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Original Research Paper

Pulmonary Medicine

COMPARISON OF AVERAGE VOLUME ASSURED PRESSURE SUPPORT (AVAPS) AND BILEVEL POSITIVE AIRWAY PRESSURE (BIPAP) MODES IN THE MANAGEMENT OF COPD PATIENTS WITH ACUTE HYPERCAPNIC RESPIRATORY FAILURE

Dr. G. Shreya Reddy	Senior Resident, Dept of Respiratory Medicine
Dr. K. Ramesh Kumar	Prof& HOD, Dept of Pulmonary Medicine, Bhaskar Medical College
Dr. G. Kranthi Randev*	Junior Resident, Dept of Pulmonary Medicine, Bhaskar Medical College *Corresponding Author
Dr. Sara Ahmed	Junior Resident, Dept of Pulmonary Medicine, Bhaskar Medical College

KEYWORDS :

OBJECTIVES:
To know the efficasy of AVAPS Modes of non invasive ventilation in management of COPD patients with type 2 Respiratory failure.To compare improvement in clinical parameters, biochemical parameters, patient tolerance between AVAPS and Conventional BIPAPA mode of ventilation

AIMS & OBJECTIVES
AIM:
- To investigate the benefits of the new AVAPS mode of Non Invasive Ventilation in patients with Type II Respiratory Failure in comparison with the conventional ST/BiPAP mode.

OBJECTIVES:
- To know the efficacy of AVAPS mode of non invasive ventilation in management of COPD patients with Type II Respiratory failure.
- To compare improvement in clinical parameters, biochemical parameters, patient tolerance between AVAPS and conventional BiPAP mode of ventilation.

METHODOLOGY
MATERIALS:
- Patients presenting with clinical features of Acute Exacerbation of COPD with Type 2 Respiratory Failure of both genders.
- Study of NIV will be done using Respironics BiPAP and AVAPS

METHODS:
- Informed and written consent will be taken from the patient.
- This is a prospective and observational study. Patients are randomized to receive NIV using either BiPAP-ST mode (group I) and AVAPS-ST mode (Group II).
- Clinical symptoms and parameters, Arterial Blood Gas (ABG), Blood Pressure, APACHE II, Length of stay (LOS) will be compared between the two groups.

Inclusion Criteria:
- Adults aged>40 yrs presenting with Acute Exacerbation of COPD and diagnosed with Type II Respiratory Failure on ABG who are consenting for the study.

Exclusion Criteria:
Patients with:
- Asthma,Obesity Hypoventilation syndrome.
- Bronchiectasis, Tuberculosis, Interstitial Lung Diseases.
- Skeletal and Neuromuscular disorders.
- Cardiac diseases like CCF, MI, RHD.
- Hepatic or Uremic Encephalopathies , Renal Failure.
- Contraindications to NIV.

Sample Size:
- Minimum of 30 patients will be taken randomly in each Group and will be assessed on management outcomes with AVAPS and BiPAP/ST modes of NIV.

Study Period:
- Over a period of 18 months I.e from January 2020 to June 2021.

Investigations:
1. Complete History Taking and Physical examination.
2. MMRC Dyspnea index,Chest X Ray
3. O2 saturation measured by Pulse oximeter.
4. Arterial Blood Gas analysis to check for PH <7.35 and PCo2 > 45mmHg
5. APACHE II score for chronic health evaluation.

- All enrolled patients are subjected to:
1. Complete History Taking and Physical examination.
2. O2 saturation measured by Pulse oximeter.

- Patients index or middle finger is placed and readings are taken after 45 secs

Methodology of NIV USE:
Initiation of noninvasive ventilation
The patients were gently placed in the sitting position and simply were explained the technique of the device. Patients were then fitted with oronasal mask ultamirage II mask (ResMed) connected to the device, which was chosen on individual basis. Patients were randomized to receive NIV using either BiPAP-ST mode (group I) or BiPAP-ST/AVAPS (group II).

