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BRIEF REPORT

M. Vitacca
E. Clini
R. Porta
N. Ambrosino

Preliminary results on nursing workload in a dedicated weaning center

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M. Vitacca (✉) · E. Clini · R. Porta · N. Ambrosino
Lung Function and Respiratory Intermediate Intensive Care Units, S. Maugeri Foundation IRCCS, Medical Center of Gussago, Via Pinidolo 23, 25064 Gussago, Italy
e-mail: nambrosino@fsm.it
Tel.: + 39-030-2528284
Fax: + 39-030-2521718

Abstract *Objective:* To evaluate the nursing time required for difficult-to-wean patients in a dedicated weaning center (WC) and to examine the correlation of the nursing time with nursing workload (NW) scores and with clinical severity and dependency.
Setting: Four-bed WC of a pulmonary rehabilitation department.
Intervention: None.
Design and measurement: Prospective, observational study of 46 consecutive patients admitted to a long-term WC. Time required by items of the Time Oriented Score System (TOSS) and other tasks specific to respiratory intermediate intensive care units were evaluated for all the activities performed on each patient in the first 2 days after admission. Patient dependency and level of nursing care at admission were measured using the Dependence Nursing Scale (DNS) and the Intermediate Therapeutic Intervention Score System (TISS-int). The Acute Physiology and Chronic Health Evaluation (APACHE) II score was also recorded at admission.
Results: On the first day each patient needed 45 ± 15 % (63 ± 23 %, 45 ± 22 %, and 29 ± 14 % for the three nursing shifts) of allocated single nursing time. On the TOSS on the first day patients required a daily mean 28 ± 10 % of total available nursing time; on the second day the results did not change. Time of care in the first 24 h was only weakly related to DNS, APACHE II score, and TISS-int; only DNS was able (although weakly; $r = 0.45$) to predict minutes of nursing care.
Conclusions: In difficult-to-wean patients from mechanical ventilation the nursing time in the first 2 days after admission is high. The use of TOSS may underestimate NW by about 38 %. Although only DNS showed the ability to predict minutes of care, the weak relationship limits its value in clinical practice.

Key words Mechanical ventilation · Intensive care unit · Intermediate intensive care unit · Chronic obstructive pulmonary disease

Introduction

While the new policy of transferring difficult-to-wean patients to dedicated weaning centers (WC) to reduce costs of care is gaining increasing acceptance, there are only few data about the human resources needed in such WCs. Measurement instruments for estimating nursing workload (NW) in general ICUs include the Therapeutic Intervention Score System (TISS) [1] and its derivatives [2], the Time Oriented Score System (TOSS) [3], and the Nine Equivalents of Nursing Manpower Use Score (NEMS) [4]. Scores of patient illness severity and NW in the first 24–48 h after admission have been proposed to predict the need for time con-

Table 1 Anthropometrics, demographics, clinical and functional characteristics of patients

Patients, n	46
Age, y	66 ± 13
Gender, M/F	36/10
Weight, Kg	60 ± 20
COPD, post-cardiac surgery, thoracic restrictive diseases, n	39–3–4
MV in ICU, days	25 ± 7
Tracheotomized, days	10.5 ± 3.6
PaO_2/FIO_2†	220 ± 80
$PaCO_2$, mm Hg†	56 ± 15
pH†	7.41 ± 0.05
Nursing time in the first 24 hours, min	656 ± 222
Nursing time in the second 24 hours, min	649 ± 202
DNS	29.2 ± 5.4
TISS int	30 ± 5
APACHE II*	16 ± 2
Weaning time, days	6.2 ± 2.5
WC stay, days	23 ± 8

PaO_2 = arterial oxygen tension; FIO_2 = inspiratory oxygen fraction; $PaCO_2$ = arterial carbon dioxide tension; DNS = dependence nursing scale [6]; TISS int = time intervention score system for intermediate unit [2]; APACHE = Acute Physiology And Chronic Health Evaluation score [5]; WC = Weaning Centre. † at admission under mechanical ventilation; * at admission

suming care and NW and to plan staff allocation [1, 2, 5]. However, these scores have been used only in general ICUs, and they do not completely describe the NW in a WC and have not been studied in relation to the level of patient dependency.

