Background

Very elderly patients (aged over 85 years) are increasingly treated in intensive care units (ICU) despite the reluctance of doctors to admit these patients considered fragile. Only a few studies in this age group have described the relevance of treatment of these patients in the intensive care unit.

Methods: The inclusion criterion for this study was patients aged 85 years or over on admission. The exclusion criteria were high dependence before admission or an inability to answer the telephone. Epidemiological data, antecedents, lifestyle, autonomy (ADL score of six items) were recorded on admission to the ICU and by telephone interview at six months.

Results: Eight French ICU included 239 patients aged over 85 years. The most common diagnoses were non-cardiogenic lung disease (36%), severe sepsis/septic shock (29%) and acute pulmonary oedema (28%). 23% of patients were dependent on admission. 71% of patients were still living when discharged from the ICU and 52% were still living at 6 months. Among the non-dependent patients before hospitalisation, 17% became dependent. The only prognostic criteria found were the SAPS II score on admission and the place of residence before admission (nursing home or “with family” had a poor prognosis).

Conclusions: Although the prognosis of these very elderly patients was good after hospitalisation in the ICU, it should be noted that the population was highly selected with few comorbidities or dependence. No triage criteria could be proposed.

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Keywords: sample; article; author
accepted with great reluctance. The great variability of the approaches depending
on the units or even the individuals shows that this decision is not rational[3].

Age is a risk factor for intensive care patients[4], but does a threshold exist? This wariness has been reinforced by several works, in particular an epidemiological study in 2003[4], which showed a net increase in intra-hospital mortality of patients aged over 75 years and especially over 85 years. The article by P. Biston[5] showed a catastrophic one-year survival rate (less than 3%) for patients aged over 85 years hospitalised in the ICU for hemodynamic failure. Many recent studies, often focused on a specific disease, have very variable conclusions and are indecisive. Very subjectively, the threshold seems to be around the age of 85 years. This impression has been confirmed by several recent studies, which estimate that the very elderly are over this age[6, 7].

In particular, the European study by C.L. Sprung[6] in 2012 clearly showed that, even if mortality is high in patients aged over 85 years, the benefit of admission to the ICU is also high. In contrast, an epidemiological study on a large sample did not retain age as a risk factor[8].

However, all of these studies only focus on survival. Many doctors, however, are afraid that these patients will only survive at the cost of a significant decrease in their autonomy. This fear is not supported by any studies of subjects aged over 75 years or over 80 years[9, 2, 10, 11]. This age group (aged 75-84 years) is now well accepted in our units. However, information on older patients is missing. For this reason, we conducted a study with a 6-month follow-up on quality of life and survival of the eldest patients.

**Methods**

This multicentre, prospective, observational cohort study included all patients aged 85 years or older who were referred for treatment in the ICU in French hospitals (one university hospital and seven non-university hospitals) from 1 January 2015 to 31 December 2016 followed by admission to the ICU or a continuing care unit up to six months later. The ethics committee issued a favourable opinion, as did the National Commission for Information Technology and Freedom. An information letter was given to each patient or to relatives on admission to the ICU. The inclusion criteria were patients aged 85 years or older and admission to the ICU or a continuing care unit. No admission or triage instructions were given to participating physicians. The non-inclusion criteria were bedridden patients, who were very dependent before admission to the ICU, patients who did not speak French or had a neurological disease (dementia, etc.) or a psychiatric disease preventing their interview at 6 months, patients for whom no telephone number or other means of contact could be obtained and the absence of social security. The exclusion criteria were the impossibility of reaching the patient or a relative at 6 months. The main endpoint was the change in autonomy before intensive care and six months after. Autonomy was assessed by the ADL score (activities of daily living [12]) of six items, validated in geriatrics, completed with data provided by the patient or a relative. An ADL score of less than three was considered a marker of dependence. The secondary endpoints were survival and any changes in place of residence. The data collected concerned, in addition to the ADL score and the place of residence before and at
six months after admission, the main antecedents, the Knaus score, the mode of admission to the ICU, the length of hospitalisation, the SAPS II score, the main treatments administered, the possible existence of a life-sustaining therapy decision withheld or withdrawn, and death in the ICU. The telephone numbers of the patient or relatives, including the attending physician or the nursing home, were recorded. At six months, by telephone interview, we obtained information on the place of residence, autonomy and the overall impression of feeling better or worse than before intensive care.

