NIV in the Treatment of Acute Respiratory Failure: Emerging Indications

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12.1 Prevention and Treatment of Surgical Complications

This is definitely an emerging field of application. It has been known for some time now that the period following thoracic surgery and major abdominal surgery can be complicated by hypoxia. This is almost always related to poor mobility of the diaphragm, which can be the consequence of traumatic damage during the operation, a pharmacological effect of the anesthetics and/or analgesics on the phrenic nerve or more banally the intense pain that prevents the patient from expanding the respiratory system adequately (i.e. the chest cage and abdomen). Decreased diaphragmatic function is associated with reduced pulmonary compliance and areas of atelectasia, which are the main risk factors for the development of pneumonia. This much feared complication of the post-operative period can, in some cases, be fatal.

For example, the development of hypoxia following respiratory complications in patients undergoing pneumectomy or lobectomy is associated with an approximately 50 % mortality rate. The prevention of atelectasia has, therefore, always been one of the aims of post-operative rehabilitation. Already in the 1980s, it was thought that the application of a positive pressure through a CPAP mask would be able to reduce the work of the respiratory muscles and on the other hand promote early recruitment of poorly aerated regions of the lungs. The first, pioneering studies, regarding both abdominal and thoracic surgery, demonstrated that following X-ray evidence of post-operative atelectasia, it was possible to reduce or prevent pneumonia and loss of respiratory function (in terms of volume) and improve gas exchange. More recently, some researchers have focused on the prevention of respiratory complications starting treatment even before the operation or immediately after the surgical procedure has been completed. Two randomized controlled trials are particularly interesting. Auriant and colleagues demonstrated that the early use of NIV to treat incipient respiratory failure after pulmonary resection was not only able to reduce the need for intubation, but even improved survival (Auriant et al. 2001). In a multicenter trial carried out in Piedmont (Italy), Squadrone and colleagues showed how the application of CPAP through a helmet significantly reduced the incidences of intubation, pneumonia

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and septic complications (Squadrone et al. 2005). This use of a helmet is very interesting since such patients often receive their treatment outside an intensive care unit, where ease of use is a fundamental determinant of acceptance by staff.

In conclusion, although the evidence has not reached level 1, predominantly because of the different techniques of ventilation used (NIV and CPAP) and the different clinical scenarios (thoracic and abdominal surgery), we feel that we can state that the most immediate new frontier of use of NIV is the post-operative setting.

12.2 Obesity Hypoventilation Syndrome

As we know well, obesity is becoming a serious socioeconomic problem, as well as a public health problem of primary importance.

This pathological state predisposes some patients to chronic alveolar hypoventilation, in some cases associated with obstructive apnea syndrome. In the light of what has already been stated, this would be an ideal field for the use of NIV and yet, surprisingly, there are very few studies to date on the use of NIV in this form of respiratory failure and most of the ones that have been done are observational studies. These studies confirm what we all expected, that is, a reduction in recourse to intubation and an improvement in blood gases.

Personally, we believe that at least a "judicious" careful attempt should be made in these conditions, although being aware that if intubation is needed in these patients, it could be difficult. Furthermore, perhaps the time has come to organize a multicenter, randomized trial to establish scientifically the role of NIV in obesity hypoventilation syndrome.

12.3 Palliation of Symptoms in the Terminally Ill Patient

The real title of this section should be "palliation and treatment of the patient who refuses intubation." Unfortunately in Italy, it is still impossible to discuss expected directives in a constructive, serious manner, as has been done in almost all civilized countries, with the result that it is still a taboo to tackle this problem. The sensation is that everything is left hypocritically in the hands of healthcare staff so that, with a paternalistic spirit or sometimes with cynicism, we decide what is good and what is not good to do.

That said, there are numerous publications on the use of NIV in patients who have reached the terminal stage of their illness and whose life expectancy is, by definition, very short and in whom pharmacological treatment has reached the so-called ceiling without providing additional benefits. These patients are rarely, if ever, admitted to an intensive care unit because of the known bed shortage and reach our attention exhausted by dyspnea and with a respiratory distress that has become insupportable.

The first thing to do is to ask yourself whether this deterioration is reversible or not. Three observational studies have demonstrated that the use of NIV in patients with acute respiratory failure who have decided not to be intubated is more effective in the case of an exacerbation of COPD or acute heart failure than in other conditions such as tumors or pneumonia. Indeed, about half of the patients with the former two causes of respiratory failure can be discharged from hospital compared with 15–20 % of other patients, particularly those with cancer.

