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ORIGINAL ARTICLE

Outcome in patients with long-term treatment in a surgical intensive care unit

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Abstract

Background This study aimed to evaluate the outcome of patients with abdominal, thoracic or vascular operations and long-term intensive care unit (ICU) treatment.

Patients and methods The present retrospective observational cohort study was performed at the authors' surgical ICU at the Marburg University Medical Centre. All patients who stayed at the ICU longer than 48 h and underwent visceral, thoracic or vascular surgery between January 2005 and December 2006 were retrospectively analysed. Patients with an ICU stay of 20 or more days were defined as the long-term study group. Clinical variables were tested for prognostic value.

Results In 2 years, 852 patients were treated at the intensive care unit. Follow-up was available in 502 patients, with 219 patients treated for two and more days and a median of 16.4 days. Sixty-seven long-term patients were compared to 152 (69.4 %) patients treated between 2 and 20 days. Overall survival after 12 months was 50.2 % (110/219), while 65.8 % (144/219) were discharged from ICU.

Older age, longer treatment at the ICU and increased simplified acute physiology score (SAPS) at admission were associated with decreased 12-month survival, while no statistical differences were observed for the underlying and malignant disease by univariate analysis.

The risk of death was 29, 56 and 61 % for patients treated 2–4, 5–19 and ≥20 days at the ICU. Decreased survival of patients treated for 5–19 and ≥20 days were confirmed by logrank test ($p=0.001$).

Conclusions Patients with long-term ICU stay showed decreased survival than patients who are treated less than 5 days but similar survival as patients which stayed between 5 and 19 days. Malignant disease is not associated with an unfavourable 12-month survival while older age, higher SAPS index at discharge and longer stay at ICU are. Long-term ICU survivors have no increased risk to succumb after discharge from ICU.

Keywords ICU · Outcome · Survival · Prolonged stay · Surgery

Nina Weiler and Jens Waldmann contributed equally to this study.

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Introduction

Intensive care units (ICUs) have increased in availability in Germany over the last 15 years [1]. Along with the enhanced density of ICU, the proportion of long-term patients have also increased. Promoted by the advanced age of the general population in Europe and USA, the mean age of ICU patients also has increased [2, 3]. Furthermore, progress in medicine qualifies older and multimorbid patients for general anaesthesia and major surgery [4–8].

Outcome in ICU is mainly determined by the severity of the underlying disease [9, 10]. Older patients showed surprisingly a favourable outcome and an acceptable quality of life if they survived the hospital stay [11]. In consequence of postoperative complications and ventilator-associated morbidity, intensive care unit stay prolong in a considerable subset of patients [12–14]. However, the impact of a prolonged ICU stay on survival prognosis is not well established in patients who underwent general surgery, as majority of the studies assess patients after cardiac surgery

[15–21]. Only preliminary data exist on ICU patient outcome after a major general surgery, and moreover, data on long-term ICU patients from a surgical ICU rarely have been published [22, 23]. Nevertheless, considering an effect of the underlying disease, it becomes rational to focus on surgical patients to draw the proper conclusions.

The definition of long-term treatment in ICU varies considerably from 5 and 14 days but shares common high mortality rates [16]. Some studies extend the definition of long-term ICU treatment beyond 28 days [15].

Although earlier studies on long-term outcome of critical ill cancer patients reported high mortality rates, both advances in treatment for malignancies and for organ failure have improved the prognosis of cancer ICU patients significantly [24]. The present retrospective study evaluated the outcome of a consecutive cohort of ICU patients after general surgery on a surgically managed ICU with special regard to prognostic variables and duration of ICU treatment.

Patients and methods

Study cohort The present study included all consecutive patients admitted immediate postoperatively or after complications, in postoperative course, occurred to the surgically managed ICU of the authors' department between January 2005 and December 2006. Patients' data were prospectively observed and retrospectively analysed. Data comprised baseline demographic data, diagnosis at admission, simplified acute physiology score II (SAPS II) at admission and discharge, duration of ICU stay, mortality in ICU and causes of death. Furthermore, mortality within 30 days and between 30 days and 1 year after discharge was evaluated. The diagnoses which lead to admission were abdominal pathologies (such as colon carcinoma and diverticulitis), thoracic surgery (such as resection and empyema), vascular surgery (such as major amputation and abdominal aortic aneurysm) and minor surgery in multimorbid patients.