Ventilatory settings
AVAPS Group: Target TV: 6-8 mL/kg; EPAP: 6 cm H20; IPAP: a minimum of 12 cm H2O and a maximum of 26 cm H2O mmHG. Expiratory positive airway pressure (EPAP) was adjusted at 4cm H2O. IPAP was adjusted at 8 cm H2O (20 cm H2O if pH from 7.15–7.25) and then up titrate IPAP to 20–30 to achieve adequate thoracic and abdominal effort and slow RR. Backup rate was set at 16–20 rate/min and inspiratory–expiratory (I : E) ratioat1:2. Inspiratory time was set at 0.8–1.2s.

S/T Group:
EPAP: 6 cm H2O; IPAP: 12 cm H2O mmHg at the beginning. IPAP was increased by 2 cm H O according to the patient"s blood gas and clinical

findings, under the physician"s decision on patients" needs. Parameters for BiPAP-ST/AVAPS mode were adjusted similar to the conventional mode besides including a setting of patient"s height, target VT (6–8 ml/kg of ideal body weight/ min in COPD patients and minimum and maximum pressure support to provide the required IPAP and EPAP ranges.

Monitoring and Data collection :

The socio-demographic data of the patients, medical history of previous diseases, NIMV indications, vital parameters (blood pressure, heart rate, SpO2, respiratory rate) obtained at the time of admission and at 60 minutes and 24 hrs of NIV application, rating on the Glasgow Coma Scale (GCS), EPAP, IPAP, and TV values were recorded in the data form. The ABG findings (PaCO2, PaO2, pH, SpO2) obtained at the time of admission and at 60 minutes and 24 hrs of NIV application and were recorded in the data form. The length of hospital stay, patient out- comes, and the occurrence of a need for transition to another mode or intubation, were all recorded.

RESULTS AND OBSERVATIONS

Atotal of 20 patients were taken under each group, the study was conducted on a total of 40 patients.

Table 1:- Age wise distribution

Age (years)	AVAPS	BIPAP
30 – 40	3	2
41 – 50	3	2
51 – 60	5	3
61 - 70	5	7
71 - 80	4	6
Total	20	20

Table 2:- Gender wise

	AVAPS	BIPAP
Male	11	11
Female	9	9

The above table shows the distribution of gender in the study group, majority of the gender group were 11 out of 20 that is 55% in AVAPS groups and 11 out of 20 that is 55% in BIPAP group.

Table 6:- PH wise distribution

PH	AVAPS	BIPAP
6.75 – 7.00	5	1
7.01 – 7.25	4	3
7.26 – 7.50	8	12
7.51 – 7.75	1	1
7.76 – 8.00	2	3

The above table shows the distribution of PH in the study group, majority of the PH group were 8 out of 20 that is 40% in AVAPS groups (7.26 – 7.50) and 12 out of 20 that is 60% in BIPAP groups (7.26 – 7.50). The mean and SD in AVAPS and BIPAP groups are 7.27±0.29 and 7.37±0.26 Since the mean is higher in BIPAP, hence BIPAP is better. On the basis of coefficient of variation AVAPS group is 3.98% and BIPAP group is 3.52% so we can say BIPAP group is more stable and consistent.

Table 7:- PCO2 wise distribution

PCO2	AVAPS	BIPAP
20 – 30	3	2
31 – 40	1	4
41 – 50	3	1
51 – 60	8	7
61 – 70	5	6

The above table shows the distribution of PCO2 in the study group, majority of the PCO2 group were 8 out of 20 that is 40% in AVAPS groups (51 - 60) and 7 out of 20 that is 35% in BIPAP groups (51 - 60). The mean and SD in AVAPS and BIPAP groups are 62.55±12.45 and 57.65±5.96 Since the mean is higher in AVAPS, hence AVAPS is better. On the basis of coefficient of variation AVAPS group is 19.90% and BIPAP group is 10.16% so we can say AVAPS group is more stable and consistent.

