RAPID COMMUNICATION

Characteristics of chronically critically ill patients: comparing two definitions

Márcio Manozzo Boniatti, Gilberto Friedman, Rodrigo Kappel Castilho, Silvia Regina Rios Vieira, Léa Fialkow

Critical Care Department, Hospital de Clínicas de Porto Alegre, Porto Alegre, RS, Brazil.

Email: marciobt@terra.com.br
Tel.: (51) 33598637

INTRODUCTION

Approximately 80% of the patients admitted into intensive care units survive the acute event, and most remain in this unit briefly.[1] However, a subgroup does not recover sufficiently quickly to become independent and from then they recover slowly.[2] These patients are called chronically critically ill (CCI) patients, and, depending on the definition criteria, comprise 5 to 10% of the patients admitted into intensive care units.[3-5]

There is a great deal of controversy regarding the definition of a CCI patient. The two most commonly used definitions are the duration of mechanical ventilation (MV) and tracheostomy.[2] The advantage of the latter is that the patients are identified by a code, simplifying the extraction of information from a secondary database.[2] However, the great variability in the indication of tracheostomy and its tendency to be performed increasingly early may contribute to the selection of patients with different evolutions than those of chronic patients.[6,7] MV varies from 4 to 29 days across different studies.[2] A recent consensus conference defined patients with cases of prolonged MV as those who need invasive MV for at least 21 days.[8]

Regardless of the definition, the main characteristics of this population are repeated episodes of shock and infection during their stays in the Intensive Care Unit (ICU).[9] It is clear that a chronic critical illness is not simply an extension of an acute critical illness but, rather, is a complex syndrome characterized by metabolic, neuroendocrine, neuropsychiatric and immunological changes.[10]

This study aims to compare the two definitions of CCI patients: tracheostomy (Tracheo group) and MV $\geq$ 21 days (MV group). In addition, we described the clinical, epidemiological and outcome characteristics of the CCI patients and tried to identify the factors that predispose patients to the evolution to chronic critical illness.

METHODS

This prospective observational study was developed in a single ICU with 25 medical-surgical beds at a university hospital in Porto Alegre, Brazil. All of the patients who were admitted into the ICU between February and May 2007 were included in the study. Any patient who stayed in the Intensive Care Unit for less than 24 hours and those who already had a tracheostomy upon admission were excluded.

The study was approved by the Institutional Ethics Committee. Informed consent was waived because no interventions were performed on the patients.

We used two definitions of CCI: tracheostomy performed for continued MV and a duration of mechanical ventilation lasting $\geq$ 21 days. During the period of study, a tracheostomy was performed only when the attending team deemed it necessary to wean the patient from mechanical ventilation. There were no tracheostomy cases for any other reason.

The following variables were collected at upon admission: age; gender; the main diagnosis in the ICU; where they were before admission to the ICU and the length of stay there; the type of admission; any preexisting illnesses ranked by a McCabe score (either as non-fatal [score of 1], ultimately fatal [score of 2] or rapidly fatal [score of 3]);[11] the presence of ARDS (Acute Respiratory Distress Syndrome);[12] the presence of shock;[13] sepsis; the severity of the disease (according to APACHE II [Acute Physiology and Chronic Health Evaluation] score) [14] and organ dysfunction (defined as a SOFA score $>$ 2 points in the organ systems that were evaluated, which included the cardiovascular, respiratory, neurological, hematological, renal and hepatic systems).[15] The daily incidence of ARDS, shock, infection, organ dysfunction, and tracheostomy and the length of time on MV was recorded prospectively. The evaluation outcomes were the evolution to chronic critical illness and the mortality in the ICU or in the hospital.

The results are presented as percentages $\pm$ standard deviation. The groups were compared using the χ-square test or Fisher's exact test to compare percentages or Student's t test or the Kruskal-Wallis test to analyze the continuous variables. A multivariate analysis was performed to determine the risk factors for evolution to chronic critical illness using backward stepwise multiple logistic regression. Factors with a value of $p < 0.1$ (as determined by a univariate analysis) were selected for the model. A value of $p < 0.05$ was considered to be statistically significant. No statistical analysis was performed when comparing the two definitions of CCI due to the overlap between the two groups.

RESULTS

During the study period, 274 patients were admitted into the ICU. Twenty-two of these patients were excluded

because they stayed in the ICU for less than 24 hours, which left 252 patients for the final analysis. Twenty-four (9.5%) patients were considered to be CCI according to one of the two possible definitions. Nineteen patients (7.5%) met the tracheostomy criterion. Fifteen (6.0%) patients had MV for at least 21 days. Ten (66.7%) of these were tracheostomized and, therefore, fulfilled both definitions.

The characteristics of non-chronic patients the tracheo group and the MV group are shown in Table 1.

When the two CCI patient definitions were compared, the patients in the MV Group were more severe, with more organ dysfunction and higher mortality in the ICU and in the hospital. (A statistical comparison was not performed due to the overlap between the two groups.) When comparing this group of patients to the non-chronic population, a significant difference in both ICU and hospital mortality was observed.