Study design Prolonged stay in ICU was defined as a continuous stay of 20 or more days. If the same patient was admitted to ICU twice or more between January 2005 and December 2006, only the longest uninterrupted stay was included. Follow-up was acquired 1 year after discharge from ICU considering outcome defined by survival or death. Information on patients was obtained from the clinical patient data system. "Sign of life" was re-admittance to the hospital or to outpatient clinic as well as treatment at a different hospital. If no information on hospital contact or in-hospital death could be obtained, rehab hospitals and attending physician were interviewed. Patients with incomplete data were omitted from the study cohort.

Statistics Statistical analysis was performed using statistical software (SPSS 17.0). Continuous, normally distributed variables are reported as average ± standard deviation; the other metric variables as median with range.

Continuous, normally distributed variables were analysed using the Student's t test. The other metric variables were tested for significance by univariate analysis (ANOVA). Categorical data were analysed by Kruskal–Wallis test. Survival was analysed using Kaplan–Meier and was confirmed by logrank test. Statistical significance was defined as $p \leq 0.05$.

Results

Demographics A total of 853 patients were admitted to the authors' ICU from January 2005 to December 2006. Follow-up was available in 502 patients, with 219 patients treated for more than 2 days and a median of 16.4 (2–138) days. Groups were defined according to the duration of ICU treatment in 2–4, 5–19 and ≥20 days and reasons for prolonged stay. Patients with a stay of 2–4 days needed to be attended longer because of extended operative procedure or cumulative comorbidities. Patients treated for 5–19 days were patients who acquired postoperative complications

Table 1 Demographics of the ICU patients' cohort

	All patients (n=502)	Patients with stay less than 2 days (n=283)	Patients with stay of 2, 3 or 4 days (n=65)	Patients with stay of 5 to 19 days (n=87)	Patients with a stay of 20 or more days (n=67)
Median age	68 (15–97)	67 (15–97)	68 (19–97)	70 (17–94)	71 (20–92)
Average age	65.3±14.7	64.2±14.8	65.6±15.3	66.9±14.7	67.5±13.1
Male/female	332:170	190:93	41:24	57:30	44:23
Malignant disease	197	123	19	34	21
Median length of stay	1.5 (0–138)	0.9 (0–1)	3.0 (2–4)	9.7 (5–19)	31.1 (20–138)
Median SAPS on admission	33 (4–86)	24 (8–86)	32 (7–60)	41 (12–81)	38.5 (4–74)
Median SAPS at discharge	30 (6–103)	24 (8–86)	29 (9–71)	39 (8–103)	36 (6–91)
Patients died within 1 year	150	41	19	49	41

such as pneumonia or temporary postoperative renal insufficiency. Patients treated for 20 or more days are patients who acquired more than one complication and needed long-term respiratory support. Details are shown in Table 1. Of long-term ICU patients with a stay of 20 or more days, 65.7 % (44/67) were admitted to the hospital in case of emergency.

Survival After 12 months, overall survival was 50.2 % (110/219), while 65.8 % (144/219) were discharged from ICU. Median survival of succumbed patients was 30 (3–343) days. Although the majority of non-survivors died in ICU (75/68.8 %), a significant subgroup died within 30 days after discharge (18/16.5 %) or within the first year (16/14.7 %). Patients in the present study died for various reasons. The most common causes of death for all ICU patients were pneumonia (21.1 %), sepsis of unknown origin (18.3 %) and intestinal leakage (13.8 %) (see Table 2).

Survival and duration of ICU stay The risk of death was 29.2 % (19/65), 56.3 % (49/87) and 61.2 % (41/67) for patients treated 2–4, 5–19 and 20 and more days at the ICU (p=0.001, see Fig. 1). Consequently, survival in patients who stayed for 5–19 or ≥20 were not statistically different (p=0.653). Patients with 20 days and more stay in ICU compared with all patients which were treated less than 20 days showed decreased survival (226.3±242.0 versus 422.15±393.0, p=0.03).

Furthermore, deaths were distributed differently among the three groups. Patients which were treated for 5–19 or ≥20 days died more frequently in ICU (38/49, 77.6 %; 29/41, 70.7 %) than the group which was treated for 2–4 days (8/19, 42.1 %, p=0.000). The risk to succumb after discharge from ICU assimilated for all patients (p=0.192, see also Fig. 2).

