

Acknowledgements

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Conflicts of interest

None.

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Non-invasive ventilation for respiratory failure due to acute exacerbations of chronic obstructive pulmonary disease in older patients

SIR—Chronic obstructive pulmonary disease (COPD) is an increasing cause of global morbidity and mortality [1]. It is a chronic progressive disease whose course is frequently punctuated with acute exacerbations, usually due to the presence of infection. Inpatient hospitalisation for acute exacerbations accounts for more than half of the average cost of treating COPD and in addition is associated with a high mortality [2, 3]. In severe disease, patients often have limited respiratory reserve and the resultant tachypnoea, increased work of breathing, and subsequent exhaustion may lead to hypercapnia, hypoxia and respiratory acidosis. The prevalence of COPD increases with increasing age [4], and in addition elderly patients are at increased risk of developing respiratory failure, for example as a result of limited reserve, loss of muscle mass, nutritional deficiencies and associated co-morbidities.

Conventional treatment for respiratory failure resulting from acute exacerbations of COPD (AECOPD) includes bronchodilators, corticosteroids, antibiotics and controlled oxygen [5]. Patients with hypercapnic respiratory failure who fail to respond to such measures may be considered for non-invasive ventilation (NIV) or for endotracheal intubation and mechanical ventilation. NIV employs a nasal or full-face mask to administer ventilatory support from a flow generator, thus unloading fatigued ventilatory muscles, decreasing the work of breathing and enhancing ventilation. Studies have shown NIV decreases the need for endotracheal intubation, decreases mortality and results in shorter duration of hospital stay, and is therefore the treatment of choice in appropriate patients [6]. Despite the extensive evidence for the use of NIV for AECOPD its use specifically in an elderly population with COPD has not been studied, and it is not known whether elderly patients gain similar benefits from NIV as do younger patients with COPD. We therefore investigated the tolerance to and outcome of NIV in a cohort of elderly patients admitted to our unit with acute hypercapnic respiratory failure due to COPD.

Methods

A prospective study of patients aged 65 years or above admitted between September 2002 and August 2003 with an AECOPD to a district general hospital in Reading, UK, was undertaken. These patients were all managed in high-

dependency beds within a medical admissions unit where staff were fully trained in the administration of NIV and of physiological monitoring. Two beds with high-dependency facilities for the administration of NIV were available within the unit.

Inclusion criteria for the study were: (i) known clinician-made diagnosis of COPD with supporting spirometry or a high probability of the disease (on the basis of clinical history, smoking history, physical examination and chest radiograph); (ii) respiratory rate >22 breaths per minute; (iii) acidosis (pH<7.35); and (iv) hypercapnia (PaCO₂>6 kPa). All patients were initially commenced on standard medical therapy for AECOPD with nebulised bronchodilators, corticosteroids, controlled oxygen and antibiotics [5]. Patients' arterial blood gases were measured within 1 h of commencement of standard medical therapy and NIV initiated if patients fulfilled the above criteria. The exclusion criteria were: (i) impending or post-respiratory arrest; (ii) impaired consciousness (Glasgow Coma Scale<8); (iii) severe uncorrected hypoxia (PO₂<7.3 kPa); (iv) cardiovascular instability; (v) copious secretions; (vi) craniofacial trauma; and (vii) pneumothorax or pneumomediastinum without the presence of an intercostal drain.

Respironics ST-D ventilators were used with full-face or nasal masks depending on patient comfort. Initial ventilator settings were IPAP = 12 cmH₂O and EPAP = 4 cmH₂O. IPAP was increased by 2 cmH₂O increments during the first hour according to patient tolerance up to a maximum of 20 cmH₂O and then subsequently according to clinical response, measurements of arterial blood gas and the patient's ability to tolerate the NIV. Arterial blood gas tension and respiratory rate were measured pre-NIV and at 1 and 4 h post-NIV. Pulse rate, respiratory rate, blood pressure and oximetry were continuously monitored. The NIV was used as much as possible in the first 48 h after admission, and patients were subsequently weaned off according to clinical improvement and arterial blood gas results.

