PHILIPS

Hospital respiratory care

Providing evidence-based care to patients in need of respiratory support

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Non-invasive ventilation (NIV) in the form of bi-level positive airway pressure (BiPAP) or continuous positive airway pressure (CPAP) has long been established as a first-line therapy option for many patients in acute respiratory failure.[1] The goals of providing NIV are to minimise the respiratory workload of the patient in respiratory failure, with the physiologic aim of improving ventilation and oxygenation.

High-flow nasal cannula (HFNC) therapy has been used in adult patients for a number of years, but has gained significant popularity after the Clinical Effect of the Association of Non-invasive Ventilation and High Flow Nasal Oxygen Therapy in Resuscitation of Patients with Acute Lung Injury (FLORALI) study was published in 2015 in the New England Journal of Medicine.[2] In the FLORALI trial, HFNC resulted in lower intubation rates and mortality in patients with *de novo* respiratory failure with $PaO_2/FiO_2 < 200$ mm Hg when compared to conventional oxygen therapy (COT) and NIV. Recently, there has been a significant amount of research published regarding the use of HFNC for a wide range of patient populations.[3-5]

This article will provide an overview of the current guidelines for NIV and discuss the potential role for HFNC, based on the available data where HFNC has been compared to NIV.

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Acute respiratory failure

Acute respiratory failure (ARF) occurs when a patient no longer has the ability to maintain effective gas exchange. It can be secondary to an imbalance in respiratory drive (i.e., drug-induced, head injury), a decrease in pulmonary perfusion (i.e., increased alveolar dead-space), intra-cardiac or intrapulmonary shunting, or neuromuscular weakness. Studies often look at respiratory rate and oxygenation, and may include arterial pH or $PaCO_2$ for objective study inclusion criteria for ARF.

Supplemental oxygen and NIV provide the support many patients need to prevent complete respiratory failure (requiring invasive mechanical ventilation). It is every clinician's duty to understand the current evidence regarding the support of patients in respiratory failure, as well as recognise signs of intolerance and failure of these therapies, so that escalation of respiratory support is not delayed.

Evidence-based practice of non-invasive respiratory support

Recently, the European Respiratory Society (ERS), in partnership with the American Thoracic Society (ATS), published updated clinical practice guidelines for NIV.[6] Many of the recommendations were consistent with previous NIV guidelines published in 2011.[1] The methodology used for these guidelines was created based on the GRADE (Grading of Recommendations, Assessment, Development and Evaluation) methodology to assess the certainty of the evidence. The strength of the recommendation is accompanied by a certainty of effect which evaluates the quality of the evidence for which recommendations are based. The following section will summarise the recommendations and offer insight into the level of certainty of effect provided.

Strong recommendations for NIV continue to be for the management of acute exacerbation of chronic obstructive pulmonary disease (AECOPD), and for acute cardiogenic pulmonary edema (ACPE). For AECOPD, the strong recommendation comes with high certainty in the evidence, which means that further evidence is very unlikely to change the recommendation. For ACPE, the strong recommendation comes with a moderate certainty in the evidence, which means if future studies were performed, it could increase the estimate of effect, or may change the estimate. Currently, there is no evidence that another form of respiratory support used as first-line therapy is as effective as NIV for the management of AECOPD and ACPE.

Conditional recommendations are made when low to moderate evidence exists supporting the effectiveness of a therapy for a specified condition. Many of the conditional recommendations for NIV from earlier studies remain conditional due to inconsistent or weak evidence demonstrating effectiveness for preventing intubation, or reintubation (often the primary outcome measured in studies of NIV), or for demonstrating mortality benefit (normally a secondary outcome measured). Conditional recommendations supporting NIV include managing acute respiratory failure in the following patient conditions: immunocompromised, postoperative, post-extubation (high-risk; prophylaxis), trauma, palliative care, and weaning hypercapnic patients.

No recommendations were made for the management of asthma exacerbation, pandemic viral illness, or *de novo* respiratory failure. *De novo* respiratory failure refers to respiratory failure associated with tachypnea and hypoxemia, in the absence of underlying chronic respiratory disease and acute cardiogenic pulmonary edema. The lack of recommendation is based

on a large amount of data evaluating the use of NIV against COT in acute hypoxemic respiratory failure. Studies have varying degrees of success, some with positive NIV results, others with high NIV failure rates. Unfortunately, NIV failure is associated with poor outcomes.[7,8] Severity of illness, underlying presence of shock, and level of baseline hypoxemia are predictors of failure of NIV, and extremely close monitoring is important when treating these patients non-invasively. Intubating a patient in hypoxemic failure should not be delayed when there is no clinical signs of improvement.

