Early continuous positive airway pressure in acute cardiogenic pulmonary oedema

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This editorial refers to ‘A randomized study of out-of-hospital continuous positive airway pressure for acute cardiogenic pulmonary oedema: physiological and clinical effects’ by P. Plaisance et al., on page 2895

Acute heart failure (AHF) syndromes are the most frequent cause of urgent consultation in patients with heart disease. In nearly 20% of cases the clinical presentation is acute pulmonary oedema. Although the diagnostic criteria of this syndrome have not been universally established, it is frequently defined by the sudden onset of severe dyspnoea and the presence of typical signs on physical examination, alveolar oedema on chest radiograph, and signs of acute respiratory failure. The latter is essential for the diagnosis. Consequently, different forms of AHF presenting with acute respiratory failure, such as hypertensive AHF, hyper-tensive pulmonary oedema, flash pulmonary oedema, and pulmonary oedema without hypertension or associated with acute coronary syndromes, may also be considered as acute pulmonary oedema.

Approximately half of the patients with acute pulmonary oedema show hypercapnia on admission. Together with severe acidosis and systemic arterial hypotension, this constitutes the main risk parameter for failure of medical treatment and the subsequent need for endotracheal intubation and mechanical ventilation. Until the early 1990s, the percentage of patients requiring these procedures was ~10–25%. However, several studies have since shown a decrease in the intubation rate as a result of the use of non-invasive ventilation (NIV). This technique delivers ventilatory support, generally applied via a face mask, without the need for an invasive pathway.

There are essentially two modalities of NIV that are used in acute pulmonary oedema. The first, continuous positive airway pressure (CPAP), was introduced in the 1980s. This technique is very simple and consists of a hermetic interface (facial or nasal mask, helmet, or pillow) connected to a source of oxygen to renew the inhaled air. The interface should be equipped with an expiratory valve mechanism that maintains continuous pressure into the lungs. The positive pressure produces respiratory and haemodynamic effects that improve oxygenation and decrease the work of breathing, the intrapulmonary shunt, and cardiac preload and afterload.

The second modality, introduced in the 1990s, is pressure support ventilation (NIPSV). In this case a ventilator is needed to deliver the air according to patient demand. This technique is habitually used with two levels of pressure, in which case it is known as bilevel ventilation or BIPAP; one level assists in inspiration and the other, like CPAP, maintains a constant positive expiratory pressure. This modality has several advantages over CPAP as it aids breathing and induces earlier improvement in several physiological parameters. However, comparative studies have not shown significant differences in the major outcomes. The disadvantage of NIPSV lies in the fact that it requires specific equipment and training. In spite of this drawback, NIPSV is currently the standard form of NIV in acute respiratory failure in several other settings such as severe chronic obstructive pulmonary disease (COPD) exacerbations or pulmonary infiltrates in immunocompromised patients. It is also used in severe asthma, cystic fibrosis, community-acquired pneumonia, and postoperative respiratory failure, as well as to avoid extubation failure and as an alternative in patients who have declined intubation. Avoiding intubation may lower the overall rate of infection, particularly nosocomial pneumonia, and, consequently, reduce mortality. Experience with the recently introduced proportional assist ventilation is still limited, and preliminary reports have not shown advantages over NIPSV, although it appears to be more comfortable for patients.

Around 20 small randomized trials comparing conventional therapy with CPAP or NIPSV have been published to date. Most of them show a more rapid improvement in physiological parameters and many present favourable outcomes. These results, reflected in three recent systematic reviews including nearly 900 patients, coincide in demonstrating a clear reduction in the risk of intubation with both modalities of ventilation when compared with conventional therapy. Besides, they do not appear to increase the rate of acute myocardial infarction, a complication that was reported as a possible hazard of the
technique in some preliminary studies. More remarkably, these meta-analyses clearly showed a tendency of NIV to reduce mortality, a finding that was statistically significant in the CPAP group. However, at the ESC Congress in Vienna in September 2007, a large multicentre trial from the UK, carried out in emergency departments with nearly 1000 patients, showed that although CPAP and NIPPV were safe techniques that improved respiratory failure more rapidly, mortality did not decrease compared with conventional therapy.\textsuperscript{13} The overall intubation rate in this trial was rather low, suggesting that patients were perhaps not ill enough to benefit from these techniques. In addition to patient selection, the crossover rate, the associated therapies and the teams’ expertise could also play a role in these neutral results. Since this trial, however, the impact of NIV on mortality remains uncertain and further studies are necessary to define which patients with acute pulmonary oedema are most likely to benefit from these techniques in terms of mortality. Patients with a high risk for intubation, including those with no hypertensive response, with hypercapnia and severe acidosis, may possibly be the target population for future research.\textsuperscript{6}

The study performed by Plaisance and co-workers\textsuperscript{14} opens up a new field of application for these techniques. These authors administered CPAP in the pre-hospital setting, as a first-line treatment in the ambulance. They found that starting CPAP 15 min earlier had important consequences on outcome. The signs of respiratory failure improved faster in the early CPAP group, and the intubation rate within the first 45 min of the protocol in the ambulance was significantly lower. More surprisingly, although none of the physiological variables other than $P_{aO_2}$ was significantly different on hospital admission (after 15 min of CPAP withdrawal), a tendency for lower hospital mortality in the early CPAP group was observed. Although the protocol of this trial does not reproduce the standard pre-hospital setting and the results on mortality could have been influenced by the treatment received outside the protocol in different hospitals, the overall reduction in the intubation rate suggests that the time of starting NIV may be crucial for success.

The favourable effects of NIV on oxygenation in out-of-hospital patients have been analysed previously in a parallel non-randomized trial performed using BIPAP at the University of Virginia.\textsuperscript{15} However, CPAP is a simpler technique that does not require special training and it may be easily started in the ambulance for many patients with acute respiratory failure secondary to AHF. The study by Plaisance et al.\textsuperscript{14} supports the early use of this technique in the pre-hospital setting. This hypothesis and the need to define better the target population for NIV warrant further investigation.

**Conflict of interest:** none declared.

**References**