Acceptable long-term outcome in elderly intensive care unit patients

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ABSTRACT

INTRODUCTION: The number of elderly intensive care unit (ICU) patients is increasing. We therefore assessed the long-term outcome in the elderly following intensive care.
MATERIAL AND METHODS: The outcome status for 91 elderly (≥ 75 years) and 659 non-elderly (18-74 years) ICU patients treated in the course of a one-year period was obtained. A total of 36 of 37 eligible elderly survivors were interviewed about their health-related quality of life (HRQOL), social services and their wish for intensive care.
RESULTS: The mortality (54% at follow-up and 64% after one year) was higher in the elderly ICU patients than in non-elderly ICU patients (33% and 37%, respectively, p < 0.001) and than in the Danish background population ≥ 75 years (9%, p < 0.001). Elderly ICU survivors had significantly lower HRQOL scores in two of four physical domains and a lower physical component summary score than age-matched controls (38 (31-46) versus 43 (36-52), p = 0.01). However, ICU survivors scored like controls in three of four mental domains and higher than controls in "mental health" (p = 0.04). At follow-up, 89% had returned to live in their own home.
CONCLUSION: Elderly ICU patients had high long-term mortality rates and survivors had impaired physical function. Nevertheless, their mental function was in line with that of the background population and the majority had returned to their home and wished intensive care again.
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A growing proportion of the elderly in the general population and advancement in medical and surgical treatments collectively contribute to the observed increase in the number of elderly patients at intensive care units (ICU) [1-3]. As a consequence, more elderly are expected to survive intensive care, even though their long-term survival is known to be low with reported rates of 34% to 52% [1, 2, 4-8]. However, survival rates alone are not adequate or exhaustive means for describing the outcome of intensive care wherefore focus is increasingly paid to health-related quality of life (HRQOL) as a measure of treatment outcome [9]. Knowledge about HRQOL after intensive care may help improve patient manage-

ment, information to survivors and their relatives, as well as policy making and resource allocation [9, 10]. Studies on HRQOL in the elderly after ICU have previously been published, but inclusion rates have varied from 61-80% which may have affected their results [2, 4, 5, 7, 11]. We therefore studied the long-term outcome – measured by mortality and HRQOL – in elderly patients following intensive care.

MATERIAL AND METHODS

Patients

We identified all patients admitted to the general 18-bed ICU at Copenhagen University Hospital, Rigshospitalet, in the one year-period from 1 June 2007 to 31 May 2008 via the administrative and clinical database (Critical Information System, v. 1140, Daintel, Denmark). The hospital operates specialized ICUs for cardiology, neurosurgery and cardio-thoracic surgery, and patients admitted to these specialized ICUs were not included.

All patients aged ≥ 75 years at ICU admission were included as our primary study population (n = 91). ICU patients aged 18 to 74 years (n = 659) and all Danish citizens aged ≥ 75 years (n = 382,536, median age 79 years (interquartile ranges (IQR) 75-95 years), data from Statistics Denmark) served as comparison groups for mortality rates. Patients were excluded from the interview if they had moved abroad or had been admitted immediately after elective surgery. If readmitted, only data from the first admission were included.

Baseline patient characteristics

For all patients aged ≥ 75 years, we collected demographic and clinical information from the ICU database: Age, gender and severity of illness (simplified acute physiology score (SAPS II) and maximum sequential organ failure assessment (SOFA)). Furthermore, we registered the duration of mechanical ventilation, ICU length of stay (LOS), ICU mortality and mortality at follow-up from the Danish Hospital Database and the Danish National Patient Registry.

Data acquisition

We aimed at a median 12-month follow-up period after discharge allowing a range of 6-18 months. Data acquisi-

tion was done in January-February 2009. After consent, the interviews were done by telephone (n = 30), but six patients preferred to answer by written questionnaire. Proxies were not allowed to answer for the patient. To ensure consistent interviews and to optimize the questionnaires for an elderly population, the investigator tested these on six aged-matched Danish citizens and appropriate corrections were made before patient interviews were performed. The results were entered directly into a specific database (TietoEnator, Denmark).

Outcomes

1. Mortality: In all ICU patients, we registered ICU mortality, follow-up mortality and one-year mortality. Furthermore, in the primary study population (ICU pa-

FIGURE 1

Study cohort.

ICU = Intensive care unit

tients ≥ 75 years), we registered hospital mortality and readmissions to ICU and hospital. Also, we determined the cause of death (data from the Danish Board of Health) in the elderly ICU patients.

