Delirium in the Intensive Care Unit: Occurrence and Clinical Course in Older Patients

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OBJECTIVES: To describe the occurrence of delirium in a cohort of older medical intensive care unit (ICU) patients and its short-term duration in the hospital and to determine the association between preexisting dementia and the occurrence of delirium.

DESIGN: Prospective cohort study.

SETTING: Fourteen-bed medical ICU of an 800-bed university teaching hospital.

PARTICIPANTS: One hundred eighteen consecutive patients aged 65 and older admitted to the ICU.

MEASUREMENTS: Baseline characteristics were obtained through surrogate interviews and medical chart review. Dementia was determined using two validated surrogate-rated instruments. Delirium was assessed daily in the ICU using the Confusion Assessment Method (CAM) for the ICU (CAM-ICU). After discharge from the ICU, patients were followed for up to 7 days using the CAM.

RESULTS: Delirium was present in 37 of 118 (31%) patients on admission. Only 45 patients had a normal mental status on admission, of whom 14 (31%) became delirious during their hospital stay. In the post-ICU period, delirium occurred in 40% of patients. Almost half of patients with delirium in the ICU had persistent delirium in the post-ICU period. Overall, 83 of 118 (70%) had delirium during hospitalization. Stupor or coma occurred in 44% of the patients overall, and 89% of survivors of stupor/coma progressed to delirium. Patients with dementia were 40% more likely to be delirious (relative risk = 1.4, 95% confidence interval = 1.1–1.7), even after controlling for comorbidity, baseline functional status, severity of illness, and invasive procedures.

CONCLUSION: Delirium is a frequent complication in older ICU patients and often persists beyond their ICU stay. Delirium in older ICU persons is a dynamic and complex process. Dementia is an important predisposing risk factor for the development of delirium in this population during and after the ICU stay. J Am Geriatr Soc 51:591–598, 2003.

Key words: delirium; intensive care; dementia; aging; geriatrics; cognitive impairment; mechanical ventilation; protocols; critical care

Delirium has been documented to be a common and serious problem in nonintensive care hospital settings and is associated with poor hospital outcomes.1–7 Previous studies in older hospitalized patients have identified specific predisposing and precipitating factors for delirium and have demonstrated that practical interventions targeted toward these risk factors are effective in preventing delirium,1,2,7 but there is a lack of research on delirium in the critical care setting, particularly in the older population. Older persons account for more than 60% of all intensive care unit (ICU) days.8,9

Delirium can be defined as an acute confusional state that usually occurs in the face of an underlying organic etiology, such as medical illness or drug use or withdrawal.10 Delirium is distinguished from dementia by its acute onset, prominent level of inattention, and change in level of consciousness. Because of the critical nature of the underlying illnesses and the lack of verbal communication in ICU patients, cognitive assessment in the ICU is particularly difficult. Thus, the challenges of identification of delirium and
demonstrated the differentiation of delirium from dementia in this setting have hampered clinical investigation. Partly for this reason, the medical literature on delirium in older ICU patients consists mainly of descriptive studies such as case reports or case series that have generally excluded patients with dementia.11

Prior studies of delirium in the general ICU adult population found a prevalence rate of 40%.12-16 Using the Confusion Assessment Method (CAM) for the ICU (CAM-ICU),17,18 a new method for the detection of delirium in the ICU based on the validated and widely used CAM,19 Ely et al. determined that 33 of 38 (87%) of all ICU patients were delirious at any time during their stay.17 Similarly, in a group of mechanically ventilated patients, 80 of 96 (83%) were delirious.18 It has also been shown that delirium in the ICU is an independent predictor of length of ICU stay and length of hospital stay.20 These studies did not focus on delirium in the older ICU population or on those with dementia. Because a large part of the current ICU population is aged 65 and older and up to 30% of these have evidence for dementia,21 a detailed and specific analysis of delirium in this vulnerable population is imperative.22 Furthermore, although it has been recognized that delirium and mental status changes are frequent complications of ICU stay, detailed evaluation of mental status profiles and trajectories of change in older patients during and after ICU stay have not been described.