The evolution of the CCI patients was characterized by repeated episodes of infection and shock, a higher incidence of ARDS and a longer duration of MV and length of stay in the ICU and in the hospital.

The median time until a tracheostomy was performed was 13.0 days of MV. Nine (37.5%) patients received MV for

Table 1 - Clinical characteristics and outcome variables of CCI patients defined by either tracheostomy or MV for $\geq$ 21 days compared to the remainder of the patients in the ICU.

Variable	Tracheo group	MV group	Non-CCI
N	19	15	228
Age	59.3 ± 17.9	63.9 ± 12.9	54.4 ± 18.6[b]
Gender, male n (%)	9 (47.4)	6 (40.0)	121 (53.1)
Place before admission			
Ward	9 (47.4)	8 (53.3)	57 (25.0)[a,b]
Emergency	3 (15.8)	2 (13.3)	61 (26.8)
Another hospital	3 (15.8)	3 (20.0)	21 (9.2)
Operating room	4 (21.0)	2 (13.3)	84 (36.8)
Another place	-	-	5 (2.2)
Length of stay in the previous location	8.9 ± 13.2	7.7 ± 8.9	7.5 ± 11.2
McCabe score			
1	16 (84.2)	13 (86.7)	193 (84.6)
2	3 (15.8)	2 (13.3)	32 (14.0)
3	-	-	3 (1.3)
Type of admission			
Medical	15 (78.9)	13 (86.7)	141 (61.8)
Elective surgery	3 (15.8)	1 (6.7)	62 (27.2)
Emergency surgery	1 (5.3)	1 (6.7)	25 (11.0)
Reason for ICU admission n(%)			
Sepsis	1 (5.3)	2 (13.3)	54 (23.7)
Cardiovascular	3 (15.9)	2 (13.3)	12 (5.3)
Respiratory	6 (31.6)	7 (46.7)	33 (14.5)
Neurological	5 (26,3)	1 (6.7)	29 (12.7)
Gastrointestinal	-	-	7 (3.1)
Postoperative	4 (21.0)	2 (13.3)	84 (36.8)
Miscellaneous	-	1 (6.7)	9 (3.9)
ARDS			
Upon admission	2 (10.5)	2 (13.3)	6 (2.6)
During evolution	4 (21.1)	5 (33.3)	15 (6.6)[a,b]
Shock			
Upon admission	3 (15.8)	3 (20.0)	66 (28.9)
During evolution	15 (78.9)	15 (100.0)	96 (42.1)[a,b]
Number of shock episodes	1.1 ± 0.7	1.5 ± 0.6	0.5 ± 0.8[a,b]
Sepsis upon admission	10 (52.6)	11 (73.3)	98 (43.0)[b]
Number of infection episodes	2.7 ± 2.1	3.1 ± 2.2	0.8 ± 0.8[a,b]
APACHE II	24.0 ± 8.4	26.1 ± 8.1	19.7 ± 8.0[a,b]
SOFA	6.4 ± 2.9	6.9 ± 3.8	5.7 ± 3.7
SOFA – neurological	1.6 ± 1.6	1.1 ± 1.6	0.7 ± 1.2[a]
SOFA – cardiovascular	0.8 ± 1.5	1.1 ± 1.7	1.0 ± 1.5
SOFA – respiratory	2.8 ± 0.7	3.0 ± 0.5	2.0 ± 1.2[a,b]
SOFA – renal	0.7 ± 1.2	0.9 ± 1.2	1.0 ± 1.4
SOFA – hematological	0.3 ± 0.8	0.6 ± 1.1	0.5 ± 0.9
SOFA – hepatic	0.2 ± 0.7	0.3 ± 0.9	0.5 ± 0.9
Dialysis (in evolution)	5 (26.3)	7 (46.7)	44 (19.3)[b]
MV (in evolution)	19 (100.0)	15 (100.0)	149 (65.4)[a,b]
Days on MV	32.2 ± 25.2	40.7 ± 24.3	3.4 ± 4.6[a,b]
Days in the ICU	36.2 ± 25.3	44.6 ± 24.4	6.2 ± 5.4[a,b]
Days in the hospital	68.4 ± 42.2	68.9 ± 44.6	26.3 ± 18.3[a,b]
ICU mortality	4 (21.1)	7 (46.7)	57 (25.0)[b]
Hospital mortality	10 (52.6)	9 (60.0)	78 (34.2)[b]

a, $p < 0.05$ for comparisons between the Tracheo group and the non-CCI patients.
b, $p < 0.05$ for comparisons between MV group and the non-CCI patients.
CCI, chronically critically ill; MV, mechanical ventilation; ICU, intensive care unit; ARDS, acute respiratory distress syndrome; APACHE, Acute Physiology and Chronic Health Evaluation; SOFA, Sequential Organ Failure Assessment.

more than 30 days, and 2 (8.3%) patients received MV for more than 80 days.

Although they were only 9.5% of the total population, the CCI patients accounted for 846 ICU bed-days, which represented 37.4% of the total number of ICU bed-days during the study period.