Table 8:- PO2 wise distribution

PO2	AVAPS	BIPAP
50 – 60	4	3
61 – 70	7	10
71 - 80	9	7

The above table shows the distribution of PO2 in the study group, majority of the PO2 group were 7 out of 20 that is 35% in AVAPS groups (61 - 70) and 10 out of 20 that is 50% in BIPAP groups (61 - 70). The mean and SD in AVAPS and BIPAP groups are 67.70±6.65 and 68.65±5.76 Since the mean is higher in AVAPS, hence AVAPS is better. On the basis of coefficient of variation AVAPS group is 9.82% and BIPAP group is 8.25% so we can say BIPAP group is more stable and consistent.

Table 9:- SPO2 wise distribution

SPO2	AVAPS	BIPAP
60 – 70	2	1
71 – 80	1	1
81 – 90	10	13
81 - 100	7	5

The above table shows the distribution of SPO2 in the study group, majority of the SPO2 group were 10 out of 20 that is 50% in AVAPS groups (81 – 90) and 13 out of 20 that is 65% in BIPAP groups (81 – 90). The mean and SD in AVAPS and BIPAP groups are 59.70±6.85 and 63.45±6.36 Since the mean is higher in BIPAP, hence BIPAP is better. On the basis of coefficient of variation AVAPS group is 11.47% and BIPAP group is 10.02% so we can say BIPAP group is more stable and consistent.

Table 11:- NIV wise distribution

NIV	AVAPS	BIPAP
1 – 2	6	9
3 – 4	9	7
5 – 6	5	4

The above table shows the distribution of NIV in the study group, majority of the NIV group were 9 out of 20 that is 45% in AVAPS groups (3 – 4) and 7 out of 20 that is 35% in BIPAP groups (3 – 4).

The mean and SD in AVAPS and BIPAP groups are 2.01±0.513 and 3.65±1.226 Since the mean is higher in BIPAP, hence BIPAP is better. On the basis of coefficient of variation AVAPS group is 25.52% and BIPAP group is 33.58% so we can say AVAPS group is more stable and consistent.

Table 12:- APACHE II wise distribution

APACHE II	AVAPS	BIPAP
8- 9	8	10
10 – 11	9	8
12 - 13	3	2

The above table shows the distribution of APACHE II in the study group, majority of the APACHE II group were 9 out of 20 that is 45% in AVAPS groups (10 – 11) and 10 out of 20 that is 50% in BIPAP groups (8 - 9). The mean and SD in AVAPS and BIPAP groups are 8.50±0.53 and 9.65±1.35 Since the mean is higher in BIPAP, hence BIPAP is better. On the basis of coefficient of variation AVAPS group is 6.23% and BIPAP group is 13.98% so we can say AVAPS group is more stable and consistent.

Table 13:- comparison of patients between AVAPS and BIPAP group

APACHE II	AVAPS mean (min – max)	BIPAP mean (min – max)	P value
Age	57(76 – 35)	61.90(80 – 36)	0.517
SBP	130.55(116 -140)	128.85(115- 139.25)	0.743
DBP	76.65(64.89)	75.05(63 – 88)	0.631
Heart rate	83.93(68 -96)	80.24(71 – 97)	0.749
PH	7.27(6.79 – 7.91)	7.37(6.94 – 7.97)	0.791
Poc2	55.54(26 – 60)	67.65(58 – 76)	0.716
Po2	52.55(56 – 68)	67.65(57 – 73)	0.812
Spo2	67.70(53 – 79)	63.45(54 – 76)	0.921
LOH	4.65(6 – 12)	6.90(6 – 13)	0.334
NIV	2.01(1 – 5)	3.65(1 – 5)	0.438
APACHE II	8.50(8 – 12)	9.65(8 - 13)	0.142

The above table shows the comparison between AVAPS and BIPAP group and there is no statistical significance difference found between these two groups