To address these matters, a prospective cohort study of all older patients admitted to the ICU was conducted. The specific aims of this study were to determine the occurrence of delirium in an older ICU population while in the ICU, to examine its persistence during hospitalization, and to analyze the association between delirium in this vulnerable population and preexisting dementia. The hypotheses are that delirium is frequent in the older population admitted to an ICU, persists beyond their ICU stay, and has substantially higher rates in those with preexisting dementia.

METHODS

Study Design and Setting

This study followed a prospective cohort design. Patients were screened from the daily admission lists of the medical ICU service of Yale-New Haven Hospital from December 6, 2000, through July 30, 2001. Yale-New Haven Hospital is an 800-bed university teaching hospital serving a large urban community and a referral population. The medical ICU had approximately 1,000 admissions in 2000, with 43% of these admissions of patients aged 65 and older. Most patients were in the hospital’s 14-bed medical ICU. Informed consent was obtained from the treating physician and the surrogate at the time of enrollment. Patients also provided informed consent or assent when they were able. The Yale University School of Medicine institutional review board reviewed and approved the research protocol.

Patient/Surrogate Selection

All consecutive patients aged 65 and older admitted to the medical ICU were screened for eligibility. Of the 197 screened patients, 51 were ineligible based on the following predetermined exclusion criteria: lack of adequate surrogate (n = 28), transfer from another ICU (n = 11), not communicative because of aphasia or advanced dementia (n = 8), or non-English speaking (n = 3). Of the 146 eligible patients, 28 patients could not be enrolled because of death before the first interview (n = 5), surrogate refusal (n = 11), or miscellaneous reasons (n = 12), leaving a final sample of 118 participants (81% of eligible patients). Although the excluded group (n = 79) was slightly older (P = .04) than the enrolled group (n = 118), it was similar with respect to sex, race, and severity of illness.

Because most of the patients in this study were critically ill, intubated, and poorly responsive, surrogate respondents were used to obtain the most-reliable baseline information. Surrogate respondents were screened to assure that they had sufficient contact with the patient to appropriately answer questions about the patient’s functional and cognitive status for the last 5 years. A predetermined hierarchy of surrogates was followed that included, in order, spouse, live-in child, or other surrogate who spent a minimum of 4 hours a week with the patient. For nursing home residents, a protocol was established to determine the best person to answer the questions (family member, friend, or nursing home staff member). If there was no identified surrogate, the patient was excluded from the study.

Study Procedures

Separate research nurses conducted the baseline assessment (surrogate interview and medical chart review) and the daily patient interviews. The baseline assessors were blinded to the patient’s delirium status. All interviews and questionnaires were pilot tested before the beginning of the study, and all interviewers were trained and standardized in the interview process. Interrater agreement for the diagnosis of delirium was 91% between the two patient interviewers.

Baseline Assessment

Standardized in-person or phone surrogate interviews included questions on demographic data, alcohol and smoking history, and known history of or evaluation for dementia. Dementia was assessed based on two surrogate questionnaires: the Modified Blessed Dementia Rating Scale (MBDRS),23 which assesses ability to perform usual tasks in the last 6 months, and the Informant Questionnaire on Cognitive Decline for the Elderly (IQCODE),24 which measures changes in ability to perform tasks in the last 5 years. Baseline functional ability was assessed based on the Katz activities of daily living (ADL) scale25 for assessment of basic function and the Lawton instrumental activities of daily living (IADL) scale26 for higher-level function.

In addition, the medical chart was reviewed to obtain demographic data, admitting diagnosis, and evidence for dementia or depression. The Charlson Comorbidity Index27 and the Acute Physiology and Chronic Health Evaluation (APACHE II) score28 were rated using chart review of data obtained within 24 hours of ICU admission.

ICU Patient Interviews

Patients were interviewed in person 6 days a week for the duration of their ICU stay. If the patient was unarousable (stupor or coma based on the Richmond Agitation Sedation Scale)29,30 or not available for interview at a given time, two more attempts were made during the day. If the
The presence of delirium in the ICU was determined using the CAM-ICU, which has been described in detail. It consists of a series of nonverbal tasks to rate the four key CAM criteria (acute and fluctuating course, inattention, disorganized thinking, and altered level of consciousness). All tasks and questions were designed to be readily completed by nonverbal, mechanically ventilated, or restrained patients in ICU settings. The CAM-ICU was validated in a large cohort study of ICU patients against delirium expert assessments and found to have a sensitivity of 95% to 100%, a specificity of 89% to 93%, and high interobserver reliability.

