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RESEARCH ARTICLE

ROLE OF NIV IN ACUTE EXACERBATION OF COPD

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Abstract

Introduction: A globally increasing trend and prevalence with increasing mort ality from COPD cases due to acute exacerbation is now a well known and established fact. The infection/ inflammation due to the environmental factors are the trigger for acute exacerbation which leads to dyspnea (SOB) due to hypoxia, hypercapnia or an increase work of breathing and most of these problems get resolved wih BiPAP, a non Invasive ventilator (NIV) devise. It has two level positive pressure delivery setting of air/ oxygen(both for inhalatio n/ exhalation) via the mask to a orientate patient. However NIV failure or serious cases with comorbidities may require intubation.

Results: The present study is prospective, observational that enrolled 84 admitted patients of acute exacerbation of COPD (AECOPD). The mean age was 61.8 yrs with male predominance (79%) and all were suitable candidate for BiPAP with a mean ABG values of 7.27/82.6/36.6/43 respectively for pH/PaC O_2PaO2/HCO_3. A significant smoking history and biomass gases exposure was present in 71% and 21% respectively. An improvement was appreciated in 88% of cases within 2 hours of BiPAP application. The remaining 12% NIV failures were shifted to the invasive mechanical ventilation.

Discussion: A primary improvement in arterial blood gases (ABG) and second ary positive changes in SpO2, BP and Pulse and respiratory rate are usually start improving after 2-4 hours of BiPAP application. The overall duration require for the BiPAP failure would depend up the initial status of COPD and accompany comorbidities. The osteoporosis (23%), systemic hypertension (14%), CAD (13%) and heart failure (13%) etc were the main comorbidities observed in our series. An initial starting pressure of 12 and 6 cm of water with step wise 2 cm incremental up to 16-18 cm could be enough to achieve a desired outcomes, without weaning problem. The BiPAP application immediate ly after the extubation from mechanical ventilator may facilitate or supplement the weaning process without the necessity of reintubation.

Conclusion: The BiPAP devise has become an essential and integral part for the management of COPD with hypercapnia. Its use is safe, result oriented and cost effective by minimizing intubation and prolong hospital stay. The shape of silicone face mask without leak may require further patient friendly improvement.

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Introduction:-

The chronic obstructive lung disease (COPD), comprises several lower respiratory ailments e.g. Emphysema, chronic bronchitis bronchiectasis etc. It is induced by the occupational noxious/ biomass gas exposure and more so in elderly male among tobacco smokers [(1)]. A meticulously taken history and clinical examination with pathological, radiological and Pulmonary function testing (FEV1/FVC < 70%) helps in diagnosis and monitoring the functional status of patients. The predisposing factors like environmental/ seasonal change, infection/ inflammation etc are mainly responsible for AECOPD events in COPD with increased in of shortness of breath (SOB), low oxygenation (Hypoxia) and accumulation of CO_2 in the blood (hypercapnia) ie. Type 2 respiratory failure, which is measured by the arterial blood gas (ABG) analyzer as pH/$PaCO_2$/PaO_2/HCO_3. Similarly change in secondary parameters like SpO_2, BP, heart and respiratory rate are helpful in monitoring and assessment of progression has became a crucial for the management of AECOPD [(1,2)]. The alveolar ventilation with blood perfussion (V/Q) mismatch due to underlying inflammation, release of cytokines, dynamic compression of air ways, air trapping, hyperventilation with increase work of breathing/ muscle fatigue etc leads to respiratory failure. It became mandatory to support ventilation either by noninvasive or invasive mechanical ventilator to save the life.

The COPD patients can be stratified/ classified as mild, moderate severe to very severe and accordingly managed in a general ward with nasal prong/mask or in the intensive care unit (ICU) with the non invasive ventilator (NIV) or the invasive mechanical ventilator support for moderate to severe and very severe cases.. The ventilator is a life saving equipment with a long past history of evolution starting from the ancient Indian text Rig Veda, around 1500–1000 BC till the present status [(3)]. There are two type of NIV matchines, one with CPAP mode, S mode, T mode, S/T mode and the another type of BiPAP with CPAP, S, Auto S mode [(4)].

