European Journal of Internal Medicine 69 (2019) 71–76

Contents lists available at ScienceDirect

European Journal of Internal Medicine

journal homepage: www.elsevier.com/locate/ejim

Original Article

The chronic ICU patient: Is intensive care worthwhile for patients with very prolonged ICU-stay (≥ 90 days)?

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ARTICLE INFO

Keywords:
Chronic critically ill
ICU
Prolonged ICU stay
Mortality
Persistent critical illness

ABSTRACT

Background: Due to medical advances, an increasing number of patients are surviving the acute critical illness. However, some patients require a prolonged critical care treatment. Data on outcome and functional status of patients with an ICU-stay ≥90 days are scarce.
Methods: Single-center retrospective study including all adult patients with ICU stay ≥90 days treated at the department of intensive care medicine at the university medical center Hamburg-Eppendorf, Germany, between January 1st 2008 and December 31st 2016.
Results: Out of 65,249 patients, we identified 96 (0.1%) patients with a very prolonged ICU stay. Median age was 61 (49.8–67) years, 30 (31%) patients were female. Patients were admitted to ICU due to abdominal (28%) reasons, followed by sepsis (23%) and transplantation (15%). Fourteen patients received organ-transplantation: 9 received liver-, 4 lung- and 1 heart-transplantation. All patients needed mechanical ventilation (MV), median duration was 74.1 (55–95.1) days. Sixty-Three (66%) patients survived the ICU-stay and 1-Year survival rate was 28%. Overall eight (8%) patients had a favourable outcome after 1-Year. Severity of illness (SOFA, SAPS II) on admission were comparable. Length of MV, use of renal replacement therapy (both $p < .01$) and maximum lactate (5.3 vs 11.5 mmol/l; $p < .001$) were significantly higher in ICU non-survivors. ICU-stay was significantly longer in ICU non-survivors (137 vs 107 days; $p < .05$). Cox-regression-model revealed age (HR 1.02, 95% CI 1.00–1.04, $p < .05$) and surgical admission (HR 0.50, 95% CI 0.28–0.90, $p < .05$) as independent predictors of 1-year mortality.
Conclusions: Only a small number of patients requires a very prolonged ICU stay. Two-third of patients survive the ICU stay and about one-third 1-Year. However, about 10% of patients have a remarkable recovery with a favourable overall outcome after 1-Year.

1. Background

The critical care management has improved substantially in the last decades. These advances are responsible for increasing survival rates in acute critical illness [1]. However, there is a rapidly growing population of patients requiring a prolonged intensive care treatment [2,3]. For this population the term "chronically critically ill" (CCI) was first described in 1985 [4]. The cohort of CCI patients is characterized by patients who survive the acute critical illness, but remain further dependent on intensive care treatment [4]. These patients are neither dying during the critical illness, nor recovering completely after the initial critical illness period. Further, they have a persistent organ dysfunction with need for critical care management [3–5]. This group of patients is very heterogeneous, earlier definitions used different lengths of ICU stay, need for prolonged mechanical ventilation (MV) or placement of tracheostomy. Due to the heterogeneity a common consensual definition currently does not exist [5]. In our cohort we chose to use a duration of ≥90 days in the ICU to define CCI in analogy to the

Abbreviations: BMI, Body mass index; CCI, Chronically critically ill; CCo, Charlson comorbidity index; ECMO, Extracorporeal membrane oxygenation; ICU, Intensive care unit; IQR, Interquartile range; LVAD, Left ventricular assist device; MV, Mechanical ventilation; OPC, Overall performance category; PDMS, Patient data management system; RRT, Renal replacement therapy; SAPS II, Simplified acute physiology score II; SOFA, Sequential organ failure assessment

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https://doi.org/10.1016/j.ejim.2019.08.024
Received 7 July 2019; Received in revised form 26 August 2019; Accepted 27 August 2019
Available online 04 September 2019
0953-6205/

definition of chronic kidney disease [6], where a duration of > 90 days delineates a chronic organ dysfunction.