A decision regarding endotracheal intubation was made in each case prior to the initiation of NIV, taking into account the patient's severity of disease, previous admissions and ventilation in intensive care and their co-morbidities.

Results

Thirty-six patients fulfilled the entry criteria during the 12-month study period and were included in the study. Their mean age was 77.4 years (ranging from 65 to 94 years), mean FEV₁ 0.72 l (SD 0.30). Mean World Health Organisation performance status was 2.4 (SD 0.6). Baseline respiratory rate and arterial blood gases are shown in Table 1. 51 per cent were male. 56 per cent were present smokers and 36% ex-smokers.

A decision to commence NIV was taken by a consultant in 14 patients, the specialist registrar in 18 patients and by the night senior house officer (SHO) in 4 patients. Thirty four patients (94%) were successfully initiated on and tolerated NIV. Two patients (6%) failed to be initiated on NIV due to inability to tolerate the mask. Of the 34 patients who were initiated on NIV, it was successful in 27 patients (79%) as

Table 1. Results pre and post commencement of NIV

| | Pre-NIV | 1 h post-NIV | 4 h post-NIV | P value |
|-------------------------|--------------|--------------|--------------|---------|
| PaO ₂ (kPa) | 7.53 (3.58) | 8.69 (3.23) | 10.18 (1.49) | <0.001 |
| PaCO ₂ (kPa) | 10.64 (2.80) | 8.78 (2.22) | 7.95 (1.90) | <0.001 |
| pH | 7.23 (0.07) | 7.31 (0.05) | 7.38 (0.07) | <0.001 |
| Bicarbonate (mmol/l) | 24.7 (6.7) | 25.4 (7.0) | 29.0 (6.3) | <0.05 |
| Respiratory rate (bpm) | 28.2 (4.4) | 21.8 (2.6) | 16.6 (4.4) | <0.005 |

NIV, non-invasive ventilation; bpm, breaths per minute. Values are expressed as mean (SD).

defined by improvement in acidosis, hypercapnia and respiratory rate. No patient developed any complications from NIV. Seven (21%) of those initiated on NIV failed to meet the above criteria of improvement. All those who failed initiation of NIV (2 patients) or failed to improve once established on NIV (7 patients) died. Mortality was therefore 25%.

A decision that NIV was to be the ceiling of treatment in these patients had already been made prior to the commencement of NIV in accordance with national guidelines and our unit's policy. This was on the basis of patients' co-morbidity, severity of underlying COPD, patients' wishes and previous admissions to hospital/intensive care. This decision was made at senior level in all patients. In those patients who died the mode of death was respiratory failure and all patients died within 12 h of their admission to the unit.

Mean length of stay in hospital of survivors was 9.5 days. Changes in PaO₂, PaCO₂ and pH and in respiratory rate prior to and 1 and 4 h post-NIV are shown in Table 1 and Figure 1.

Discussion

This study demonstrates that NIV can be used successfully in elderly patients admitted with hypercapnic respiratory failure secondary to AECOPD. Our findings of improvement of acidosis, respiratory rate and hypercapnia from the use of NIV are consistent with findings of other randomised trials undertaken in a younger population [7–12]. A fall in PaCO₂ and improvement in pH, as occurred in our patients, especially in the first 1–4 h of using NIV has been consistently shown to be associated with favourable response to treatment [13].

