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Predictors of mortality in chest wall disease treated with noninvasive home mechanical ventilation

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Summary
Rationale: The long-term evolution of patients with chest wall disease and chronic respiratory failure treated with noninvasive home mechanical ventilation (NIHMV) is poorly known.
Objectives: The aim of this prospective observational study was to analyze the variables associated with mortality in a cohort of chest wall disease patients with chronic respiratory failure undergoing long-term follow-up after starting treatment with NIHMV.
Methods: Chest wall disease patients who began NIHMV between 1996 and 2005 were followed up, with death as the primary outcome. The patients' clinical characteristics, lung function, and arterial blood gases were recorded at the start of treatment. Patients were seen and evaluated 1 month after starting NIHMV. The prognostic value of clinical and functional variables were assessed by Cox regression analyses.
Main results: We included 110 patients, 61 with tuberculosis sequelae and 49 with kyphoscoliosis. By the end of follow-up, 34 patients (28%) had died. The 5-year survival was 69% in those with tuberculosis sequelae and 75% in kyphoscoliosis. $PaCO_2$ $\geq$50 mmHg at 1 month of home ventilation and comorbidity (Charlson Index $\geq$3) were independent predictors of mortality.
Conclusion: Our results suggest that PaCO2 levels $\geq$50 mmHg at 1 month after starting noninvasive home mechanical ventilation and the presence of comorbid conditions are risk factors for mortality in patients with chest wall disease. The importance of early detection of suboptimal home ventilation as well as comorbidities is highlighted.

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Introduction

Noninvasive home mechanical ventilation (NIHMV) is indicated in chest wall diseases (CWD) developing chronic respiratory failure (CRF).[1,2] Therefore, in a European epidemiologic survey (Eurovent), CWD accounted for approximately one-third of the indications for home mechanical ventilation.[3]

After implementation of NIHMV in CWD patients with CRF, improvements in hypoventilation symptoms[4,5] and arterial blood gases (ABG),[6–10] and a reduction in hospital admissions due to respiratory complications[4,9] have been shown. Despite these short-term favorable outcomes, the long-term evolution of NIHMV in these patients is poorly known. Survival in patients with CWD receiving NIHMV has been estimated in 2 series.[8,10] Leger et al.[8] found that nearly 80% of patients continue NIHMV at 3 years. In the study by Simmonds et al.,[10] this figure differed slightly depending on the cause of CWD: 94% and 79% of patients with tuberculosis sequelae and kyphoscoliosis, respectively, continued NIHMV at 5 years.

The relationship between clinical and respiratory function variables and mortality in CWD patients undergoing NIHMV remains to be defined. In a 10-year analysis from the ANTADIR Observatory, prognostic factors of mortality were evaluated in patients with tuberculosis sequelae and kyphoscoliosis.[11] However, less than 30% of these patients were receiving NIHMV, and the authors did not perform a separate analysis of this subsample. Taking into account all patients, regardless of the therapy received, female sex, younger age, a high body mass index, and higher PaO_2 and $PaCO_2$ values were all favorable independent prognostic factors.[11] Survival of patients with kyphoscoliosis[12] and tuberculosis sequelae[13] was also evaluated in the 2 Swedish studies mentioned above. In both studies, survival was associated with the therapy applied (NIHMV or LTOT) and this fact likely precluded the finding of associations between other independent variables and mortality. This paucity of evidence highlights the need for further studies focused on CWD patients undergoing NIHMV and followed-up on a long-term basis. Knowledge of prognostic factors for mortality has clinical interest, since it may help to improve the management of these patients.

The aim of the present study was to analyze the variables associated with mortality in a cohort of patients with CWD and CRF undergoing long-term follow-up after starting treatment with NIHMV.

Patients and methods

All adult patients ($\geq$18 years) with CWD who started NIHMV in a teaching hospital (Vall d'Hebron Hospital, Barcelona, Spain) were considered for inclusion in this prospective, observational study. Patients were enrolled between January 1996 and December 2005. The indication for NIHMV was based on Spanish and international guidelines,[1,14] including clinical symptoms (dyspnea, fatigue, orthopnea, or morning headache) and one of the following criteria: 1) stable patients with chronic hypercapnia ($PaCO_2$ >45 mmHg), 2) patients admitted due to acute hypercapnic respiratory failure requiring noninvasive mechanical ventilation, and 3) patients with oxygen saturation <90% during $\geq$30% of the night.

Patients with hypoventilation due to other respiratory diseases (neuromuscular, chronic obstructive pulmonary disease [COPD], and obesity-hypoventilation syndrome) were not included in the study. Having a tracheostomy for airway access and discontinuation of NIHMV due to noncompliance were exclusion criteria. The flow chart for selecting patients is shown in Fig. 1.

The study protocol was approved by the hospital ethics committee and written informed consent was obtained from all patients.

Variable measurements

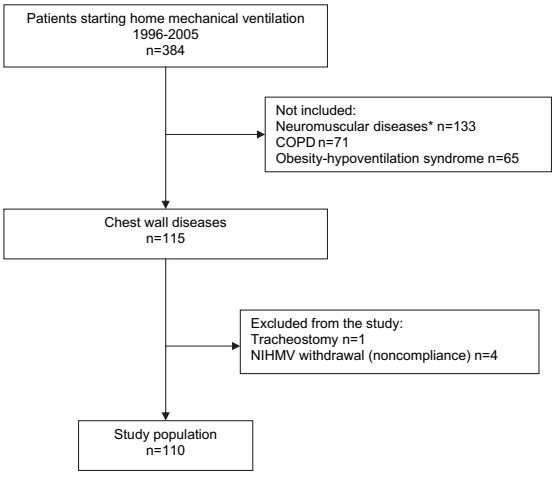
Patients' characteristics were systematically recorded in a computer database. Forced spirometry[15] and static volumes (MasterLab Pro, Jaeger GmbH, Wuerzburg, Germany) were obtained according to the European Respiratory Society guidelines.[16] In stable patients, baseline respiratory function values were defined as the most recent ones obtained prior to initiating NIHMV. In patients who started NIHMV during acute respiratory failure, these values were obtained once the patient had stabilized before hospital discharge.

Samples for ABG testing were taken with the patient breathing room air and processed with a pH and blood gas analyser (IL-1306; Instrumentation Laboratories, Milan, Italy).

Comorbid conditions were recorded using the Charlson Index.[17] A score of 1–6 was assigned to each disease, depending on its associated risk of death. In this study, all patients had a minimal score of 1, since CWD was considered a chronic pulmonary disease.

Mechanical ventilation

NIHMV was initiated in the respiratory ward. Custom-made[8] or commercial nasal masks were used. The choice of



*Includes 11 patients with post-polio kyphoscoliosis.
COPD = chronic obstructive pulmonary disease; NIHMV = noninvasive home mechanical ventilation

Figure 1 Flow chart of patient enrollment.