For this purely descriptive study on a very large total population, with a margin of error of 10% and a confidence level of 95%, the optimal sample size was 157 patients.

Quantitative variables were expressed as the mean (standard deviation) when following a Gaussian distribution or median (interquartile range 25–75%) and were compared using the Student T or Mann-Whitney U test, respectively. Factorial analysis was carried out to describe variability. Qualitative variables were expressed as frequencies (95% confidence interval) calculated by angular transformation and were compared using the Chi-square or Fisher’s exact probability test for categorical variables. Data were tested for normality using the Shapiro-Wilk test. Factors found to be significantly associated with survival were analysed further with a Cox proportional hazard model to adjust for the potential or confounding effect of each factor. Hazard ratios with 95% CI were used to report the results. The time variable was defined as the number of days from ICU triage. The variables were included in Cox’s regression analysis or logistic regression because all were associated with P < 0.2 on univariate analysis. All tests were two-sided with 5% significance, and performed using the R software [13] with notably the packages tidyverse [14] and epiDisplay [15].

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Results

The eight centres recruited a total of 245 patients from March 2015 to December 2016 (figure ??). Three patients were excluded. For three patients, the data at 6 months could not be collected; the exploitable sample was therefore 239 cases.

The characteristics of the sample are summarised in Table 1. Admission diagnoses were varied, but the most frequent were acute non-cardiogenic respiratory failure (36%), severe sepsis / septic shock (29%) and acute pulmonary oedema (28%). A total of 51 (21.4%) patients were hospitalised only in the continuing care unit. A total of 214 patients (89%) were not dependent before hospitalisation in the ICU.

A total of 68 (28.6%) patients died in the ICU. Death in the ICU was linked to the severity on admission, but not to age, autonomy before admission, length of hospitalisation or the treatments used.

At six months

A total of 123 (52.3%) of patients were still living at six months (Figure 2). In addition to the SAPS II score, the predictive factors were where the patient came from and the place of residence before hospitalisation, the worst being the nursing home and living with family (Tables 4 and 5). For the ADL score, only items 1 and 5 changed (Table 2).
Among the 88 non-dependent patients before intensive care and still living at six months, 15 (16.7% [9.9; 26]) became dependent. One question dealt with the overall feeling of the change in the quality of life over these six months. One third of the patients answered that they felt better, one third did not notice any difference and one third felt worse.

A total of 53 (22%) of the patients underwent a procedure to withhold or withdraw life-sustaining therapy. These patients were not older, institutionalised more often or had a more serious medical history. The ADL score showed greater dependence (26.4% vs 14.1% - p = 0.003). The mortality rate of the patients having undergone a procedure to withhold or withdraw life-sustaining therapy was 66% compared to 17.8% for the other patients (p <0.0001). At six months, mortality was 84.9% vs 36.8% (p <0.0001). Hospitalisation in the ICU was longer without any difference in the treatments used.

Discussion

The results showed significant early mortality (40% of deaths at 30 days) but, at six months, survival was close to 50%. Early mortality in the hospital was similar to that found in other studies on comparable populations, which confirmed the quality of our sample[16, 17]. More importantly, autonomy was preserved: 60% of patients with a maximum ALD score before hospitalisation had the same score at six months and less than 10% became dependent (ALD score >3). These results were positive and encourage admitting very elderly patients more easily to our units. However, the patients in the study were selected and therefore were not representative of this age group. Only 7% lived in a nursing home before hospitalisation compared to 30% in the general population[1]. The patients admitted to the intensive care unit were non-disabled (almost half had a maximum ALD score before hospitalisation). Triage of the population therefore implemented for these demographic characteristics. As a reminder, no instructions on the triage of patients were given to the investigators. A second triage was carried out on the disease or the immediate severity. In our sample, there was an over-representation of diseases that often improve, such as acute pulmonary oedema or pneumopathies with a low severity on admission (average SAPS2 score of 53 including 18 points related to age).

