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The impact of the initial ventilatory strategy on survival in hematological patients with acute hypoxemic respiratory failure

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Abstract

Purpose: The aim of this study was to assess the impact of the 3 types of initial respiratory support (noninvasive positive pressure ventilation vs invasive positive pressure ventilation vs supplemental oxygen only) in hematological patients with acute hypoxemic respiratory failure (ARF).

Materials and Methods: This study is a retrospective analysis of a cohort of hematological patients admitted to the intensive care unit (ICU) of a tertiary care hospital between January 1, 2002, and June 30, 2006.

Results: One hundred thirty-seven hematological patients were admitted at the ICU with ARF (defined as Pao_2/Fio_2 <200): within the first 24 hours, 24 and 67 patients received noninvasive positive pressure ventilation and invasive positive pressure ventilation, respectively, and 46 received supplemental oxygen only. Intensive care unit mortality in the 3 patient categories was 71%, 63%, and 32%, respectively ($P = .001$), and in-hospital mortality was 75%, 80%, and 47%, respectively ($P = .001$). In multivariate regression analysis, increasing cancer-specific severity-of-illness score upon admission and more organ failure after 24 hours of ICU admission, but not the type of initial respiratory support, were significantly associated with ICU or in-hospital mortality.

Conclusions: Intensive care unit and in-hospital mortality in our population of hematological patients with hypoxemic ARF was determined by severity of illness and not by the type of initial respiratory support.

1. Introduction

Prognosis of hematological malignancy has improved in the last decades because of advances in diagnosis and therapy [1-5]. However, this therapeutic intensification, coupled with longer survival time, has led to an increased occurrence of potential life-threatening complications in these profoundly

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immunosuppressed patients [6-8]. Acute respiratory failure (ARF) is known to occur in up to 50% of hematological patients and to be associated with a rather grim prognosis, as up to 70% to 75% patients requiring mechanical ventilation eventually die in the hospital. However, the general trend toward increased survival in critically ill cancer and hematological patients [6-8] has also been observed in those patients with ARF [9-13] as well as in other severely ill subgroups [14-19]. Since the publication of studies describing improved outcome associated with the use of noninvasive positive pressure ventilation (NIPPV) in hematological and solid cancer patients with ARF [12,20], including a randomized controlled trial [20], NIPPV has been advocated as a preferable initial mode of respiratory support. In contrast to this, we have observed that NIPPV was not linked with outcome in a cohort of hematological patients requiring mechanical ventilation [10]. However, this study was, in part, based on retrospectively collected data, included patients treated with continuous positive airway pressure rather than NIPPV, and covered a period before the publication of the aforementioned randomized controlled trial of Hilbert et al [20] and of the British Thoracic Society guidelines for the use of NIPPV [21]. In the current report, we have updated on the impact of the initial type of respiratory support (NIPPV vs invasive positive pressure ventilation [IPPV] vs supplemental oxygen only, within the first 24 hours of intensive care unit [ICU] admission) on outcome in hematological patients admitted to the ICU with severe hypoxemic ARF (defined as a Pao_2/Fio_2 <200 at ICU admission).

2. Patients and methods

This retrospective study includes all consecutive patients with a hematological malignancy admitted to the medical ICU of the Ghent University Hospital between January 1, 2002, and June 30, 2006. Demographic, clinical, laboratory, and physiological data were recorded prospectively in all patients. The study was approved by the Ethical Committee of the Ghent University Hospital, and informed consent was waived due to the observational nature of the study.

Since 2002, hematological patients admitted with hypoxemic ARF have been systematically considered for a trial of NIPPV. Noninvasive positive pressure ventilation was provided to hemodynamically stable and alert patients with persisting hypoxemia (Pao_2/Fio_2 <200) and respiratory distress (tachypnea, ie, respiratory rate >30 minutes, or active contraction of accessory respiratory muscles) despite maximal supplemental oxygen provided through a Venturi mask. Contraindications to the use of NIPPV as issued by the guidelines of British Thoracic Society Standards of Care Committee [21] were generally respected. Although septic shock and frank hemodynamic instability were considered as a formal contraindication for NIPPV, allowance was made for a moderate dose of vasopressor therapy (dopamine <0.006 $\mu g\ kg^{-1}\ min^{-1}$, norepinephrine <0.1 $\mu g\ kg^{-1}\ min^{-1}$, or dobutamine at any dose) to achieve mean arterial pressures of at least 65 to 70 mm Hg, provided that patients were cooperative and showed no signs of imminent cardiorespiratory collapse. Noninvasive positive pressure ventilation was provided through bilevel positive pressure ventilation using a full face or total face mask. Ventilator settings used were a positive end-expiratory pressure between 3 and 8 cm H_2O, to which inspiratory pressures up to 10 cm H_2O (biphasic positive airway pressure [BiPAP Vision, Respironics Inc, Murrysville, Pa] or assisted spontaneous breathing [EVITA 4; Dräger Medical AG & Co, Lübeck, Germany]) were added. A decision to switch from NIPPV to IPPV was at the discretion of the treating physician on the following grounds: increasing respiratory deterioration (as evidenced by a >20% fall in Pao_2/Fio_2 or a 20% rise in $PaCo_2$, or signs of respiratory muscle fatigue such as paradoxical abdominal movement) despite maximal tolerable NIPPV settings, increasing hemodynamical instability (defined as use of norepinephrine exceeding >100 $ng\ kg^{-1}\ min^{-1}$), neurological deterioration (defined as development of agitation or somnolence; Glasgow Coma Scale <13), intolerance of NIPPV, or when invasive investigations were judged necessary because of clinical failure of empirical therapy. All decisions regarding initiation and withdrawal of NIPPV in individual patients were made by senior ICU staff members experienced in the use of NIPPV.

2.1. Data collected

Variables collected within 24 hours of ICU admission included the initial type of respiratory support (NIPPV, IPPV, supplemental oxygen only), age, sex, underlying hematological malignancy, disease status, allogeneic bone marrow or peripheral stem-cell transplantation (BMT), leukopenia at admission, oliguria (defined as 24-hour urinary output <400 mL), and vasopressor need. As described previously [1,15], ICU admission diagnosis was recorded by consensus between 3 ICU physicians (Pieter Depuydt, Johan Decruyenaere, Renaat Peleman) who were blinded to the patient's outcome and who used a set of predefined working definitions. Laboratory data included white blood cell count, lowest Pao_2/Fio_2, highest $PaCo_2$, and all parameters necessary to calculate severity of illness, according to the Simplified Acute Physiology Score (SAPS) II and the cancer-specific severity-of-illness score (CSSIS) as developed by Groeger et al [22]. For SAPS II, only the worst laboratory values of the first 24 hours were considered. The CSSIS is a logistic regression model aimed to estimate the probability of hospital mortality and consisting of 16 unambiguous and readily available physiological and laboratory variables upon ICU admission, cancer-specific variables, and the length of hospitalization before ICU admission. Organ failure after the first 24 hours of ICU admission was quantified by the Sequential Organ Failure Assessment (SOFA) score [23].