2. HRQOL: We used the short-form (SF) 36 [12] which assesses four domains of physical health and four domains of mental health. Each of the 36 questions transfers into a weighted score that has a minimum of zero and a maximum of 100 points with a higher score indicating a better HRQOL. The SF-36 has two summary scores – a physical and a mental component score – that are calculated from the eight domains. Also, patients were asked to rate their present physical and mental status by comparing it to their status before the ICU admission. Patients were given the options of better, unaltered or worse.

3. Domicile type: Was provided as one of three categories: own home, protected housing/with family or nursing home.

4. Level of home-based public social service: The level was categorized in accordance with the Social Service Department of Copenhagen Council: weekly visit, single daily visit or multiple daily visits.

5. Willingness to receive intensive care again: The patients were asked if they would be willing to receive intensive care again if necessary. They were asked to answer: yes, no or do not know. If "no" was chosen, the patients were asked to reflect on the answer (data not shown).

Ethics

Patients were interviewed after giving their consent to participate. Danish law exempts database studies and questionnaire surveys from ethical board approval. The study was approved by the Danish Data Protection Agency.

Statistics

Data are given as number of patients (%) or medians (IQR)). Where proportions were not tested against a control group, we have provided 95% confidence intervals (CI). Mann-Whitney U-, χ^2- and Fisher's exact tests were used to analyze demographic data. The results of the SF-36 questionnaire were analyzed using Wilcoxon's Signed-Rank test and Spearman's rho test for correlations. $p < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS software version 15 (SPSS Inc., Chicago, USA) or Prism v. 4.00 (Graph Pad, San Diego, USA).

Trial registration: not relevant.
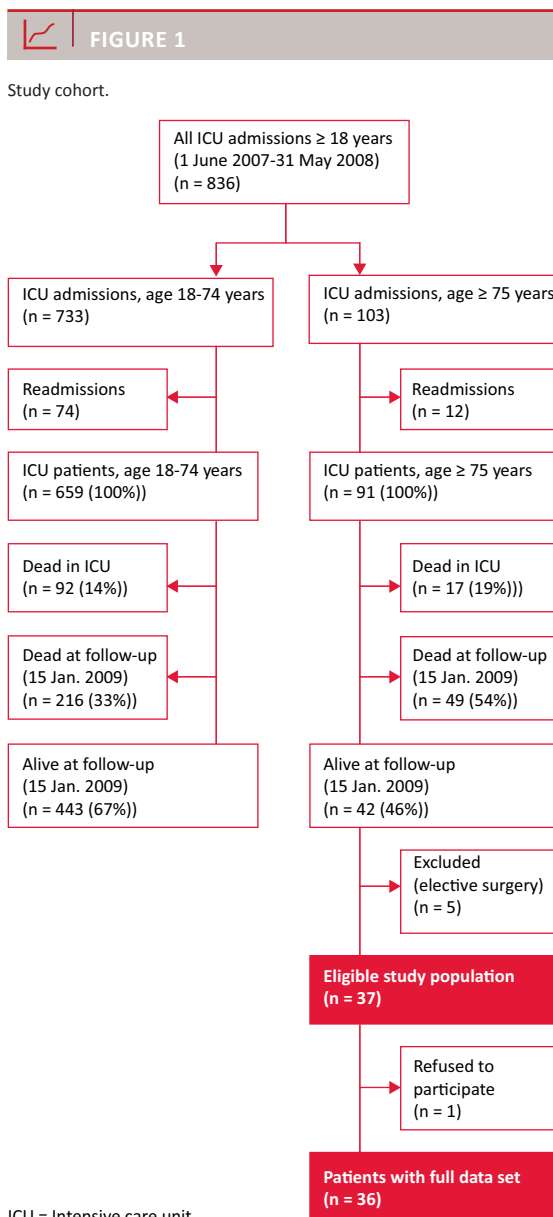
RESULTS

Patient characteristics

During the one-year study period, 836 admissions of patients aged ≥ 18 years were registered at the ICU (**Figure 1**). After excluding readmissions, we had a study population consisting of 659 non-elderly patients (aged 18-74 years) and 91 elderly patients (aged ≥ 75). There were no differences in follow-up time (a median of 384 days in elderly ICU population versus a median of 407 days in non-elderly ICU patients, p = 0.32) between the two groups, but the elderly patients had a significantly higher age (79 years versus 56 years, p < 0.001) and SAPS II (48 versus 43, p < 0.001) on admission than the non-elderly patients. Between the two groups, there were no significant differences in male gender distribution (56% versus 63%, p = 0.22), ICU-LOS (two versus two days, p = 0.82) or need for mechanical ventilation (80% versus 79%, p = 0.86).

