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OUTCOME OF NON-INVASIVE VENTILATION IN COVID-19 PATIENTS

Pulmonary Medicine

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ABSTRACT

Introduction: In covid-19, significant number of patients developed severe respiratory symptoms and Acute Hypoxemic Respiratory Failure(AHRF) that required oxygen support. Initially treatment included early intubation and invasive ventilation, but Non-invasive ventilation(NIV) has been proven to be an effective bridging adjunct in early part of disease process and may prevent the need for invasive mechanical ventilation, which also decreases the risks to health care workers.

Aims & Objectives: To study the outcome of non-invasive ventilation in covid-19 patients ;Primary outcome is number of patients recovered and death, Secondary outcome is the need for invasive mechanical ventilation

Materials & Methods: This prospective study was conducted in the Department of Pulmonary Medicine, Dr.PSIMS & RF, which included 84 patients of covid-19 admitted in intensive care unit (ICU) during the period of May 2020 to November 2020. All patients were treated with NIV as per the requirement and followed up with laboratory parameters , CXR and outcome was studied during the course of hospital stay.

Observation And Conclusion: out of 84 patients studied,67% recovered , 33% died . 19 patients required invasive mechanical ventilation. Age of < 65yrs ;SPO2 of 88-92% at the time of presentation, absence of obesity ;Normal C-Reactive protein(CRP) and Ferritin with Mild involvement on chest x-ray and longer duration of NIV has better recovery rate.

So, by our study we conclude that NIV has a definite role in management of COVID-19 and also decrease the need for invasive ventilation .

KEYWORDS

AHRF, COVID-19, NIV

INTRODUCTION:

The novel coronavirus disease 2019(COVID-19) outbreak that began in 2019 and spread rapidly across the world has been observed to cause viral pneumonia and acute hypoxemic respiratory failure(AHRF)[1]. Since the disease was first identified, significant number of patients are in need of increased oxygen support [2]. During initial outbreak, early intubation and invasive ventilation were preferable because of notion that usage of NIV has more risk of aerosol spread [3].Emerging evidence has shown that NIV may have a significant and positive role than initially thought [4]. NIV may be an appropriate bridging adjunct in the early part of the disease progress and may prevent the need for intubation or invasive ventilation. [5]

Non-invasive ventilation (NIV) is a method of respiratory support, in which a mask is used as the main interface which can be easily applied and also easily disconnected from the patients respiratory tract [6] . The key to success with NIV is proper patient selection[7]. It is important to emphasize that a strict selection of patients is required for NIV,the main criteria are the stable hemodynamics, preservation of consciousness and patient consent[7]. NIV has significant advantages over traditional mechanical ventilation[6]. Mask ventilation allows to minimize the number of infectious and mechanical complications.[8] Nosocomial pneumonia is a common complication of lung ventilation and is critical factor in determining patient outcome[8]. With NIV,there is no direct contact with trachea,so the patient can release sputum after removing the mask[9]

MATERIALS AND METHODS:

This prospective study was conducted in the Department of Pulmonary Medicine, Dr.PSIMS & RF. This study included 84 patients of covid-19 admitted in ICU during the period of May 2020 to November 2020.

Inclusion Criteria:

Patients diagnosed with covid-19 of Age > 18 yrs; Given consent for NIV; Hemodynamically stable patients; patients with respiratory distress.

Exclusion Criteria:

Hemodynamically unstable patient; Refusal of NIV; All contraindications to NIV ;other systemic diseases like congestive heart failure(CHF)/chronic kidney disease(CKD)/acute myocardial infarction (ACUTE MI) /CIRRHOSIS.

Informed consent from the subjects or their legal relatives was taken. Institution ethical committee clearance was taken. Chest x-ray (CXR) was done and graded according to RALE (Radiographic Assessment of Lung Edema). Each lung was assessed individually based on consolidation/groundglass opacities and was given 0-4 points. 0 – no involvement ; 1- <25% ; 2- 25-50% ; 3- 50-75% ; 4 - >75% . Overall score is sum of points from both lungs. We have divided our study population into two groups; patients with <=4 points and patients with >4 points on CXR . Along with Inflammatory markers; C-Reactive protein (CRP) and FERRITIN, all baseline investigations such as RFT,LFT,ECG,2D Echo were done to rule out co-morbid conditions at the time of admission. All patients were treated with NIV as per the requirement and followed up with laboratory parameters, CXR and outcome was studied during the course of hospital stay.

RESULTS:

Data was pooled from 84 covid-19 patients who were admitted in ICU in Dr.Psims & RF between May 2020 to November 2020. The demographic characteristics are described in Table-1. Out of 84 covid-19 patients studied , 79.7% are below 65 years and 20.2% are above 65 years. Males constituted more than half of the study population (64.2%). The clinical characteristics and co-morbidities are described in Table-2. Majority of the patients presented with saturation(Spo2) on room air (RA) within the range of 80-88% at the time of admission(45.2%). 26.1%(22) of patients had Spo2 within the range of 88-92%. More than half of the study population are hypertensive(55.9%), followed by diabetes(53.5%), obesity(29.7%), thyroid disorders(15.4%). The laboratory and radiological profile are described in Table-3.

