Pulmonary Sequelae of Severe H1N1 Infection Treated with High Frequency Oscillatory Ventilation

Abstract:

During the recent influenza A (H1N1) pandemic, due to severe respiratory failure many patients required treatment with alternative ventilator modalities including High Frequency Oscillatory Ventilation (HFOV). We present four such patients treated with HFOV at an academic, tertiary referral hospital in Ireland. We detail outcomes of clinical examination, pulmonary function testing, quality of life assessment and radiographic appearance on CT Thorax at follow-up at 6 months. Further clinical assessment and pulmonary function testing were performed at median 19 months (range 18-21 months) post-discharge. At initial review all patients were found to have reduced gas transfer (median predicted DLCO 76%) with preservation of lung volumes and normal spirometrical values at 6 months (median FVC 5.42L [101% predicted] and FEV1 4.5L [101.2% predicted] respectively), with improvements in gas transfer (median predicted DLCO 83%) at subsequent testing. Post-inflammatory changes on CT Thorax at 6 months were seen in all 4 cases. To our knowledge this is the first report to document the long-term effects of severe H1N1 infection requiring high frequency oscillation on respiratory function. We conclude that the effects on respiratory function and pulmonary radiological appearance are similar to those observed following conventional treatment of Acute Respiratory Distress Syndrome [ARDS].

Introduction

In the management of ARDS the use of Rescue therapies including high frequency oscillatory ventilation (HFOV) and extracorporeal membrane oxygenation (ECMO) are generally reserved for patients refractory to conventional ventilation. We classified the predominant CT pattern as: normal attenuation; consolidation; ground-glass opacification (hazy areas of increased attenuation without obscuration of the underlying vessels); mixed pattern (combination of consolidation, ground glass opacities and reticular opacities in the presence of architectural distortion); ground glass attenuation with traction bronchiectasis; or honeycomb pattern. The extent of disease was quantified by dividing each lung into three zones: upper (above the carina), middle (below the carina but above the inferior pulmonary vein), and lower (below the inferior pulmonary vein). Each zone was assigned a score: 1 when <25% involvement, 2 when 25-50% involvement, 3 when 50-75% involvement, and 4 when >75% involvement. The total of all 6 zones was recorded, with a maximal possible score of 24. Assessment was in consensus by two radiologists, blinded to the patients clinical information.

Similar methodology for grading CT thorax findings as severe acute respiratory syndrome (SARS) studies was used. We classified the predominant CT pattern as: normal attenuation; consolidation; ground-glass opacification (hazy areas of increased attenuation without obscuration of the underlying vessels); mixed pattern (combination of consolidation, ground glass opacities and reticular opacities in the presence of architectural distortion); ground glass attenuation with traction bronchiectasis; or honeycomb pattern. The extent of disease was quantified by dividing each lung into three zones: upper (above the carina), middle (below the carina but above the inferior pulmonary vein), and lower (below the inferior pulmonary vein). Each zone was assigned a score: 1 when <25% involvement, 2 when 25-50% involvement, 3 when 50-75% involvement, and 4 when >75% involvement. The total of all 6 zones was recorded, with a maximal possible score of 24. Assessment was in consensus by two radiologists, blinded to the patients clinical information.

Case 1

A 36-year-old male smoker presented febrile, tachypnoeic and agitated in mild type I respiratory failure. Chest x-ray showed bilateral infiltrates. Sputum cultured streptococcus pneumoniae for which ceftriaxone was commenced. Following positive H1N1 screen oseltamivir was commenced. His condition however, deteriorated rapidly requiring full ventilator support. CT thorax performed on day Nine of ICU admission demonstrated bilateral infiltrates with right lower lobe consolidation. Bronchoscopy demonstrated normal proximal airways with minimal secretions to sub-segmental level. Due to worsening respiratory status on day 10 HFOV was commenced. A right-sided pneumothorax developed on day 4 of HFOV requiring chest drain insertion. He gradually improved and after a 51 day ICU admission was transferred to a general respiratory ward for a period of intensive rehabilitation prior to discharge. At review six months later, CT thorax showed residual scarring in both lungs, particularly at the apices and left upper lobe anteriorly with interval resolution of small pneumatomosels. Findings were predominantly consolidative, ground glass and reticular. CT score was 8/24 (Figure 1, Table 1). SF-36 demonstrated moderate limitation in physical and mental wellbeing (Table 2). PFTs showed a mild decrease in DLCO, with improvement on follow-up testing (Table 1). Resting oxygen saturations were normal at both follow-up assessments.

Case 2

A 56-year-old female non-smoker with breast carcinoma presented with a 2-day history of non-productive cough, breathlessness and fever. Three cycles of docetaxel, epirubicin and cyclophosphamide had been completed three months prior to presentation. The patient was hypoxic and in respiratory failure. Chest x-ray demonstrated bi-basal consolidation. H1N1polymerase chain reaction (PCR) was positive. Piperacillin/tazobactam, vancomycin and oseltamivir...
were commenced. Non-invasive ventilation was well tolerated initially but the patient deteriorated requiring intubation and HFOV. HFOV was continued for 22 days. She suffered severe critical illness neuromyopathy but following intensive rehabilitation at ward level the patient was extubated. At 6 months DLCO was 87% predicted, with spirometry within normal limits. Resting oxygen saturations were normal. CT demonstrated mild linear fibrotic changes bilaterally, most marked in the lower lobe. DLCO was 19/24. SF-36 data demonstrated poor functioning in role limitation and social functioning (Table 2). At 18-month follow up, interval improvement in SF-36 was noted (Table 1).

In conclusion, by 6 months, despite the necessity for prolonged ventilation, FVC and FEV1 were in the normal range but DLCO was reduced in all subjects. There was radiological evidence of mild, persistent pulmonary parenchymal abnormality characterised as predominantly ground-glass and reticular in nature. Repeat PFTs at mean 19.25 months showed interval improvement in DLCO. To the best of our knowledge this is the first report of patient follow up which focuses specifically on those who required HFOV for treatment of ARDS due to H1N1 infection.

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References


