Author's response to reviews

Title: Noninvasive mechanical ventilation with average volume assured pressure support (AVAPS) in patients with chronic obstructive pulmonary disease and hypercapnic encephalopathy

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Author's response to reviews: see over
The Biomed Central Editorial Team

Thank you for consideration of our manuscript for publication in your journal.

We have reviewed the above manuscript according to your reviewer’s comments.

Author’s response to reviews

Title: Noninvasive mechanical ventilation with average volume assured pressure support (AVAPS) in patients with chronic obstructive pulmonary disease and hypercapnic encephalopathy

Object: ISRCTN 05135218: We designed a prospective interventional study match-controlled study, whose goal was the rapid recovery of consciousness in a group of patients undergoing BIPAP S / T + AVAPS (target volume), and compared to match-controlled to the traditional method NIV (BiPAP S / T)

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Reviewer # 1: (Sairam Parthasarathy)

Reviewer’s report:

Claudett and colleagues report an interesting study on the use of AVAPS in patients with acute hypercapnic respiratory failure and ecephalopathy. They found that in a small group of patients, AVAPS facilitated quicker recovery of mentation when compared to bilevel PAP therapy, although there was no difference in NIV days or days in the hospital. This is an interesting study with good study design and important findings. I only have minor comments.
Please clarify how tidal volume was set. The formula appears to be that for ideal body weight calculation based upon height. Please clarify as such. Also, provide rationale for the choice of range in tidal volume target. For example, if the range for tidal volume is 9 to 12 ml/kg IBW, then why was 9 instead of 12 ml/kg IBW chosen in a given patient? 2. Please consider combining all 4 figures into one figure.

The formula raises of \( 45.5 + (0.91 \times [\text{height in cm - 152.4}] ) \) corresponds to the calculation of ideal body weight based on height.

Although recommended target volume manufacturers with Respironics BiPAP Synchrony AVAPS is 6-8 ml/kg of IBW in obese patients according to tolerance, clinical conditions and patient outcomes, these recommendations are based on levels of target volume that could detrimental effect on sleep structure causing discomfort in clinically stable patients. The studies reported precautions when this method is used in chronic patients with obesity hypoventilation and sleep disorders (1)

Our group corresponded to patients with infectious exacerbations of COPD and acute respiratory failure with their altered status of consciousness (hypercapnia encephalopathy) (GSC < 10) with an average BMI of 24.23 ± 2.62 SD and with an APACHE II of 18.55 ± 2.73 SD with a mean pH 7.29 and PCO2 levels range (47 -94 mmHg) with increased alveolar hypoventilation and altering their state of consciousness as measured by the Glasgow Coma Scale (range 6-10), we scheduled a target volume between (500-700ml) (8 - 12 ml/kg/body weight of great) in our patients, with a mean of 10.26 ± 2.23 target Vt ml (range 7.89 to 11.83), with peak inspiratory pressures during therapy programmed up to 26, once the patient achieved clinical stable condition the target Vt in our patients were reprogrammed to 6 to 8 ml/kg/weight according to the manufacturer's specifications.

The decision was taken by the expert physician in charge of patient case-dependent (sensory severity scale or measured initial Glasgow).

The apparatus as BiPAP Synchronics in mode S/T + AVAPS incorporates a software that allows you to reach the maximum inspiratory pressure to ensure fixed between breaths or reach a preset volume. BiPAP mode S/T + AVAPS delivered pressure changes progressively allowing the patient to conform much better to those pressures while the target tidal volume is reached.

Patients is the acute decompensation of COPD, accompanied by an altered mental status require. (volume settings between 8-12 ml/kg/weight) for rapid dissemination or carbon monoxide swept cerebrospinal fluid and brain and its sensory recovery as early as possible (2)

2. Please consider combining all 4 figures into one figure.

Done

3.- There is no additional information in supplementary file #4.

Done
4. Table 3: Was leak adjusted for mean pressure levels? Consider dividing mean pressure administered by mean leak levels to determine if there is true difference in leak (Sleep 2011; 34(6):801-6).

Proceed further, to make the recommended changes regarding the location of the variables in Table 3, the bug fixes in symbolization indicated by the reviewers, the combination of the four figures in one single figure,

Level of interest: An article of importance in its field

Quality of written English: Acceptable

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests: I declare that I have no competing interests.