Better recovery rate(77.6%) is observed in patients of age<=65 years compared to patients of age >65 years(23.5%). There is no difference noted in mortality rate in relation to sex (The data is described in TABLE-1). Among 22 patients with Spo2 within the range of 88-92% on room air at admission, all patients recovered(100%). Patients with Spo2 <=70% had shown highest mortality rate(88.8%). Highest mortality rate (68%) was observed in patients with obesity.

Higher mortality rate is observed in patients with elevated CRP(79.4%) and Ferritin(87.5%) values compared to patients with normal CRP and Ferritin values. Patients on NIV for a duration of 3-6 (87.5%) days and > 6 days (100%) had shown better recovery rate compared to 0-3 days(33.3%).The data on duration of NIV are described in Table-4. The outcome of NIV is 67% recovered and 33% died; 19 underwent invasive mechanical ventilation.

Table-1 : Demographic Characteristics

CHARACTERISTICS		N	%	RECOVERED	DEATH
AGE (years)	<=65	67	79.7%	52(77.6%)	15(22.3%)
	>65	17	20.2%	4(23.5%)	13(76.4%)
SEX	Male	54	64.2%	36(66.6%)	18(33.3%)
	Female	30	35.7%	20(66.6%)	10(33.3%)

Table-2 : Clinical Characteristics And Co-morbidities

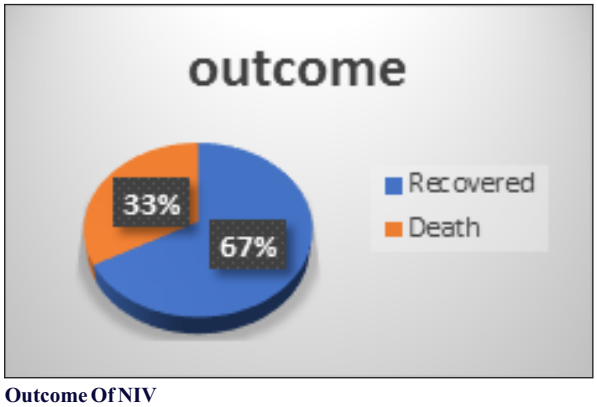
CHARACTERISTICS		N	%	RECOVERED	DEATH
Respiratory rate at admission	< 30	52	61.9%	40(76.9%)	12(23.07%)
	>= 30	32	38.09%	14(43.75%)	18(56.25%)
Spo2 at admission (at Room Air)	88-92	22	26.1%	22 (100%)	0
	80-88	38	45.2%	26(68.4%)	12(31.5%)
	70-80	15	17.8%	7(46.6%)	8(53.3%)
	<= 70	9	10.7%	1(11.1%)	8(88.8%)
C0-morbidities	Hypertension	47	55.9%	24(51.1%)	23(48.9%)
	Diabetes	45	53.5%	22(48.9%)	23(51.1%)
	Obesity	25	29.7%	8(32%)	17(68%)
	Thyroid disorders	13	15.4%	4(30.8%)	9(69.2%)

Table-3 : Laboratory And Radiological Profile

CHARACTERISTICS		N	%	RECOVERED	DEATH
CRP	Normal	50	59.5%	49(98%)	1(0.2%)
	Elevated	34	40.4%	7(20.5%)	34(79.4%)
Ferritin	Normal	52	61.9%	52(100%)	0
	Elevated	32	38.09%	4(12.5%)	28(87.5%)
CXR	<=4	54	64.2%	50(92.5%)	4(7.4%)
	>4	30	35.7%	6(20%)	24(80%)

Table-4 : Duration Of NIV

DURATION OF NIV (DAYS)	N	%	RECOVERED	DEATH
0 – 3	33	39.2%	11(33.3%)	22(66.6%)
3 – 6	48	57.1%	42(87.5%)	6(12.5%)
>6	3	3.57%	3(100%)	0



Outcome Of NIV

DISCUSSION :

Out of 84 covid-19 patients studied, 79.7% are below 65 years and 20.2% are above 65 years. Males constituted most of the study population (64.2%). Our study is similar to a study by Rosanna Vaschetto et.al; 73% of study population were males [10].

In patients of age <=65 years, better recovery rate (77.6%) is observed compared to patients of age > 65 years(23.5%). Our study demonstrated similar results to a study done by Sergey N.Avdeev et.al ,NIV failure was in patients with older age group(68 years) vs NIV success group (61 years) [11].

61.9% of patients presented with respiratory rate (RR) of < 30/min, out of which 76.9% recovered and 23.07% died . 38% of patients presented with RR > 30/min, out of which 43.7% recovered and 56.25% died . Our study unveiled similar results to a study done by Sergey N.Avdeev et.al, patients who failed NIV has higher respiratory rate(24-30/min),than in NIV success group(RR-24/min) [11].