There were only two **recommendations against** the use of NIV. The use of NIV in AECOPD patients with pH > 7.35 is not recommended as a way of preventing acidosis, and the use of NIV as rescue in patients failing extubation after invasive ventilation is also not recommended.

The role of HFNC in the management of acute respiratory failure

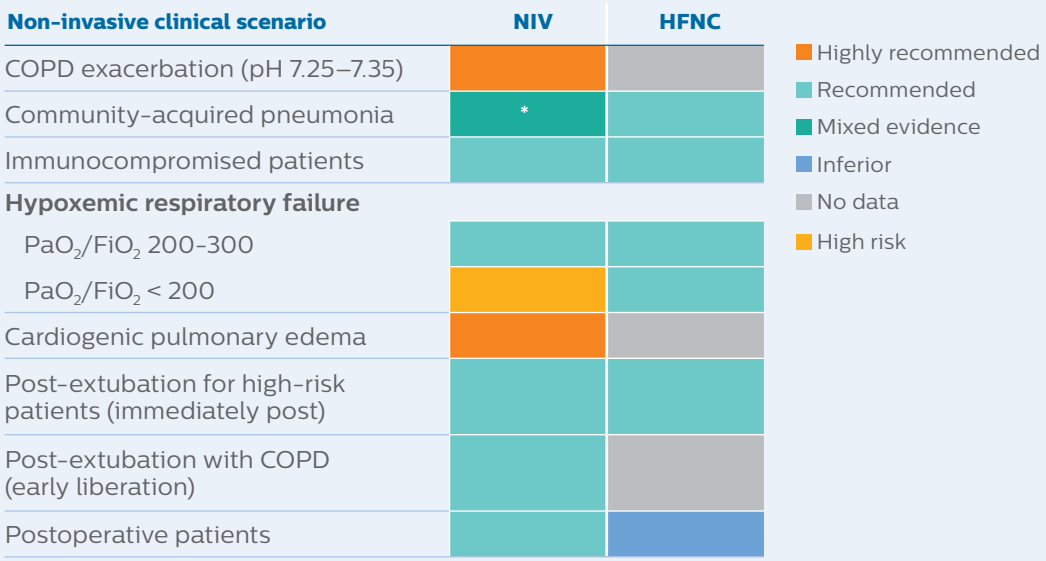
The use of HFNC in the management of acute respiratory failure is rapidly increasing, and studies are regularly being published on the subject. Many studies compare HFNC to either COT or NIV, or both. It is worth noting that most of the evidence in support of HFNC is currently only in the area where conditional or no recommendations are given for the use of NIV. Individual studies have demonstrated benefits over NIV in patients that are immunocompromised and patients in hypoxemic failure (with pH > 7.35). Other studies looking at HFNC used immediately after extubation (transition from invasive ventilation after passing a spontaneous breathing trial) have shown HFNC to be superior over COT in low-risk patients (low risk of reintubation), and HFNC was non-inferior to NIV immediately after extubation in high-risk patients. There are several systematic reviews and meta-analyses that have looked at the current evidence regarding HFNC and compared it to COT and NIV in mostly hypoxemic respiratory failure. They appear to support the idea that HFNC is superior to COT, but not to NIV.[9-13] However, a considerable amount of heterogeneity exists between studies, making the analysis of true effect weak, and further evidence is likely to change the estimate of effect.

When providing support to patients, many clinicians will opt to choose the least invasive option. Although further data is needed to demonstrate a benefit over NIV, it appears that HFNC is a safe alternative for hypoxemic respiratory failure, immunocompromised patients, and immediately post-extubation in patients at low or high risk of extubation failure. However, if hypercarbia occurs during a SBT, or a patient is morbidly obese, NIV should be the preferred therapy post-extubation. Furthermore, unlike NIV, there are currently no clinical guidelines available that are endorsed by groups such as the ERS/ATS. Clinicians should remain aware of the current evidence and understand when it is appropriate to escalate therapy, as was seen in a recent non-inferiority study where non-invasive positive-pressure ventilation (NPPV) prevented intubation in 87% of patients who failed HFT and were subsequently placed on NIV.[14]