Reviewer's report

Reviewer # 2: (Patrick Murphy)

Major Compulsory Revisions

METHODS

‘Noninvasive Mechanical Ventilation: BiPAP S/T with AVAPS’

How was the maximum IPAP (18-26) decided? Also it needs to be clear to what this refers. The maximum set IPAP on the device or the maximum delivered IPAP received by the patient during therapy. This is a critical point and needs to be unambiguous as it alters the data interpretation. There appears to different methods for calculating the Vte. Was it set at 9-12ml/kg or was the complex formula used. If the later why was this chosen? There appears to be two rampsset, both seem to relate to the rise time rather than the ramp. This section requires rewriting for clarification. Were leaks, IPAP, Vte recorded from the ventilator software or by other means? ‘Noninvasive Mechanical Ventilation: BiPAP S/T with AVAPS’.

We rewrite this section:

Noninvasive Mechanical Ventilation: BiPAP S/T with AVAPS

Ventilatory parameters were initially programmed in the BiPAP S/T mode and AVAPS with an inspiratory positive airway pressure (IPAP) maximum programmed into the device- of 26 cmH2O, to IPAP minimum programmed value of 12 cmH2O and an expiratory positive airway pressure (EPAP) of 6 cmH2O. The programmed tidal volume was at 8 to 12 ml / kg of IBW, and once the patient reached clinical stability and sensory, the target Vt in our patients were reprogrammed to 6-8 ml/kg/weight according to manufacturer's specifications, the decision was made by the expert physician in charge of patient case dependent, respiratory rate was 15 breaths/min, rise time set at 300-400 ms and inspiratory time was at a minimum
of 0.6 s. Were given supplements O2 via an adapter circuit close to the facemask in order to maintain SaO2 above 90%. Patients were maintained on continuous NIV initially.

Maximum IPAP received delivered, exhaled tidal volume (EVT), Vmin, and leaks were monitored through the ventilator software. We used BiPAP Synchrony with AVAPS and Autotrak (Respironics Inc., Murrysville, Pennsylvania, USA) and a Mirage IV series facemask (Resmed).

Ventilation Control Group Parameters: BiPAP S/T

Ventilatory parameters were initially programmed in BiPAP S/T mode. IPAP was programmed at 12 cmH2O, EPAP was programmed at 6 cmH2O. Respiratory rate was set at 15 breaths / min, rise time set at 300-400 ms, and inspiratory time was at a minimum of 0.6 s. Progressively increased levels were IPAP in increments of 2 cmH2O according to the discretion of the attending physician. Supplements were added O2 via an adapter circuit close to the facemask to maintain SaO2 above 90%. Patients were maintained on continuous NIV initially until normalized blood pH (> 7.35). We monitored EVT, Vmin, and leakage. We used BiPAP Synchrony and Autotrak (Respironics Inc.), and two types of facemasks: Mirage IV series mask (Resmed) and Series II full facemask (Respironics). We monitored EVT, Vmin, and leakage in order to program inspiratory pressure Levels and adjust the mask.

DISCUSSION

In the reviewers opinion the data does not advocate the use of AVAPS as a first choice ventilatory mode for hypercapnic coma secondary to exacerbations of COPD but reiterates the importance of aggressive titration of the inspiratory pressures to ensure adequate correction of alveolar hypoventilation. Although there is a superior recovery in GCS in the AVAPS group this can be accounted for by the more efficacious high inspiratory pressure provided. The use of such low pressures in the control arm that would be lower than used in routine clinical practice in the UK or that are recommended for therapy in this patient group. (1,2). The discussion should be redrafted to reflect the this and the conclusion should be more tempered to reflect the data which shows safety of AVAPS mode when used for acute hypercapnic coma in COPD but cannot be used to recommend it as first line therapy even in experienced units.

We add to the discussion:

The goal in our study was, the rapid recovery of consciousness in a group of patients undergoing BIPAP S/T + AVAPS (target volume), we scheduled a target volume between (500-700ml) in our patients, with a Vt target average 10.26 ± 2.23 ml (range 7.89 to 11.83), with peak inspiratory pressures during therapy programmed to 26, once the patient achieved clinical stable condition and, in the target Vt our patients were reprogrammed to 6-8 ml/kg/weight according to manufacturer's specifications.

