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Inside this issue: Non-invasive ventilation

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Determinants of noninvasive ventilation success or failure in morbidly obese patients in acute respiratory failure

Authors: Lemyze M, et al.
Reference: PLoS One 2014; **9**: e9756
URL: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0097563

Non-invasive ventilation is commonly used to manage acute respiratory failure (ARF) in patients with morbid obesity. Determinants of therapy success or failure in this population were evaluated in this prospective observational study of 76 patients with a BMI >40kg.m^2 and ARF admitted to ICU or a step-down respiratory unit and requiring NIV. In hospital mortality was 30%. NIV was unsuccessful in only 13 patients (17%). Factors associated with a successful response to NIV included a diagnosis of idiopathic hypercapnic deterioration of OHS and a high $PaCO_2$ at admission. Failure of NIV was most likely to occur in those with multiorgan failure, hypoxemic respiratory failure or pneumonia at admission. An important finding was that around half those with hypercapnic respiratory failure exhibited a delayed response to NIV, taking up to 48 hours for respiratory acidosis to improve. These individuals were more likely to be treated with diuretics in ICU or to have been using respiratory depressant drugs prior to admission. Given the lack of randomised data evaluating NIV in morbid obesity, this study provides useful data regarding likely response to therapy.

Energy and protein intakes of hospitalised patients with acute respiratory failure receiving non-invasive ventilation

Authors: Reeves A, et al.
Reference: Clin Nutr 2014; 33: 1068-1073
URL: http://www.sciencedirect.com/science/article/pii/S026156141300318X#

Malnutrition is a major complication of acute respiratory failure (ARF) that is associated with poorer patient outcomes. While evidence-based enteral feeding protocols are available for intubated patients, limited research has been undertaken into the nutritional intake of hospitalised patients receiving NIV. This prospective observational study measured energy and protein intakes of patients with ARF requiring NIV and receiving standard hospital nutritional care. Thirty-six participants were studied. Almost two thirds of the participants had COPD, with most of the remaining patients were diagnosed as obstructive sleep apnea or obesity hypoventilation syndrome. Average energy and protein intakes for the group were 1434±627kcal and 63±29g respectively. Three quarters of the participants consumed <80% of energy and protein requirements. The causes of reduced intake for patients receiving NIV are multifactorial including poor appetite related to illness, fatigue and breathlessness. More time on NIV was associated with lower odds of patients consuming enough to meet minimum daily protein requirements. Recognising that many patients requiring NIV experience inadequate oral intake provides a basis for developing protocols and procedures to optimise nutritional intake during a hospital admission.

Noninvasive ventilation and breathing-swallowing interplay in chronic obstructive pulmonary disease

Authors: Terzi N, et al.
Reference: Critical Care Medicine 2014; 42: 565-573.
URL: http://journals.lww.com/ccmjournal/toc/2014/03000

An important factor contributing to inadequate nutrition in the very breathless patient may be their inability to cease NIV for a long enough period to take in sufficient food. Conversely, if the patient attempts to eat during NIV, poor patient-ventilator interactions could increase the risk of aspiration. This study evaluated swallowing with and without NIV in 15 consecutive COPD patients with acute exacerbations requiring NIV using water bolus sizes of 5 and 10mls. The efficiency of swallowing, dyspnea and breathing-swallowing synchronisation improved significantly with NIV. In the first 8 patients, a conventional pressure support device was used and it was found that swallowing induced ventilator triggering and autotriggering. The remaining 7 patients were studied using a prototype feature on a commercially available ventilator which allowed deactivation of pressure support and PEEP via an off-switch pushbutton operated by the patient. No swallowing-induced ventilator triggering or post-swallow autotriggering was seen with this prototype feature. Although the methodology used in this study could not rule out microaspiration during NIV, breathing-swallowing coordination was improved, dyspnea was reduced and PaCo2 was lower with NIV compared to spontaneous breathing. All patients stated a preference for swallowing with NIV, irrespective of the off-switch modification. Further work is needed to determine the extent to which approaches such as this improves nutritional intake in breathless patients with acute respiratory failure requiring NIV.

Use of noninvasive ventilation in patients with acute respiratory failure, 2000–2009. A population-based study

Authors: Walkey AJ and Wiener RS.
Reference: Ann Am Thorac Soc 2013;10: 10-17.
URL: http://www.atsjournals.org/doi/pdf/10.1513/AnnalsATS.201206-034OC

This study reviewed hospitalisations in US adults for acute respiratory failure (ARF) over the period 2000-2009. The data analysed came from a database which captured nearly 11.6 million hospitalisations with an ARF claim, 37% of which were also coded as COPD. As other studies have previously confirmed (Chandra et al, Am J Respir Crit Care Med 2014; 185: 152-159), NIV is being increasingly used as first line therapy in COPD patients presenting with ARF. Over the same period the proportion of non-COPD patients receiving NIV also increased. This study raised two important points. Firstly patients without a COPD diagnosis were more likely to fail NIV. Secondly, NIV failure was associate with higher hospital mortality than patients receiving invasive ventilation as initial therapy. This study provides a timely reminder about the importance of patient selection when applying NIV in the acute setting, with the potential of increased adverse outcomes in those in whom therapy is applied in the absence of supporting evidence.

