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Specialized treatment of patients with persistent critical illness

Outcome of patients treated at the REMEO clinic 2015 – 2018

Slutversion
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Specialiserad vård av patienter med långvarig kritisk sjukdom – utfall för patienter vårdade på REMEO kliniken 2015 – 2018

Bakgrund: Förbättringar inom intensivvård har lett till ett ökat antal patienter med långvarig kritisk sjukdom i behov av förlängd intensivvård. Denna patientgrupp har dokumenterats ha hög morbiditet och mortalitet men specialiserade kliniker internationellt har rapporterat bättre resultat. År 2013 startades REMEO, Sveriges första klinik specialiserad på vård och rehabilitering av denna patientgrupp. Tidigare forskning på denna grupp patienter saknas i Sverige. *Syfte*: För att dokumentera utfallet av ett nytt behandlingskoncept för patienter med långvarig kritisk sjukdom vill vi studera överlevnad, lyckandefrekvens av urträning ur ventilator, dekanylering samt utskrivningsdestination för patienter vårdade på REMEO-kliniken 2015-2018. *Material och Metoder:* 181 patienter med vårdtillfällen mellan 2015-01-01 och 2018-12-31 inkluderades. Demografiska data samt uppgifter om vårdtid, tid till urträning ur ventilator och dekanylering, utskrivningsdestination samt mortalitet hämtades ur kvalitetsregister samt folkbokföringsregistret. *Resultat:* Medelålder var 61 år (standardavvikelse 16) och medianvårdtiden 47 dagar (interkvartilavstånd 31-77). Åttionio procent av ventilatorberoende patienter blev ventilatorfria och 90% av trakeostomerade patienter dekanylerades. Inneliggande mortalitet var 3% och 1-års mortalitet från utskrivning var 20%. Majoriteten skrevs ut direkt till hemmet eller till vidare rehabilitering. *Slutsats:* Långvarigt kritiskt sjuka patienter vårdade på en specialiserad klinik i Sverige har god överlevnad och hög frekvens av lyckad urträning ur ventilator samt dekanylering. De flesta kan sedan skrivas ut till hemmet eller fortsatt rehabilitering. Resultaten är bättre än tidigare rapporterat internationellt, men skillnader i patienturval kan inte uteslutas och förhindrar regelrätt jämförelse. Ytterligare studier med mer detaljerad information om patientkaraktäristika samt vårdens utformning behövs för att visa hur dessa patienter bäst behandlas och rehabiliteras.

Specialized treatment of patients with persistent critical illness – outcome of patients treated at the REMEO clinic 2015 – 2018

Introduction: Advances in intensive care have increased survival, but also the number of persistently critically ill patients. Though high morbidity and mortality rates have been reported for these patients, specialized clinics have shown improved outcome. In 2013 the first specialized clinic in Sweden, REMEO, was started. *Aims:* To investigate the outcome of patients with persistent critical illness treated at a specialized clinic in Sweden by documenting mortality, success rate of weaning from mechanical ventilation and decannulation, and discharge destination for patients treated at the REMEO-clinic 2015-2018. *Material and Methods*: A total of 181 patients were included. Demographic data, data on length of stay, weaning and decannulation were collected from quality registries and the Swedish population registry. *Results:* The mean age was 61 years (standard deviation 16) and the median length of stay was 47 days (interquartile range 31-77). Eighty-nine percent of ventilator-dependent patients were weaned and 90% of tracheostomized patients were decannulated. In-clinic mortality was 3% and 1-year mortality from discharge was 20%. The majority of patients were discharged to home or to further rehabilitation. *Conclusions:* Persistently critically ill patients treated in a specialized clinic in Sweden have high survival and high success rates of weaning from mechanical ventilation and decannulation with high discharge rates to home or further rehabilitation. These results are better than previously reported internationally. However, as patient characteristics may vary between studies, no direct comparison can be made. Further studies are needed to fully understand how to best treat and rehabilitate these patients.

Keywords: Persistent critical illness, Chronic critical illness, PMV

Abbreviations

ICU – Intensive care unit

IQR – Inter Quartile Range

LOS – Length of stay

LTACH – Long-term acute-care hospital

LÖF – County council mutual insurance company

MAP – Mean arterial pressure

NAMDRC - National Association for Medical Direction of Respiratory Care

NG – Nasogastric

NIV – Non-invasive ventilation

PEG – Percutaneous Endoscopic Gastrostomy

PMV – Prolonged mechanical ventilation

QOL – Quality of life

SD – Standard deviation

SFAI – The Swedish society of anesthesiology and intensive care medicine

SFOHH – The Swedish ENT Association of Otorhinolaryngology, Head and Neck Surgery

Introduction

Advances in intensive care have improved survival for acute critically ill patients with a majority of them being treated at the intensive care unit (ICU) for only a few days (1). The mean length of stay (LOS) is 2,7 days for patients treated at an ICU in Sweden (2). However, these advances have also led to more patients in need of prolonged intensive care.