The decision was taken by the expert physician in charge of patient case-dependent (sensory severity scale or measured initial Glasgow).
Some studies found favorable results in patients using NIV in hypercapnic encephalopathy reduction in days of mechanical ventilation (26) reduced risk of nosocomial infection (27, 28) and avoid intubation (29) Recently, a pilot study tested the safety and efficacy of using an endotracheal tube through BiPAP in patients with a mean GCS of 6, a mean pH of 7.1, and poor management of Secretions, with a success rate of 85% (17/20) 30

Studies examining the use of NIV in hypercapnic encephalopathy indicate that various modes can be employed at different pressure levels. Gonzales et al (3) used BiPAP Vision or BiPAP ST-D 30, In which IPAP Levels were initially programmed at 12 cmH2O and increased every 4 hours.

In our study, patients on BiPAP S/T with AVAPS had an initial IPAP of 19.82, vs. 12.36 in the Control group. BiPAP S/T with AVAPS achieves the necessary inspiratory pressure level for a predetermined tidal volume, ensuring optimal pressure for the patient and facilitating a suitable inspiratory volume, this alveolar hypoventilation overcomes rapidly also, corrects pCO2 levels, and CO2 levels decreases in the brain so as to improve the patient's level of consciousness.

The conclusion should be more tempered to reflect the data which shows safety of AVAPS mode when used for acute hypercapnic coma in COPD but cannot be used to recommend it as first line therapy even in experienced units

Done

We propose the use of BiPAP S/T with AVAPS as a safe strategy of noninvasive ventilatory treatment in patients with exacerbations of COPD and hypercapnic encephalopathy (GCS < 10), with the caveat that these patients should be treated in units with ample experience and under close surveillance.

Minor Essential Revisions

METHODS

‘Discontinuation of NIV’

….after normalisation of arterial pH (<7.35)... Should this read (>7.35)?

Treatment with NIV was used on a continuous initially regimen based on patient tolerance and after normalization of arterial pH (> 7.35) ventilation was given in 3-hour blocks.

RESULTS
Tables - ensure correct units for all variables

Done

Table 3 - GSC - should this be GCS - as primary outcome this should be the first row of the table

Done

- Minute volume and exhaled tidal volume - should these rows be the other way round; otherwise the values seem nonsensical

Done

- EPAP - all values should have SD even if 0

Done

- Maximum IPAP - as mentioned earlier

Done

- Base excess - please check the data. There is considerable variation over the time course.

Done

Discretionary Revisions

Done

Proceed further, to make the recommended changes regarding the location of the variables in Table 3, the bug fixes in symbolization indicated by the reviewers, the combination of the four figures in one single figure,

METHODS

Patients

Why was the sample size chosen? Was a power calculation performed? If so it should be provided.

The sample size calculation

Based on the publication of Zhu GF, et al, (4) who evaluates a selected group of patients with hypercapnic encephalopathy (Coma hypercapnic) into 2 groups, 22 patients with Glasgow Coma Scale (GCS) <10 served as group A and 21 with GCS ≥ 10 as group B. Selective group of 21 patients with Glasgow score > 10. Based on this study publication, the power to detect a difference of Glasgow average of 2, with standard deviation of 1.5 SD between interventions
with a power of 80% and a significance level of 0.05. (2-sample t test, alpha = 0.05 assumed standard deviation = 1.5. Sample size (11 for each group; difference (2) and Power 0.84)

References

1. Miller SDW, Elliott MW. High inspiratory pressures are tolerated by patients with acute COPD requiring noninvasive ventilation. Eur Respir J. 2009;34(s53):39s.


Level of interest: An article whose findings are important to those with closely related research interests

Quality of written English: Acceptable

Statistical review: No, the manuscript does not need to be seen by a statistician.

Declaration of competing interests:

I have previously received expenses for travel to conferences from Philips-Respironics. I have received an honorarium for co-authoring a commissioned article covering AVAPS mode of ventilation for the Global clinical newsletter published by Philips-Respironics. The Lane Fox Clinical Respiratory Physiology Group, within which I have worked, has received unrestricted research grants from: ResMed, Abingdon, Oxfordshire, UK; Philips-Respironics, Murrysville, PA; Fisher and Paykel Healthcare, Auckland, New Zealand; and B&D ElectroMedical, Stratford-upon-Avon, Warwickshire, UK.

References

figures in one single figure,

References