It is difficult to simply define a population at risk in this age group. No criterion on admission was linked to survival or autonomy at six months within the limitation of the small size of our sample. The place of residence before hospitalisation was statistically linked to survival and autonomy but, in practice, it cannot be used: patients living “with family” can also be perfectly autonomous or very dependent. Patients living in nursing homes were probably selected on admission and therefore not particularly representative of this population.

The same reservations can be made on the evaluation of the patient’s autonomy at six months: the place of residence is not particularly informative. In order to be able to interview patients by telephone, a simple score had to be retained. The SF36 score[18] for example, much more complete and well validated, would have been unusable by telephone.

The decision to admit a very elderly patient to the intensive care unit remains difficult and no simple criteria can be advised, which has already been shown.
Several unconvincing scores have been proposed[8]. If age over 85 years old is not a clear prognostic factor, comorbidities and general condition, as vague as this notion may be, are probably more significant. The small size of our sample did not allow the definition of patient groups or referral criteria. The concept of frailty has recently been introduced to define a class of non-disabled patients, but at high risk of deterioration after major hospitalisation (intensive care, surgery, etc.) in studies focused on patients aged 75-85 years[9]. However, no simple index, usable in the emergency department, has been validated to date. In addition, in patients aged over 85 years, more than 80% of patients are classified as "fragile"; therefore, these indices are not particularly discriminating in this age group. The criteria usually used, although simple, are difficult to collect in an emergency department when deciding to admit to the ICU (walking speed, muscle strength, etc.). Nevertheless, the concept is interesting and could help to refine the triage of patients on admission.

Conclusions

The positive results in survival and in a state of autonomy at six months after hospitalisation in the ICU of patients aged over 85 years encourage the easier admission of these patients. However, these positive results are obtained at the cost of very severe triage, the rules for which still need to be defined.

Appendix

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Abbreviations

intensive Care Unit : ICU

Availability of data and materials

Data are available on request from Philippe Michel.

Ethics approval and consent to participate

The opinion of the Committee is in DAAR_CPP-avis-ethique.pdf. The consent forms are in DAAR_ni-patient.pdf and DAAR_ni-proche.pdf.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

all authors have approved the manuscript for submission

Authors’ contributions

PM: data retrieval, statistical analysis, writing
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Figures

Figure 1 Flowchart

Figure 2 Survival Curve
Table 1  Summary of the population – Before ICU state

| sexe (f) | mean ± standard deviation n/total (%) | IC 95 % |
|----------|---------------------------------------|---------|
| Aged 85 years | 54/239 (23 %) | [17 ; 28] |
| Aged 86 years | 57/239 (24 %) | [18 ; 30] |
| Aged 87-88 years | 60/239 (25 %) | [20 ; 31] |
| Aged 89-90 years | 35/239 (15 %) | [10 ; 20] |
| Aged ≥90 years | 33/239 (14 %) | [9.6 ; 19] |

Admission

| Place of residence | n/total (%) | IC 95 % |
|-------------------|-------------|---------|
| Short hospitaliation | 91/238 (38 %) | [32 ; 45] |
| Home via the mobile emergency service | 63/238 (26 %) | [21 ; 32] |
| Rehabilitation department | 10/238 (4.2 %) | [1.9 ; 7.4] |
| Home via the emergency department | 74/238 (31 %) | [25 ; 37] |

Place of residence

| n/total (%) | IC 95 % |
|-------------|---------|
| Home, alone | 107/239 (45 %) | [38 ; 51] |
| With a partner | 67/239 (28 %) | [22 ; 34] |
| With family | 28/239 (12 %) | [7.8 ; 16] |
| Retirement home | 21/239 (8.8 %) | [5.4 ; 13] |
| Nursing home | 16/239 (6.7 %) | [3.7 ; 10] |

Antécédents

| Item | n/total (%) | IC 95 % |
|------|-------------|---------|
| cancer | 27/239 (11 %) | [7.4 ; 16] |
| Heart failure | 60/239 (25 %) | [20 ; 31] |
| Renal failure | 15/239 (6.3 %) | [3.4 ; 9.9] |
| Respiratory failure | 43/239 (18 %) | [13 ; 23] |
| Neurological disease | 23/239 (9.6 %) | [6 ; 14] |
| ADL Score ≥3 | 25/239 (10.5 %) | [6.9 ; 15.1] |