Patients in need of prolonged intensive care are a heterogeneous group of patients and different definitions have been used over the years to classify them. These patients are sometimes described as chronically critically ill, persistently critically ill, chronically medically complex or long-stay patients. Chronic critical illness includes patients who survive an acute, catastrophic illness or surgical procedure but are left with a need for prolonged mechanical ventilation (PMV), commonly being defined as mechanical ventilation for ≥6 hours a day during a period of ≥21 days (3, 4). Recently, persistent critical illness was defined by Iwashyna et al as when the reason for being in ICU is more related to the ongoing critical illness then the original reason for admission (4). This definition also takes in to account that not all patients require prolonged mechanical ventilation. The transition to persistent critical illness has in several studies been found to occur between day seven and eleven (4, 5).

Chronic critical illness is associated with high mortality and morbidity (6). Data published in 2015 showed chronically critically ill patients treated in an ICU to have a 1-year mortality of 58% (7). The same study showed that for chronically critically ill patients treated in a weaning unit the 1-year mortality was roughly 48%. Risk factors associated with higher mortality include but are not limited to, advanced age, use of vasopressors, thrombocytopenia and inability to be liberated from mechanical ventilation (6). Patients in need of prolonged intensive care also demonstrate increased impairment in muscle strength, increased activity impairment and lower self-reported quality of life (QOL) compared to short-stay ICU-patients (8).

In addition to the high mortality and morbidity, chronic critical illness also constitutes a significant economic burden. Data from the US shows that readmission charges for these patients are almost twice as high compared to charges for patients in need of short-term ICU care (9). It is estimated that the cost in 2009, for chronically critically ill patients was 26 billion USD, approximately 1,4% of all healthcare spending in the United States (10).

Ventilation

Patients in need of mechanical ventilation rely on an artificial airway to enable secure ventilation. Most patients initially receive an endotracheal tube to enable respiratory stabilization in the acute phase. For most patients in need of prolonged mechanical ventilation, a tracheotomy is performed. Benefits of a tracheostomy tube include airway security, increased patient mobility and comfort which, for some patients, include the ability to speak (11). Tracheostomy can also facilitate weaning from mechanical ventilation (11, 12).

Swedish national recommendations on tracheotomy and tracheostomy care were published in 2017 by the national patient insurance company, The county council mutual insurance company (LÖF) (13). Included in this work were representatives from The Swedish society of anesthesiology and intensive care medicine (SFAI) and The Swedish ENT Association of Otorhinolaryngology, Head and Neck Surgery (SFOHH). In these recommendations, the authors state that there are no evidence-based recommendations on when to perform a tracheotomy. However, the authors recommend tracheotomy to be performed within 7-10 days for patients who are expected to need mechanical ventilation for more than 14 days. Other than this, tracheotomy is recommended for patients with various ear, nose, throat (ENT) problems including tumors and airway anomalies and for patients in need of chronic mechanical ventilation to enable a lower level of care.

The process of withdrawing mechanical ventilation is defined as weaning. In a majority of patients, this process is short and efficient, and withdrawal can be made as soon as the reason for respiratory failure is resolved. However, some patients need to be gradually withdrawn from mechanical ventilation. The reasons for this vary (14). A weaning definition specifically established for PMV patients states that complete liberation from mechanical ventilation, or only nocturnal non-invasive ventilation (NIV) for 7 consecutive days should be considered as successful weaning (15).

Success rates of weaning from mechanical ventilation in patients in need of PMV is reported to be low, ranging from 38% to 78% in different studies (16). In a randomized controlled trial (RCT) published in 2009, researchers showed improved success of weaning for patients that had daily interruptions of sedatives combined with physical and occupational therapy (17). Furthermore, these actions resulted in an improved return to premorbid functional status at

discharge compared to the control subjects who only received daily interruption of sedatives and standard care. However, the mentioned study only included patients who had been on mechanical ventilation for less than 72 hours. The role of physical therapy and mobilization in patients requiring PMV has been studied to a lesser extent. An integrative review including eight articles on this topic published in 2017 came to the conclusion that mobilization may improve the outcome of patients in need of PMV. However, the authors emphasized that the studies lack consistency in the definitions of weaning which makes it difficult to draw adequate conclusions from the material (18).