The real incidence of CCI is unknown, estimates indicate that there are 100,000 CCI patients in the US per annum [3]. Due to different factors the population is ageing [7], earlier studies found age as risk factor for CCI [2,3,8]. Especially prolonged MV or length of ICU stay are associated with unfavourable long-term survival and quality of life [9–11]. Functional outcome after prolonged critical illness is worse and often persistent after CCI [10]. Mortality rates of up to 50% were described in patients with CCI and exceed most malignancies [2,3]. Besides the treatment and outcome also socioeconomic factors play an important role [2]. Discussion about limitation of therapy and futility in CCI patients are controversial in patients with a very prolonged ICU stay [3,12,13].

However, specific clinical characteristics and outcome of patients with a very prolonged ICU stay (≥ 90 days) are unknown. Therefore, the aim of the study was to investigate ICU-characteristics and outcome of patients with an ICU stay ≥90 days.

2. Methods

Following institutional approval, we undertook a single-centre retrospective observational cohort study at the University Medical Centre Hamburg-Eppendorf (Germany). All patients admitted to the department of intensive care medicine between January 1st 2008 and December 31st 2016 with an ICU stay ≥90 days were included in this study. We excluded all patients with a discontinuous ICU stay, ICU stay < 90 days or patients below an age of 18 years. Eligible patients were identified from our electronical data management system (PDMS, Integrated Care Manager® (ICM), Version 9.1 – Draeger Medical, Luebeck, Germany). We reviewed all patient charts of eligible patients and focused on baseline characteristics and complications during ICU stay. The extracted data included age, gender, comorbidities, admission diagnosis, length of ICU/hospital-stay, treatment modalities and organ support (mechanical ventilation, vasopressor, renal replacement therapy, blood transfusions, antibiotics), laboratory parameters and discharge information. Routine laboratory assessment was performed on daily basis within usual practice.

Severity of illness was evaluated in all patients using sequential organ failure assessment (SOFA) [14] and simplified acute physiology score (SAPS II) [15] on admission. Furthermore, we assessed SOFA score additionally on day 14, 45 and 90 after ICU admission. Charlson comorbidity index (CCo) was calculated in all patients [16].

Patient outcome/survival was assessed through reviewing patient charts 28 days, 3 months, 6 months and 1 year after ICU admission. We further requested the German registry of death for all patients on year after end of the study. Furthermore, we also measured the overall performance of the patients based on the reviewed data using the overall performance categories (OPC) scale [17]. The OPC scale is a 5-category scale for measuring overall performance. The five categories are: OPC I, good overall performance: healthy, alert, capable of normal life; OPC II, moderate overall performance: conscious or moderate disability, performs independent activities of daily life, but is disabled for competitive work; OPC III, severe overall disability: conscious or severe disability, dependent on others for daily support; OPC IV, coma or vegetative state; OPC V, brain death/dead. As generally accepted an OPC score of I–II was defined as favourable overall outcome, III–V as unfavourable. Patients were reevaluated daily to identify those who were eligible for ICU discharge by experienced intensive care physicians. Patients were eligible for ICU discharge if the patient's physiologic status has stabilized and there was longer need for ICU monitoring and treatment. Especially, patients had to be hemodynamic stable (catecholamine free), respiratory stable (without respirator dependency or high continuous oxygen demand) for transfer to the next lower level of care. Otherwise, options for transferring patients to specialized rehabilitation facilities with higher level of care were evaluated.

Data were analysed using IBM SPSS Statistics Version 24.0 (IBM Corp., Armonk, NY). Data are presented as count and relative frequency or median and 25–75% interquartile range (IQR). Binary variables were compared via Chi-Square-Analysis or Fisher's exact, as appropriate. Metric variables were compared via Mann-Whitney-*U* Test. Survival function estimates were calculated using Kaplan Meier method and were compared by log rank test. We assessed factors associated with the occurrence of CCI and used a cox-regression model to assess factors associated with mortality in patients with CCI. A p-value < .05 was considered statistically significant.

