minority groups. The prevalence of moderate-severe dementia (defined as MBDRS >4) in our study population was 66 of 395, or 17%. Patients with dementia were significantly older, were more likely to be female, were more likely to be on Medicaid, were more likely to be admitted from a nursing home, were less likely to be currently married, and had a lower education level. Patients with dementia were also more likely to have disability in activities of daily living and instrumental activities of daily living, and they had significantly higher APACHE II scores on ICU admission. They were less likely to

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.

have full code status on admission to the ICU and less likely to have a history of tobacco use. ICU physicians were aware of the presence of preexisting dementia 43% of the time.

Table 2 compares ICU admitting diagnosis and the Charlson comorbidity categories between patients with and without dementia. The only ICU admitting diagnosis for which patients differed by dementia status was septicemia; those with dementia were significantly more likely to have septicemia than those without dementia. In comparing Charlson comorbidities, we found that patients with dementia were significantly less likely to have a history of chronic pulmonary disease and more likely to have diabetes.

Table 3 compares ICU and hospital outcomes in patients with and without dementia. The median length of ICU stay was 3 days with a range of 1–64, and median length of mechanical ventilation was 4 days with a range of 1–145. The range of length of mechanical ventilation was longer than ICU stay due to several patients who remained intubated but were transferred out of the ICU. The median length of mechanical ventilation was shorter in patients with dementia, but the difference was not statistically significant. Median length of hospital stay was not significantly different between the patients with and without dementia.

Patients with dementia were more likely to have their code status changed to less aggressive care while in the ICU ($p = .04$). Overall, patients who had their code status changed to less aggressive care were significantly more likely to die in both the ICU and the hospital than those without such a change ($p < .05$). Forty-three percent of those patients whose code status was changed to a less aggressive level of care died in the ICU, compared with only 12% of patients without such a change. Fully two thirds of them died in the hospital (including in the ICU), compared with only 17% of patients whose code status was not downgraded. Interestingly, patients who entered the ICU with a do-not-resuscitate/do-not-intubate order were not more likely to die. There were no significant differences in ICU readmission rates, new nursing home discharge, and mortality rates between patients with and without dementia.

To examine whether patients with dementia received less aggressive ICU care, we compared the use of ICU interventions in patients with and without dementia (Table 4). Forty-six percent of this older population received intubation and mechanical ventilation. Of those who were intubated and extubated, 23% required reintubation. Patients with dementia were less likely to be reintubated (9% vs. 26%) but this difference was not statistically significant. Eighteen percent were

Table 1. Baseline characteristics of the study population[a]

Characteristic	Overall n = 395	Dementia Present n = 66	Dementia Absent n = 329	p Value[b]
Age, mean ± SD, yrs	77.0 ± 7.7	80.0 ± 7.9	76.4 ± 7.5	<.001
Male gender	182 (46)	23 (35)	159 (48)	.04
Nonwhite race	93 (24)	21 (32)	72 (22)	.08
Medicaid status[c]	75 (19)	30 (46)	45 (14)	<.001
Admitted from a nursing home[c]	65 (17)	30 (46)	35 (11)	<.001
Currently married[c]	163 (42)	16 (24)	147 (45)	.002
Education, mean ± SD, yrs[c]	11.8 ± 3.2	10.0 ± 3.4	12.1 ± 3.1	<.001
Health measures				
Any disability in ADL	194 (49)	60 (91)	134 (41)	<.001
Any disability in IADL	368 (93)	66 (100)	302 (92)	.01
APACHE II score, mean ± SD	23.1 ± 7.0	24.9 ± 7.3	22.7 ± 6.9	.02
Charlson Comorbidity Index, mean ± SD	1.96 ± 2.1	1.6 ± 1.8	2.0 ± 2.2	.10
Full code status on ICU admission[c]	324 (82)	48 (73)	276 (84)	.02
History of tobacco use[c]	267 (68)	33 (53)	234 (71)	.005

ADL, activities of daily living; IADL, instrumental activities of daily living; APACHE, Acute Physiology and Chronic Health Evaluation; ICU, intensive care unit.

[a]Data are presented as number (percentage) unless otherwise indicated; [b]p value compares dementia-present to dementia-absent groups; [c]numbers as follows due to missing data: Medicaid status (n = 389), admitted from a nursing home (n = 393), currently married (n = 392), education (n = 364), full code status on ICU admission (n = 393), history of tobacco use (n = 390).

