Rapid Communication

Patients Aged 90 Years or Older in the Intensive Care Unit

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Background. Age is an important prognostic factor in patients admitted to intensive care units (ICUs), but it is not as important as illness severity. However, age seems to remain an independent triage criterion for ICU admission, and 90 years of age seems to represent a psychological barrier for many ICU physicians. The aim of this preliminary study is to compare the management and outcome of patients aged 90 years or older admitted to a respiratory ICU with those of patients aged 70 years or younger.

Methods. In our matched case–control study over a 6-year period, 36 patients aged 90 years or older (case patients) were selected and matched according to sex with 72 controls chosen in the 20- to 69-year age range. The Simplified Acute Physiology Score (SAPS) II was then computed without using age as a variable.

Results. Pre-existing comorbidities were significantly less frequent in cases than in controls (5.1% vs 30.5%, \(p < .01\)). Compared to controls, cases were more frequently admitted for cardiac failure (22% vs 7%, \(p < .05\)) and less frequently for neurological diseases (0% vs 11%, \(p < .05\)). The use of advanced life-support measures in the ICU such as mechanical ventilation, central venous or arterial catheterization, and vasoactive and/or inotropic drugs was not significantly different between case patients and controls. This was also the case for ICU mortality and for the mean duration of ICU and hospital stay. Although there was a trend toward a higher hospital mortality among case patients than among controls, it did not reach statistical significance (47% vs 27%, \(p = .07\)).

Conclusion. Our results reinforce the idea that age alone is not a relevant criterion for ICU admission.

A GE alone is an important prognostic factor in elderly patients admitted to intensive care units (ICUs), but it is not as important as illness severity (1–5). However, age seems to remain an important independent triage criterion for ICU admission (6), even when age is the only difference between two patients in a hypothetical case scenario (7). Ninety years of age seems to represent a psychological barrier for many ICU physicians.

Data describing the outcome of elderly patients’ ICU stays are available (4,8–12) but, to our knowledge, this issue has not been specifically studied in the population of patients aged 90 years or older. This population has become significant in developed countries. It represents 0.4% of the population of the European Union (13), and should continue to grow as a consequence of increased life expectancy (currently 80.1 years for women and 73.7 years for men (13)). Older patients are more demanding of health resources than are younger ones (14), but the efficacy of their care is not always well established. This is, for example, the case for the utilization of ICU resources.

The aim of this preliminary study is to compare the management and outcome of patients aged 90 years or older who are admitted to a respiratory ICU with those of patients aged less than 70 years, through a retrospective pairwise comparison over a 6-year period.

METHODS

Setting

The study was conducted in a 10-bed respiratory ICU (approximately 500 admissions per year, from both the community and various departments of the hospital; mean duration of stay = 6 days) located within the Department of Pneumology, Groupe Hospitalier Pitié-Salpêtrière, Paris, France. The hospital is a 2200-bed university hospital providing care to patients with medical and surgical conditions.

Selection of Patients

The data were extracted from the ICU database (FusionF; Varimed, Angers, France). This database is prospectively managed and comprehensively describes patient stays. The study period extended from August 1, 1995, to September 1, 2001. During this period, the database comprised 2846 records, corresponding to 100% of the actual admissions.

All patients aged at least 90 years were selected as “indexes” for the study, without any exclusion criteria. Two controls were selected for each case. The control patients were chosen in the 20- to 69-year age range. Each case patient was randomly matched to a control according to both gender and the Simplified Acute Physiology Score (SAPS)
II (15) computed without using age as a variable. The SAPS II score provides an estimate of the risk of death without having to specify a primary diagnosis: a score is thus calculated and converted into a probability of hospital mortality. The calculation of the SAPS II score takes 17 variables into account: age, type of admission (scheduled surgical, unscheduled surgical, or medical), three underlying disease variables (acquired immunodeficiency syndrome [AIDS], metastatic cancer, and hematologic malignancy), and 12 physiology variables. Because age has an important weight in the computation of the SAPS II score, and the aim of this study was to compare elderly patients with younger ones suffering acute diseases of comparable “physiological” impact, we matched cases and controls by using the SAPS II score computed without the contribution of age. This approach was chosen to avoid biasing the study in favor of the elderly patients, and hence made the subsequent comparisons conservative, if anything.

### Data Collection

For each patient, we collected (a) prehospitalization attributes [age, the existence of a chronic disease as defined in the SAPS II score, and an estimate of how the underlying patient’s health status is supposed to affect his/her life expectancy, according to McCabe and Jackson (16) (0 = absence of underlying disease likely to be fatal; 1 = presence of an underlying disease likely to be ultimately fatal; 2 = presence of an underlying disease likely to be rapidly fatal)]; (b) diagnosis at ICU admission; (c) advanced life support measures taken during the ICU stay (mechanical ventilation and its route of administration [endotracheal tube or mask], central venous catheterization, arterial catheterization, right heart catheterization, inotropic and/or vasopressive drugs use, and/or dialysis) (Of note, the term dialysis refers to both conventional dialysis and continuous veno-venous hemodiafiltration); (d) ICU and hospital outcome (discharge or death); and (e) length of ICU and hospital stays.