3. Results

3.1. Study patients

During the study period (2008–2016) 65249 patients were treated at the department of intensive care medicine. We could identify 96 patients with a continuous ICU stay over ≥90 days, which therefore were included in our study.

3.2. Baseline characteristics

The median age of the study population was 61 (49.8–67) years, 31% (n = 30) were female. Reason of hospital admission was primary surgical (unplanned) in 41% (n = 39), surgical (planned) in 33% (n = 32) and medical in 26% (n = 25) patients. Reason of ICU admission was abdominal/gastroenterological (28%, n = 27) in first place, followed by sepsis (23%, n = 22), transplantation (15%, n = 14), cardiological (13%, n = 12), respiratory failure (10%, n = 9), neurological (8%, n = 8), renal failure (3%, n = 3) and trauma (1%, n = 1). Of the 14 patients with transplantation, 9 received liver-, 4 lung- and 1 heart-transplantation. According ICU admission with sepsis we observed the primary focus as follows: pneumonia (45%, n = 10), abdominal (23%, n = 5), positive blood cultures without other focus (14%, n = 3), pleura empyema (9%, n = 2), aplasia (5%, n = 1) and landauzy-sepsis (5%, n = 1). Length of ICU- and hospital stay were median 109.5 (96–141.75) and 137.5 (113–161.25) days, respectively.

Comorbidities were frequent in our cohort, charlson comorbidity index (CCo) was median 4 (2–6.3) points. Leading comorbidities were chronic respiratory disease (36%, n = 35), followed by chronic kidney disease (34%, n = 33) and malignant disease (tumor, etc.) (34%, n = 33). Further common comorbidities were dementia (23%, n = 22), coronary heart disease (21%, n = 20) and diabetes (17%, n = 16). (See Supplementary Table S3). Prior hospital admission, normal OPC (I/II) was observed in most patients (90%, n = 86). Table 1 reports the main characteristics of the study cohort on admission.

3.3. ICU characteristics and procedures during the ICU stay

In both ICU-survivors and non-survivors age, gender and BMI were distributed equally. Median length of ICU stay was significantly longer in ICU non-survivors with 137 (97–157) days compared to 107 (95.5–126) days (p < .05). Severity of illness represented by SOFA and SAPS II on admission was higher in patients who did not survive the ICU stay. Lactate and pH levels on admission were comparable in ICU survivors and non-survivors, highest measured lactate levels during the stay at the ICU were significantly higher in ICU non-survivors (11.5 vs 5.3 mmol/l, p < .001). Comorbidities represented by CCo were distributed equally in both groups. Reason of ICU admission was distributed equally in ICU-survivors and non-survivors. Moderate to severe anemia was noted at ICU-admission in 19 (20%) patients and was significantly more frequent in ICU non-survivors (33% vs 13%, p < .05). Need for isolation due to multi-drug-resistant pathogens on admission was significantly higher in ICU non survivors (33% vs 8%, p < .05).

During the ICU stay all patients were mechanically ventilated and received vasopressor support. Median duration of mechanical

Table 1
Main characteristics of the study cohort at ICU admission.

Parameters	All patients (n = 96)
Age (years)	61 (49.8–67)
Gender (female)	30 (31)
BMI (kg/m^2)	25.7 (21.4–29.5)
SOFA - admission (pts.)	10 (6–13)
SAPS II - admission (pts.)	42 (33–52)
Hospital admission	
Surgical	
Unplanned	39 (41)
Planned	32 (33)
Medical	25 (26)
Reason of ICU admission	
Abdominal/Gastroenterological	27 (28)
Sepsis	22 (23)
Transplantation	14 (15)
Cardiological	12 (13)
Respiratory failure	9 (10)
Neurological	8 (8)
Renal failure	3 (3)
Trauma	1 (1)
Comorbidities	
Charlson comorbidity index (pts)	4 (2–6.3)
Chronic respiratory disease	35 (36)
Chronic kidney disease	33 (34)
Malignancy (Tumor)	33 (34)
Dementia	22 (23)
Coronary heart disease	20 (21)
Diabetes	16 (17)

Data are expressed as n (%) or median (interquartile range).
Abbreviations: pts., points; CHF, ICU, intensive care unit.