Non-invasive ventilation (NIV) is widely used in the clinic for different indications (19, 20) NIV is also used in the process of weaning from mechanical ventilation. Multiple studies on NIV and weaning have been performed on patients with endotracheal intubation with some studies showing increased weaning success (21) and decreased mortality (22). A recent study on the usage of NIV in tracheostomized patients albeit small and not a randomized controlled trial showed that NIV could be used to increase the success of weaning and decannulation in difficult-to-wean patients (23).

The situation in Sweden

The increase in chronically critically ill patients have internationally given rise to specialized clinics focusing on weaning from mechanical ventilation and rehabilitation of these patients. The need for specialized weaning units or long-term acute care facilities is apparent for example in the US, primarily because of financial drivers (24). In Sweden however, the focus of specialized care of this group of patients has not been apparent until recently.

In 2013, a clinic specialized in treating patients in need of prolonged intensive care, PMV and rehabilitation were established in Sweden, the REMEO clinic (25). The novel concept of rehabilitation of patients in need of prolonged intensive care used at the REMEO clinic is based on close collaboration of a multidisciplinary team. The team includes, but are not limited to, specialized weaning nurses, a speech therapist, physiotherapists, occupational therapists and physicians that create individualized training programs to enable weaning from the ventilator and decannulation. Up until now, no data on patient outcome, other than regular quality work, has been compiled on patients admitted to this clinic. The fact that the number of patients surviving acute critical illness is increasing necessitates a better understanding of the outcome

of these patients. This is especially important as this is a group of patients at risk of high morbidity and mortality and with significant needs for high-quality medical care and rehabilitation. With this study, we provide knowledge on the outcome of persistently critically ill patients treated in a newly started clinic focusing on care and rehabilitation for this particular group of patients.

Aim

To investigate the outcome of patients with persistent critical illness treated at a specialized clinic in Sweden by documenting mortality, success rate of weaning from mechanical ventilation and decannulation, and discharge destination for patients treated at the REMEO-clinic 2015-2018.

Material and Methods

Study group and design

This descriptive study was based on quantitative data reported as a part of the daily quality work performed at the REMEO clinic. All 210 unique admissions reported from 2015 to 2018 were screened for the inclusion criteria, admittance date; 1st of January 2015 or later and discharge date; 31st of December 2018 or earlier. A total of 191 unique admissions were eligible to be included in the study. Admissions that were not related to regular care were excluded through further analysis. All admissions were analyzed to identify unique patients, n = 181. For patients with multiple admissions recorded in the dataset a thorough analysis was made to decide if these admissions were part of the same hospital admission, in which case they were treated as split admissions. The date for admission and discharge of a split admission were set to the first day of the first admission until the last day of the last admission. Seven patients were found to have split admissions and the reason for these patients' treatments at other units during their stay at REMEO is reported in Table 1.

Table 1. Characteristics of patients with split admissions.

Patient-ID	Number of admissions	Days in other care	Unit of other care
95	2	31	ICU
103	3	14 + 9	ICU
109	2	3	Intermediate care
111	2	2	Regular hospital care
114	2	17	ICU
153	2	14	Regular hospital care
166	2	21	ICU

One patient was recorded with two separate admissions where analysis showed that the last admission was not related to regular care at the REMEO clinic and that admission was therefore excluded. One patient was recorded with three separate admissions where two of them were found to be part of a split admission and the last admission was not related to regular care at the REMEO clinic. The last admission was therefore excluded. A total number of 181 patients with coherent (n=174) or split (n=7) admissions were included in the final analysis (Fig. 1).

