COVID 19: Respiratory Management by Non Invasive Ventilation

Dr. Meera Shah*, Dr. Urjita Modi, Dr. Mehul Gajjar**,Dr. Kishor Kalsaria***, Dr. Shreya Pathak****, Dr. Bhavesh Jarwani*****

*Resident Doctor(R3), **Assistant Professor,***Resident Doctor(R2), ****Resident Doctor(R1),*****Professor & Head Of Department, Emergency Medicine Department, Smt. NHL Municipal Medical College, SVP Hosptial,, Ellis Bridge, Paldi, Ahmedabad-380006. Gujarat

Abstract: Background: During this long COVID-19 pandemic outbreak, continuous positive airway pressure (CPAP) and non invasive ventilation (NIV) are being widely used to treat of NIV in COVID-19 acute respiratory distress syndrome (ARDS) are lacking, and for this reason it is extremely important to accurately determine the outcomes of this strategy. This study aimed to evaluate clinical data and outcomes of NIV in patients with COVID-19 ARDS. Material And Methods: This is retrospective observation study conducted at government hospital during April 2020 to July 2020. The study was approved by local ethical committee. We analyzed patients with the laboratory confirmed case of COVID-19 infection admitted in intensive care unit who require positive pressure ventilation and perfusion which are not able to maintain on simple O2 masks/ nasal cannula /NRBM. Data related to clinical features and co-morbidities were recorded at admission and clinical laboratory data were recorded at start of NIV and respiratory parameter were recorded at the time of admission, start of NIV and at the time of weaning or shift to invasive ventilation. Result: Out of 119 patients 42 patients were successfully weaned off from non invasive ventilation while remaining were shifted to invasive mechanical ventilation. The patients who were shifted to invasive ventilation were all died. Low P/F ratio, high CRP, high D-dimer, high LDH and high ferritin levels were related to conversion to invasive ventilation and high mortality among the group. Conclusion: Although there is a role for non-invasive respiratory therapies in the context of COVID-19 ARF, more research is still needed to define the balance of benefits and risks to patients. Indirectly, non-invasive respiratory therapies may be of particular benefit in reducing the risks to healthcare workers by obviating the need for intubation, a potentially highly infectious procedure. [Shah M A Natl J Integr Res Med, 2021; 12(4):1-7]

Key Words: Acute Respiratory Failure; High Flow Nasal Cannula; Noninvasive Ventilation

Author for correspondence: Dr. Urjita Pranav Modi, 9, Shyamal Row House Scheme No.5, Manekbaug Hall Road, Near Shymal Cross Road, Ambawadi, Ahmedabad. E-Mail: drurjitamodi@gmail.com
Mobile: 9924085700

Introduction: The COVID-19 outbreak began in 2019 and spread rapidly across the world. It is a challenging situation in which health care workers determine the best course of treatment and ensure the virus not being spread. There are many options for managing patients in respiratory failure, amongst which NIV is one of the useful methods which prevents the patients to be put on invasive ventilation. The most common NIV therapies: High Flow Nasal Cannula (HFNC) and Continuous Positive Airway Pressure (CPAP) or Bilevel Positive Airway Pressure (BiPAP)

As COVID-19 is extremely contagious and is being transmitted quickly, it's virtually important to adhere to infection control measures as outlined by hospital and health department policy to avoid transmission of COVID-19 during therapy. Recommendation Center for Disease Control and prevention includes using negative pressure isolation room for patient, and gloves, gowns and masks for caregivers[1,2]. The key recommendation from WHO when NIV is used in COVID-19 patient[3]. NIV should only be used in a selected patient with hypoxemic respiratory failure as NIV is generally used in hypercapnic respiratory failure. Patient treated with NIV should be closely monitor for clinical deterioration. Due to potential for aerosolization, NIV should be used with aerosol precaution.

Image 1: Components Of A High Flow Nasal Cannula System[3]