Table 14:- comparison of the change in pH and Poc2

Difference	AVAPS	BIPAP	P value
	Median (IQR)	Median (IQR)	
pH1	0.07(0.01 – 0.08)	0.00(0.021 – 0.07)	0.021
pH2	0.01(0.00 – 0.05)	0.04(0.01 - .05)	0.813
pH3	0.04(0.00 – 0.74)	3.41(0.12 – 11.5)	0.09
POC2(1 – 2)	6.45(2.34 – 14.00)	4.75(2.17 – 10.8)	0.118
POC2(2 - 3)	3.47(0.018 – 10.0)	7.42(2.13- 14.84)	0.03
POC2(1 - 3)	11.28(7.42- 21.20)	5.72(1.43 – 17.23)	0.039

The above table shows the comparison between AVAPS and BIPAP group and there is statistical significance difference found among these groups expect pH2 and POC2(2 - 3)

DISCUSSION

The present study is a prospective observational study conducted at Bhaskar General Hospital over a period of 18 months from January 2020 to June 2021 on patients presenting with clinical features of Acute Exacerbation of COPD with Type 2 Respiratory Failure.

Our study included adults with age over 40 years who presented with Acute Exacerbation of COPD and diagnosed with Type II Respiratory Failure on ABG. Patients were randomized to receive NIV using either BiPAP-ST mode (group I) or BiPAP-ST/AVAPS (group II). Clinical symptoms and parameters, Arterial Blood Gas (ABG), Blood Pressure, Respiratory rate, APACHE II, Length of stay (LOS) was compared between the two groups. The aim of the study was to investigate the benefits of the new AVAPS mode of Non Invasive Ventilation in patients with Type II Respiratory Failure in comparison with the conventional ST/BiPAP mode. The investigations carried out on the patients were – clinical history, MMRC Dyspnoea index, Chest X Ray, O2 saturation, ABG analysis for pH and APACHE II score.

Literature discusses different modalities of non-invasive ventilation includin continuous positive airway pressure (CPAP) and bilevel positive airway pressure (BiPAP) which are being the most commonly used. A relatively newer modality is Average volume-assured pressure support (AVAPS) which is non-invasive ventilation & integrates the characteristics of both volume and pressure-controlled non-invasive ventilation. [1][2] The method Bilevel positive airway pressure-spontaneous/timed (BiPAP S/T) with average volume assured pressure support (AVAPS) uses a fixed tidal volume that automatically adjusts to a patient's needs. [3] The major theoretical advantage of BiPAP S/T with AVAPS is the auto-adjusting IPAP level to maintain targeted tidal volumes. This allows the ventilator to maintain a given tidal volume in an environment of deteriorating respiratory compliance.

The clinical significance of AVAPS has been reported in various studies conducted previously. In Obesity hypoventilation syndrome, AVAPS has proven to be competent in improving oxygenation, sleep quality, and health-related quality of life (HRQOL) as well as in decreasing PtcCO2 more efficiently. [4]

CONCLUSION:

AVAPS has shown clinically significant importance in managing chronic respiratory failure such as in hypercapnic chronic obstructive pulmonary disease (COPD), Obesity hypoventilation syndrome, Kyphoscoliosis and Congenital central hypoventilation syndrome as well as in Acute respiratory failure such as in COPD-associated acute hypercapnic respiratory failure,acute exacerbation of COPD compounded with hypercapnic encephalopathy etc.

The present study investigated the benefits of the new AVAPS mode of Non Invasive Ventilation in patients with Type II Respiratory Failure in comparison with the conventional ST/BiPAP mode.

BIPAP with AVAPS mode in NIV facilitates rapid recovery in pH, Pco2, and reduction in the number of days of hospitalisation when compared to conventional BIPAP STmode. According to the results obtained from this study, the AVAPS modality has positive effects on pH and gas variation and patient comfort; therefore, it can be confidently used in clinical practice.

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