Table 2. Intensive care unit (ICU) admitting diagnosis and Charlson comorbidity components[a]

	Overall n = 395	Dementia Present[b] n = 66	Dementia Absent[b] n = 329
ICU admitting diagnosis			
Respiratory	170 (43)	31 (47)	139 (42)
ARDS	29 (7)	3 (5)	26 (8)
Bronchitis	14 (4)	1 (2)	13 (4)
Hypoxemia	20 (5)	3 (5)	17 (5)
Pneumonia	24 (6)	5 (8)	19 (6)
Respiratory failure	65 (16)	14 (21)	51 (16)
Gastrointestinal illnesses	93 (24)	15 (23)	78 (24)
Gastrointestinal hemorrhage	84 (21)	14 (21)	70 (21)
Other causes[c]	40 (10)	10 (15)	30 (9)
Septic shock	38 (10)	9 (14)	29 (9)
Septicemia	16 (4)	6 (9)[b]	10 (3)[b]
Hypotension	20 (5)	2 (3)	18 (5)
Cardiac[c]	27 (7)	1 (2)	26 (8)
Congestive heart failure	11 (3)	0	11 (3)
Neurologic	17 (4)	0	17 (5)
Renal disorder	10 (3)	0	10 (3)
Charlson comorbidities			
Myocardial infarction	55 (14)	8 (2)	47 (14)
Congestive heart failure	126 (32)	26 (39)	100 (30)
Peripheral vascular disease	19 (5)	0[b]	19 (6)[b]
Cerebrovascular	20 (5)	1 (2)	19 (6)
Chronic pulmonary	106 (27)	8 (14)[b]	97 (29)[b]
Rheumatologic disease	7 (2)	1 (2)	6 (2)
Peptic ulcer disease	29 (7)	4 (6)	25 (8)
Diabetes	62 (16)	16 (24)[b]	46 (14)[b]
Renal disease	14 (4)	3 (5)	11 (3)
Liver disease	9 (2)	1 (2)	8 (2)
Cancer	54 (14)	4 (6)[b]	50 (15)[b]

ARDS, acute respiratory distress syndrome.

[a]Data are presented as number (percentage); [b]for these comparisons $p < .05$, for all others p = nonsignificant: p value compares dementia-present to dementia-absent groups; [c]other causes include overdoses, infection without sepsis, and electrolyte abnormalities. The majority of cardiac admissions were admitted to a separate coronary care unit.

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.

placed on noninvasive ventilation with bilevel positive airway pressure or continuous positive airway pressure. Thirty-one percent received enteral nutrition, and 10% received total parenteral nutrition. The overall use of other interventions was small, with only 9% of the study population receiving hemodialysis, 7% pulmonary artery catheters, 4% tracheostomy, and 1% continuous venovenous hemofiltration. At least one intervention was required for 61% of the patients. There were no significant differences in the use of any of the ICU interventions between the patients with and without dementia.

Table 5 presents the final model for length of ICU stay. Variables that were significant predictors of length of ICU stay included an admitting diagnosis of septic shock or respiratory disease, intubation, and change in code status to less aggressive. Patients with a history of dementia had shorter length of ICU stay—only 77% as long as those without dementia. The coefficient for dementia was stable across the models that were examined. Other variables, including gender, age, marital status, and functional status, did not have significant impact on ICU length of stay. The APACHE II and Charlson comorbidity scores were not independent predictors of ICU length of stay. Mortality was not a significant predictor of ICU length of stay ($p = .61$), and its inclusion did not alter the relationship between dementia and length of stay in the multivariable model.

Length of mechanical ventilation was highly correlated with length of ICU stay. Patients with a history of dementia again demonstrated a shorter length of mechanical ventilation. Other variables, as listed for Table 5, did not have significant impact on length of mechanical ventilation.

When we examined the MBDRS, which was our risk factor variable for dementia, as a continuous measure our results did not change. Thus, considering dementia along its full range of severity, from mild to severe, did not alter our findings.