Table 2 Causes of death in all ICU patients

Cause of death	Number	Percentage
All	109	100
Pneumonia	23	21.1
Sepsis of unknown origin	20	18.3
Intestinal leakage, obstruction, ischemia	15	13.8
Myocardial infarction	10	9.2
Bleeding	7	6.4
Other	5	4.6
Liver failure	4	3.7
Peripheral ischemia	2	1.8
Pulmonary embolism	2	1.8
Stroke	2	1.8
Unknown	19	17.4

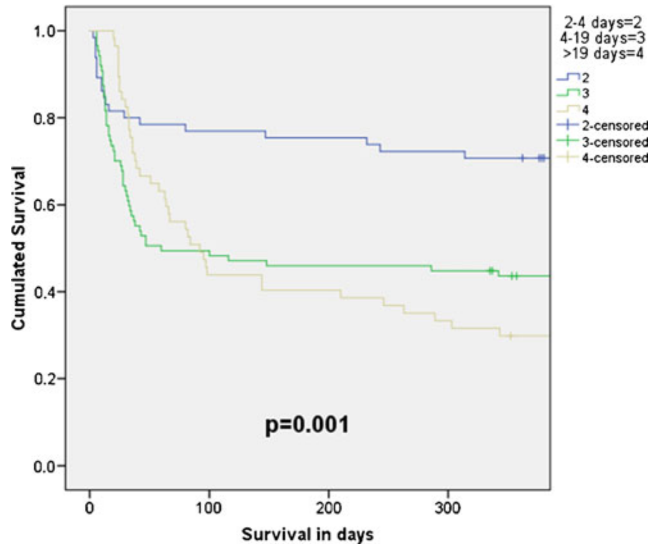

Fig. 1 Survival of all ICU patients (n=219). Kaplan–Meier survival curve

Prognostic factors At univariate analysis, advanced age (p=0.002), longer treatment at the ICU (p=0.04) and increased SAPS at admission (p=0.000) and discharge (p=0.000) were associated with decreased 12-month survival (see also Table 1). Neither the presence of malignancy (p=0.155) nor the underlying disease (see Fig. 3) which has led to the admission revealed to have impact on the 12-month survival when analysed for the entire patient cohort.

Female gender was a negative predictor of outcome in patients with a stay of 5–19 days (p=0.007, 230±360 versus 420±409 days) which was confirmed by logrank test. In all other patients, gender had no influence on survival (see

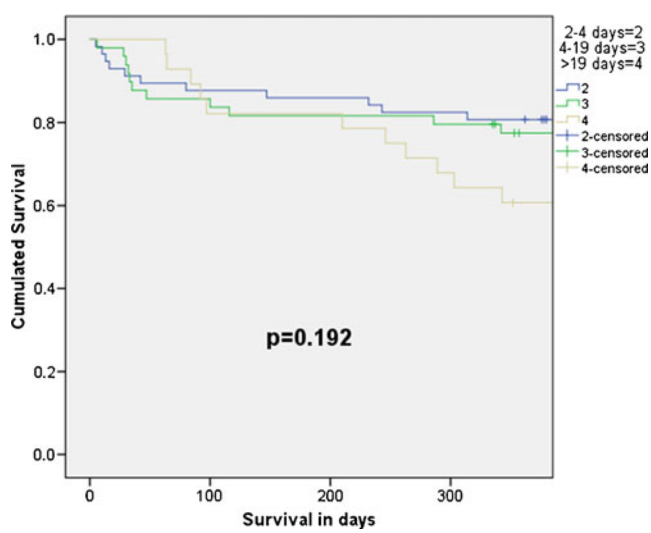

Fig. 2 Risk to succumb after discharge from ICU. Kaplan–Meier survival curve for patients who survived in ICU

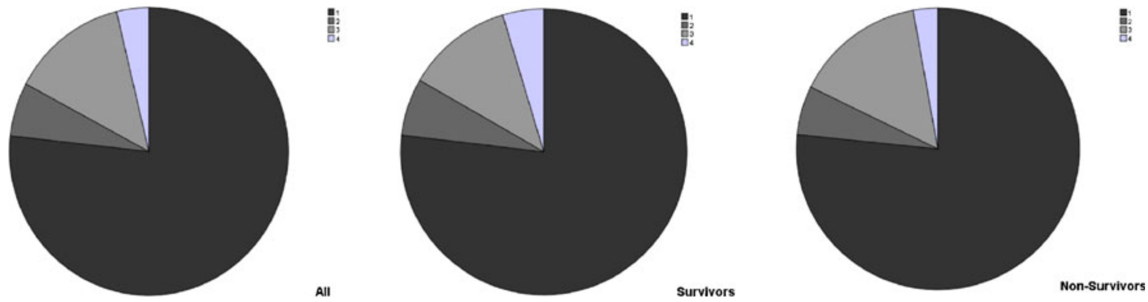

Fig. 3 Underlying diseases and risk of death (p=0.965). *1* abdominal pathologies, *2* thoracic surgery, *3* vascular surgery, *4* general surgery

Fig. 4). However, malignant disease was not associated with decreased survival in any subgroup.