### Statistical Analysis

Continuous variables are expressed as mean ± SD, and categorical variables are expressed as percentages of the index and control populations. The former were compared using the Mann–Whitney U test, whereas the latter were compared using the chi-square test or Fisher’s exact test when appropriate. Differences were considered statistically significant when the probability p of a type I error was .05 or less.

### Results

During the study period, 38 patients aged 90 years or older were admitted to the ICU. Matching was impossible in two of those cases because no suitable controls were available. We therefore compared 36 cases (92.8 ± 2.4 years) with 72 control patients (42.4 ± 13.9 years). The SAPS II score after subtraction of the contribution of age was 34 ± 20 in both groups. The full SAPS II score was, expectedly, higher in the cases patients than in the controls (52 ± 20 vs 39 ± 22, respectively; p < .005).

### Preexisting Comorbidity

A metastatic cancer, a hematologic disease, or AIDS were significantly less frequent in the cases (n = 2, 5.1%) than in controls (n = 22, 30.5%; p < .01). Nevertheless, the McCabe scores were identical (0.5 ± 0.7 vs 0.7 ± 0.8, respectively). The distribution of the two populations in terms of the McCabe classes was also identical (for McCabe classes 0, 1, and 2: 64%, 25%, and 11% in cases vs 50%, 28%, and 22% in controls, respectively).

### Diagnostic on Admission

Table 1 displays the relative distribution of each main diagnostic at admission to the ICU for cases and controls. Cardiac failure was more frequent in cases and neurological diseases were more frequent in controls, but the repartition of the other diagnostic classes was not significantly different between the two groups.

### Advanced Life-Support Measures in the ICU

In the two groups, mechanical ventilation was required in 50% of patients (18/36 in cases and 36/72 in controls). Noninvasive ventilation was used more frequently in cases (6/18, 33%) than in controls (3/36, 8%), but the difference did not reach statistical significance (p = .053). The proportion of patients receiving a central venous or arterial catheter was not significantly different between cases (11/36 [30%] and 7/36 [19%], respectively) and controls (28/72 [39%] and 22/72 [30%], respectively), as the proportion of patients undergoing a hemodynamic investigation using a Swan–Ganz pulmonary artery catheter right heart catheterization (5/72 [7%] in cases versus 2/36 [5%] in controls).

### Table 1. Diagnostic at Admission in the ICU

<table>
<thead>
<tr>
<th>Primary Diagnostic</th>
<th>Cases (N = 36)</th>
<th>Controls (N = 72)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acute respiratory failure</td>
<td>12</td>
<td>29</td>
<td>NS</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>7</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>COPD</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Status asthmaticus</td>
<td>0</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Atelectasis</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Pleura*</td>
<td>3</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Hemoptysis</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>2</td>
<td>5</td>
<td>NS</td>
</tr>
<tr>
<td>Septic shock</td>
<td>4</td>
<td>4</td>
<td>NS</td>
</tr>
<tr>
<td>Intoxication</td>
<td>1</td>
<td>8</td>
<td>NS</td>
</tr>
<tr>
<td>Neurological†</td>
<td>0</td>
<td>8</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Cardiac failure</td>
<td>8</td>
<td>5</td>
<td>&lt;.05</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>7</td>
<td>NS</td>
</tr>
<tr>
<td>Gastrointestinal bleeding</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Acute renal failure</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Metabolic</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Postoperative</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

Notes: * Pleura: pneumothorax, hemothorax, pyothorax, and any pleural effusion associated with respiratory failure. † Neurological: stroke, coma, status epilepticus, and encephalitis.

NS = nonsignificant; ICU = intensive care unit; COPD = chronic obstructive pulmonary disease.
The use of vasoactive and/or inotropic drugs was not significantly different among cases (12/36, 33%) than among controls (22/72, 29%). Dialysis was instituted in 2 cases and in 6 controls.

Outcome

ICU mortality was not significantly different among cases (10/36, 28%) and controls (13/72, 18%). Hospital mortality was higher in cases than in controls (17/36, 47% vs 20/72, 27%, respectively), but not significantly so \((p = .07)\). ICU and hospital mortality in patients receiving each kind of advanced life-support measure in the ICU did not significantly differ between cases and controls (Table 2).

Length of Stay

Mean duration of ICU and hospital stay was not significantly different between cases (5.1 ± 5.6 and 27.3 ± 32.7 days, respectively) and controls (6.0 ± 6.6 and 21.4 ± 15.4 days, respectively) (Figure 1).

DISCUSSION

These results show that the management and length of stay of patients aged 90 years or older do not differ from those observed in younger patients with equal illness severity upon ICU admission. This is in line with previous observations in younger populations of elderly patients (4,8–11). Although there was a trend toward a higher mortality in the patients aged 90 years or older, it did not reach statistical significance, possibly in line with an insufficient power.