**Post-ICU Patient Interviews**

The presence of delirium in the post-ICU period was assessed using the CAM. Patients were interviewed 2 and 7 days after transfer from the ICU using the Mini-Mental State Examination (MMSE) and the Digit Span test, which were then used to rate the CAM. Logistical constraints limited the number of follow-up observations that could be performed during the 1-week follow-up period. An early observation point was selected on Day 2 when a full evaluation, including MMSE, could be performed. The Day 7 observation was chosen to allow a post-ICU recovery period. The complete CAM instrument, which consists of nine items (inattention, disorganized thinking, altered level of consciousness, disorientation, memory impairment, perceptual disturbances, psychomotor agitation or retardation, and inappropriate behavior), was used. The CAM instrument has been validated against geropsychiatric diagnosis and found to have a sensitivity of 94% to 100%, a specificity of 90% to 95%, and high interobserver reliability.

**Primary Outcome: Delirium**

The primary outcome of delirium was defined using two methods. In patients who could be interviewed, delirium was defined by a positive rating on the CAM-ICU or the CAM. If a patient could not be interviewed and was awake, delirium status was determined by the presence of significant evidence of delirium in the last 24 hours by nurse interview or by review of the medical chart (55 of 758 interview days). A positive result on the CAM-ICU or the CAM required the presence of acute onset of mental status change and inattention (mild or marked) as well as the presence of disorganized thinking (mild or marked) or altered level of consciousness (hyperalert or lethargic). These features were assessed at each daily visit.

If a patient was delirious at any point during the study period, they were categorized as having a delirium occurrence. Prevalent delirium was defined as the presence of delirium at the initial assessment (within 48 hours of admission), and incident delirium was defined as the development of delirium at any time during the entire hospital stay in patients with normal mental status (free of delirium, stupor, or coma) at initial assessment. Patients might have had several separate episodes of delirium throughout the course of their ICU stay and hospitalization. A separate episode of delirium was defined by the recurrence of delirium after a period of at least 2 days of cognitive ratings without delirium or stupor/coma. In the few cases where one or more CAM-ICU or CAM criteria were rated as uncertain (39 of 758 interview days), determination of delirium status was based on all available data, including baseline data, previous and subsequent evaluations, results of cognitive testing for that day, the ratings for other CAM features if available, and medical chart review for that day.

In the ICU setting, several patients were stuporous or comatose continuously or intermittently. Although these cases have been categorized as severe delirium in previous studies, they were considered separately in this study. If patients were continuously comatose or stuporous for a particular day, they were assigned a rating of stupor/coma. If an interview was completed during a period of wakefulness, the CAM-ICU rating took priority. A person could only have one rating per day: no delirium, delirium, or stupor/coma. Abnormal mental status was defined as the presence of delirium or stupor/coma.

To clarify and describe the occurrence of delirium and its trajectory of change in this study population, the rate of delirium at five different time frames or periods were determined: on admission, during the rest of the ICU period (excluding the initial interview), during the entire ICU period, during the post-ICU period (up to 7 days), and during the entire hospital monitoring period (from the first interview in the ICU to 7 days post-ICU, death, or discharge) were determined. In addition, the rate of subsequent delirium in patients who were stuporous or comatose was determined; these were defined as transitional cases of delirium.

**Definition of Dementia**

Two validated surrogate-rated instruments, the MBDRS and the IQCODE, were used to define dementia. Dichotomous variables for preexisting dementia were created for each measure based on previously used, validated cutpoints in the medical literature. The MBDRS score ranges from 0 to 17 and is calculated as the sum of 11 items about any impairment in the last 6 months. Higher scores reflect a higher likelihood of dementia. A cutpoint of 3 or more was used in this study. The IQCODE score is the average score of 16 items rating deterioration in ability to perform a task in the last 5 years. The range of scores is from 1 to 5, with scores greater than 3 indicating worsening status and greater likelihood of dementia. In validation studies, an IQCODE score of 3.31 or greater had a sensitivity of 79% and a specificity of 82% for detecting dementia.