Table 2
Differences between ICU-survivors and ICU non-survivors.

Parameters	ICU-survivors (n = 63)	ICU non-survivors (n = 33)	p value
Age (years)	62 (49.5–67)	60 (51–67)	0.92
Gender (female)	19 (31)	11 (33)	0.82
BMI (kg/m^2)	24.7 (21.2–28.5)	27.5 (24.3–32)	0.08
Length of ICU stay (days)	107 (95.5–126)	137 (97–157)	< 0.05
Reason of ICU admission			
Abdominal/Gastroenterological	19 (31)	8 (24)	0.64
Sepsis	11 (17)	11 (33)	0.06
Transplantation	10 (16)	4 (12)	0.77
Cardiological	8 (13)	4 (12)	0.94
Respiratory failure	5 (8)	4 (12)	0.49
Neurological	8 (13)	0 (0)	< 0.05
Renal failure	2 (3)	1 (3)	0.97
Trauma	0 (0)	1 (3)	0.34
ICU characteristics			
SOFA - admission (pts)	9 (6–13)	11 (6–14)	0.17
SOFA – day 14 (pts)	10 (8–12)	11 (8–13)	0.63
SOFA – day 45 (pts)	7 (4.5–9)	9 (6–12)	< 0.05
SAPS II - admission (pts)	40 (33–50)	45 (45–55)	0.12
Charlson comorbidity index (pts)	4 (2–6.5)	4 (2–6)	0.76
Lactate – admission (mmol/l)	1.7 (0.95–3.1)	1.5 (0.9–2.4)	0.49
Lactate – maximum (mmol/l)	5.3 (3.4–7.5)	11.5 (5.9–15)	< 0.001
pH – admission (level)	7.38 (7.31–7.46)	7.37 (7.26–7.45)	0.69
Isolation - admission	5 (8)	9 (33)	< 0.05
Procedures during ICU stay			
Mechanical Ventilation	63 (100)	33 (100)	1
Duration of mechanical ventilation (days)	68 (52–89)	94 (66–105)	< 0.01
Red blood cell transfusion	32 (18–44)	47 (32–77)	< 0.01
Vasopressor therapy	63 (100)	33 (100)	1
Antibiotic therapy	63 (100)	33 (100)	1
Antiviral therapy	26 (41)	17 (52)	0.23
Antimycotic therapy	54 (86)	30 (91)	0.35
Complications during ICU stay			
Renal replacement therapy	43 (68)	31 (94)	< 0.01
Cardiac arrest	9 (14)	8 (24)	0.18
Non-occlusive bowel ischemia	8 (13)	6 (18)	0.33
Therapy directive			
Advance Directive	1 (2)	0 (0)	0.66
Limitation of therapy	7 (11)	17 (52)	< 0.001

Data are expressed as n (%) or median (interquartile range).
Abbreviations: BMI, Body mass index; ICU, intensive care unit; pts., points; mmol/l, millimol per liter; SOFA, Sequential Organ Failure Assessment; SAPS, Simplified Acute Physiology Score.

ventilation was significantly longer in ICU-non-survivors (94d vs 68d; $p < .01$). Prolonged mechanical ventilation was associated with increased mortality (see Supplementary Fig. S1). ICU non-survivors needed significantly more blood transfusions ($p < .01$). All patients received antibiotic treatment with at least three different antibiotic agents. Use of antiviral (45%, $n = 43$) and antimycotic (88%, $n = 84$) agents was distributed equally in both groups. No patient received renal replacement therapy (RRT) prior to ICU admission, RRT was used significantly more frequent in ICU non-survivors (94% vs 68%, $p < .001$). 41% ($n = 26$) of ICU survivors needed further RRT after discharge. Extracorporeal membrane oxygenation (ECMO) was used in 17 (18%) of patients overall and was distributed equally in ICU survivors ($n = 12$, 19%) and non-survivors ($n = 5$, 13%). Overall 17 (18%) patients suffered from cardiac arrest and 14 (15%) had non-occlusive bowel ischaemia during the ICU stay, rates of ICU survivors and non-survivors did not differ significantly. (Detailed data shown in Table 2).