Table 3. Intensive care unit (ICU) and hospital outcomes[a]

	Overall n = 395	Dementia Present n = 66	Dementia Absent n = 329	p Value
Days on mechanical ventilation, median (range)[b]	4 (1–145)	2 (1–13)	4 (1–145)	.06
Length of ICU stay in days, median (range)	3 (1–64)	3 (1–18)	3 (1–64)	.07
Length of ICU stay in days for subjects who died, median (range), n = 97		4 (1–18)	6 (1–36)	.25
Length of hospital stay in days, median (range)	11 (1–237)	11 (1–86)	11 (1–237)	.16
Change in code status to less aggressive	61 (15)	16 (24)	45 (14)	.04
Readmission to the ICU[c]	39 (12)	5 (9)	34 (12)	.51
New discharge to a nursing home[d]	76 (23)	8/35 (23)	68/293 (23)	1.0
ICU mortality rate	65 (16)	8 (12)	57 (17)	.37
Hospital mortality rate	97 (25)	14 (21)	83 (25)	.53

[a]Data are presented as number (percentage) unless otherwise indicated: p value compares dementia-present to dementia-absent groups; [b]n = 183 number of patients on mechanical ventilation; [c]excludes people who died in their first ICU admission, n = 334; [d]excludes people who were admitted from a nursing home, n = 328.

Table 4. Intensive care unit (ICU) interventions[a]

Intervention	Overall n = 385	Dementia Present n = 66	Dementia Absent n = 329
Intubation	183 (46)	27 (41)	156 (47)
Reintubation[b]	33/143 (23)	2/22 (9)	31/121 (26)
BIPAP/CPAP	70 (18)	10 (15)	60 (18)
Enteral nutrition[c]	123 (31)	22 (33)	101 (31)
Total parenteral nutrition[c]	41 (10)	3 (5)	38 (12)
Hemodialysis[c]	37 (9)	5 (8)	32 (10)
PA catheterization[c]	28 (7)	3 (5)	25 (8)
Tracheostomy[c]	17 (4)	0 (0)	17 (5)
CVVH[c]	5 (1)	1 (2)	4 (1)
Any ICU intervention	242 (61)	41 (62)	201 (61)

BIPAP/CPAP, bilevel positive airway pressure/continuous positive airway pressure; PA, pulmonary artery; CVVH, continuous venovenous hemofiltration.

[a]Data are presented as number (percentage): no significant differences between groups; [b]excludes people who died while intubated; [c]numbers as follows due to missing data: enteral nutrition (n = 393), total parenteral nutrition (n = 393), hemodialysis (n = 393), PA catheterization (n = 394), tracheostomy (n = 394), CVVH (n = 393).

Table 5. Multiple linear regression model for intensive care unit length of stay (log transformed variable)

Variable	Parameter Estimate (SD)	p Value
Dementia[a]	−0.26 (0.09)	.004
Intubation	0.76 (0.07)	<.001
Admitting diagnosis of sepsis	0.35 (0.12)	.003
Admitting diagnosis of respiratory disease	0.22 (0.07)	.003
Change in code status to less aggressive	0.41 (0.09)	<.001

[a]Dementia is defined as Modified Blessed Dementia Rating Scale >4.
Adjusted R^2 for the model, .36.

DISCUSSION

Seventeen percent of our study population had evidence of moderate-severe dementia by a well-validated measure based on proxy report. Despite the fact that the patients with dementia were significantly older, had higher APACHE II scores on ICU admission, and were more likely to have a do-not-resuscitate/do-not-intubate order, dementia did not exert significant impact on ICU outcomes. Contrary to our *a priori* hypothesis, patients with dementia did not have increased rates of intubation or length of mechanical ventilation even after we adjusted for baseline differences in code status. Despite the baseline differences, which documented increased severity of illness, there were no differences in ICU or hospital mortality rates between patients with and without dementia.

Contrary to our hypothesis, ICU length of stay was not increased in patients with dementia. In our multivariate

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.

model, dementia was a predictor for shorter length of stay. The physicians were aware of preexisting dementia in this study only 43% of the time, and controlling for physician recognition did not affect the length of stay variable; therefore, it is unlikely that early discharge of patients because of dementia contributed to the similar lengths of ICU stay. One possible explanation for this shorter length of ICU stay is that patients with dementia may have been more likely to be discharged earlier from the ICU for comfort care and limitation of therapeutic interventions, but our finding persisted even after adjusting for change in code status to less aggressive. Patients with preexisting dementia had significantly higher APACHE II scores on ICU admission, so their shorter length of ICU stay cannot be explained by less severe illness on admission. After we controlled for APACHE II score in our regression models, this variable was not statistically significant and patients with dementia still had shorter length of ICU stay. There were no differences in ICU mortality rates between patients with and without dementia, so increased early mortality in patients with dementia is also unlikely to have contributed to the shorter ICU length of stay.