Nocturnal non-invasive ventilation in COPD patients with prolonged hypercapnia after ventilatory support for acute respiratory failure: a randomised, controlled, parallel-group study

Authors: Struik FM, et al.
Reference: Thorax 69: 826-834.
URL: http://thorax.bmj.com/content/69/9/826.full.pdf+html

The value of NIV in the management of acute exacerbations of COPD is firmly established. However, evidence for its use in stable hypercapnic COPD patients is less persuasive. Patients who remain hypercapnic following an acute exacerbation of COPD have been proposed as a target group who may benefit from long term NIV. This multicentre study – the RESCUE trial – enrolled COPD patients admitted to hospital with acute respiratory failure and who remained hypercapnic 48 hours or more after NIV was ceased. Participants were randomised to home NIV (n=101) or standard therapy (n=100) and followed over a 12 month period. No difference in time to respiratory readmission or mortality between groups was found, nor did the number of exacerbations, lung function, mood, dyspnea or level of daily activity differ between groups. There was however, a trend for improvement in health related quality of life in the NIV group. Although daytime $PaCO_2$ at 12 months was significantly lower in the NIV group, the mean difference was just 0.5kPa (95% CI -0.04 to 0.9, $p<0.05$), and this difference was lost when the data was analysed under the same oxygen flow conditions between baseline and 12 month follow up. An important finding of this study was the similar rate of $PaCO_2$ improvement in both groups over the first 3 months. While post-exacerbation hypercapnia is a common and increasingly cited reason for initiating home NIV in patients with COPD, this data suggests that at least 25% of these individuals will spontaneously return to eucapnia over a period of weeks, and that NIV does not alter time to readmission or death. The results suggest that selection of COPD patients for home ventilation should be based on daytime $PaCO_2$ levels after a period of a least several weeks of clinical stability at home rather than on discharge $PaCO_2$ levels.

Non-invasive ventilation effectiveness and the effect of ventilatory mode on survival in ALS patients

Authors: Sancho J, et al.
Reference: Amyotroph Lateral Scler Frontotemporal Degener 2014;15: 55-61.
URL: http://informahealthcare.com/doi/pdf/10.3109/21678421.2013.855790

Noninvasive ventilation has been shown to have a positive impact on quality of life and survival in patients with amyotrophic lateral sclerosis (ALS). Ventilation can be delivered using either a pressure or volume preset mode of therapy. There is limited data to determine if one mode of ventilation is more effect than the other in this population. This retrospective observational study analysed data from 82 ALS patients ventilated using pressure-preset NIV and 62 patients on a volume ventilator. Those managed with volume ventilation experienced better nocturnal gas exchange (% total sleep time SpO_2<90%: 3.5$\pm$6.4% versus 21$\pm$27% in the pressure preset group) and a higher likelihood of relief of symptoms of hypoventilation. No difference in compliance or mean survival was found between the two groups. The authors concluded that volume-NIV was probably more effective than pressure-NIV in this group of patients. However, these findings need to be considered carefully given the way in which therapy was delivered. The mean tidal volume delivered with pressure-NIV was significantly lower than that used for volume ventilation (418$\pm$137mls versus 782$\pm$108mls, p<0.001). This discrepancy would readily explain the poorer control of hypoventilation in the pressure-NIV group. This highlights the importance of monitoring patients during NIV to ensure effective ventilation is delivered in order to maximise the clinical benefits of therapy. Whether newer modes of ventilation which combine volume and pressure attributes within a single breath (volume-targeted pressure support) offer any advantages over these more traditional modes of home ventilation in this patient group remains to be evaluated.

Non-invasive positive pressure ventilation for the treatment of severe stable chronic obstructive pulmonary disease: a prospective, multicentre, randomised, controlled clinical trial

Authors: Kohnlein T, et al.
Reference: Lancet Respir Med 2014;2: 698-705.
URL: http://www.sciencedirect.com/science/article/pii/S2213260014701535

In this prospective, multicentre randomised trial, the investigators enrolled patients with stable GOLD IV COPD with a $PaCO_2 \geq$ 52mmHg to either NIV (n=102) or control (n=93) for a 12 month period. The primary end-point was survival. Unlike previous studies in this population, a high intensity approach to nocturnal ventilation was employed wherein high inspiratory pressures and back up rates were used to target a reduction in baseline $PaCO_2$ $\geq$20% or achieve a spontaneous $PaCO_2$ value of <48mmHg. One year mortality was 12% in the intervention group and 33% in the control group. Daytime gas exchange, and health related quality of life improved significantly more in the NIV group. The results are in contrast with previous studies which failed to show NIV to have a significant effect on gas exchange in this population. This is likely due to the ventilation technique employed in this trial

which actively targeted a substantial reduction in $PaCO_2$ during the initial treatment period. However, to achieve this patients allocated to NIV were admitted to hospital for a mean period of 5.6±1.1 days to initiate therapy. Elective readmission to hospital then occurred at 14 days, 3, 6, 9 and 12 months post-randomisation to ensure NIV was optimised. With limited resources, many centres would not find such a treatment schedule feasible. Whether similar results can be achieved in the ambulatory setting without such an intensive initiation program remains to be seen.