The SAPS score at discharge was a robust predictor of overall survival and in each group analysed individually (p=0.000, see also Table 1). In patients with a stay of 2 to 4 days, the SAPS score at admission was equally distributed in survivors and non-survivors, but in patients staying 5 to 19 days and patients staying 20 and more days, high SAPS at admission was a negative predictor of outcome (p=0.000, p=0.039).

Discussion

The definition of a prolonged ICU stay of 20 and more days was based on previous studies with a similar design [15]. Surprisingly, a decrease in survival sets in with a stay of 5 and more days. Other studies operate with various definitions for "long-term" patients ranging from 48 h to 30 days which complicates the comparability of studies [13, 15, 16, 22, 25, 26]. Heimrath et al. showed a deterioration of outcome for patients staying 48 h in ICU confirming that even a brief extension of ICU stay worsens the survival [16]. We observed 12-month survival rates of 71, 44 and 39 % for patients which were treated 2–4, 5–19 or ≥20 days at ICU. The overall 12-month survival of the present ICU cohort was similar to previously published studies with mixed surgical cohorts, although the definition of long term may vary [13, 22, 27]. Friedrich et al. demonstrated a 50 % 6-month survival rate for long-term ICU patients with a stay in ICU of at least 30 days [15]. However, the risk to succumb in ICU was higher in long-term patients and seems to be consistent with previously published data [28]. The mortality rate in the present long-term patient cohort after discharge from ICU appears to be similar than previously reported with a trend to improved outcome after surviving the acute illness [29]. The present study confirmed that long-term ICU survivors have no unfavourable outcome compared to "short-term" ICU survivors [17, 27].

Malignant disease was not associated with an unfavourable 12-month survival in all ICU patients while older age, longer stay and higher SAPS index at admission and discharge showed a decreased survival. The long-term survival analyses did not include the quality of life of the surviving patients. Even though this represents a crucial aspect of long-term survival, the primary approach was to investigate long-term survival in a cohort of surgical patients to allow the comparison between short- and long-term stay [25].

The present study reveals a number of limitations. Data are generated from a single centre and therefore reflect a distinct treatment pattern. Another issue might be the handling of treatment limitation which most certainly affects patient outcome. The design of the retrospective cohort study harbours several limitations as selective bias, etc. Furthermore, the number of patients per group was relatively small. The incomplete follow-up of over 300 patients has substantially contributed to decrease the total number of included patients.

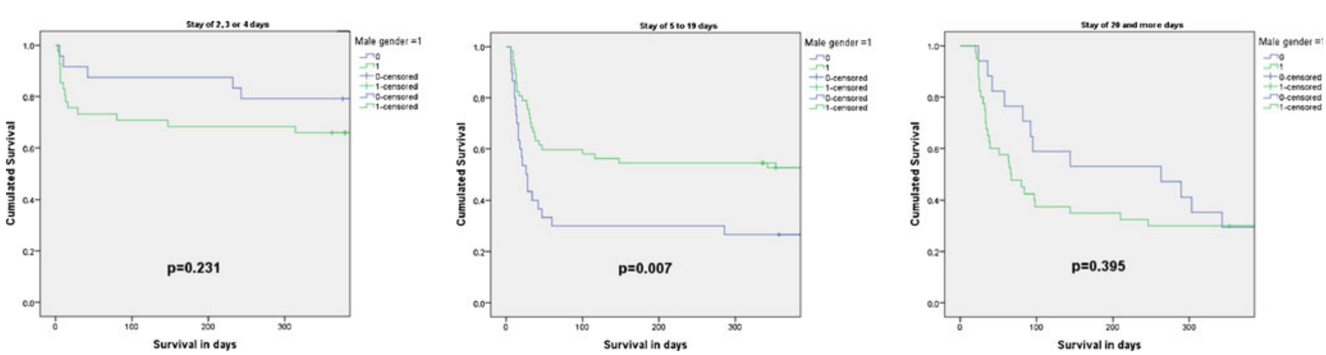

Fig. 4 Gender and risk of death. Kaplan–Meier survival curve

In the background of an incomplete understanding for the consequences of long-term ICU treatment and its late mortality, clinical predictors of long-term survival provide useful tools. Previous studies in long-term ICU cohorts have identified clinical variables to predict outcome [14, 30, 31]. Age, immunocompromise, >90 ventilator days, renal failure after 30 days in ICU, SAPS score at admission and malignant disease have been reported to be reliable survival predictors [15, 22, 23]. In the present study age, SAPS at admission and discharge as well as the duration of ICU stay were significantly increased among ICU non-survivors. However, gender was an inconsistent predictor of survival and malignant disease was not associated with decreased survival in this study.

Conflicts of interest None.

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