In our model of length of ICU stay, intubation was a highly significant predictor of prolonged length of ICU stay. In our model, change in code status to less aggressive was associated with prolonged length of ICU stay. In fact, it appears that physicians withdraw care or change code status immediately before death, which is why it appears that limiting care is associated with increased ICU length of stay.

People >65 yrs are the fastest growing segment of the U.S. population, and it is projected that their numbers will increase to 58.9 million by the year 2025 (16). Patients >65 currently comprise 42–52% of intensive care unit admissions (17, 18). The prevalence of cognitive impairment and dementia in community samples ranges from 10.3% to 18.8% (19, 20). Longitudinal studies of dementia suggest that life expectancy is increasing in both Alzheimer's and multiple-infarct dementia patients (21). Physical consequences of dementia predispose patients to infection, especially aspiration pneumonia (22, 23) and urinary tract infections (24). Pneumonia is an important cause of death in demented patients (25, 26). Once patients are admitted to the ICU, there is often an implicit assumption that they will receive all the care measures that are available to treat their specific illness. Prior research has demonstrated that 49% of elderly persons with dementia, once they were admitted to the hospital, received at least one invasive treatment in their last days of life (27). However, it is difficult to predict who will derive benefit from intensive care. Although multiple studies have attempted to address this issue, lingering questions remain about whether older persons, particularly those with dementia, will benefit from ICU care. This study has shown that there are no short-term outcome differences in older ICU patients with and without dementia. Dementia in the absence of numerous comorbidities is not a reason to avoid aggressive care for an acute, potentially reversible illness.

The majority of older patients and their family members are extremely willing to undergo intensive care treatment even for 1 month of prolonged life (28). Unfortunately, patients with dementia may sometimes be unable to participate in decision making regarding their health care. Rates of advance directives in patients with dementia vary depending on the study site. In a study of 50 nonhospitalized demented patients, 48% had an advance directive (29), but in a study of 80 hospitalized patients with dementia, only 8% had any kind of advance directive (27). A study of nursing home patients found that decisionally incapacitated residents consent to treatment more often than do decisionally capable residents (30). Both nursing home patients and their proxies were likely to consent to treatment in the case of critical illness (31). Based on the available literature, therefore, it seems likely that the majority of older patients will choose to have some form of intensive care if needed.

A few caveats deserve comment. Our sample size (n = 395) had >80% power to detect less than a 1-day difference in length of mechanical ventilation and ICU or hospital stay. It is possible that a larger sample size might detect less than a 1-day difference in these outcomes, but this is unlikely to be clinically meaningful. It is possible that dementia may affect mortality from critical illness, but the difference is likely to be small.

The possibility of selection bias in our study cohort should be considered, in that patients with severe dementia and numerous medical comorbidities may not have been referred for ICU admission. In our patient population, there was a nonsignificant trend toward fewer comorbidities in patients with dementia, lending modest support for the possibility of selection bias. Another caveat is that direct testing of patients for preexisting dementia and functional status is not feasible in studies involving critically ill, often intubated, older persons. However, the best available proxy measures and strict screening of proxy respondents were used to ensure the most accurate data. This study is based on a single academic medical center, and patients admitted exclusively with coronary disease and surgical patients were not included as they are admitted to separate units. As a result, the findings of this study may not be generalizable to other settings. This sample does consist, however, of a large prospective cohort of consecutive ICU admissions of older persons and is representative of the patients at a large academic medical center. Appropriateness of use of ICU interventions was not assessed, as this was considered beyond the scope of the present study. This study did not look at the role of delirium in the ICU, which has been shown to be an important risk factor in poor outcomes from both ICU and hospital care (32–34). Studies in both ICU and non-ICU settings have demonstrated that delirium is more common in patients with dementia (35, 36). Future studies using new instruments for measuring delirium in the ICU (37, 38) should be undertaken in conjunction with baseline assessments of dementia to understand potential interactions between dementia and the severity and duration of delirium in outcomes from ICU care.