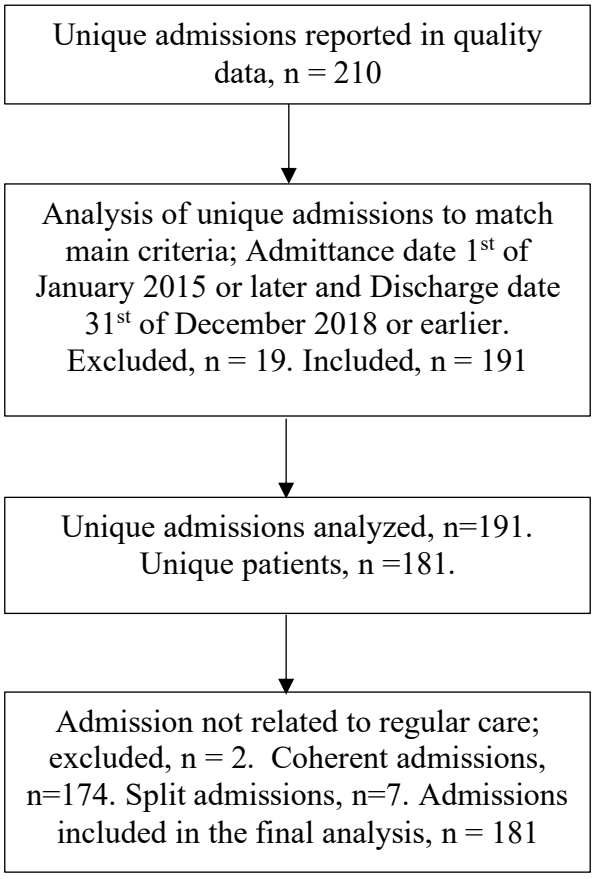

Figure 1. Flow-chart of the inclusion process.

One-year mortality from discharge was assessed by collecting mortality data from the Swedish population registry trough the quality database.

Data compilation

Data on patients admitted to the clinic in 2015 was stored in an analog registry. Data on patients admitted to the clinic in between 2016 and 2018 was stored in Microsoft Excel (Microsoft Corp) spreadsheets for each month. Further parameters for all patients were stored in a digital quality database. For patients missing decannulation date, weaning date, LOS in previous care or discharge information the data were collected from the patient journals in Take Care

(CompGroup, Stockholm, Sweden) by the supervisor or co-supervisor to complete the quality database records. All patient data, previously structured in a month by month dataset were structured longitudinally in a Microsoft Excel (Microsoft Corp) spreadsheet. The dataset was then anonymized by removing initials and names.

Statistics

Dichotomous data are presented as number (percent). Continuous data are presented as mean ± standard deviation (SD) or median and interquartile range (IQR) depending on skewness. For categorical data, we used the Pearson Chi-Square test. Non-parametric analysis was used for data that were assessed as skewed. Mann-Whitney U test and Kruskal Wallis ANOVA test were used for comparison of continuous data between groups. Mortality analysis was performed using Cox regression analysis. All statistical analysis was performed using SPSS Statistics Version 25 (IBM Corp). P-values < 0,05 were considered statistically significant.

Ethical considerations

Evaluation of new treatment methods is warranted for ethical reasons, both for the patients treated and for the purpose of making the most efficient use of society´s resources. It is not ethically acceptable to initiate futile, or perhaps even harmful, treatment methods. However, when evaluating medical care, ethical considerations also need to be taken into account to ensure patient confidentiality as revealing patient identities may be perceived as harmful. To guarantee that no patient was harmed by inclusion in the study, several measures were taken. The dataset was anonymized to ensure patient confidentiality. Because of the rather small dataset, we decided not to present outliers in the variables LOS in previous care and LOS at REMEO to ensure patient confidentiality. When presenting data from a limited number of patients, all with very complicated and unique medical histories, detailed descriptions of medical records may reveal patient identities and was thus avoided. Because of the nature of this work, being retrospective, the included patients will not benefit from this work. However, the knowledge gained from this study could potentially improve the quality of care for future patients and could also prove useful for the design of future studies. These potential benefits for future patients outweigh the fact that included patients do not benefit from this study.

Ethical approval was applied for and granted by the ethical review board in Stockholm.
Ethical review nr: 2019-04466

Results

The patients in this study were predominately men (64%). The mean (SD) age of the patients was *61 (±16)* years.

The median (IQR) LOS in previous care was *45 (31-77)* days. The absolute majority of patients, *177 (98%)* spent more than 10-days in previous care. There was no significant difference in LOS in previous care depending on sex. One hundred and thirty-one patients (72%) had a tracheostomy on admittance to REMEO. Patients with a tracheostomy had an approximately 17% longer LOS in previous care compared to patients without a tracheostomy, *47 (33-84)* days versus *40 (27-63)* days; $p < 0,05$. One-hundred and thirty-one patients (72%) had either a Percutaneous Endoscopic Gastrostomy (PEG) tube or a Nasogastric (NG) tube at admittance to the clinic.

The median LOS at REMEO was *47 (28-75)* days. Due to the risk of compromising patient confidentiality outliers in the data are not presented in detail. Three patients had a LOS at REMEO extending to more than a year. There was no significant difference in LOS at REMEO depending on sex. However, patients with a tracheostomy at admittance had a longer LOS at REMEO compared to patients with no tracheostomy at admittance. The same results were found for patients with a PEG tube or NG tube that had a longer LOS at REMEO compared to patients without any of these (Table 2).