Therefore we performed a study to evaluate the nursing time required in the first days of care of these patients. As a secondary end-point we compared the nursing time with TOSS and with the Intermediate TISS (TISS-int), with APACHE II score [5], and the Dependence Nursing Scale (DNS) [6].

Methods

Patients

Among all 70 patients admitted to our respiratory intermediate intensive care unit, we prospectively examined 46 (66%) consecutive tracheotomized difficult-to-wean patients who had transferred from ICUs of other hospitals. Demographics, anthropometrics, arterial blood gas values during mechanical ventilation at admission, and diagnoses are shown in Table 1.

In our WC the nurse to patient ratio was 1:2, 1:3, 1:4, in the three daily shifts for a whole staff of 6.5 nurses. Weaning attempts were performed by decreasing the level of pressure support ventilation or by increasing periods of spontaneous breathing [7].

Measurements

At admission, anthropometric data, previous history of patient in the ICU, and clinical severity as assessed by the APACHE II score were recorded. An expert panel of nurses and medical physicians from our WC calculated the time (in minutes) required by the activities indicated in the 13 TOSS items [3] and by additional tasks considered specific to these "chronically unstable" patients (Table 2). The time required for these tasks was assessed according to measurements performed on 30 patients (mean number of samples for each task = 87, range 13–160) over three consecutive months by ten nurses blind to the study (Table 2). A lead nurse calculated the total nursing time per patient spent during the three daily shifts in the first 48 h after admission, noting the number of single tasks and the number of nurses required by each task. The nursing time was also computed using items and times required, according to the TOSS [3]. The DNS [6] and TISS-int [2] were also computed.

Statistical analysis

Analysis of variance for repeated measures was used to test differences between the first 2 days, between nursing shifts within the same day, and between the TOSS and the NW. Relationships between nursing time and APACHE II, DNS, and TISS-int were evaluated by linear and forward and backward stepwise regression analysis.

Results

Of the 46 patients 40 (87%) were weaned from mechanical ventilation in 6.2 ± 2.5 days; two (4.3%) died in the WC, and the other four, unweanable patients were discharged home with invasive mechanical ventilation. Table 1 reports the mean total duration of assistance in the first 2 days after admission, DNS, TISS-int, APACHE II score, and length of hospital stay. On the first day patients needed 302 ± 109, 216 ± 10, and 138 ± 60 min during the three nursing shifts. Daily nursing time was 45 ± 15% and 45 ± 14% of allocated single nursing time in the first and second days. By TOSS examination, in the first day our patients required 187 ± 87, 130 ± 64, and 81 ± 29 min of NW for single shift, with a daily mean of 399 ± 140 min of care (28 ± 10% of total available nursing time).

Most of nursing time was spent on body hygiene (28 ± 5%, 22 ± 4%, 4 ± 1% in the first, second, and third shifts, respectively), mobilization (19 ± 5%, 15 ± 4%, 3 ± 1%), positioning (20 ± 4%, 19 ± 4%, 4 ± 1%), and tracheal suctioning (13 ± 2%, 13 ± 2%, 11 ± 3%).

Minutes of care in the first 24 h were only weakly related to DNS [$r = 0.45$; $P = 0.001$, standard estimation error (SEE) = 200], to APACHE II score ($r = 0.35$, $P = 0.02$, SEE = 209), and to TISS-int ($r = 0.31$, $P = 0.03$, SEE = 213). DNS, but not APACHE II or TISS-int, was able to predict minutes of care in the first 24 h (prediction equation: minutes of assistance = 112.31 + 18.572 × DNS; $r = 0.45$; $P < 0.001$; SEE = 200). However, the predictive value was low.

Discussion

Among "chronically unstable" patients those with prolonged weaning are reported to need a high amount of nursing assistance [8, 9]. This study evaluated NW required by weaning from the ventilator in a four-bed dedicated WC. Measuring the exact NW needed for weaning might indeed be of interest for centers dedicated to these procedures in a very particular type of patients.