This study is the first to document no difference in short-term outcomes of older ICU patients with dementia compared with patients without dementia, specifically demonstrating no differences

> *Presumptions that outcomes from critical care are less favorable in patients with dementia should not drive treatment decisions in the intensive care unit.*

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.

in length of mechanical ventilation or length of ICU or hospital stay. Moreover, despite increased illness severity and baseline functional impairments, patients with dementia did not require increased use of standard ICU interventions and did not have increased short-term mortality rates. The capacity to benefit from ICU care must be an important consideration whatever the age of the patient, but how benefit is defined and measured needs to be carefully considered and many factors need to be taken into account. We did not examine functional decline, cognitive decline, or quality of life post-ICU in this older cohort of patients, which represent important outcomes of ICU care for future studies. Understanding these factors will be critical to determine whether a patient truly benefits from ICU care. Based on the results from this observational cohort of older ICU patients, we conclude that presumptions that outcomes from critical care are less favorable in patients with dementia should not drive treatment decisions in the ICU, aside from possibly code status. Multiple factors should be incorporated into decision making regarding admission to the ICU including competing comorbidities and patient preferences.

ACKNOWLEDGMENTS

We acknowledge the contributions of Peter Charpentier for database development, Katy Araujo for data management and manuscript review, David Bruce for data management, Wanda Carr for data entry, and Karen Wu and Sandy Ginter for enrolling participants and interviewing family members. We thank the families, nurses, and physicians in the Yale Medical Intensive Care Unit, whose cooperation and participation made this study possible.