3.4. Outcomes at ICU discharge

Out of the 96 patients with very prolonged ICU-stay, 33 (34%) patients died in the ICU. Patients with primary medical admission had a significant higher ICU mortality as compared to surgical admissions (48 vs 30%; $p < .001$) (Fig. 1). Pre-dominant cause of death was multiple organ failure related to sepsis (67%, $n = 22$), circulatory failure (12%, $n = 4$), respiratory failure (9%, $n = 3$), liver failure (6%, n = 2) and brain failure (6%, n = 2). According sepsis related death, the primary focus was intra-abdominal infection (36%, $n = 8$), respiratory infection (27%, $n = 6$), blood stream infection without other focus (14%, n = 3), more than one focus (14%, n = 3), unclear focus (9%, n = 2). Circulatory failure was associated with cardiac arrest (2 cases), myocardial infarction and pulmonary embolism. Primary respiratory failure as cause of death was related to accidental ECMO cannula dislocation, failing of respirator weaning in the case of lung fibrosis and severe bleeding of a lung artery. Death related liver failure was associated with delayed graft dysfunction/rejection in one case and due to acute liver failure in the second case. Brain failure was triggered due to embolic stroke in one case and due recurrent intracranial bleeding after traumatic brain injury in another case. Therapy was limited due to futility in 17 (52%) of ICU-non-survivors. Overall outcome at ICU discharge was unfavourable (OPC III/IV) in most patients (95%, $n = 60$). Patients, who survived the ICU stay were discharged to the normal ward (49%, $n = 31$), other hospital (33%, $n = 21$), rehabilitation facility (16%, $n = 10$) or nursing facility (2%, n = 1).

3.5. Outcome and characteristics of long-term (1-year) survivors

One year after ICU admission, 27 (28%) of patients with a very prolonged ICU-stay were alive. Of these 8 patients (30%) had a favourable OPC (I/II). Long-term survivors were significantly younger (55 vs 64 years, $p < .01$) and more frequent female (45 vs 26%, $p = .07$). Older age was significantly associated with mortality ($p < .05$, Fig. 2). Length of ICU- and hospital stay did not differ significantly between both groups. Reason of hospital admission was pre-