Table 2. Statistics of LOS at REMEO in days. Statistically significant differences are marked with *

LOS REMEO	Tracheostomy	Median	53*
		Interquartile Range	34-83,5
	No tracheostomy	Median	36,5*
		Interquartile Range	22-52
	PEG-tube or NG-tube	Median	53*
		Interquartile Range	36-84
	No PEG-tube or NG-tube	Median	29*
		Interquartile Range	20-51

Abbreviations: LOS – Length of stay; PEG = Percutaneous endoscopic gastrostomy; NG = Nasogastric

Patients were mainly discharged to home with or without assistance and to other rehabilitation units. A minority of patients were sent to ICU (Fig. 2).

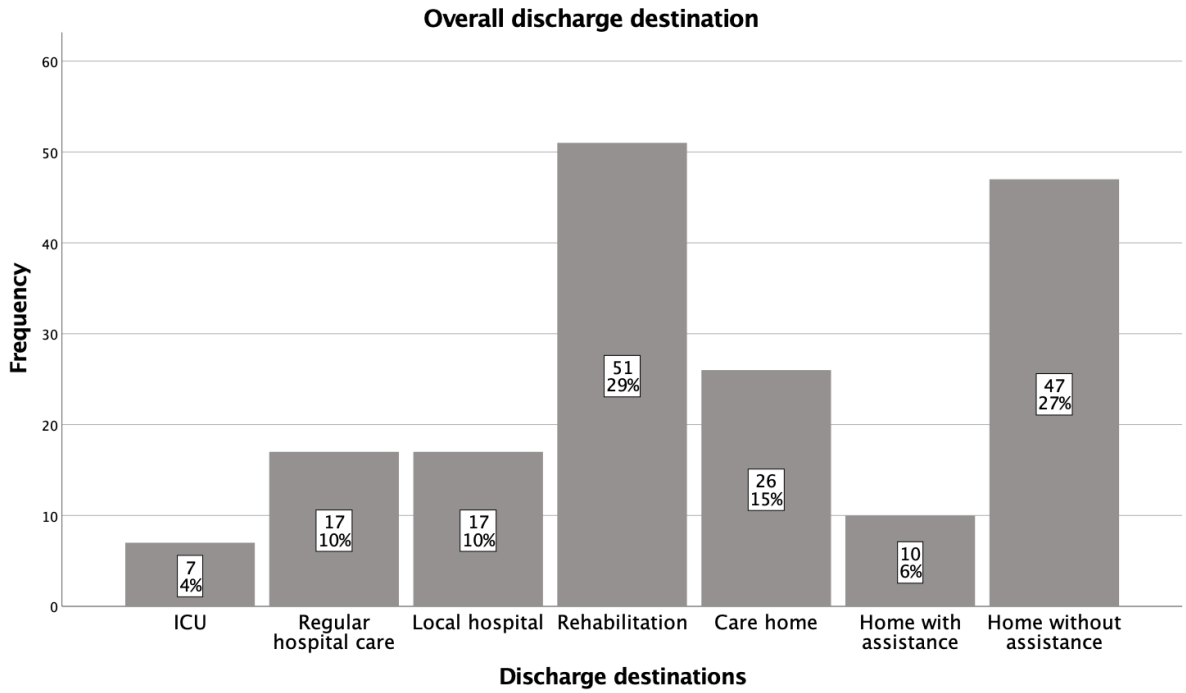

Figure 2. Patient discharge destinations, excluding in-clinic mortality.

Weaning from mechanical ventilation and decannulation

A majority of the patients in need of invasive ventilation at admittance to the clinic were not in need of chronic invasive ventilation. All of the patients in need of invasive ventilation were tracheostomized. The median (IQR) duration of invasive ventilation after admittance to the unit was *29 (17-66)* days including patients with chronic and non-chronic invasive ventilation. No statistically significant difference in the use of invasive ventilation in male versus female patients was observed, *37%* (*n=43)* versus *30% (*n=19*).* The majority of patients (89%) in need of non-chronic invasive ventilation were successfully weaned at the clinic. Patients with a PEG-tube or an NG-tube had a statistically significantly longer period of invasive ventilation before weaning compared to patients without a PEG-tube or NG-tube, *p<0,05.* There was no significant difference in success of weaning from invasive ventilation between male and female patients. However, male patients were more likely to receive treatment with NIV compared to female patients, *p<0,05*.

About two thirds of patients (*n=117)* admitted had a non-chronic tracheostomy at admittance to the clinic. The majority of patients (*89,7%)* with a non-chronic tracheostomy at admittance were successfully decannulated at the clinic. There was a significant difference in median time to decannulation between patients with a PEG-tube or NG-tube compared to patients without any of this, *p<0,05.* (Table 3).

