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Case report

Noninvasive mechanical ventilation in a patient with respiratory failure after hematopoietic progenitor transplantation

D Marín, E González-Barca, E Domingo, J Berlanga and A Grañena

Clinical Hematology Service, Ciutat Sanitaria i Universitaria de Bellvitge, Hospital Duran i Reynals, Institut Catalá d'Oncologia, Barcelona, Spain

Summary:

Respiratory failure requiring orotracheal intubation (OTI) and mechanical ventilation (MV) is almost always a fatal complication in patients who undergo hematopoietic progenitor transplantation (HPT). We present the case of a woman who suffered respiratory failure with bilateral infiltrates on a chest X-ray taken on day +14 following autologous bone marrow transplantation. We managed the patient satisfactorily with noninvasive ventilation, avoiding OTI. We believe that patients with non-progressive pulmonary lesions and without multiple system organ failure, may be correctly managed with noninvasive positive-pressure ventilation (NPPV).
Keywords: noninvasive ventilation; respiratory failure; hematopoietic progenitor transplantation

Respiratory failure (RF) requiring OTI and MV is almost always a fatal complication in patients who undergo hematopoietic progenitor transplantation (HPT), with a global 6 month survival rate between 2 and 5%.[1–5] In the past few years, the use of noninvasive positive-pressure ventilation (NPPV) has been introduced to treat patients with RF of different etiologies. We therefore considered this a potentially useful strategy in patients who undergo HPT and develop RF. We present the case of a patient who developed severe RF on day +14 post HPT, and in whom NPPV with bilevel airway pressure (BiPAP) was used with good outcome.

Case report

A 68-year-old white female without outstanding antecedents was diagnosed with diffuse large cell lymphoma stage IVB in March of 1996. She received eight chemotherapy cycles with cyclophosphamide, vincristine, doxorubicin and prednisone, achieving complete remission for 6 months. In February of 1997 she presented with a massive abdominal relapse and received four alternating cycles with etoposide, cytarabine, cisplatin, methylprednisolone, and etoposide, ifosfamide, mitoxantrone. Peripheral stem cells were harvested during recovery from the third cycle of chemotherapy. Pretransplant studies detected a slight decrease in the cardiac ejection fraction by isotopic ventriculography (45%). She underwent HPT in partial response and was conditioned with BCNU 520 mg i.v. for 1 day, etoposide 350 mg i.v. for 4 days, cytarabine 350 mg i.v. for 4 days and melphalan 254 mg i.v. 3.38×10^6 $CD34^+$ cells/kg were infused.

She developed fever during the neutropenic period (day +3) with grade IV mucositis, and empirical antibiotic treatment was started with ceftazidime 2 g/8 h i.v., amikacin 500 mg/12 h i.v. for 2 days and vancomycin 500 mg/6 h i.v. Routine cultures were persistently negative. On day +10, due to the persistence of fever, amphotericin B 70 mg/24 h i.v. was added to the empirical treatment. From day +3 to day +13 although the patient gained 11 kg in weight, her central venous presure (CVP) increased to 25 cm H_2O, peripheral edema appeared, and albumin levels dropped from 35 g/l to 29 g/l. Chest X-ray was normal. On day +12 haematopoietic recovery began (700 neutrophils). The patient received total parenteral nutrition from day +7 to day +17.

One day +14, she developed sudden dyspnea, tachypnea and RF with a PO_2/FiO_2 ratio of 135 and bilateral infiltrates on chest X-ray. Diuresis therapy was intensified and inotropic support was added (dopamine at 4 μg/kg/min and dobutamine at 9 μg/kg/min). Although her fluid balance became negative and the CVP decreased to 12 cm H_2O, on day +15 X-ray and respiratory function deteriorated (FiO_2 of 0.7 PO_2 of 51 mmHg, 85% saturation and respiratory rate of 48) and MV with BiPAP was initiated, with an 0.8 FiO_2, 17 cm H_2O of inspiratory positive-airway pressure (IPAP) and 5–6 cmH_2O of expiratory positive-airway pressure (EPAP), achieving a tidal volume of 600–700 ml. Her oxygen saturation increased to 99% and respiratory rate decreased to 22. Over the following 3 days pulmonary function improved and PO_2/FiO_2 increased to 252, allowing a FiO_2 decrease to 0.4 on day +17 and EPAP to 3 cm H_2O on day +19. On day +20, we alternated BiPAP (with 0.3 of FiO_2 3 cm H_2O of EPAP and 12 cm H_2O of IPAP) with 0.6 O_2 by face mask. On day +20, with a negative accumu-