In this study, dementia was defined as present if the MBDRS score was 3 or higher and the IQCODE was 3.31 or higher. However, if the results on the two tests were discrepant (n = 26), dementia was defined as a MBDRS score of 3.5 or higher or an IQCODE score 3.5 or higher. This strategy was chosen because it allowed for incorporation of all patients who had probable dementia and to fully use both of these complementary measures.
Statistical Analysis

Descriptive statistics were used to examine baseline characteristics of the study population. Baseline characteristics between the enrolled and excluded patients were compared using the two-tailed Student t test for continuous variables and the chi-square test for categorical data. Stratified bivariate analyses were used to determine the rate of delirium in the ICU according to dementia status. The relative risks (and associated 95% confidence intervals [CIs]) for delirium-related outcomes given the presence of dementia were calculated using standard methods. Dementia status and other covariables were analyzed in a multiple logistic regression model using a full regression to predict the development of any delirium during the study period. Because of the relatively small sample size, the number of variables entered into the model was limited to five that met statistical significance at P < .05 in bivariate analysis. Model calibration was measured using the Hosmer-Lemeshow goodness-of-fit test with P > .05. Odds ratios and 95% CIs generated using the logistic regression were converted to relative risks (RRs) and their corresponding CIs using previously described methods. All statistical tests were two-tailed, and a P-value < .05 was considered to indicate statistical significance. Statistical analyses were performed using SAS version 8.12 (SAS Institute, Cary, NC).

RESULTS

Baseline and Hospital Data

In the study group of 118 patients, the mean age was 76; 50% were men, and 22% were nonwhite. Other baseline characteristics are shown in Table 1. The mean APACHE II score (23.9) indicated moderate to high illness severity. As expected, a substantial portion of the study sample (37%) was intubated and on mechanical ventilation before the first evaluation, because respiratory failure was the most common reason for ICU admission. Three-quarters of patients were admitted directly from the emergency room. Of those transferred to the ICU from the wards, the median duration of hospitalization before ICU admission was 7.2 days (range 2–31).

Thirty-six patients (30%) were found to have evidence of preexisting dementia. Of the 36, only 12 patients (33%) had any history of dementia from the surrogate interviews or from chart review. The median length of stay of the initial ICU admission was 4 days (range 1–64), and the median length of the entire hospital stay was 13 days (range 3–131). The overall rate of intubation and mechanical ventilation was 49%, and the median duration of initial intubation was 4 days (range 1–25). The hospital mortality rate was 27%.

Occurrence of Delirium

The rates of delirium-related outcomes are shown in Table 2. The table demonstrates that delirium may present at any time during the course of hospitalization. Delirium was present at initial assessment in 37 patients, for a prevalence rate of 31.4%. Delirium later developed in 14 patients who had had normal mental status at initial assessment (incidence rate of 31.1%) and in 32 (88.9%) of the 36 patients who had stupor/coma at initial assessment (transitional cases). For the 14 incident cases, the median time to development of delirium was 4 days (range 1–10 days). The cumulative rate of delirium for the ICU period alone was 62%. Patients had an abnormal mental status (delirium or stupor/coma) on 67.8% of the 912 ICU days

Table 1. Baseline Characteristics of the Study Sample (N = 118)