Table 3. Statistics of ventilation related parameters including weaning and decannulation. Statistically significant parameters are marked with *.

Ventilation	Invasive ventilation	Frequency	62
		Percent	34,3%
	Chronic invasive ventilation	Frequency	7
		Percent	4%
	Non-chronic invasive ventilation	Frequency	55
		Percent	30%
	Weaning from non-chronic invasive ventilation	Frequency	49
		Percent	89%
	Time to weaning (days)	Median	25,5
		Interquartile Range	16,5-45,5
	Time to weaning, patients with PEG or NG (days)	Median	29*
		Interquartile Range	21-52
	Time to weaning, patients without PEG or NG (days)	Median	13*
		Interquartile Range	7-22
	NIV	Frequency	49
		Percent	27,1%
	NIV Male Patients	Frequency	39*
		Percent	33,3%
	NIV Female Patients	Frequency	10*
		Percent	15,6%
	Tracheostomy	Frequency	131
		Percent	72,3%
	Chronic tracheostomy	Frequency	14
		Percent	7,7%
	Non-chronic tracheostomy	Frequency	117
		Percent	64,6%
	Decannulation from non-chronic tracheostomy	Frequency	105
		Percent	89,7%
	Time to decannulation (days)	Median	25
		Interquartile Range	13,5-43
	Time to decannulation, patients with PEG or NG (days)	Median	26*
		Interquartile Range	15-55
	Time to decannulation, patients without PEG or NG (days)	Median	15,5*
		Interquartile Range	9-22

Abbreviations: NIV = Non-invasive ventilation, PEG = Percutaneous endoscopic gastrostomy, NG = Nasogastric

Mortality

A total of *3% (n=6)* of patients died at the clinic. The 30-day mortality from discharge was *9% (n=17).* The cumulative 1-year mortality from discharge was *20% (n=36)*. The cumulative 1-year mortality including in-clinic mortality was *23% (n=42)* (Fig. 3).

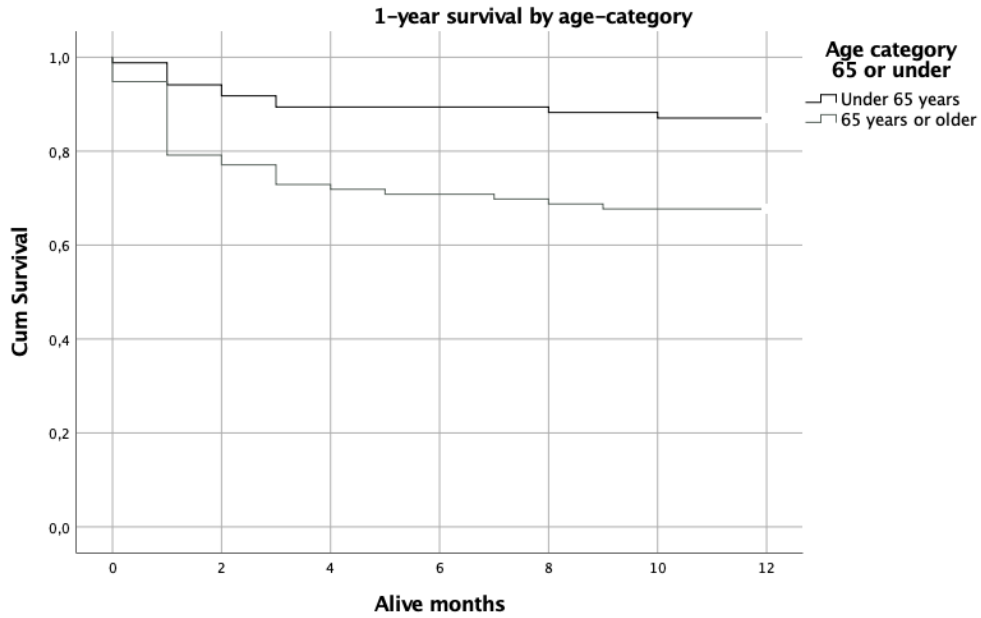

Figure 3. 1-year cumulative survival after discharge by age at REMEO.

There was no statistically significant difference in 30-day, 6-month or 1-year mortality depending on sex, the presence of a tracheostomy at admittance, successful decannulation, weaning success or the need for invasive ventilation.

Discussion

To our knowledge, this is the first study to document the outcome of patients with persistent critical illness treated at a specialized unit in Sweden. We showed a low 1-year mortality and a high success rate of weaning from mechanical ventilation and decannulation. Patients with PEG- or NG-tube showed an increased LOS at the clinic as well as an increased time to successful weaning from mechanical ventilation. The majority of the patients were discharged for further rehabilitation or discharged directly to their homes.