The clinical conundrum

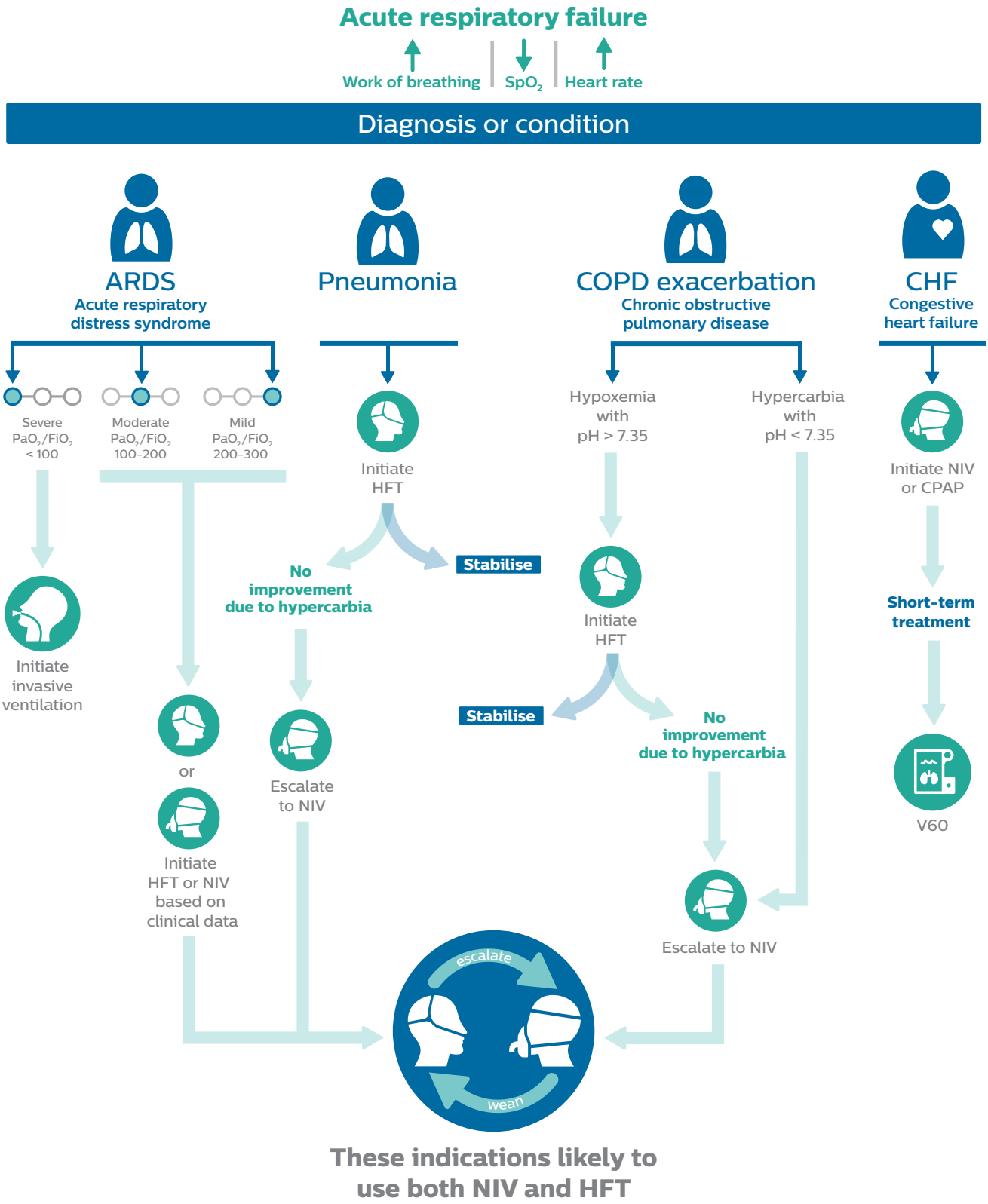
When there is supportive evidence for two different therapies used to treat a patient, a problem can arise where multiple devices are required while escalating or de-escalating therapy. More space is required in the patient area for extra equipment, and transitioning between two separate devices can be time-consuming. Additionally, if the patient is being managed with NIV, but has time off from NIV while HFNC is used, the need for two devices limits the availability of these devices for other patients when department resources are scarce. The addition of HFT to a NIV platform such as the Philips V60 allows quick escalation to NIV and may limit any further deterioration due to delays in locating, preparing and installing a separate device.

Executive summary of the current landscape



Recommendation based on the author's review of the currently available literature, including existing guidelines.

* Mixed evidence exists in this category, without a clear consensus in the literature. Monitor patients closely and consider the presence of other risk factors.



Reference: Rochwerg B, Brochard L, Elliott MW, et al. Official ERS/ATS Clinical Practice Guidelines: Noninvasive Ventilation for Acute Respiratory Failure. Eur Respir J 2017;50:1602426. https://doi.org/10.1183/13993003.02426-2016.