Mortality and causes of death

Mortality at follow-up (54% versus 33%, p < 0.001) and at one year (64 vs. 37%, p < 0.001) were significantly higher among elderly than among non-elderly patients. In contrast, ICU-mortality was not significantly different between the two groups (19% versus 14%, p = 0.23). The elderly ICU patients had a significantly (p < 0.001) higher one-year mortality rate (64%) than the Danish background population in 2007 (9%). Data on causes of death and re-admissions are outlined in **Figure 2**.

In the primary study population (ICU patients ≥ 75 years), 37 ICU-survivors were eligible for interview. A single patient refused to participate, but the remaining 36 elderly ICU survivors completed the investigation with full data (inclusion rate of 97% (95% CI 92-100)).

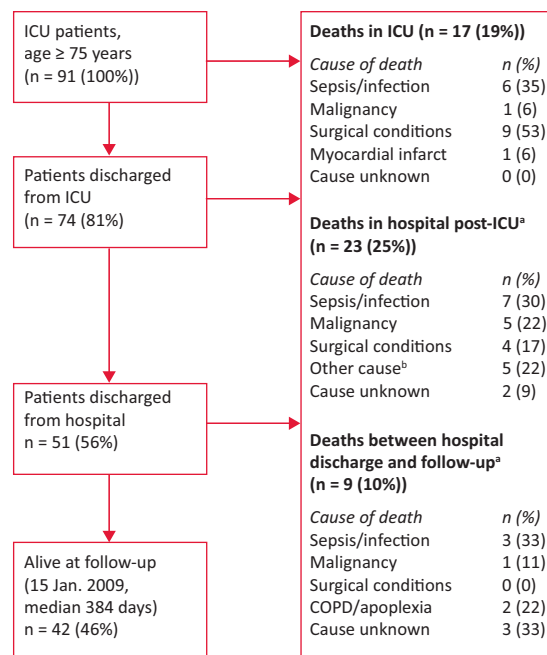### Health-related quality of life

In comparison with an age-matched Danish background population, the elderly ICU survivors scored significantly lower in two of four physical domains and in the physical component summary score (**Table 1**). In contrast, the elderly ICU survivors scored significantly higher in the domain of mental health compared with general population controls. In the remaining three mental domains and the mental component summary score, the elderly population did not differ from controls (Table 1).

Additional outcomes

At follow-up, most elderly ICU survivors had returned to live in their home, but the rate living independently of home-based public social service had decreased (**Table 2**). Data on changes in self-rated physical and mental health are also given in Table 2.

FIGURE 2

Mortality in elderly intensive care unit patients ≥ 75 years.

ICU patients, age ≥ 75 years (n = 91 (100%))

→ **Deaths in ICU (n = 17 (19%))**

Cause of death	n (%)
Sepsis/infection	6 (35)
Malignancy	1 (6)
Surgical conditions	9 (53)
Myocardial infarct	1 (6)
Cause unknown	0 (0)

Patients discharged from ICU (n = 74 (81%))

→ **Deaths in hospital post-ICU[a] (n = 23 (25%))**

Cause of death	n (%)
Sepsis/infection	7 (30)
Malignancy	5 (22)
Surgical conditions	4 (17)
Other cause[b]	5 (22)
Cause unknown	2 (9)

Patients discharged from hospital n = 51 (56%)

→ **Deaths between hospital discharge and follow-up[a] (n = 9 (10%))**

Cause of death	n (%)
Sepsis/infection	3 (33)
Malignancy	1 (11)
Surgical conditions	0 (0)
COPD/apoplexia	2 (22)
Cause unknown	3 (33)

Alive at follow-up (15 Jan. 2009, median 384 days) n = 42 (46%)

ICU = intensive care unit; COPD = chronic obstructive pulmonary disease.
a) In the group of patients discharged from initial ICU admittance but dead at follow-up (n = 32), eight (25%) patients were readmitted to the ICU – all of these patients died in hospital but after ICU redischarge. A total of seven (22%) patients were readmitted to hospital. The median number of readmission days was zero (0-7). We only included a hospital readmission if the patient had been discharged to his/her own home and was then readmitted to hospital. In contrast, all ICU readmissions were included (even if the patient had not been discharged to his/her own home before being readmitted to the ICU).
b) Other causes of death: apoplexia, COPD, uraemia, diabetes and myocardial infarct.