The NIV definitely reduces the intubation and mortality in AECOPD cases and even beneficial to a selected stable COPD patient with hypercapnia [(2)]. AECOPD patients present with SOB due to hypoxia and the increase work of breath (WOB) leads to further accumulation/increase of PaCO2 ie hypercapnia may present with mild cognitive (eg. Confusion, disorientation) to serious life threatening conditions with an increase intra cranial pressure and SOB etc. The BiPAP is a non invasive ventilator with least technicality, quick and easy to initiate, and patient friendly and is most suitable for conscious AECOPD cases. It works best with having raised PaCO2 more than 50 mm and blood pH >7.20 to 7.35 to resolve WOB, hypoxia and hypercapnia[(1,2,5)]. The effect of NIV start appearing quite early within a couple of hours and it may primarily be assessed by the patient's feeling of comfort and improvement with a favorable change in ABG. Similarly the secondary outcome indicators should also be considered like increase of SpO2, stabilize respiratory and heart rate and an over all duration of hospital stay [(1,2,6,7)]. The present study was undertaken to understand and assess the effectiveness of non invasive ventilation with positive pressure ventilation ie BiPAP in AECOPD cases with hypercapnia at a tertiary care institute near a pilgrim city of Mahakal, Ujjain, India

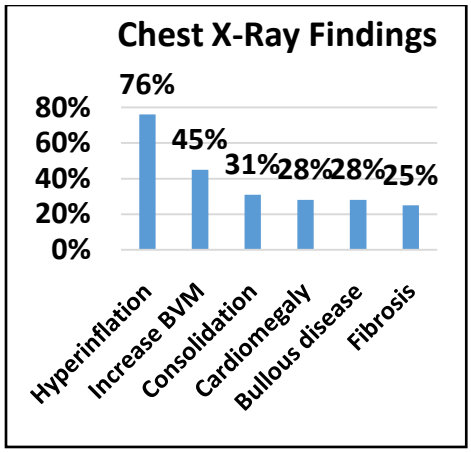
Observations and Results:-

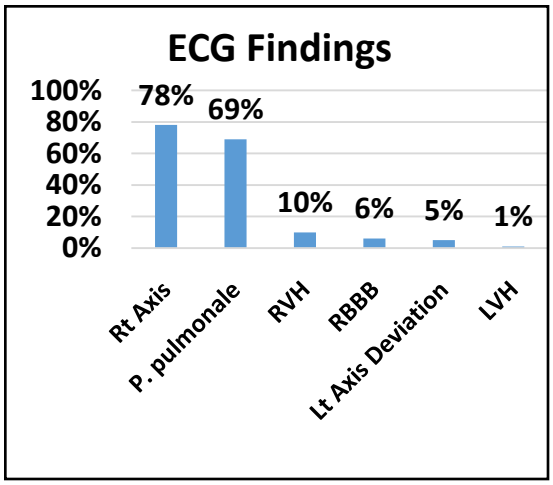
Our study is a prospective observational with an analysis of 84 admitted patients of acute exacerbation of COPD (AECOPD) at a rural based Medical College. This study observed mean age of 61.8 yrs with male predominance of 79% and all the parameters were suitable for BiPAP application with a mean pH 7.27 (above 7.2), mean PaCO2 82.6 mm Hg, mean low PaO2 of 43 % and a mean HCO3 of 36.6 mg. A significant smoking history was present in 71% and 21% had exposure with biomass gases. A definite improvement was observed with the use of BiPAP while comorbidities leads to prolonged hospital stay. The 10 cases (12%) out of the total 84 showed a poor response and had to placed on mechanical ventilator, however a BiPAP support was also provided to all of them just after the weaning which could enable to avoid reintubation.

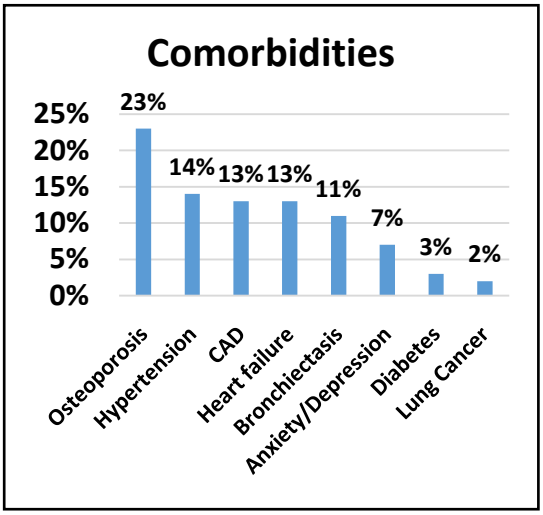
Table 1: A profile of AECOPD Cases Managed with BiPAP