<table>
<thead>
<tr>
<th>Baseline Characteristic*</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, mean (range)</td>
<td>76 (65–94)</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>59 (50.0)</td>
</tr>
<tr>
<td>Non-Caucasian, n (%)</td>
<td>26 (22.0)</td>
</tr>
<tr>
<td>Education years, mean ± SD</td>
<td>11.7 ± 3.0</td>
</tr>
<tr>
<td>Medicaid, n (%)</td>
<td>21 (17.8)</td>
</tr>
<tr>
<td>Nursing home resident, n (%)</td>
<td>20 (16.9)</td>
</tr>
<tr>
<td>Married, n (%)</td>
<td>64 (54.2)</td>
</tr>
<tr>
<td>History of heavy alcohol use, n (%)</td>
<td>25 (21.2)</td>
</tr>
<tr>
<td>Vision or hearing impairment, n (%)</td>
<td>50 (42.4)</td>
</tr>
<tr>
<td>Disability in any basic activities of daily living, n (%)</td>
<td>58 (49.1)</td>
</tr>
<tr>
<td>Depression, n (%)</td>
<td>17 (14.4)</td>
</tr>
<tr>
<td>Dementia, n (%)</td>
<td>36 (30.5)</td>
</tr>
<tr>
<td>Charlson comorbidity index, mean ± SD</td>
<td>2.8 ± 2.4</td>
</tr>
<tr>
<td>Acute Physiology and Chronic Health Evaluation II score, mean ± SD</td>
<td>23.9 ± 6.2</td>
</tr>
<tr>
<td>Mechanical ventilation on admission, n (%)</td>
<td>44 (37.3)</td>
</tr>
<tr>
<td>Principal ICU admission diagnosis, n (%)</td>
<td>46 (39.0)</td>
</tr>
<tr>
<td>Respiratory failure</td>
<td>46 (39.0)</td>
</tr>
<tr>
<td>Gastrointestinal bleed</td>
<td>28 (23.7)</td>
</tr>
<tr>
<td>Sepsis/infection</td>
<td>12 (10.2)</td>
</tr>
<tr>
<td>Cardiac arrest/shock</td>
<td>11 (9.3)</td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>7 (5.9)</td>
</tr>
<tr>
<td>Other</td>
<td>14 (11.9)</td>
</tr>
</tbody>
</table>

* SD = standard deviation; ICU = intensive care unit.

36 patients who had stupor/coma at initial assessment (transitional cases). For the 14 incident cases, the median time to development of delirium was 4 days (range 1–10 days). The cumulative rate of delirium for the ICU period alone was 62%. Patients had an abnormal mental status (delirium or stupor/coma) on 67.8% of the 912 ICU days

Table 2. Rate of Delirium-Related Outcomes (N = 118)

<table>
<thead>
<tr>
<th>Delirium-Related Outcome</th>
<th>n/N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prevalent delirium (at initial assessment)</td>
<td>37/118 (31.4)</td>
</tr>
<tr>
<td>Incident delirium (arising during hospitalization)†</td>
<td>14/45 (31.1)</td>
</tr>
<tr>
<td>Transitions from baseline stupor/coma to delirium‡</td>
<td>32/36 (88.9)</td>
</tr>
<tr>
<td>Overall rates of delirium in specific time periods:</td>
<td></td>
</tr>
<tr>
<td>During ICU period only</td>
<td>73/118 (61.8)</td>
</tr>
<tr>
<td>During post-ICU period only§</td>
<td>33/83 (39.8)</td>
</tr>
<tr>
<td>During entire hospitalization‡</td>
<td>83/118 (70.3)</td>
</tr>
</tbody>
</table>

† Timeframe includes duration of initial intensive care unit (ICU) stay plus up to 7 days after transfer from ICU.
§ Only 83 patients had post-ICU interviews, as described in the text.
of monitoring for the entire sample. The cumulative rate of delirium in the post-ICU period alone was 40%. The prevalent rates of delirium in patients who could be assessed at Days 2 and 7 post-ICU were 36% (30/82) and 40% (12/30), respectively.

The cumulative rate of delirium in the entire hospitalization study period was 70.3% (83/118), which reflects the sum of the prevalence, incidence, and transition occurrences. Overall, stupor or coma developed in 44% of the sample. Multiple episodes of delirium occurred in 14 patients, of whom 11 had two episodes, two had three episodes, and one had four episodes.

**Losses in Follow-Up Period**

Post-ICU interviews were not conducted with 35 patients because of death in the ICU (n = 16, 46%), death soon after discharge from the ICU (n = 6, 17%), hospital discharge before the second-day interview (n = 6, 17%), tracheostomy placement (n = 3, 9%), transfer to an ICU in another hospital (n = 2, 6%), or refusal (n = 2, 6%).