DISCUSSION

In this study, we found that elderly ICU patients had a high long-term mortality in comparison with both non-elderly ICU survivors and with the Danish background population of comparable age. In terms of HRQOL, the elderly ICU survivors had impaired physical function compared with an age-matched Danish background population, and 56% rated their physical status at follow-up as worse than before their ICU admission. In accordance with this, the proportion of elderly ICU survivors who were independent had decreased from 75% pre-ICU to 47% post-ICU. However, the majority of elderly ICU survivors had returned to live in their homes at follow-up and their mental function was comparable to that of the background population. The vast majority (89%) would be willing to undergo ICU treatment again if necessary.

Mortality

In the present study, we found that ICU mortality in the elderly ICU patients (19%) was comparable to that reported in previous studies in which ICU mortality rates

📋 **TABLE 1**

SF-36. Physical and mental domains and physical and mental component summary scores of the SF-36 of long-term intensive care unit survivors ≥ 75 years and age-matched controls (data from the Danish SF-36 manual). Data were expressed as medians (interquartile ranges) and analyzed using Wilcoxon's signed-rank test.

	Included ICU-survivors ≥ 75 years (n = 36)	Age-matched controls (n = 229)	Difference (ICU-survivors vs controls)	p value
Physical function	60 (30-80)	65 (43-85)	−5	0.04
Role physical	25 (0-50)	50 (0-100)	−25	0.007
Bodily pain	73 (51-100)	74 (51-100)	−1	0.37
General health	65 (46-79)	62 (47-77)	+3	0.42
Physical component summary score	38 (31-46)	43 (36-52)	−5	0.01
Vitality	68 (48-85)	60 (40-80)	+3	0.14
Social function	100 (81-100)	100 (63-100)	0	0.39
Role emotional	67 (33-100)	67 (33-100)	0	0.21
Mental health	92 (72-96)	80 (64-96)	+12	0.04
Mental component summary score	58 (49-64)	55 (46-62)	+3	0.25

ICU = intensive care unit

in elderly patients varied from 11-31% [1-4]. In contrast, the hospital mortality of the present study (44%) was markedly higher than that of previous studies (12-33%) [1-4]. The mortality rates at follow-up (54%) and after one year (64%) were higher than those of observed by Mahul et al [13] and Rockwood [8] (both 49% at one year). These differences in mortality rates may be explained by differences in age limits (the definition of "elderly" varied from 65-80 years), population composition and methodology; differences which hamper exact comparison. When comparing the one-year mortality in the Danish background population ≥ 75 years (9%) with the one-year mortality in our ICU population (64%), we found a 55% difference in mortality.

The two groups were comparable with regard to age, but not to gender composition (56% males in the elderly ICU population versus 38% males in the background population). Given the comparable distribution in age between the two groups, we find it unlikely that this large difference in mortality is caused by the difference in sex distribution alone. This suggests that there is a markedly increased risk of death in an elderly ICU population in comparison with the age-adjusted background population.

Health-related quality of life
ICU survivors generally have a lower HRQOL than age-matched populations [5, 14]. However, elderly ICU survivors have a tendency to assess their perceived health as good or satisfactory even though they generally have a decreased physical function compared with their own pre-admission status and with community controls [2, 7, 14, 15].

The present study supports these findings as elderly ICU survivors had lower scores in the domains of physical function, but similar scores in the domains of mental function as an age-matched background population. As suggested by others, this somewhat surprising finding may be explained by the fact that a lower functional status in the elderly may be accompanied by lowered expectations and a preserved or raised subjective assessment of HRQOL [15]. Interestingly, this trend does not seem to apply to younger ICU survivors [8, 16].

📋 **TABLE 2**

Additional outcome measures. Additional outcome measures of the 36 included intensive care unit survivors ≥ 75 years. Data are expressed as numbers (%) and analyzed using Fisher's exact test.