Greater number of patients in our study presented with Spo2 on room air at admission within the range of 80-88%(45.2%). Better recovery rate is observed in patients with Spo2 in the range of 88-92%(100%) compared to patients with Spo2 of <=70% (11.1%). Hence Spo2 at the time of admission provides a better idea of severity of illness and also serves as a prognostic marker.

47 patients are hypertensive, 45 patients are diabetic and obesity was noted in 25 patients of which 17 were death(68%). In a study done by Sergey N.Avdeev et al; of 61 patients studied,NIV failure was seen in 17 patients with body mass index(BMI) of 33.5kg/$m^2$and NIV success was seen in 44 pateints with BMI of 31kg/m^2[11]. We studied all patients in intensive care unit(ICU), so BMI couldn't be assessed accurately. Obesity has emerged as a novel risk factor for hospitalization and death due to COVID-19[12]. Recent studies emerging from multiple countries have shown that obesity may be an independent factor to predict the risk and outcome of COVID-19 patients[13].

Thyroid disorders are observed in 13 patients, of which 4 recovered and 9 died(69.2%). There are no promising studies or literature available on whether thyroid disorders are associated with increased mortality in covid-19. In our study ,it can be a incidental finding or may be a co-existing co-morbidity.

48 patients are on NIV for a duration of 3-6 days, among them 42(87.5%) recovered compared to patients on NIV for 0-3 days(33.3%). 3 patients are on NIV for > 6 days,all of them(100 %)recovered. Our study displayed similar results to a study done ;where NIV duration was shorter in patients with NIV failure group (3 days) vs (8 days) in NIV success group.[11]

According to extensive literature and many studies on inflammatory markers in covid-19 till date, results demonstrated that, in majority of patients with covid-19; CRP levels are increased , indicating a strong correlation with disease severity and prognosis[14] . In our study , increased mortality(79.4%) is observed in 34 patients with elevated CRP values compared to 50 patients with normal CRP values;of which 49(98%) recovered.

Studies also demonstrated elevation of serum ferritin levels due to cytokine storm and secondary to hemophagocytic lymphohistiocytosis have been reported in covid-19 patients[14]. In our study increased mortality(87.5%) is observed in 32 patients with elevated ferritin levels compared to 52 patients with normal ferritin levels;of which 52(100%) recovered.

Plentiful studies have shown Chest CT scan was found to be more sensitive and CXR was found to have limited value in initial diagnosis of covid-19 with sensitivity of 69% [15]. But by our study ,we have found that CXR is useful in assessing severity of illness and to render timely and appropriate treatment. Additionally ,in areas of limited resource facility for CT,CXR will be of foremost importance. Patients with covid-19 had typical radiological findings on chest imaging including multifocal and bilateral ground glass opacities(GGO) and consolidation with peripheral and basal predominance[15].

In a study done by Liqa.A.Rousan , baseline x-rays were done for study population of 88 patients; out of which 13 demonstrated abnormalities, of which 10 had abnormal x-ray at admission and 3 developed x-ray abnormality during followup [15].

In our study, higher mortality rate(80%) is observed in 30 patients with CXR score of >4 points compared to (7.4%)of mortality in 54 patients with CXR score of <=4 points.

In our study ,out of 84 patients studied, 56(67%) recovered and 28(33%) died. Similar observations were revealed in other studies. In a cohort of 1933 patients; 390 patients were treated with NIV of which 217 recovered and 173 death[16]. In a study done by Mukhtar et al; among study population of 55, 39 required ventilatory support of which 30 were successfully treated with NIV[17].

Some of the covid-19 patients who developed progressive worsening respiratory distress were refractory to NIV; Intubation is inevitable in those cases[18]. In our study 19 patients are in need of invasive mechanical ventilation. Similar observations were observed in other studies. In a study done by Maurizio Bertaina et al, out of 390 patients, 62 were on invasive mechanical ventilation[16].

In a study done by Mukhtar et al, out of 39 patients, 9 were in need of invasive mechanical ventilation[17]. COVID-19 patients who were invasively ventilated exhibited pessimistic outcomes,this suggests that early intubation may not help patients but instead, make things head towards the wrong direction. We should try to avoid invasive ventilation and utilize NIV at the early stage of respiratory failure until invasive ventilation is inevitable[18].

CONCLUSION:

NIV has a definite role in management of COVID-19 and also decrease the need for invasive ventilation.

The results gathered from our study suggests that,even though there is a positive role of NIV in COVID-19, factors like advanced age, severity at the time of presentation,presence of multiple co-morbidities,raised inflammatory markers,appropriate patient selection,adequate knowledge regarding the usage of NIV and early initiation , monitoring can effect the outcome.

Limitation:

This was single centred study ,limits generalizability to other population.
The sample size was small.

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