Our data are very preliminary and very particular, performed in a small number of patients, most of them with chronic obstructive pulmonary disease, and treated by a small group of motivated nurses. Therefore it is difficult to draw conclusions that are relevant to a general ICU.

The reason for adding new items or duplicating the previous items was that a WC dedicated to chronic patients requires different allocation of time for some activities than a general ICU. The nursing time required by our patients is high. Minutes of care in the first 24 h were only weakly related to DNS, APACHE II score, and TISS-int. Only DNS was able to weakly predict minutes of care in the first 24 h: from a purely statistical point of view this suggests a "better" relationship between DNS and minutes of care than other indices, and that DNS may be useful for defining minutes of care.

A further interesting finding of our study is the varying amount of NW required during different nursing shifts. The nursing time for the patients in this study exceeded that suggested by the nurse-to-patient ratio allocated in our WC (1:2, 1:3, 1:4 in the different shifts). Nevertheless this allocation was sufficient for our WC routine activities. In fact, at least 16 % of patients admitted to our WC required less NW. Furthermore, although we did not specifically evaluate the time course of NW in relation to the length of stay, mean DNS per patient decreased over time (from 28 ± 10 at admission, to 22 ± 10 at half length of stay to 16 ± 10 at discharge). Although the relationship between DNS and nursing time was weak ($r = 0.45$), this decrease also suggests a progressive reduction in nursing time. Interestingly, the mean duration of treatment in the WC was sufficient to compensate the initial increased nursing time.

In conclusion, this study shows that for difficult-to-wean patients: (a) the nursing time in the first 2 days after admission is high, especially during the first shift; (b) an index for measuring NW, such as TOSS, usually used in a general ICU, may underestimate the time required for tasks in the WC by 38 %; (c) the DNS, although the only measure able to predict minutes of care, is only weakly related to time of care and therefore has only limited usefulness in clinical practice.

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APPENDIX: Specific tasks considered besides TOSS [3] to evaluate nursing time

	Minutes (mean ± SD)
TASKS for Standard care:	
Care for evacuation (bed pan, urinal)	8.5 ± 2
Logging of vital signs (T, ABP, f, HR)	8 ± 3
Logging of weight	5 ± 1
Fluid balance	5 ± 2
Change of posture	4 ± 3
Mobilisation from bed to chair	13 ± 5
Calibration of monitoring devices	9 ± 2
Positioning and control of monitoring devices	10 ± 2
Cleaning of equipment	7 ± 2
Pharmacy	10 ± 3
Skin ulcer care	15 ± 3
Patient admission procedures	7 ± 3
Dressing	11 ± 4
Meal check	4 ± 2
File records	7 ± 1
TASKS for Drugs, Fluids, Nutrition:	
Drug therapy: preparation and administration, whatever route	4 ± 1
Inhaled therapy: preparation and administration	4 ± 2
Inhaled therapy (education and control)	2 ± 1
Oxygen therapy	3 ± 2
Naso-Gastric tube insertion	8 ± 2
Feeding	12 ± 3
TASKS for Respiration:	
Tracheotomy wound care	3 ± 2
Endotracheal suctioning	5 ± 2
Change and care of suctioning system	5 ± 1
Manual assistance with Ambu bag	8 ± 4
Tracheal cannula care	3 ± 1
Diagnostic tests (breathing pattern and mechanics)	10 ± 5
Nocturnal monitoring	5 ± 2
Bedside X-ray	5 ± 1
Change and care of ventilator's circuits	16 ± 4
Ventilator check	10 ± 2
Heat and moisture instruments care	3 ± 3
Fiberoptic bronchoscopy assistance	30 ± 6
Assistance in changing tracheal cannula	10 ± 7
Education for suctioning	10 ± 3
Tracheal aspirate collection	5 ± 3
TASKS for Unscheduled activities:	
Manual evacuation	15 ± 8
Assistance to thoracocentesis	18 ± 5
Cleaning of environment	15 ± 6

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