Studies of the use of NIV in AECOPD have included patients with a mean age of 60 years [5]. Indeed one study specifically excluded elderly patients [7]. The mean age of patients in our study is 77.4 years. We are aware of only one previous study that has investigated the use of NIV in elderly patients. Benhamou *et al.* [14] reported 30 patients with hypercapnic respiratory failure with a mean age of 76 years but only 20 of whom had COPD. They used a volume-cycled ventilator as opposed to the pressure-cycled ventilators used in our study. Treatment failure was 40% which is much higher than in our study but this may reflect that their patient group was heterogeneous with only 20 patients (68%) having COPD. We did not use an elderly control group as we felt that as treatment with NIV is now standard treatment for respiratory failure due to AECOPD

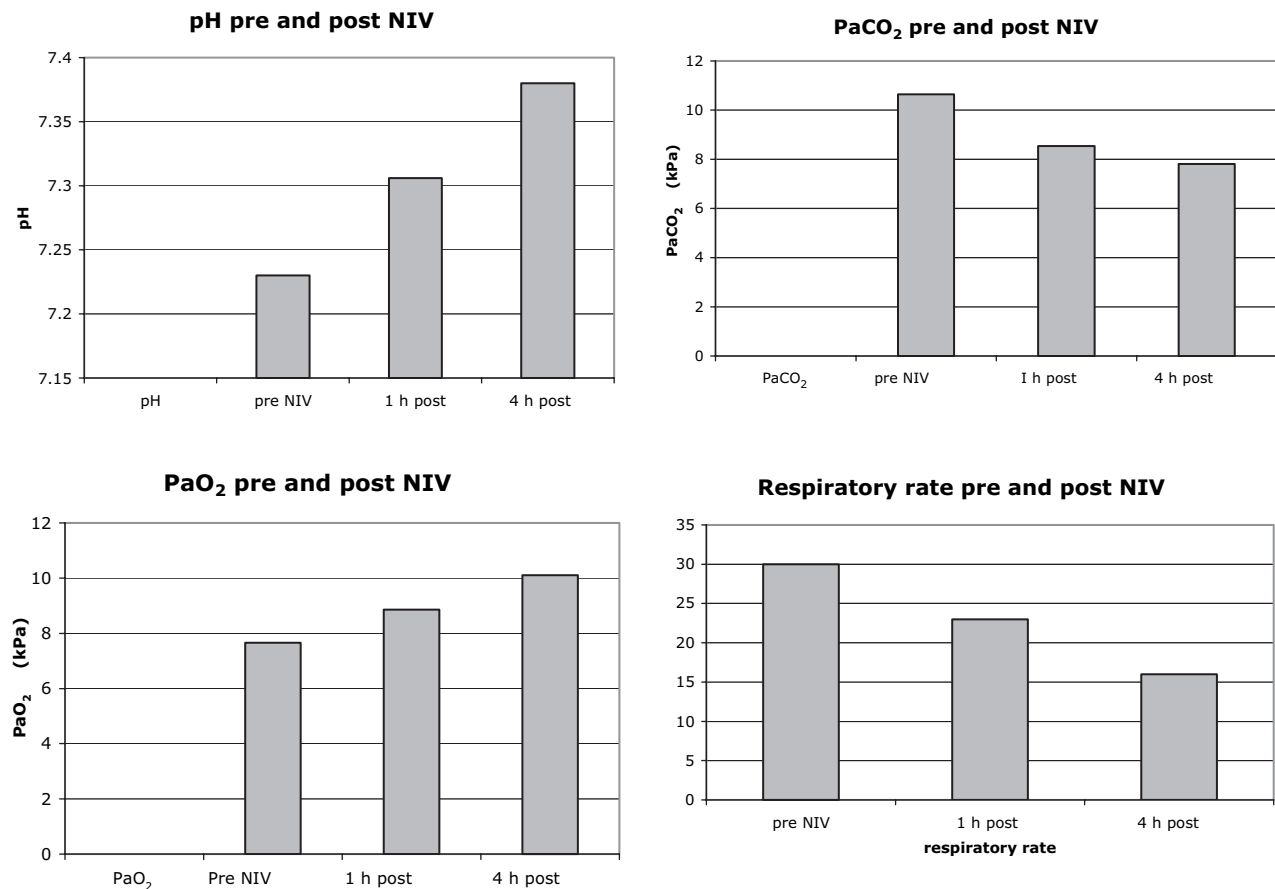


Figure 1.

in younger patients it would be unethical to withhold this treatment in elderly patients [5]. Without a control group, blinding treatment could not be undertaken but of note even large randomised controlled trials in younger patients have not included blinded treatment due to the practical difficulties of 'sham' ventilation [7–12].