Only 30 patients had a 7-day post-ICU interview. During the 5-day interval between the two post-ICU evaluations, 44 of 53 (83%) were discharged, four died, and five were readmitted to the ICU. There was no significant difference in baseline or hospital factors between those who had a 7-day post-ICU interview and those who did not.

**Trajectories of Change**

Figure 1 demonstrates the trajectory of change of mental status during two time periods: the ICU period (upper figure) and the post-ICU period (lower figure). During these two periods, if a patient was delirious on any day, they were assigned to the delirium group.

The upper diagram reflects the ICU period and changes from baseline mental status at the initial assessment (no delirium, delirium, or stupor/coma) to the rest of the ICU stay (excluding the initial assessment). The 23 patients who only had one ICU assessment are not reflected in the subsequent numbers. Ten of the 45 patients with no delirium initially (32%) developed delirium (n = 7) or stupor/coma (n = 3). Twenty-one of 37 patients (70%) with initial delirium had persistent delirium during the ICU stay. Twenty-nine of 36 patients with initial stupor/coma (85%) later developed delirium while in the ICU.

The lower diagram reflects the changes from the overall ICU status (no delirium, delirium, or stupor/coma) to the end of the post-ICU period. The 35 patients without any post-ICU interview are not reflected in the subsequent numbers. This diagram shows that seven patients developed incident delirium in the post-ICU period. Twenty-three of 49 patients with ICU delirium (47%) had persistent delirium in the post-ICU period. In addition, three of four patients with stupor/coma (75%) developed delirium.

**Effect of Dementia**

Table 3 shows the rates of selected delirium-related outcomes stratified by dementia status. The RRs and 95% CIs reflect the risk of developing delirium given the presence of dementia. The overall rate of delirium in the hospital was 40% higher in those with dementia than in those without dementia (RR = 1.4; 95% CI = 1.1–1.7). Although not statistically significant, patients with dementia were 1.6 times more likely to have delirium at initial presentation and 2.2 times more likely to have incident delirium. The effect of dementia was significant in the post-ICU period, where patients with dementia were 2.4 times more likely to develop delirium.
Figure 2 demonstrates the effect of dementia on the cumulative rate of delirium throughout the hospital stay: on admission, during the ICU stay, and during the entire hospital stay. During all time periods, patients with dementia were more likely to have delirium than those without dementia, and the difference achieved statistical significance in the post-ICU period. To determine the independent contribution of dementia to the risk of delirium during hospitalization, dementia status and relevant covariables (Charlson comorbidity score, APACHE II score, impairment in basic ADLs, and any invasive procedures other than mechanical ventilation) were included in a multivariate logistic regression model. Ventilator status was not included in the model because it was highly collinear with severity of illness. The model was well calibrated ($P_{H11021} = .44$ for Hosmer-Lemeshow goodness-of-fit test). After multivariate analysis, dementia remained a significant risk factor for delirium in the hospital, with an adjusted RR of 1.26 (95% CI = 1.1–1.6).

**DISCUSSION**

This study demonstrates that delirium is a frequent complication in older ICU patients, occurring in 70%. More importantly, the incidence rate of delirium in this setting was 31%. Incident delirium was as likely to occur in the ICU as in the post-ICU period, but post-ICU incident delirium may be a result of the ICU stay, given that it tended to occur soon after an (often brief) ICU stay. Most patients with delirium have persistence of delirium beyond the ICU stay. In survivors of stupor/coma, delirium is nearly inevitable. This study demonstrates that the trajectories of delirium and mental status changes in the ICU population reflect a complex and dynamic process throughout the course of hospitalization.

Dementia is an important predisposing factor for the development of delirium in this population, with almost 1.5 times the risk for delirium during the hospitalization. Moreover, post-ICU delirium is significantly more common in patients with dementia (RR = 2.4). Patients with dementia are more likely to present to the ICU with delirium that persists in the post-ICU period. Furthermore, if delirium did not occur in the ICU, patients with dementia were more likely to develop delirium upon transfer from the ICU. It remains to be determined how much underlying vulnerability factors (e.g., underlying illnesses or dementia) and precipitating events that occur in the ICU (e.g., invasive procedures, mechanical ventilation, multiple psychoactive medications, or sleep deprivation) independently contribute to the etiology of ICU delirium.