Knauss Score

| Item | n/total (%) | IC 95 % |
|------|-------------|---------|
| A | 15/239 (6.3 %) | [3.4 ; 9.9] |
| B | 143/239 (60 %) | [53 ; 66] |
| C | 68/239 (28 %) | [23 ; 39] |
| D | 13/239 (5.4 %) | [2.8 ; 8.9] |
| SAPS II | 53 ± 21 | [50 ; 56] |
| Invasive ventilation | 84/239 (35 %) | [29 ; 42] |
| Only NIV | 69/239 (29 %) | [23 ; 35] |
| Catecholamines | 79/239 (33 %) | [27 ; 39] |
| EER | 8/239 (3.3 %) | [1.3 ; 6.3] |
| Chirurgie | 19/239 (7.9 %) | [4.7 ; 12] |
| Nosocomial infection | 10/239 (4.2 %) | [1.9 ; 7.3] |
| Blood transfusion | 31/239 (13 %) | [8.8 ; 18] |
| Life-sustaining therapy withheld or withdrawn | 53/239 (22 %) | [17 ; 28] |
| Death in the ICU | 68/239 (28 %) | [23 ; 35] |
| Length of hospitalisation | 5.9 ± 6.1 | [5.1 ; 6.7] |

Table 2  ADL score before intensive care and at six months

| Item | Before hospitalisation | After 6 month | p |
|------|------------------------|---------------|-----|
| Item 1 (personal care) | 185 (77.4) | 60 (63.8) | 0.0168 |
| Item 2 (clothing) | 193 (80.8) | 70 (74.5) | 0.264 |
| Item 3 (toilet use) | 202 (84.5) | 75 (79.8) | 0.381 |
| Item 4 (transfers) | 204 (85.4) | 77 (81.9) | 0.541 |
| Item 5 (continence) | 219 (91.6) | 77 (81.9) | 0.001 |
| Item 6 (feeding) | 220 (92.1) | 90 (95.7) | 0.339 |
Table 3 Before ICU and 6 month later

| Place of residence before admission | Before ICU | 6 month later | p  |
|------------------------------------|------------|---------------|----|
| Alone                              | 107 (45.0%)| 41 (40.2%)    | 0.60|
| With a partner                     | 67 (28.2%) | 27 (26.5%)    |    |
| With family                        | 27 (11.3%) | 8 (7.8%)      |    |
| Retirement home                    | 21 (8.8%)  | 13 (12.7%)    |    |
| nursing home                       | 16 (6.7%)  | 9 (8.8%)      |    |

| ADL Score                          | 0.08       |
|------------------------------------|------------|
| ¡ 3 (dependant)                    | 40 (17%)   |
| Knauss Score                       | 0.43       |
| A                                  | 15 (6.3%)  |
| B                                  | 142 (59.7%)| 46 (54.1%)    |
| C                                  | 68 (28.6%) | 24 (28.2%)    |
| D                                  | 13 (5.5%)  | 5 (5.9%)      |