There are numerous published studies of the effects of NIV on younger patients demonstrating similar improvements in arterial blood gases. Mehta and Hill [15] have reviewed improvements in arterial blood gases in younger patients and have shown mean improvements in PaCO₂ of 9.07–8.00 kPa compared to 10.64–7.95 kPa in our group and in PaO₂ of 7.70–8.93 kPa compared to 7.53–10.18 kPa in our study. The results are also comparable to previously published data of NIV also undertaken in a medical admissions unit by one of the authors using the same protocol where PaCO₂ improved from 10.11 to 8.48 kPa and PaO₂ from 6.64 to 9.4 kPa [16].

Patients who died had slightly worse FEV₁ (0.56 versus 0.76 l) and baseline PaO₂ (6.83 versus 8.56 kPa) but there was no difference in baseline pH or PaCO₂. The study was not powered to detect predictors of success with NIV or survival, but previous studies in younger patients have addressed this [17–19]. In a multicentre study of 236 patients Plant *et al.* [18] found baseline acidosis and PaCO₂ to be associated with treatment failure and improvement at 4 h in

acidosis and respiratory rate to be predictive of success. Confalonieri *et al.* [19] have recently shown that patients with a Glasgow Coma Scale of <11, acute physiology and chronic health evaluation II score >29, respiratory rate >30 breaths per minute and pH <7.25 have a predicted risk of failure >70%. The mean pH pre-NIV in our patients was 7.23 yet treatment failure (defined as mortality, need for intubation or intolerance of NIV) in our study was 25% which compares favourably with 21% from a meta-analysis of published studies in younger, less severe patients [20]. Confalonieri *et al.* also showed a pH <7.25 after 2 h of NIV was associated with >90% risk of failure. The mean pH at 1 h was 7.31 in our study which may explain why although our patients were unwell at the start of treatment, those that tolerated NIV had a good outcome.

Two patients were unable to tolerate the mask and therefore continue with NIV. A further seven patients were initiated on NIV but failed to improve as defined by improvement in acidosis, hypercapnia and respiratory rate. Data from an uncontrolled study suggest that this group of patients, 'late failures of NIV', have a poor outcome irrespective of whether they continue on NIV or are intubated and mechanically ventilated in an intensive care unit [21].

There have been a number of studies examining endotracheal intubation and mechanical ventilation of elderly patients within an intensive care unit. Of six prospective

studies, including age-specific data with patients ventilated for a variety of conditions, four studies concluded that age had an important effect on outcome [22–25] whereas two concluded that age had no effect [26, 27]. However evidence does suggest that age affects the intensity of care given to patients, even though clinicians may underestimate the degree of intervention desired by older patients [28, 29]. Our study is the largest study of NIV in the elderly with respiratory failure due to AECOPD and demonstrates high treatment success, decreasing the need for mechanical ventilation of elderly patients, with its associated risks, in the intensive care unit. Further larger studies of NIV in elderly patients are required to confirm our findings.

Conclusion

This study demonstrates NIV can be successfully used as an alternative to endotracheal intubation and mechanical ventilation in an intensive care unit in selected elderly patients with acute hypercapnic respiratory failure due to AECOPD. Its tolerability, success rate and associated low mortality are comparable to its use in younger patients.