The admission factors that were associated with the evolution to chronic critical illness (as assessed by the univariate analysis) were neurological dysfunction, admission from a ward, pulmonary dysfunction and a higher APACHE II score (Table 2). Due to the small number of CCI patients, the multivariate analysis could not identify a variable that was independently associated with the evolution to chronic critical illness.

Only the patient age was different between surviving and non-surviving CCI patients (Table 3). All of the patients in this group who were more than 75 years old died in the hospital.

DISCUSSION

The main contribution of our study is the finding that the CCI patients who were defined by a duration of MV of ≥ 21 days were more severely ill than those defined by tracheostomy. The first definition appears to be more specific and manages to include a subgroup that is distinct from the rest of the critically ill population.

We found that MV group had higher APACHE II and SOFA scores, higher rates of infection and shock, a greater need for dialysis and increased mortality in the ICU and in the hospital. Another recent study reported that those who are chronically ill according to a duration of MV of ≥ 21 days had higher mortality and used more resources than those who were chronic due to tracheostomy.[6]

It may be important to identify patients with a high risk of becoming chronic early to be able to manage them. In our study, a higher APACHE II score, neurological dysfunction, pulmonary dysfunction and admission from a ward were associated with the evolution to chronic critical illness. The severity scores have been identified as predictors of prolonged MV,[3,9] although with low accuracy.[16,17] Admission from a ward has been previously identified as a factor associated with the evolution to chronic critical illness.[3] The status of neurological dysfunction as a predictor of CCI is a new finding. Presumably, this result is due to the very early tracheostomy in neurological patients,[18] who do not necessarily depend on MV.

Although CCI patients are in worse condition when they are admitted into the ICU, the impact of a prolonged stay in the ICU on the survival of these patients is still controversial. It is very difficult to compare these studies because they are heterogeneous. Some have found higher mortality in CCI patients,[5,19,20] while others have not.[6,9] The mortality found in our study varied according to the definition used; the CCI patients on MV for ≥ 21 days had a higher mortality than the rest of the population, and this difference was not found when tracheostomy was the criterion.

Indeed, some patients may benefit from these efforts, and others may not.[21] In this scenario, identifying the predictors of a poor prognosis might help doctors choose more aggressive treatments or treatments that prioritize comfort.[21] In our study, only patient age was associated with mortality in the CCI patients. The subgroup that was 75 years or older had 100% mortality. Indeed, age appears to be a major factor, as this group was not different from the remainder of the chronic patients in terms of their severity or comorbidity scores. Recently, the ProVent score (a need for a vasopressor, hemodialysis, a platelet count of $\leq 150\times10^9$/L and age ≥ 50 years) was created to predict mortality in this group and had good discriminatory power.[22]

This study has a few limitations. First, because it was performed in a single ICU, it is difficult to generalize the results. Second, the small number of patients may limit the analysis of the results, thus limiting its generalization even further. Finally, its observational design may have added selection bias, as there is great variability in the indication for a tracheostomy. However, comparing these two definitions of CCI patients will help identify this difference.

Table 2 - Predictors of evolution to chronic critical illness.

	CCI (n = 24)	Non-CCI (n = 228)	P
Neurological dysfunction	12 (50.0)	50 (21.9)	<0.01
Admission from ward	12 (50.0)	57 (25.0)	<0.01
Pulmonary dysfunction	23 (95.8)	153 (67.1)	<0.01
APACHE II	24.3 ± 8.0	19.7 ± 8.0	<0.01

CCI, chronically critically ill; APACHE, Acute Physiology and Chronic Health Evaluation.

Table 3 - Comparison of surviving and non-surviving CCI patients.

Variable	Survivors	Non-survivors	P
N	11	13	
Age	50.2 ± 13.6	68.7 ± 15.0	< 0.01
Gender, male	6 (54.5)	5 (38.5)	0.68
Type of admission			0.72
Medical	8 (72.7)	11 (84.6)	
Elective surgery	2 (18.2)	1 (7.7)	
Emergency surgery	1 (9.1)	1 (7.7)	
ARDS			
Upon admission	2 (18.2)	-	0.19
During evolution	4 (36.4)	1 (7.7)	0.14
Shock			
Upon admission	2 (18.2)	3 (23.1)	0.76
During evolution	8 (72.7)	12 (92.3)	0.30
Sepsis	7 (63.6)	7 (53.8)	0.69
APACHE II	22.6 ± 7.1	25.9 ± 8.6	0.32
SOFA	6.6 ± 3.0	6.9 ± 3.9	0.83

CCI, chronically critically ill; ARDS, acute respiratory distress syndrome; APACHE, Acute Physiology and Chronic Health Evaluation; SOFA, Sequential Organ Failure Assessment.

CONCLUSIONS

CCI patients are in a more severe condition upon admission into the ICU, and their evolution is characterized by repeated episodes of infection and shock. Defining CCI patients according to their MV time (≥ 21 days) appears to be more specific and includes a subgroup that is markedly different from the remainder of the critically ill population. This should be taken into account in future studies.

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