	Status related to ICU			Self-perceived status at follow-up compared with pre-admission status				Willingness to receive intensive care again if necessary			
	pre-ICU admission	post-ICU discharge	p value	worse	unaltered	better	p value	yes	no	do not know	p value
Domicile type											
Own home	34 (94)	32 (89)	0.34	–	–	–	–	–	–	–	–
Protected housing or with family	1 (3)	1 (3)	0.51	–	–	–	–	–	–	–	–
Nursing home	1 (3)	3 (8)	0.31	–	–	–	–	–	–	–	–
Home-based public social service											
No service	27 (75)	17 (47)	0.01		–	–	–		–	–	–
Weekly visit	6 (17)	12 (33)	0.04	–	–	–	–	–	–	–	–
Single daily visit	1 (3)	2 (6)	0.50	–	–	–	–	–	–	–	–
Multiple daily visits	2 (6)	5 (14)	0.21	–	–	–	–	–	–	–	–
Self-perceived physical status	–	–	–	20 (56)	13 (36)	3 (8)	0.16[a]	–	–	–	–
Self-perceived mental status	–	–	–	8 (22)	25 (70)	3 (8)	< 0.001[a]	–	–	–	–
Willingness	–	–	–	–	–	–	–	32 (89)	2 (6)	2 (6)	< 0.001[b]

ICU = intensive care unit.
a) unaltered/better vs worse.
b) yes vs no/do not know

Domicile type

As for post-ICU domicile type, we found that 89% had returned to live in their home. This again supports the findings of Mahul et al [13] (88% returned to home), Merlani et al [4] (81%) and Kaarlola et al [2] (97%). In the present study, the proportion who were independent decreased from 75% pre-ICU to 47% post-ICU. However, among the 47%, only 20% were dependent on single/ multiple daily visits, while 33% received weekly visits. This signifies that even though limited compared with pre-ICU status, 80% of the elderly ICU survivors were still relatively independent.

Intensive care again

In previous studies, when ICU survivors have been asked if they would undergo ICU treatment again if necessary, 75-93% said yes [4, 7, 8]. Our data support these findings, as 89% of the elderly ICU survivors would be willing to receive intensive care again.

Design differences

There are differences in designs of previous studies assessing long term outcome and HRQOL in terms of the definition of "elderly" (ranging from ≥ 65 to ≥ 80 years), time to follow-up, whether patient or proxy had responded and, finally, what scale of HRQOL had been used [2-4, 6, 7, 13-15]. These considerable differences in study design complicate comparison between studies.

With regard to age, we chose to define elderly patients as ≥ 75 years of age (defining 12% of our adult ICU population as elderly). Also, this age limit matches the oldest control group of the SF-36 [17].

We aimed at – and obtained – a median 12-month follow-up period after discharge allowing a range of 6-18 months, as both Konopad et al [16] and Mahul et al [13] have reported that after the first six months, the changes in HRQOL were minor. In previous HRQOL-studies, follow-up time varied from one month to seven years [2, 4, 9] with the majority of studies assessing long-term outcome at six [18] or 12 months [5, 16].

We chose SF-36 because it is a generic HRQOL instrument that has been demonstrated to have reliability and validity in ICU populations [19]. Importantly, there exists a transculturally adapted and validated Danish version of the SF-36 with data from healthy Danish citizens that allowed us to compare our ICU population with a normal age-matched population.

Strengths and limitations

The strengths of this study are that we had well-defined groups of patients and data from electronic databases and national registries in which data had been entered prospectively. Furthermore, we obtained full follow-up for all patients, the inclusion rate was high (97%), data

Elderly patient at the intensive care unit.

sets were 100% complete and the reliability of the questionnaires was high (no proxy answers).

The limitations of the present study include the single-centre setting and the relatively small group of elderly ICU survivors eligible for an interview. Given these limitations, a more definitive study should be performed including patients from multiple centres and countries, multiple HRQOL-analyses at three, six and 12 months and cost-effectiveness analyses.

Perspective

One could argue that our findings – despite low survival rates – indicate that ICU treatment for the elderly is worthwhile. This contrasts with the fact that both physicians and close relatives often seem to underestimate the elderly patient's wish for life-sustaining treatment [10, 20]. Furthermore, older age has been found to be associated with lower resource intensity, lower hospital costs and higher rates of withholding of life-sustaining treatments [20]. Based on our findings and those of others [3, 6], we argue that old age in itself is not an appropriate criterion for restriction of ICU admission [2, 14, 15], and that high-dependency care for the elderly is worthwhile [7].

CONCLUSION

The elderly ICU patients had high long-term mortality rates and survivors had impaired physical function. In contrast, their mental function was in line with that of the background population and the majority had returned to their home. In accordance with these results, most elderly ICU survivors would be willing to undergo intensive care again. The results of our study suggest that the elderly may have a decent life after intensive care.

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