Key points

- NIV provides ventilatory support through a patient's airway using a nasal or full-face mask.
- NIV has been shown to be an effective treatment for acute hypercapnic respiratory failure due to AECOPD. It can obviate the need for intubation and thus reduce complications and mortality and shorten the length of hospital stay.
- Its benefit in an elderly population has not previously been described.
- This study demonstrates NIV is as well tolerated and as successful in an older as in a younger population.
- NIV should therefore be the treatment of choice for hypercapnic respiratory failure due to AECOPD in selected elderly patients. In addition it may be used successfully as a ceiling of treatment in those patients in whom endotracheal intubation and ventilation on intensive care unit is not appropriate.

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The Checklist of Nonverbal Pain Indicators (CNPI): testing of reliability and validity in Norwegian nursing homes

SIR—Studies have shown that 45–80% of nursing home (NH) patients complain of pain [1], and that demented and mentally impaired NH patients are inadequately treated with regard to pain compared with mentally intact patients [2–4]. Assessing and uncovering pain in demented patients is a challenge. Among other things, experience, staff attitudes [5] and communication difficulties [3] are a part of the problem.

To overcome difficulties with verbal communication, several observational instruments have been developed to facilitate the detection of pain among mentally impaired NH patients [6–8]. The instruments vary in their comprehensiveness, and none of these is commonly used.

Auxiliary nurses and nurses' assistants are groups of caring personnel that are in close contact with patients in situations that frequently give rise to pain, e.g. during daily activities. However, the ability to sense and interpret vague symptoms and signs varies among nursing personnel.

A pain assessment instrument for use in daily practice should be simple and short so that it can be kept in mind. A

common understanding of the patients' verbal and non-verbal expressions is a prerequisite for proper pain assessment of mentally impaired NH patients. The Checklist of Non-verbal Pain Indicators (CNPI) is a tool that may meet these requirements. Against this background we wanted to study the test–retest and inter-rater reliability, and the concurrent validity of a Norwegian version of the CNPI, when the assessments were carried out by nursing staff caring daily for the patients.

Methods

The CNPI, an observational tool, is a modified version of the University of Alabama Pain Behavior Scale [9]. The tool incorporates six behaviours that are commonly considered to be associated with pain in demented persons: vocalisation, grimaces, bracing, rubbing, restlessness and verbal complaints [10, 11]. In order to make the CNPI more easy to use, each behaviour item is accompanied by characteristic key words, e.g. for 'restlessness': constant or intermittent shifting of position, rocking, intermittent or constant hand motions, inability to keep still; for 'vocal complaints': words expressing discomfort or pain, e.g. 'ouch', 'that hurts', cursing during movement, or exclamations of protest, e.g. 'stop', 'that's enough'. Each behaviour is scored 'yes = 1 or no = 0', giving a maximum sum score of six.

Seven NHs were invited to participate in the study. A ward nurse chose a convenient sample among patients, who, according to medical records, were diagnosed as demented, or who were considered to be mentally impaired, defined as having two or more errors on the Short Portable Questionnaire (SPMQ) [12]. Based on nurses' records, the ward nurse who did not participate in the assessments recorded whether the patients had been suffering from pain during the week prior to assessment and performed the SPMQ.

One of the authors instructed the nursing staff on each participating ward how to use the CNPI. The patient behaviour was assessed while staying in bed, and thereafter during the regular morning grooming and mobilising. The same person made the assessments on two consecutive days. Blinded to these judgements, another carer repeated the assessment on the third day. The assessments were performed by carers with varying degree of training (nurses, auxiliary nurses, nurses' assistants), who were regularly doing the patient care. This setting was chosen in order to reflect everyday practice in a NH.

Each assessment was introduced with the question: 'Have you any pain or aches today?' Patients who could not clearly answer 'yes' or 'no' were defined as 'non-communicative'. After the assessment was done, the assessors rated their own opinion of pain intensity on a visual analogue scale (VAS).

Statistics

Descriptive and non-parametric statistics were applied. Wilcoxon signed rank test was used to compare sum scores of CNPI assessments at rest and during movement. Internal consistency was measured by Cronbach's α , agreement between ratings was assessed by Cohen's κ and concurrent validity by means of Spearman's rank