REFERENCES

1. Gallagher P, Clark K: The ethics of surgery in the elderly demented patient with bowel obstruction. *J Med Ethics* 2002; 28:105–108
2. Riesenberg D: Hospital care of patients with dementia. *JAMA* 2000; 284:87–89
3. Richter J, Eisemann MR: Attitudinal patterns determining decision-making in severely ill elderly patients: A cross-cultural comparison between nurses from Sweden and Germany. *Int J Nurs Stud* 2001; 38:381–388
4. Pisani MA, Inouye SK, McNicoll L, et al: Screening for preexisting cognitive impairment in older intensive care unit patients: Use of proxy assessment. *J Am Geriatr Soc* 2003; 51:689–693
5. Blessed G, Tomlinson BE, Roth M: The association between quantitative measures of dementia and of senile change in the cerebral grey matter of elderly subjects. *Br J Psychiatry* 1968; 114:797–811
6. Pisani MA, Redlich C, McNicoll L, et al: Underrecognition of preexisting cognitive impairment by physicians in older ICU patients. *Chest* 2003; 124:2267–2274
7. McLoughlin DM, Cooney C, Holmes C, et al: Carer informants for dementia sufferers: carer awareness of cognitive impairment in an elderly community-resident sample. *Age Ageing* 1996; 25:367–371
8. Jorm AF, Scott R, Cullen JS, et al: Performance of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) as a screening test for dementia. *Psychol Med* 1991; 21:785–790
9. Inouye SK, Wagner DR, Acampora D, et al: A controlled trial of a nursing-centered intervention in hospitalized elderly medical patients: The Yale Geriatric Care Program. *J Am Geriatr Soc* 1993; 41:1353–1360
10. Inouye SK, van Dyck CH, Alessi CA, et al: Clarifying confusion: The confusion assessment method. A new method for detection of delirium. *Ann Intern Med* 1990; 113:941–948
11. Juva K, Makela M, Erkinjuntti T, et al: Functional assessment scales in detecting dementia. *Age Ageing* 1997; 26:393–400
12. Katz S, Ford AB, Moskowitz RW, et al: Studies of illness in the aged. The index of ADL: A standardized measure of biological and psychosocial function. *JAMA* 1963; 185:914–919
13. Lawton MP, Brody EM: Assessment of older people: Self-maintaining and instrumental activities of daily living. *Gerontologist* 1969; 9:179–186
14. Knaus WA, Draper EA, Wagner DP, et al: APACHE II: A severity of disease classification system. *Crit Care Med* 1985; 13:818–829
15. Charlson ME, Pompei P, Ales KL, et al: A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *J Chronic Dis* 1987; 40:373–383
16. Martin LG: Population aging policies in East Asia and the United States. *Science* 1991; 251:527–531
17. Chelluri L, Pinsky MR, Donahoe MP, et al: Long-term outcome of critically ill elderly patients requiring intensive care. *JAMA* 1993; 269:3119–3123
18. Knaus WA, Wagner DP, Draper EA, et al: The APACHE III prognostic system. Risk prediction of hospital mortality for critically ill hospitalized adults. *Chest* 1991; 100:1619–1636
19. Fields SD, MacKenzie CR, Charlson ME, et al: Cognitive impairment. Can it predict the course of hospitalized patients? *J Am Geriatr Soc* 1986; 34:579–585
20. Graham JE, Rockwood K, Beattie BL, et al: Prevalence and severity of cognitive impairment with and without dementia in an elderly population. *Lancet* 1997; 349:1793–1796
21. Gruenberg EM: Epidemiology of senile dementia. *Adv Neurol* 1978; 19:437–457
22. Volicer L, Hurley AC: Risk factors for pneumonia in nursing home residents. *J Am Geriatr Soc* 1995; 43:1443–1444
23. Campbell-Taylor I, Nadon GW, Sclater AL, et al: Oro-esophageal tube feeding: An alternative to nasogastric or gastrostomy tubes. *Dysphagia* 1988; 2:220–221
24. Lipsky BA, Boyko EJ, Inui TS, et al: Risk factors for acquiring pneumococcal infections. *Arch Intern Med* 1986; 146:2179–2185
25. Burns A, Jacoby R, Luthert P, et al: Cause of death in Alzheimer's disease. *Age Ageing* 1990; 19:341–344
26. Beard CM, Kokmen E, Sigler C, et al: Cause of death in Alzheimer's disease. *Ann Epidemiol* 1996; 6:195–200
27. Ahronheim JC, Morrison RS, Baskin SA, et al: Treatment of the dying in the acute care hospital. Advanced dementia and metastatic cancer. *Arch Intern Med* 1996; 156:2094–2100
28. Danis M, Gerrity MS, Southerland LI, et al: A comparison of patient, family, and physician assessments of the value of medical intensive care. *Crit Care Med* 1988; 16:594–600
29. Mezey M, Kluger M, Maislin G, et al: Life-sustaining treatment decisions by spouses of patients with Alzheimer's disease. *J Am Geriatr Soc* 1996; 44:144–150
30. Diamond EL, Jernigan JA, Moseley RA, et al: Decision-making ability and advance directive preferences in nursing home patients and proxies. *Gerontologist* 1989; 29:622–626
31. Ouslander JG, Tymchuk AJ, Rahbar B: Health care decisions among elderly long-term care residents and their potential proxies. *Arch Intern Med* 1989; 149:1367–1372
32. Ely EW, Gautam S, Margolin R, et al: The impact of delirium in the intensive care unit on hospital length of stay. *Intensive Care Med* 2001; 27:1892–1900
33. Francis J, Martin D, Kapoor WN: A prospective study of delirium in hospitalized elderly. *JAMA* 1990; 263:1097–1101
34. Inouye SK, Rushing JT, Foreman MD, et al: Does delirium contribute to poor hospital outcomes? A three-site epidemiologic study. *J Gen Intern Med* 1998; 13:234–242
35. Inouye SK, Charpentier PA: Precipitating factors for delirium in hospitalized elderly persons. Predictive model and interrelationship with baseline vulnerability. *JAMA* 1996; 275: 852–857
36. McNicoll L, Pisani M, Zhang Y, et al: Delirium in the intensive care unit: Occurrence and clinical course in older patients. *J Am Geriatr Soc* 2003; 51:591–598
37. Ely EW, Inouye SK, Bernard GR, et al: Delirium in mechanically ventilated patients: Validity and reliability of the confusion assessment method for the intensive care unit (CAM-ICU). *JAMA* 2001; 286:2703–2710
38. Ely EW, Margolin R, Francis J, et al: Evaluation of delirium in critically ill patients: Validation of the Confusion Assessment Method for the Intensive Care Unit (CAM-ICU). *Crit Care Med* 2001; 29:1370–1379

Copyright © Lippincott Williams & Wilkins. Unauthorized reproduction of this article is prohibited.