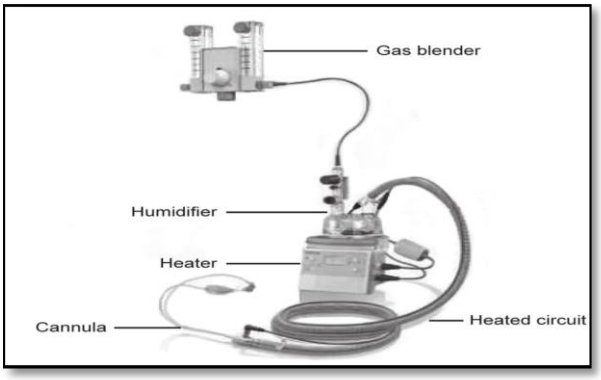
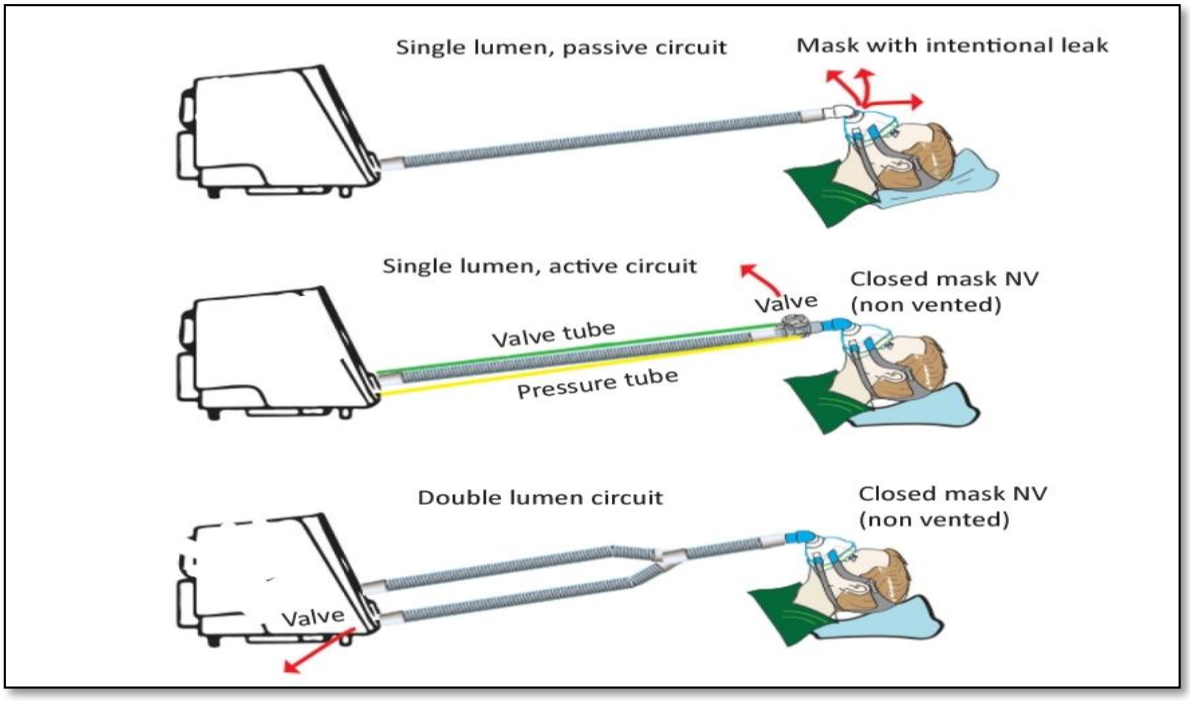


Image 2: Different Circuit/Masks For BIPAP/CPAP Treatment3



Objectives Of Study: To assess benefit of NIV in Covid 19 patient with acute hypoxemic respiratory failure eg. Prevention of mechanical and infectious complication associated with intubation; preservation of natural protective reflex of the upper respiratory tract; reduced need for muscle relaxant/ opioids; preservation of physiological cough, the patient's ability to talk, swallow, eat, cough up sputum. To foresee adverse outcomes on NIV eg. Skin irritation and abrasion, claustrophobia, mucosal dryness, pulmonary barotraumas , aspiration pneumonia.

Material & Methods: This is retrospective observation study conducted in SVP hospital between April 2020 to July 2020. The study was approved by local ethical committee. As this was a retrospective study the requirement for informed consent was waived. We analyzed patient with the laboratory confirmed case of COVID-19 infection admitted in intensive care unit.

Inclusion Criteria: patient with age > 18 years and who require positive pressure ventilation and perfusion which are not able to maintain on simple O2 masks/ nasal cannula /NRBM.

Exclusion Criteria: patients who were intubated and age<18 years and > 80 years. Data related to clinical features and co-morbidities were recorded at admission and clinical laboratory data were recorded at start of NIV and respiratory parameter were recorded at the time of admission, start of NIV and at the time of weaning or shift to invasive ventilation.

Limitations Of Study: Prolonged ICU stay can vary patient outcome due to secondary infection & nutrition status. Longer follow up of patient.