Ambulatory adaptation to noninvasive ventilation in restrictive pulmonary disease: A randomized trial with cost assessment

Authors: Pallero M, et al.
Reference: Respir Med 2014;108:1014-1022:
URL: http://www.sciencedirect.com/science/article/pii/S0954611114001632

The most clinically- and cost-effective strategy of adapting a patient with chronic respiratory failure (CRF) to home non-invasive ventilation has not been established. In this study, 53 patients with CRF secondary to chest wall restriction, obesity hypoventilation syndrome or neuromuscular disease were randomised to either outpatient or in-hospital adaptation to therapy. Outpatient setup of NIV was significantly less costly and was not inferior to in-hospital adaptation with respect to improvements in diurnal blood gases, health-related quality of life, six minute walk distance or compliance with therapy. However, the study only analysed direct costs and not those costs associated with patient transport or time off work for carers. Volume mode ventilation was used in this study. In the Asia-Pacific region, pressure modes of ventilation such as bilevel therapy would more commonly be used, and are generally easier for the patient to adapt to. In addition, patients with COPD were not studied. To what degree these aspects would influence adaptation time and hence costs in other centres cannot be determined from the current study.

Randomized trial of 'intelligent' autotitrating ventilation versus standard pressure support non-invasive ventilation: impact on adherence and physiological outcomes

Authors: Kelly JL, et al.
Reference: Respirology 2014: 19: 596-603.
URL: http://onlinelibrary.wiley.com.ezproxy1.library.usyd.edu.au/doi/10.1111/resp.12269/epdf

Volume targeted pressure support (VtPS) modes of ventilation provide automatic adjustment of pressure support in order to deliver a target volume to the patient irrespective of changes in patient inspiratory effort or lung mechanics. Such modes are increasingly being incorporated into standard ventilators used for home ventilation. To date, clinical outcomes with these newer modes have been shown to be comparable to fixed pressure ventilation, although theoretically they should offer some benefits. This study evaluated one such mode incorporating VtPS along with an intelligent “learn” feature which automatically sets ventilator settings based on the patient’s

awake breathing pattern in a small group of patients with chronic hypoventilation naïve to NIV. Patients were randomised to "intelligent" VtPS or standard NIV titrated by an experienced clinician for a 4 week period and then crossed over to the other mode. Overnight gas exchange and ventilation were similar between the two modes, with the "intelligent" device achieving this will a lower mean level of pressure support. Adherence was over 1 hr higher during the "intelligent" VtPS mode. These are promising results and may improve tolerance to therapy in patients poorly adherent to standard fixed pressure ventilation. These algorithms may also serve to improve nocturnal ventilation from centres less experienced with NIV titration or with limited access to overnight sleep studies. However, an important caveat of this study was that more major adjustments to settings were required after the initial set up using the automated titration process. While these newer modes of automated ventilation may offer a number of advantages in initiating NIV therapy, they do not negate the importance of clinical input and review into the process.

Effects of noninvasive ventilation on treadmill 6-min walk distance and regional chest wall volumes in cystic fibrosis: Randomized controlled trial

Author: Lima CA, et al.
Reference: Respir Med 2014;108: 1460-1468.
URL: http://www.resmedjournal.com/article/S0954-6111(14)00149-8

Evidence is accumulating of the benefits of using NIV as an adjunct to exercise training in patients with lung disease (see Menadue et al, Cochrane Database System Rev 2014;5: CD007714). However, the impact of this intervention on exercise tolerance in young persons with cystic fibrosis (CF) has not been specifically investigated. This randomised controlled crossover trial was conducted in 13 patients aged 7-15 years diagnosed with CF, and compared 6-minute treadmill walking distance with and without NIV. Walking distance was significantly better during the NIV period (p=0.039). In addition, NIV-assisted exercise prevented significant oxygen desaturation and improved recovery of respiratory rate beyond 5 minutes of cessing exercise. Small improvements in post-exercise lung function (FEV1) and ventilation (tidal volume and minute ventilation) also occurred during the NIV session only. These results suggest NIV-assisted exercise training is feasible in young subjects with CF and could be used to improve exercise training intensity and endurance in those with severe dyspnea and a ventilatory limitation to exercise. As with adult patients, it will be important to determine if improvements achieved during NIV-assisted exercise training can be translated into benefits with respect to quality of life and physical activity levels.

Next APSR congress

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