Our survey, sponsored by the European Respiratory Society, confirmed that also in the real world of subintensive care units, the use of NIV as the "last" treatment (or 'ceiling NIV') is fairly popular given that about 30 % of the patients admitted into these structures in a terminal stage of their chronic respiratory disease receive this treatment.

The major problem, also from an ethical point of view, is to understand how closely this method approaches futile medical care, prolonging a patient's suffering once the acute event has been resolved, or how much it extends an existence that appears acceptable and is accepted by the patient. Here there is a difficult concept to measure, particularly in these conditions: the quality of remaining life. This is not easily quantifiable by either questionnaires or scales. For example, when two patients were asked why they insisted on being kept alive, one answered "because I want to see my first grandchild, who will be born in 2 months" while the other needed 3 months to see his favorite football team finally win the national league. While we might all be able to understand the former, even fans of the same football team might find it more difficult to understand the latter! Nevertheless, a person's wishes should always be respected.

NIV could be considered the more natural and less traumatic support in this difficult period of a person's life, given that its suspension would be less cruel than, for example, extubation. A particular case is when dyspnea occurs suddenly in the terminal stage of a patient's disease. Although numerous studies have demonstrated that it not at all easy to predict the real survival of patients, we are often faced with patients with insupportable dyspnea (or rather, pain of the respiratory system), in the last hours of their life. A classical example is a patient affected by a solid tumor or one with a malignancy of the hematopoietic system. A search of the literature would surprise you, because there are no studies demonstrating the efficacy of oxygen in reducing dyspnea and, therefore, the last resort is morphine, although this could dull the senses of the patient who perhaps wants to stay lucid to say goodbye to his dear ones or deal with last bureaucratic business. A pilot study in patients with solid tumors showed that in a good percentage of cases (about 60 %) the use of NIV was able to reduce dyspnea.

The first randomized, controlled multicenter study designed to determine the feasibility and effects of NIV versus oxygen on dyspnea in patients with end-stage cancer and respiratory distress showed that NIV is more effective than oxygen in reducing dyspnoea and decreasing the doses of morphine needed in patients with end-stage cancer. However, also in these circumstances, we should evaluate each case individually to ensure that we do not indiscriminately prolong a patient's suffering.

In conclusion, in such a delicate, but emerging field, NIV appears to be an additional instrument for improving, as much as possible, the quality of death but certainly not that of life, which it is futile to try to do at this stage.

12.4 Asthma

This is a relatively unexplored and controversial field of application of NIV. Observational studies have shown that NIV can be a valid alternative to intubation even when a patient has become hypercapnic. We have used the words "even when" because during the initial stages of an asthma attack, the patient tries to compensate for the unpleasant sensation caused by the bronchial obstruction by increasing his or her minute ventilation, that is, by hyperventilating. The development of hypercapnia is prognostically a very worrying sign since it means that the respiratory pump is failing and that the patient's conditions are worsening rapidly. In the absence of randomized controlled trials or more robust studies, we do not feel that we can recommend the use of NIV in the presence of a high $PaCO_2$.

On the other hand, the situation is different when the ventilation method is used to prevent a possible worsening of the patient's conditions. Two controlled studies have been carried out in patients without frank respiratory failure, comparing the effect of NIV and placebo ventilation. In one study NIV improved peak inspiratory flow and in the other it decreased hospital admissions. The effects described in the former of the two studies could only be achieved with high insufflation pressures and not with low ones or medical therapy alone. An important detail, described later, is that bronchodilator therapy can be administered during NIV and so ventilatory support does not need to be suspended in order to give drugs.

Thus, the current rationale for the use of NIV during an attack of asthma is only that of preventing further worsening, but not as a real treatment of the respiratory failure. Nevertheless, in a protected environment, a brief trial of NIV can also be indicated in a patient in a critical condition.

12.5 Restrictive Neuromuscular and Chest Cage Disorders

It is really surprising that we all seem to have successfully ventilated at least one patient of this type in our career and yet there are so few studies on the issue.