Several studies on the outcome of patients in need of prolonged intensive care have been conducted in the last years (5-8, 24, 26). However, extrapolation to a Swedish context is difficult primarily because of differences in health care organizations and social support

systems. In recent literature, persistent critical illness has been defined as a continued need for intensive care despite alleviation of the initial reason for intensive care. The transition into this phase of critical illness usually occurs after 10-days of intensive care (4). As 98% of patients included in this study had a LOS in previous care longer than 10-days it is likely that a majority suffered from persistent critical illness. However, the patient characteristics previous to their admission to REMEO were not documented in the database and are thus unknown.

The data presented in this study further emphasizes the fact that persistently critically ill patients are indeed a heterogeneous group. The median LOS at the REMEO clinic is 47 days while the longest is well over a year and the shortest just a couple of days. Non-medical factors such as housing, care at home and administrative factors contribute to extended LOS. However, these circumstances are not explored further in this study due to the risk of violating patients' integrity when reporting details of small numbers of individuals.

While this study includes patients with persistent critical illness it should be noted that the study population is likely to be skewed compared to the entire population of persistently critically ill patients. A selection bias is likely to occur at the referring unit when selecting patients to refer to REMEO. Furthermore, knowledge about the REMEO clinic might be missing in some hospital ICU departments and lack of contracts with other units in the country introduce the potential for further selection bias. However, the patients admitted to the REMEO clinic represent a group of patients with advanced need for medical care and fit the definition of persistent critical illness.

The mean age of patients included in this study is similar to the mean age of patients included in multiple international studies (5, 8, 27, 28) further indicating that the studied group of patients included in this study is similar to patients included in international studies. The same applies to rates of male and female patients that were similar in this study compared to international studies (4, 8, 26, 28).

In this study a majority, 89% of patients in need of PMV, were successfully weaned. Comparisons to previous studies are difficult to perform since inclusion criteria, definitions of weaning and methods vary greatly. In a study published in 2017, the authors reported a weaning success of 73% for the study population (27). However, in this study, they excluded patients that could not achieve a successful spontaneous breathing trial (SBT) for > 4 hours. A study

published in 2019 on patients treated in a long-term acute-care hospital (LTACH) reported a weaning success of 53,7% (26).

The median time to weaning from invasive ventilation in this study is approximately 2,5 times longer than the time to weaning reported in the previously mentioned study on weaning (27). This might to some extent explain the higher rates of successful weaning reported in this current study with longer time accepted for the process of weaning in patients included. Reasons for this is likely multifactorial and could include differences in weaning protocols and differences on an organizational and financial level.

This study shows a majority of patients being successfully decannulated at the clinic. While there are international studies on weaning success in this group of patients there is a lack of studies on success of decannulation. Some studies exclude patients with tracheostomy when reporting of weaning from a ventilator (29) while some include tracheotomized patients but do not report data on decannulation (26).

The results of this study show that patients with a PEG- or NG-tube have a longer LOS at the clinic and increased time to weaning and decannulation. It is likely that patients without PEG- or NG-tube had less of a disease load compared to patients with PEG- or NG-tubes. However, with limited information on indications for the placement of a PEG- or NG-tube and further limited information on clinical parameters we are unable to explore this in further detail. Further studies would be needed to fully explain the impact of PEG- or NG-tubes on weaning and decannulation.

Male patients are more likely to suffer from obstructive sleep apnea syndrome (OSAS) than female patients (30, 31). This difference in the prevalence of OSAS is a possible reason for the more frequent use of NIV in male patients in the current study. However, since information regarding current diagnoses of patients was not included in this study, it is not possible to rule out other explanations to this difference.

The 1-year mortality for patients in need of prolonged intensive care treated at the REMEO clinic is considerably lower than mortality data presented in studies from other countries in this group of patients. The results of this study show a 1-year mortality of 23% compared to a pooled 1-year mortality of 59% in a meta-analysis from 2015 (7) and a 1-year mortality of 33% in a

more recent study on this group of patients (26). However, the latest study reported weaning success of approximately 54% which is considerably lower than the results from this new study. When comparing the results in this study to other studies one must consider multiple possible confounding factors. First and foremost, the admission criteria for the REMEO clinic could differ considerably compared to admission criteria for other clinics. As an example of this, one of the studies included in the previously mentioned meta-analysis included patients in need of vasopressors and hemodialysis (32) while patients with these requirements are not admitted to the REMEO clinic (33). The previously mentioned meta-analysis used the definition of chronic critical illness and included only studies on patients in need of PMV (7). While the results of this study do not indicate a difference in mortality depending on the need of mechanical ventilation the fact that only about a third of patients admitted to the REMEO clinic required mechanical ventilation must be considered.