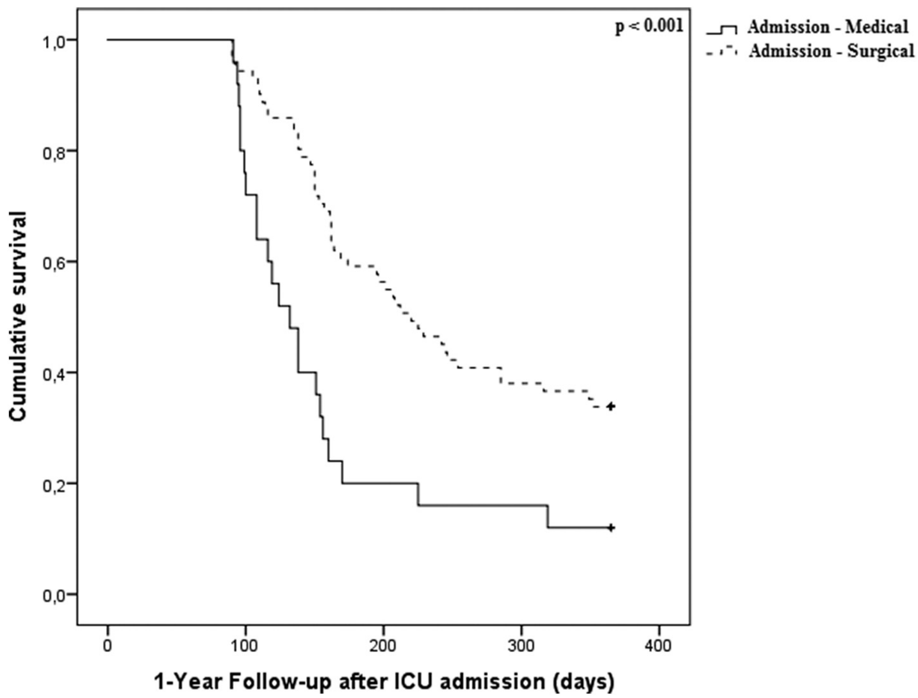

Fig. 1. Kaplan Meier analysis of 1-year survival of patients with a very prolonged ICU stay (> 90 days) stratified according medical or surgical admission.

dominantly surgical in both groups, and significantly higher in long-term survivors (p < .05). Patients after transplantation had a significantly higher 1-Year survival (*p* < .01). SOFA score on admission and after 14 days was comparable between both groups. After 45 days SOFA score was significantly lower in 1-Year survivors (6 vs 9 points, *p* < .05). Lactate on admission was significantly higher in patients with 1-Year survival (2.7 vs 1.3 mmol/l, p < .01). We did not observe differences according procedures and complications during ICU stay, further also comorbidities were distributed equally (see Supplementary table S1). Multivariate cox regression revealed age (HR 1.02, 95% CI 1.00–1.04, p < .05) and surgical admission (HR 0.50, 95% CI 0.28–0.90, p < .05) as independent predictor for 1-year mortality.

3.6. Clinical decision making after 90 days of critical care therapy

After 90 days of continuous ICU therapy 56 (58%) patients were on MV, 45 (47%) patients needed catecholamine support and 48 (50%) had RRT. Median lactate levels was 1.1 (0.7–1.4) mmol/l. Active infection was present on 90 day in 56 (58%) patients. The median SOFA score was 10 (3–14) points on day 90. Furthermore, we performed a cox