I remember the first patient in whom I (S.N.) used NIV for the very first time in my life was a woman with kyphoscoliosis and very severe hypercapnic respiratory failure. The success achieved not only astonished me, but also my colleagues at that time, and it was perhaps then that my enthusiasm for NIV was born.

Having said this, there is a common belief that the main application of NIV is restrictive disorders and that this form of ventilation works better in these disorders than in COPD. However, the only study that has analyzed this problem showed the

reverse: NIV was more effective at reducing the need for intubation in patients with exacerbation of COPD than in patients with hypercapnia caused by other restrictive chest disorders.

The only study, performed in Italy, which has compared NIV versus invasive ventilation in a small group of patients with neuromuscular diseases showed a series of improvements in clinical outcomes in the group ventilated non invasively. In fairness it should be said that the patients in the group treated NIV did have mini-tracheotomies to enable efficient removal of bronchial secretions, so the method should be considered "partially" non invasive.

In conclusion, despite the fact that clinical experience suggests that restrictive diseases respond well to the application of NIV, we are still waiting for firm scientific evidence.

12.6 Ventilatory Support During Bronchoscopy

This use of NIV in bronchoscopy was described more than a decade ago in a study performed by Prof. Antonelli's group in Rome (Antonelli et al. 2002). It is still common practice to use preventive intubation in severely hypoxic patients before carrying out fibrobronchoscopy. We are thinking, for example, about patients with severe pneumonia or an exacerbation of pulmonary fibrosis in whom we must carry out at least bronchoalveolar lavage and/or transbronchial biopsy. By taking due precautions, maintaining careful monitoring and, above all, having appropriate equipment available (i. e., good CPAP or a good ventilator and particularly a mask with an *ad hoc* and not self-made orifice), these interventions can be carried out safely, even in very hypoxic patients, without necessarily having to use more invasive measures (Fig. 12.1). Randomized studies against high-flow oxygen have demonstrated the efficacy of NIV or CPAP (for example with the Boussignac system) in drastically reducing desaturations both during and after the interventions. A more recent observational study also demonstrated that bronchoscopy could be performed in patients using a helmet as the ventilator interface. For curiosity's sake, we also mention a study by Natalini et al. who used external negative pressure ventilation to carry out bronchoscopy using a rigid instrument (Natalini et al. 1998).

In conclusion, this is a rapidly expanding application which should, in our opinion, become a first-line procedure in hypoxic patients who must undergo diagnostic bronchoscopy.

12.7 Future Indications Supported by Single Studies

In this paragraph, we briefly mention some potential applications of NIV which have so far only been supported by single observational studies and precisely for this reason, although interesting, require further confirmation.

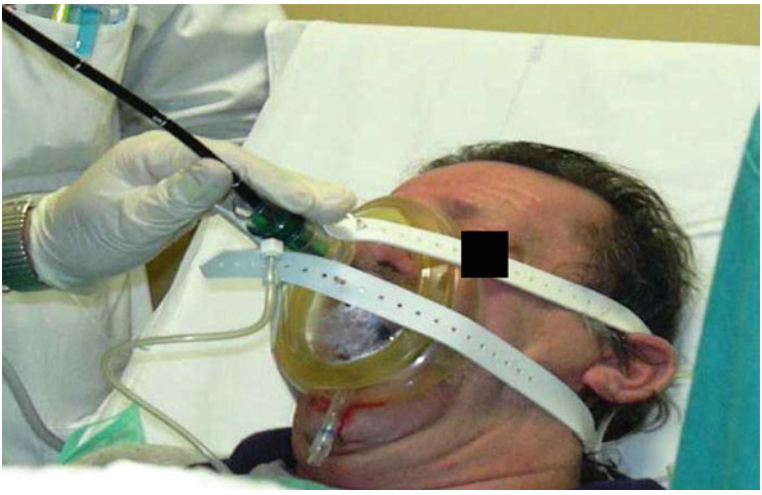

Fig. 12.1 Bronchoscopy made possible by NIV in a severely hypoxic patient

For example, NIV has been used to treat acute respiratory failure secondary to disorders such as exacerbations of cystic fibrosis, pulmonary fibrosis, thoracic trauma with flail chest, acute pancreatitis, or as a bridge in patients who are to be transplanted or in whom intubation could be a limit to the indication for the intervention.

Suggested Reading

Prevention and Treatment of Surgical Complications

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Future Indications Supported by Single Studies

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