SN	Parameters	Results	Interpretation/ inference
	Total cases (N)	84 (100%)	
	Sex Ratio Male : Female	**No. (percent)** 79 : 21	Male predominance with a ratio near 4:1
	Age Groups	**No. (percent)**	93% of the cases of AECOPD belongs to above the age the group of 50 Yrs and the mean age of 61.8

	40-50 yrs 51-60 yrs > 61 yrs	06 (07%) 29 (35%) 49 (58%)	yrs
	SOB (mMRC) Grade III Grade IV	 20 (24%) 64 (76%)	Dyspnea of mMRC grade 3 or 4 with type 2 respiratory failure was observed in all the cases.
	Symptoms Cough&Phlegm Fever Pedal edema Cynosis Haemodynamic instable	 84 (100%) 19 (23%) 38 (45%) 01 10	Cynosis and bilateral pedal edema are usually present with SOB, increase JVP, CCF/ corpulmonale and PAH needed evaluation. Haemodynamic instability with low cardiac output warren deterioration with positive airway pressure. Fever denotes control of infection/inflammation.
	Smoker	60 (71%)	
	COPD severity Mild >80 **Post FEV1** Moderate 50-79 Severe 30 49 Very severe <30	**No. (percent)** 06 (07%) 16 (19%) 54 (64%) 08 (10%)	According to the GOLD classification for severity of COPD, it based on PFT, No. of Hospitalization, CAT score, etc
	Investigations Leucocytosis Deranged LFT Anaemia Hyponatremia Deranged Renal Hperkalemia	 56 (67%) 13 (14%) 12 (14%) 09 (11%) 03 (04%) 02 (02%)	Leukocytosis was observed with 67% cases most likely due to bacterial LRTI required antibiotic. Deranged LFT, RFT and anaemia as comorbidities may further deteriorate COPD outcome. The hyponatremia is usual with ill health and poor dietetic intake require correction.







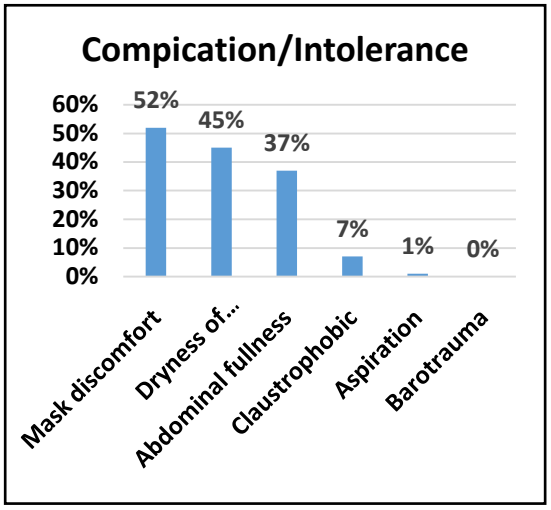
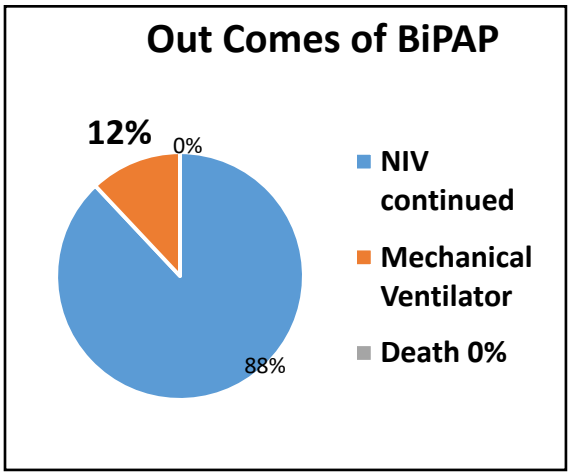


table 2: At admission & at Intervals Outcome Indicators (primary & Secondary)