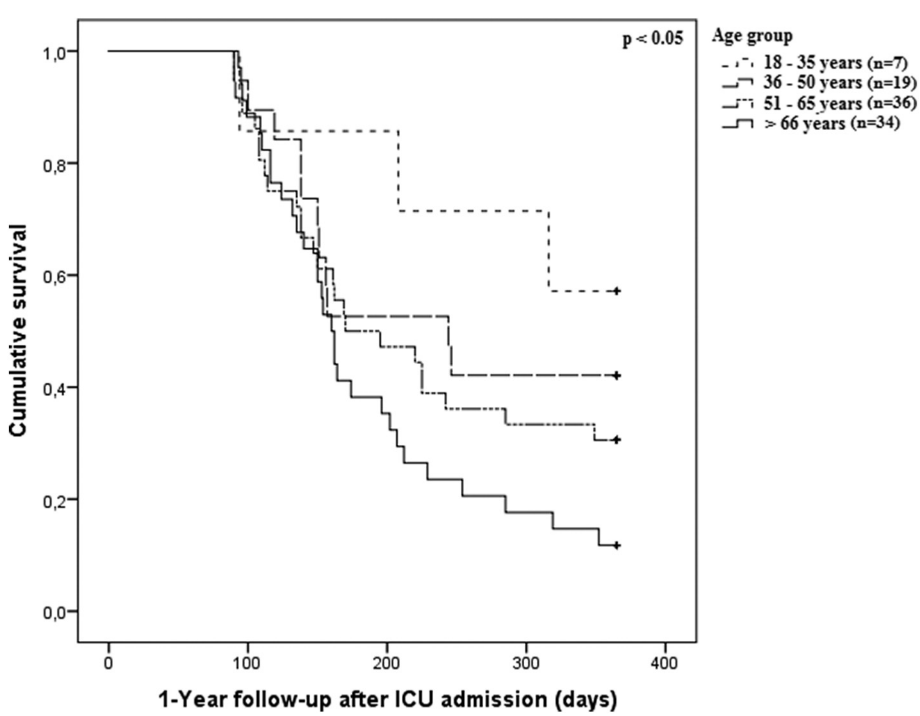

Fig. 2. Kaplan Meier analysis of 1-year survival of patients with a very prolonged ICU stay (> 90 days) stratified according age.

regression analysis on day ninety to find factors associated with death or weakness (OPC III/IV) after 1-Year. The regression model revealed that age (HR 1.03, 95% CI 1.01–1.05, $p < .01$), medical admission (HR 1.73, 95% CI 1.02–2.92, $p < .05$) and lactate on day 90 (HR 1.38, 95% CI 1.16–1.69, $p < .001$) were independent predictors for 1-year mortality or weakness (OPC III/IV).

4. Discussion

In our study evaluating long-term outcome and ICU-characteristics in the group of patients with a very prolonged ICU stay (≥ 90 days), we could show that 63% of patients survived the ICU stay and 28% survived 1-Year. This is the first study presenting long-term outcome and ICU characteristics of patients with an ICU stay of ≥90 days.

Many critically ill patients survive the initial acute critical illness, but are further dependent of organ support. Due to a lack of consensus, prior studies on patients with CCI used a wide variation of definitions. Describing this complex syndrome is not easy [18]. In our study we used a duration of over 90 days to define CCI in analogy to the definition of chronic kidney disease [6].

Literature suggests that 5–10% of patients admitted to the ICU suffer from CCI [3]. Ageing and advances in acute care management are factors for the increasing number of CCI [1,3,7]. This population of patients are consuming a large number of ICU resources and bed capacity, even if the cut-off defining a prolonged ICU stay was 9 to 14 days in earlier studies [19–22]. However, due to the chosen definition we only found 96 patients with CCI. We could show that this population is resource consuming, we observed a long duration of MV, ECMO use and a high number of isolation due to colonisation with multi-drug-resistant organisms. However, this study was not designed to investigate the hospitalization costs and impact on ICU utilization.

In our study, we observed an ICU mortality of 37% and 1-year mortality of 72%. Despite of a significant longer stay in ICU our findings were comparable to earlier studies of CCI patients [11,23–25]. Different studies suggested that older age could be a factor associated with mortality in CCI patients [3,23,26]. We did not observe a difference in age according ICU survival, but found that 1-year non-survivors were significantly older than 1-year survivors. Multivariate cox regression revealed that age was an independent predictor of 1-year mortality in our cohort. Furthermore patients suffered from a high number of comorbidities, contrary to other studies we did not find an association of comorbidities with outcome [23]. A recent study hypothesized that antecedent patient characteristics are the main predictor for outcome in CCI patients [22]. We were not able to confirm this finding in our study. In patients with very prolonged ICU stay outcome probably relies more on factors/complications during the ICU stay than on antecedent patient characteristics alone. However, probably this factor has more impact in patients with shorter ICU stay. Interestingly we observed a significantly higher survival in patients with a surgical admission diagnosis and regression analysis revealed it as a protective factor for 1-year mortality. This association was not found in earlier studies, probably explainable by the fact that most studies did not investigate mixed ICU collectives [10,23]. Severity of illness, represented by SOFA-Score, showed significant differences in the course of ICU stay. This is in accordance to earlier studies [23] and shows that outcome is most determined through the ICU course and complications than admission characteristics.