The strengths of this study include the daily use of state-of-the-art methods for cognitive assessment in critically ill older patients, including the delirium and dementia assessments. The CAM and CAM-ICU are well-validated, widely accepted instruments for the assessment of delirium. The dementia assessments used two surrogate-

<table>
<thead>
<tr>
<th>Delirium-Related Outcome</th>
<th>Dementia*</th>
<th>Relative Risk (95% Confidence Interval)</th>
</tr>
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<tbody>
<tr>
<td>Present</td>
<td>Absent</td>
<td></td>
</tr>
<tr>
<td>Prevalent delirium</td>
<td>15/36 (41.7)</td>
<td>22/82 (26.8)</td>
</tr>
<tr>
<td>Incident delirium</td>
<td>5/9 (55.6)</td>
<td>9/36 (25.0)</td>
</tr>
<tr>
<td>Overall rate of delirium in post-ICU period only</td>
<td>18/28 (64.3)</td>
<td>15/55 (27.3)</td>
</tr>
<tr>
<td>Overall rate of delirium during entire hospitalization†</td>
<td>31/36 (86.1)</td>
<td>52/82 (63.4)</td>
</tr>
</tbody>
</table>

* See dementia definition in text.
† Timeframe includes duration of initial intensive care unit (ICU) stay plus up to 7 days after transfer from ICU.

Figure 2. Cumulative rate of delirium throughout the hospital course stratified by dementia. Graph depicting the cumulative rates of delirium stratified by dementia status (36 patients with dementia and 82 patients without dementia) during three separate periods of the study: on admission or baseline; by the end of the intensive care unit (ICU) period; and by the end of the post-ICU period up to 7 days. * Indicates statistical significance at $P < .05$ for comparison of groups with and without dementia.
rated instruments that are well validated. Their use in the ICU setting represents an innovative and effective approach that increases the likelihood of detecting patients with potential dementia. This approach is extremely important in the ICU, given that dementia is often unrecognized and detailed neuropsychological testing of patients on admission is not feasible.

A few caveats deserve comment. Although many pertinent ICU-related factors (e.g., psychoactive medications) are likely to affect the occurrence and outcome of delirium, collecting these data was beyond the scope of the present study. This is an important area for future research. There was a delay of up to 48 hours from ICU admission until the first interview, which likely affected the baseline rates of delirium, stupor, and coma. In addition, patients were only followed for two interviews, at Days 2 and 7 after their ICU transfer. This provides only two snapshots of their mental state and may not provide the full picture of the trajectory of change of their mental status. Post-ICU delirium may have been missed and underestimated by this strategy. This study was conducted in a single medical ICU in a single hospital and may not be generalizable to all ICUs. Despite these limitations, this study provides the most comprehensive study to date of the patterns of delirium associated with ICU admission in older patients.

The findings from this study suggest substantial implications for improving practice patterns for older patients in the ICU. The high rate of delirium identified in the ICU highlights the importance of this problem and the need to better address this neglected problem in the critical care setting. The high incidence rates may provide an opportunity for the prevention of delirium in the ICU using similar strategies to those used in general medical wards. Delirium is particularly important to address because it affects substantially patients’ communication ability and decision-making capacity in the ICU, and many ICU treatments may contribute to its genesis and exacerbation. Future work is needed to further elucidate risk factors for delirium in the ICU and to understand its long-term persistence and associated outcomes. This study suggests that patients with dementia are at high risk for delirium and are particularly vulnerable to the adverse effects of ICU admission. A strategy of delirium prevention in the ICU must include specific approaches for the detection of patients with dementia and the differentiation of delirium from dementia. Ultimately, this work may lead to the development and testing of preventive strategies for delirium in older ICU patients. This study provides a detailed clinical epidemiological investigation of delirium in the ICU setting and lays the groundwork for future studies to identify risk factors for delirium in this important setting and to intervene to prevent the development of delirium.

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