Table 4 Death at six months: risk factors

| Alive   | Dead   | p    |
|---------|--------|------|
| Gender (f) | 65 (58 %) | 47 (38.2 %) | 0.123 |
| age      | 87.56 ± 2.55 | 87.49 ± 2.55 | 0.815 |
| admission|         | 0.108 |
| Short hospitalisation | 39 (43.8 %) | 50 (56.2 %) |
| Mobile emergency service      | 34 (54.8 %) | 28 (45.2 %) |
| Rehabilitation department     | 5 (50 %)    | 5 (50 %)     |
| Emergency department          | 46 (63 %)   | 27 (37 %)    |
| Place of residence before admission | 0.0453 |
| Home, alone                    | 56 (53.8 %) | 48 (46.2 %) |
| With a partner                 | 41 (61.2 %) | 26 (38.8 %) |
| With family                    | 9 (33.3 %)  | 18 (66.7 %)  |
| Retirement home                | 13 (61.9 %) | 7 (33.3 %)   |
| nursing home                   | 5 (31.2 %)  | 12 (75.1 %)  |
| cancer                          | 14 (51.9 %) | 13 (6.25 %)  | 0.919 |
| Heart failure                   | 26 (43.3 %) | 34 (19.4 %)  | 0.0899 |
| Renal failure                   | 2 (13.3 %)  | 13 (5.91 %)  | 0.00157 |
| Respiratory failure             | 25 (59.5 %) | 17 (8.81 %)  | 0.333 |
| Neurological disease            | 12 (52.2 %) | 11 (5.19 %)  | 0.952 |
| ADL score before admission      | 5.12 ± 1.61 | 4.89 ± 1.86  | 0.312 |
| Knauss score before admission   | 0.733       |
| A                                 | 8 (53.3 %)  | 7 (46.7 %)   |
| B                                 | 77 (55.4 %) | 62 (44.6 %)  |
| C                                 | 32 (47.1 %) | 36 (52.9 %)  |
| D                                 | 7 (53.8 %)  | 6 (46.2 %)   |
| SAPS II                           | 45.34 ± 14.27 | 62.04 ± 24.15 | 0.0001 |
| catecholamines                   | 30 (38.5 %) | 48 (30.6 %)  | 0.002 |
| Surgery                           | 0.07 ± 0.26 | 0.1 ± 0.33   | 0.492 |
| Nosocomial infection              | 1 (10 %)    | 9 (4 %)      | 0.006 |
| Length of hospitalisation in ICU  | 5.43 ± 3.45 | 6.39 ± 8.06  | 0.235 |
| Invasive ventilation             | 31 (36.9 %) | 53 (35.1 %)  | 0.0003 |
| NIV only                          | 32 (28.5 %) | 34 (27.6 %)  | 0.99 |
| Renal dialysis                    | 3 (37.5 %)  | 5 (2.2 %)    | 0.379 |
Table 5 Log-binomial regression modeling risk factors

|                          | OR   | IC95 %          | p    |
|--------------------------|------|-----------------|------|
| Age                      | 0.92 | [0.80 ; 1.06]   | 0.27 |
| Gender (m)               | 1.97 | [0.95 ; 4.07]   | 0.07 |
| Lieu de vie avant         |      |                 |      |
| Alone                     | 1    |                 |      |
| With a partner            | 0.43 | [0.19 ; 1.00]   | 0.05 |
| With family               | 5.16 | [1.71 ; 15.60]  | 0.003|
| Retirement home           | 0.92 | [0.27 ; 3.17]   | 0.89 |
| nursing home              | 6.18 | [1.44 ; 26.59]  | 0.01 |
| Heart failure             | 1.63 | [0.70 ; 3.80]   | 0.25 |
| renal failure             | 11.56| [1.98 ; 67.53]  | 0.01 |
| SAPS II                   | 1.06 | [1.04 ; 1.08]   | 0.0001|
| Method of admission       |      |                 |      |
| Short hospitalisation     | 1    |                 |      |
| Mobile emergency service  | 0.50 | [0.20 ; 1.25]   | 0.14 |
| Rehabilitation department | 0.65 | [0.11 ; 3.86]   | 0.64 |
| Emergency department      | 0.25 | [0.10 ; 0.61]   | 0.002|
| Nosocomial infection      | 15.01| [1.40 ; 160.44] | 0.03 |
| catecholamines            | 0.88 | [0.37 ; 2.07]   | 0.76 |
| Length of hospitalisation (ICU) | 1.02 | [0.94 ; 1.10] | 0.63 |
patients included
238 patients

patients over 85 years
n = 241

Died in ICU
n=68

Died before 6 month
n=47

Alive at follow-up
n=123

Consent withdrawn n = 1
patient < 85 years n=1
cognitive impairment n=1

Consent withdrawn n = 3
In ICU

- Stay duration: $5.9 \pm 6.1$ days
- Invasive Ventilation: 36%
- NIV: 21%
- Vasopressor Drug: 33%
- RRT: 2%

Limiting care: 22%

Dead: 66%

Total dead: 29%

- Home: 84%
- Retirement home: 9%
- Nursing home: 7%