Previous international studies have shown failure to wean from mechanical ventilation to increase mortality (6) while the results of this study show no difference in mortality in patients that were successfully weaned compared to patients not weaned. However, given the rather small number of patients included and the high rate of weaning success, the number of patients discharged with mechanical ventilation was very small (n=7) including patients dead at the clinic. It is likely that a difference in mortality would not be apparent in the results of this study and further studies would be needed to enable a solid understanding of the effect of weaning on survival.

A majority of patients were discharged to home with or without assistance or to further rehabilitation. As a specialized center for care, treatment and rehabilitation of persistently critically ill patients and patients in need of PMV one of the major objectives is to enable lower level of care and ultimately return to home. Data presented in this study indicates that this is successful. Compared to previous studies on persistently critically ill patients the discharge rate to home in this study is strikingly high (5, 27). However, patients being discharged to home are not always discharged to home because of return to a somewhat premorbid state but also include patients who do not benefit from further rehabilitation. This study did not include parameters on current diagnoses or data on health status post-discharge and therefore further analysis on this subject could not be performed.

Strengths and limitations

This study has several strengths. The primary strength of the study lies in the fact that it is the first study to be made on this population of patients in Sweden. Second, the data used in the study are up-to-date and to a large extent validated by cross checking information in the quality registries to patient journals. Third, because of included social security numbers in the study material and availability to the Swedish population registry mortality data for all of the included patients could be included and analyzed. However, there are also some weaknesses. First, the small number of included patients with a high heterogeneity makes statistical analysis difficult and limits the power of this study. Second, no data on previous diseases, previous care and clinical parameters were included thus making it difficult to study factors that have an impact on mortality and weaning success. Third, with different definitions being used for weaning and for characterizing this group of patients, comparisons to other studies and clinics are difficult. Fourth, the novel concept of care provided at the REMEO clinic could not easily be described since it is highly individualized and therefore different models of treatment could not be isolated or analyzed in this study. Fifth, it could be argued that the concept of care, staff and procedures might have changed during the study period having impact on the results of this study.

Significance

The major significance of this study lies in the fact that it is the first study to be performed on persistently critically ill patients in Sweden. These patients have increased in numbers due to advances in intensive care and consume extensive health care resources. Therefore, this study has considerable public health relevance. It provides a baseline understanding of patient characteristics and outcome of persistently critically ill patients treated in a specialized clinic, the REMEO clinic. Knowledge from this study could prove useful in designing future studies as this study illustrate multiple knowledge gaps and further indicates the need for additional data to be studied.

Earlier studies on gender-differences in critically ill patients treated in an ICU have indicated that female patients have a higher mortality at younger age compared to age-matched male patients (34). However, a more recent Swedish study on ICU patients (35), show no difference in the outcome variables depending on gender similar to findings of this study. Furthermore, the distribution of male to female patients is similar in this study compared to the previously mentioned Swedish study. However, we noticed a higher frequency of NIV treatment for male patients compared to female patients. The reasons for this could not be found in the material

included in this study. There is limited research on gender differences in patients with persistent critical illness. While this study does approach this subject, it was not the main aim and further studies focusing on this would therefore be needed.

Future studies

This study provides knowledge on the outcome of patients treated at the REMEO clinic. With regards to previously mentioned weaknesses future studies on this group of patients should focus on providing knowledge on the effect of premorbid state, clinical parameters and discharge status on the outcome of patients. Future studies are also needed on this group of patients treated in other units to provide a solid understanding of the outcome of persistently critically ill patients treated without the specialized care provided at the REMEO clinic. The effect of PEG- or NG-tube on delaying weaning and decannulation needs further research since this study did not include the necessary data to explain this.

This study is unable to answer the question whether specialized care for persistently critically ill patients are superior to regular hospital care in a Swedish context. Future studies on the population of persistently critically ill patients in Sweden are needed to fully understand the effect of specialized care for these patients.

Conclusion

This study shows persistently critically ill patients treated at the newly started Remeo clinic with a novel concept for combined intensive care and rehabilitation, to have low mortality and a high success rate of weaning from mechanical ventilation and decannulation compared to international studies. Furthermore, most patients were discharged to home or to further rehabilitation at a lower level of care. The primary importance of this study lies in the fact that it is the first study to be performed on this group of patients in Sweden. Several weaknesses are present that warrant the need for further studies in this group of patients in a Swedish context.

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