Considering the ICU survival alone, we observed a fairly good outcome. However, after > 90 days of ICU therapy almost all patients had unfavourable overall outcome (OPC III/IV). Besides the high comorbidity rate many patients are suffering progressive muscle weakness, endocrine alterations and malnutrition [12]. Different risk factors have been described for development of unfavourable outcome in patients with CCI including age, high severity of illness score and presence of cerebral dysfunction during CCI [12]. However, their prognostic impact is less clear [12]. The vast majority of patients had an unfavourable outcome at ICU discharge. Interestingly, despite a long ICU stay more patients were transferred to the normal ward than directly to a rehabilitation facility. Probably, because of the high complexity of these cases. Previous studies have shown that patients after cardiac surgery and prolonged ICU stay have an encouraging physical and psychological recovery [27]. Furthermore, studies showed that in CCI patients an only moderate disability in quality of life was perceived, even in very elderly patients [10,28]. After 1-Year we observed that 30% of survivors had an acceptable overall outcome. However, the aim after a very prolonged ICU therapy, should be a self-determined life and for patients in working age a return to their job [13].

Clinical decision making on continuing or withholding medical therapy after 90 days of continuous critical care treatment is not simple. Clinical guidance, risk-assessment, is needed for decision making in this special patient population. We performed a cox-regression analysis to identify factors after 90 days of ICU therapy associated with death or weakness (OPC III/IV) after 1-Year. We revealed that age, medical admission and lactate are independent predictors of 1-year mortality. Interestingly lactate, a parameter which is available in every ICU, was one of the strongest predictors. Furthermore, lactate clearance could be of interest in future studies investigating clinical guidance and decision in this CCI population. However, we did not observe that widely used scoring systems (e.g. SOFA) predicted outcome in this population. Nevertheless, scoring systems help to guide clinical decisions, can be used to early detect changes in organ functions and re-assess the clinical status.

An advance directive was only available in one patient of the study cohort. This is quite a low number, but can be partly explained by the high number of unplanned surgical interventions and emergency medical admission diagnosis. However, a higher number of advanced directives in the phase of an acute critical illness and prolonged therapy would be desirable for decisions on therapy limitations. In CCI, investigating patient's wishes is a cornerstone [29]. Due to sedative agents, mechanical ventilation, progressive disease, delirium or other factors a communication won't be possible in many patients. Nevertheless, it should be aimed to discuss the medical situation with the patient or close relatives/friends to find out patient's wishes as soon as possible. *Re*-evaluation of the therapy should be performed on regular basis and a defined aim in e.g. quality of life after ICU therapy is quite important.

Our study has several limitations. First, our results are obviously limited due to the small number of patients included, the retrospective and single-centre design. However, it is the first and by far largest study focussing on patients with a very prolonged ICU stay including ICU characteristics and long-term outcome. Second, our study included only patients with a very prolonged ICU stay and does not compare with other patients with a prolonged ICU stay, which should be taken into account when interpreting our results. Third, we show results of a large department of intensive care medicine in a tertiary care centre highly experienced in critical care, including management of patients with prolonged critical illness. Thus, our results are not generally transferable to other settings.

5. Conclusions

In conclusion, we could show that a very prolonged ICU stay is a rare occurrence in a mixed ICU collective. Although ICU survival is acceptable, overall performance after a very prolonged ICU stay is worse. However, despite massively long critical illness some patients have a remarkable recovery.

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejim.2019.08.024.

Ethics approval and consent to participate

The study was performed according regulations of the local ethics committee. Due to the retrospective character of the study informed consent was waived.

Consent for publication

Not applicable.

Availability of data and materials

The datasets supporting the conclusions of this article are included within the article.

Competing interest

The authors declare that they have no competing interests.

Funding

No financial support has been received conducting this study.

Authors' contributions

KR, DA, SK and JM participated in study conception and design. KR, DA, LE, VF, SK and JM were involved in acquisition of data. KR, DA, VF, SK and JM contributed to analysis and interpretation of data. KR and JM drafted the manuscript. VF, SK and JM were involved in critical revision of the manuscript for important intellectual content. SK and JM participated in supervision. All authors read and approved the final manuscript.

Acknowledgements

No financial support has been received for conducting this study.

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