Conclusion

The use of NIV and HFNC in the management of acute respiratory failure is well supported in the literature. In conditions where there is evidence of efficacy for both HFNC or NIV – such as post-extubation of high-risk patients, mild hypoxemic respiratory failure, immunosuppressed and postoperative patients – the ability of the clinician to rapidly escalate support is important. Having NIV and HFNC available in one device allows a timely and convenient transition of therapies – whether escalation or de-escalation of therapy – or providing HFNC between NIV sessions. Finally, although the ability to escalate therapy is important, preventing the delay of intubation in patients who need invasive ventilation requires understanding and recognition of predictors of failure.

References

1. Keenan SP, Sinuff T, Burns KEA, et al. Clinical practice guidelines for the use of noninvasive positive-pressure ventilation and noninvasive continuous positive airway pressure in the acute care setting. Can Med Assoc J. 2011;183:E195–E214.
2. Frat JP, Thille AW, Mercat A, et al. High-flow oxygen through nasal cannula in acute hypoxemic respiratory failure. N Engl J Med. 2015;372:2185–2196.
3. Hernández G, Vaquero C, Colinas L, et al. Effect of Postextubation High-Flow Nasal Cannula vs Noninvasive Ventilation on Reintubation and Postextubation Respiratory Failure in High-Risk Patients: A Randomized Clinical Trial. JAMA. 2016;316:1565–1574.
4. Hernández G, Vaquero C, González P, et al. Effect of Postextubation High-Flow Nasal Cannula vs Conventional Oxygen Therapy on Reintubation in Low-Risk Patients: A Randomized Clinical Trial. JAMA. 2016;315:1354–1361.
5. Corley A, Caruana LR, Barnett AG, Tronstad O, Fraser JF. Oxygen delivery through high-flow nasal cannulae increase end-expiratory lung volume and reduce respiratory rate in post-cardiac surgical patients. Br J Anaesth. 2011;107:998–1004.
6. Rochwerg B, Brochard L, Elliott MW, et al. Official ERS/ATS clinical practice guidelines: noninvasive ventilation for acute respiratory failure. Eur Respir J. 2017;50:1602426.
7. Nava S, Schreiber A, Domenighetti G. Noninvasive ventilation for patients with acute lung injury or acute respiratory distress syndrome. Respir Care. 2011;56:1583–1588.
8. Demoule A, Girou E, Richard JC, Taille S, Brochard L. Benefits and risks of success or failure of noninvasive ventilation. Intensive Care Med. 2006;32:1756–1765.
9. Leeies M, Flynn E, Turgeon AF, et al. High-flow oxygen via nasal cannulae in patients with acute hypoxemic respiratory failure: a systematic review and meta-analysis. Syst Rev. 2017;6:202.
10. Ou X, Hua Y, Liu J, Gong C, Zhao W. Effect of high-flow nasal cannula oxygen therapy in adults with acute hypoxemic respiratory failure: a meta-analysis of randomized controlled trials. CMAJ. 2017;189:E260–E267.
11. Zhu Y, Yin H, Zhang R, Wei J. High-flow nasal cannula oxygen therapy versus conventional oxygen therapy in patients with acute respiratory failure: a systematic review and meta-analysis of randomized controlled trials. BMC Pulm Med. 2017;17:201.
12. Monro-Somerville T, Sim M, Ruddy J, Vilas M, Gillies MA. The Effect of High-Flow Nasal Cannula Oxygen Therapy on Mortality and Intubation Rate in Acute Respiratory Failure: A Systematic Review and Meta-Analysis. Crit Care Med. 2017;45:e449–e456.
13. Ni YN, Luo J, Yu H, et al. Can High-flow Nasal Cannula Reduce the Rate of Endotracheal Intubation in Adult Patients With Acute Respiratory Failure Compared With Conventional Oxygen Therapy and Noninvasive Positive Pressure Ventilation? A Systematic Review and Meta-analysis. Chest. 2017;151:764–775.
14. Doshi, Pratik, et al. High-Velocity Nasal Insufflation in the Treatment of Respiratory Failure: A Randomized Clinical Trial. Emergency Medicine Journal 2018. https://doi.org/10.1016/j.annemergmed.2017.12.006.
15. Schunemann HJ, et al. An official ATS statement: grading the quality of evidence and strength of recommendations in ATS guidelines and recommendations. American Journal of Respiratory and Critical Care Medicine. 2006;174.5:605-614.

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