Parameter	Mean ± SD At Admission	Mean ± SD After 1 hr	Mean ± SD After2 hrs	Mean ± SD After 1 Day	Mean ± SD At 7th Day/ Discharge
Pulse	118.4 ± 16.8	115.0 ± 17.3	94.7 ± 10.89	103.1 ± 14.4	
Systolic pressure	117.3 ± 18.6	114.0 ± 17.4	102.4 ± 13.7	108.4 ± 15.0	
Diastolic pressure	76.6 ± 10.9	73.4 ± 9.9	68.8 ± 9.3	72.1 ± 10.2	
Respiratory rate	28.8 ± 3.1	26.5 ± 4.2	20.9 ± 1.6	22.7 ± 3.5	
SpO2	71.2 ± 10.9	77.3 ± 11.2	92.8 ± 3.6	94.7 ± 3.1	> 95
pH	7.31 ± 0.05	7.35 ± 0.1	7.42 ± 0.1	7.37 ± 0.1	7.42 ± 0.1
PCO2	82.6 ± 15.1	78.9 ± 17.1	61.6 ± 9.6	68.1 ± 11.8	56.8 ± 3.2
PO2	43.1 ± 13.1	51.7 ± 12.8	71.9 ± 16.2	59.1 ± 10.9	78.4 ± 7.1
HCO3-	36.6 ± 5.9	36.7 ± 5.7	38.7 ± 5.5	37.3 ± 5.4	32.8 ± 4.9



Discussion:-

World wide the increasing trend of COPD mortality and prevalence is well recognized, however a stable COPD during the course, may presented as AECOPD that may require repeated hospitalization for control of the SOB with increase WOB and it usually presented with type-2 respiratory failure. Teng W et al mentioned a mortality of 11% among the inpatient that may even raised to 49% within a period of 2 years after discharge from hospital [(6)]. Most of the conscious and haemo dynamically stable cases of AECOPD could be managed with NIV to minimize the motality and hospital stay. The COPD patients tend to have higher rates of ventilator dependence, weaning failures, and reintubation as compared with other causes of acute respiratory failure, so the NIV may be useful just after extubation as a bridge to support themselves to breath spontaneously [(8)]. Our study had also applied BiPAP just after weaning from ventilator in 12 cases with favorable outcome.

Singh R et al [(9)] mentioned about the change/ improvement in ABG, consciousness, oxygenation, heart and respiratory rate as indicators to monitoring NIV at 1, 2 & 24 Hrs. Failure was labeled if patient was shifted or switch on to the invasive mechanical ventilation or died and reported NIV failure in 13% cases while 12% (10/84) was observed in our study without any death [(9)]. Our study started to show significant improvements in 88% cases on BiPAP after 2 hours with a positive pressure of 12 and 6 cm water for IPAP (inspiratory positive airway pressure) and EPAP (expiratory PAP) respectively, however the pressure was increase to optimize the outcomes. Jaykumari Choudhary et al,[(7)] studied 30 cases reported increase of pH by 0.04 after the 4 hours with NIV. Similarly Gudelli M [(10)] studied 50 cases of AECOPD with noninvasive positive pressure ventilation (NIPPV) with favorable results after 1st hr, however the mortality remained 8% (4/50) [(10)].

The Joshi V et al mentioned a NIV success rate of 97.7 % (42 out of 43) and also reported a total mean duration of change in pH and clinical improvement in 10 to 15 hours in most of their cases, and further mentioned that the total duration on NIV may extend to >20 hours that depends upon the zero point/starting condition of ABG and grade of dyspnea [(11)]. Kavitha Venkatnarayan et al [(12)] studied the weaning process with NIV in 90 cases of COPD, who improved and they concluded that a step wise reduction in pressure or even an immediate withdrawal can be done without weaning failure [(12)]. Similarly Thampan SJ et al also mentioned that weaning by step-wise duration or stepwise pressure reduction have equal success rates, so it could be concludes that prolonged duration with NIV weaning may not require [(13)].

NIV could be CPAP or BiPAP (also called biLevel) and both have similar technology, one provides continued positive pressure while BiPAP provides dual pressure support ie a slightly higher pressure for inspiration (IPAP) and a lower of 4-6 cm of water during expiration (EPAP). The starting pressure of 12 and 6 cm of water respectively for inspiratory and expiratory had been adopted as protocol in our cases and a 2 cm incremental step up, to a higher limit up to 16 cm to optimize the factors ie. Infection/ inflammation etc should also be taken care of with steroids, antibiotics, diuretic and inhalation therapy, however the preexisting co-morbidities especially HT, CAD and CHF are most likely to delay/ alter the out come [(2)].

Conclusion:-

The BiPAP as a non invasive ventilator is safe and effective devise for majority of the COPD with type 2 respiratory failure and could be assessed and monitored with ABG and secondary parameters. It has become an integral part for the management of AECOPD. A scope to improved/ modified an interface between patient & BiPAP machine still needed as a leak proof, comfortable patient friendly mask.

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