Correspondence: Dr D Marín, Ciutat Sanitaria i Universitaria de Bellvitge, Hospital Duran i Reynals, Hematología Clínica, Autovia de Castelldefels, Km 2'7 (08907), L'Hospitalet de Llobregat, Barcelona, Spain
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lated balance of 171, the BiPAP was removed and replaced with 0.5 O_2 by face mask. The main complication during NPPV was facial skin necrosis that resolved a few days after the BiPAP was stopped. Chest X-rays improved gradually beginning on day +19, although bilateral infiltrates persisted until day +35. On day +24 fever disappeared and the antibiotics were gradually stopped. All cultures were negative. The patient was discharged on day +37.

Discussion

We describe a patient who developed severe RF on day +14 post HPT that resolved without the need for OTI, using NPPV for 6 days. Survival rates at 6 months post OTI due to RF secondary to a pulmonary lesion in patients who undergo HPT are 3–5% regardless of etiology.[1–5] The etiology of pulmonary lesions in patients who undergo HPT is complex and multifactorial. Lee *et al*[6] described a situation known as engraftment syndrome (ES) characterised by bilateral pulmonary infiltrates, hypoxia, non-infectious fever, and capillary leak syndrome – which in itself can produce hypoalbuminemia of up to 90% basal level and a weight gain of 105% over basal – on days when haematopoietic recovery takes place. This ES is thought to be caused by the liberation of cytokines during the engraftment process. The prognostic implications of this syndrome are unknown. The RF of our patient could be partially due to this ES and partially due to bilateral heart failure.

Recently, the use of NPPV in the treatment of respiratory failure has become a common practice,[7] in order to avoid OTI. We chose BiPAP with a facial mask because respiratory effort can be decreased by the pressure support and the end-expiratory pressure is useful to treat pulmonary distress and edema. We maintained continuous BiPAP for 5 days and intermittent BiPAP for 1 day. The procedure was well tolerated, causing only facial skin necrosis as a complication, which has been reported in 2–18% of patients.[7] The use of NPPV allowed us to keep the patient in a conventional room supervised by the haematologist in charge of the HPT, thus avoiding the need for transfer to an intensive care unit.

Crawford *et al*[5] presented a series of 1482 patients who underwent HPT, 348 of whom were subjected to OTI, and they concluded that these patients should not be admitted to the ICU due to high post OTI (97%) mortality. Faber-Langendoen *et al*[4] with a series of 653 patients, 191 of whom were subjected to OTI, recommended that patients not be intubated if they were older than 40 years or if RF began before day +90 post HPT. In these series, no correlation was found between patient survival rate, once intubated, and the conditioning regimen, development of graft-versus-host disease, underlying disease, allogeneic *vs* autologous HPT, or origin of the pulmonary lesion causing RF. The largest and most recent study on BMT patients undergoing MV is that of Rubenfeld *et al*,[8] which attempts to establish mortality predictors in these patients so as to identify – during the first 4 days of MV – patients who will survive. The study concludes that there are no survivors among patients who have suffered lung injury (PEEP >5 cm H_2O or FiO_2 >0.6 after the first 24 h of MV) and have either required more than 4 h of vasopressor support (dopamine >5 μg/kg/min, norepinefrine or epinefrine) or have sustained hepatic and renal failure (bilirubin >68 μmol/l, creatinine >177 μmol/l during the first 3 days of MV).

Therefore, OTI indications in a patient who undergoes HPT are controversial. The poor prognosis of these patients mitigates against OTI and MV, but, on the other hand, patients requiring OTI are young, disease-free and develop RF due to complications of therapy. Patients who fail NPPV due to progression of pulmonary lesions or multiple organ failure are probably in the bad prognosis group described by Rubenfeld. This is a difficult group about which to make decisions, and each centre should to come to a consensus according to its results after OTI. We believe that patients with non-progressive pulmonary lesions and without multiple system organ failure, such as the patient presented in this case report, can be adequately managed with NPPV.

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