This study must be considered preliminary and exploratory in nature. Indeed, it suffers from several limitations. First, it is a single-center study, with all the possible corresponding biases. Second, the small size of the study population limits the power of the statistical comparisons between the two groups. Indeed, although management, mortality, and length of stay of cases and controls were not significantly different, there was a trend toward a higher in-hospital mortality for cases. These two limitations call for larger, multicenter studies. Third, our study does not provide long-term follow-up data, which would involve a prospective and long-term design. Of note, interpreting long-term results will be difficult in a group of patients of which the age exceeds, by definition, the average life expectancy of the general population.

Matching the index cases to controls according to a severity score that predicts hospital mortality (15) could explain the lack of difference between the ICU mortality in the 2 groups. However, the matching criterion was not the SAPS II per se, but the SAPS II corrected for age. The mortality prediction value of this modified score is unknown. Other outcomes that do not relate to the SAPS II were similar in the two groups. Indeed, ICU and hospital lengths of stay were not significantly different (despite a trend toward a higher in-hospital mortality in index cases). Moreover, the ICU management of the two groups was similar, indicating that the physicians in charge of the patients did not consider them differently from the average cases. The similarities between management and outcome could be explained by dissimilarities between the baseline characteristics of the two groups. In other words, the index cases may have represented a population selected, at the point of triage, for an exceptionally good “baseline health,”

Table 2. ICU and In-Hospital Mortality in Patients Receiving Advance Life Support Measures in the ICU

<table>
<thead>
<tr>
<th>Measure</th>
<th>ICU Mortality Cases</th>
<th>ICU Mortality Controls</th>
<th>p</th>
<th>In-Hospital Mortality Cases</th>
<th>In-Hospital Mortality Controls</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical ventilation</td>
<td>8/18 (44%)</td>
<td>13/36 (36%)</td>
<td>.76</td>
<td>9/18 (50%)</td>
<td>17/36 (47%)</td>
<td>.85</td>
</tr>
<tr>
<td>Endotracheal intubation</td>
<td>7/12 (58%)</td>
<td>12/33 (36%)</td>
<td>.19</td>
<td>7/12 (58%)</td>
<td>16/33 (48%)</td>
<td>.56</td>
</tr>
<tr>
<td>Central venous catheter</td>
<td>8/11 (72%)</td>
<td>11/28 (39%)</td>
<td>.12</td>
<td>9/11 (81%)</td>
<td>14/28 (50%)</td>
<td>.14</td>
</tr>
<tr>
<td>Arterial catheter</td>
<td>6/7 (86%)</td>
<td>10/22 (45%)</td>
<td>.14</td>
<td>7/7 (100%)</td>
<td>12/22 (54%)</td>
<td>.07</td>
</tr>
<tr>
<td>All catheter</td>
<td>8/11 (73%)</td>
<td>12/29 (41%)</td>
<td>.15</td>
<td>9/11 (81%)</td>
<td>15/29 (52%)</td>
<td>.16</td>
</tr>
<tr>
<td>Vasoactive/inotropic drugs</td>
<td>9/12 (75%)</td>
<td>12/22 (54%)</td>
<td>.42</td>
<td>10/12 (83%)</td>
<td>12/22 (54%)</td>
<td>.19</td>
</tr>
</tbody>
</table>

Note: ICU = intensive care unit.

Figure 1. Box plot representation of the duration of stay of cases and controls in the intensive care unit (ICU) (left panel) and in the hospital (right panel). Box is drawn stretching from the lower hinge (the 25th) to the upper hinge (the 75th percentile). Line across the box shows the median. Whiskers are drawn from the box to the 10th (lower whisker) and 90th percentile (upper whisker), and circles represent outliers.
either by the physicians proposing their admission to the ICU or by the physicians accepting the admission. In this view, chronic fatal diseases such as cancer, hematologic disease, or AIDS were less frequent among the cases than among the control patients. These conditions are known to negatively influence the outcome (15,16). However, good sense imposes us to hypothesize that the lower proportion of chronic underlying diseases in the patients aged 90 years or older is due to the fact that patients who reach such an advanced age do so because they do not have severe chronic diseases. Another possible bias could be the selection of the elderly patients for diseases with a reputation of good response to ICU care. The diagnostic distribution on admission to the ICU exhibited a higher proportion of cardiac failure in the index group and a higher proportion of neurological diseases in the controls. Both could explain why the outcome of elderly patients was not worse than the outcome of younger patients. Indeed, it has been shown that the prognosis of elderly patients requiring endotracheal intubation for pulmonary edema is sufficiently good to justify an aggressive therapy (17). Conversely, the outcome of elderly patients admitted for intracerebral hemorrhage seems to be poor (18,19).

Despite all the above, our results reinforce the idea that age alone is not a relevant criteria for ICU admission. They are meant to prompt physicians responsible for the proposition or decision of ICU admissions not to censure themselves because of an age superior to the average life expectancy of the population. Larger studies including long-term functional follow-up are needed to refine the assessment of ICU relevance in this setting and to determine whether our results are observed at other institutions and whether there are variations among institutions and nations.

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References


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