Table 1: Age, Gender And Symptomwise Distribution Of Covid

				FIRST SYMPTOM AT THE TIME OF ADMISSION				
Age	Total Patient	Male	Female	Fever	Breath-Elessness	Sore Throat	Cough	Other
18-20	0	-	-	-	-	-	-	-
21-30	1	0	1	1	-	-	-	-
31-40	4	4	-	2	1	-	1	-
41-50	13	9	4	9	2	-	1	1
51-60	34	22	12	19	8	1	3	3
61-70	39	29	10	24	6	2	1	6
71-80	28	20	8	17	4	-	5	2
TOTAL	119	84	35	72	21	3	11	12

Total 119 patients were included in study. Out of which 72 patients were admitted with complaints of fever, 21 patients were admitted with c/o breathlessness, 3 patients were admitted with c/o sore throat, 11 patients were admitted with c/o cough and 12 patients were admitted with other non-specific complaints (eg. bodyache, headache, weakness etc.)

Table 2: Correlation Of Severity Of Covid With Co-Morbid Condition, Biochemical Parameters And Usage Of Immunomodulators And Anti-Coagulants

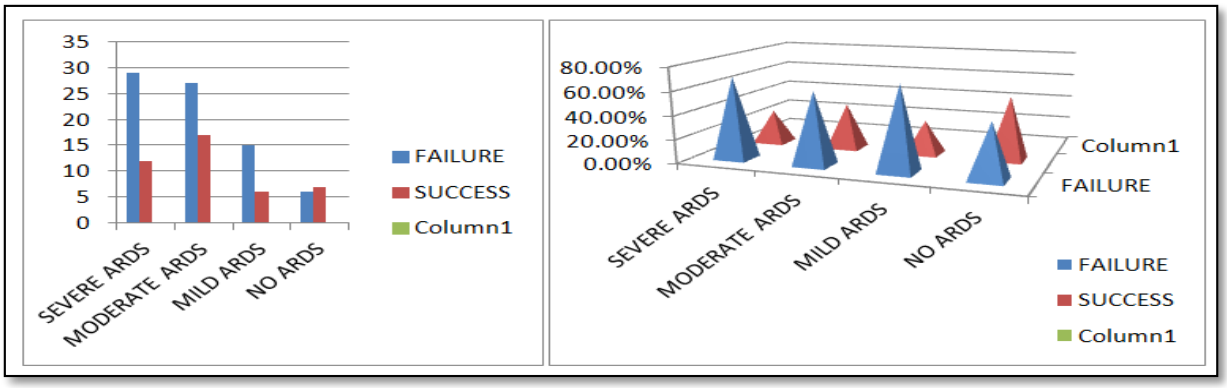
	All Patient (119)	Success Group (42)	Failure Group (77)	P-Value
Age	62 (18-80 Years)	59 (37-80 Years)	63 (27-80)	
Male	84	26	58	
Female	35	16	19	
Total Duration Of NIV	5.5 Days (1-16 Days)	4.9 Days (1-20 Days)	4.8 Days (1-21 Days)	
Co-Morbidity				
Hypertension	64	22	42	0.973
Diabetes Mellitus	68	22	46	0.56
IHD	22	3	19	0.035
CKD	13	3	10	0.5
Asthma/COPD	1	-	1	0.76
P/F Ratio				
At The Time Of Admission	144 (46-692)	180 (50-667)	160 (46-692)	
Start Of NIV	138 (48-364)	157 (60-364)	126 (48-314)	
At The Time Of Termination	143 (60-633)	203 (86-633)	106 (60-316)	
Start Of NIV				
CRP	144 (0.6-419)	108 (0.1-286)	116 (0.6-419)	0.635
LDH	694 (226-6602)	571 (269-1058)	777 (226-6602)	0.014
D-Dimer	5.9 (0.3->4)	7.9(0.5 ->4)	9.3 (0.5->4)	
Ferritin	1655 (1.18->1650)	620 (1.18->1650)	643 (63-1650)	0.79
RR	34	34	34	
Treatment				
Tocilizumab	53	29	24	0.00015
Steroid	119	75	44	
Anticoagulant	119	75	44	
Higher Antibiotics	119	75	44	
Other				
Prone Position	90	65	25	0.005
Complication				
Facial Abarasion	23	10	13	
Aspiration	1	-	1	
Hypotension	1	-	1	
Dry Nose	35	15	20	
Epistaxis	4	1	3	

Out of 119 patients 42 patients (35.29%) were successfully weaned off from NIV support and discharged and 77 patients (64.70%) were shifted on IMV all of them were died. Patients who failed NIV and shifted on IMV were older (63(27-80) years) with co-morbidities; low P/F ratio at the time of admission (160 (46-692) and onset of NIV (126 (48-314)); high CRP(116 (0.6-419)p 0.635), LDH(777 (226-6602)p 0.014), ferritin (643 (63-1650)p 0.79), d-dimer(9.3 (0.5->4)) level compared to patients who were weaned off and successfully discharged.

Mean total duration of NIV is 5.5 days for all patients, in which success group duration of NIV is 4.9 days and for failure group is 4.8 days.

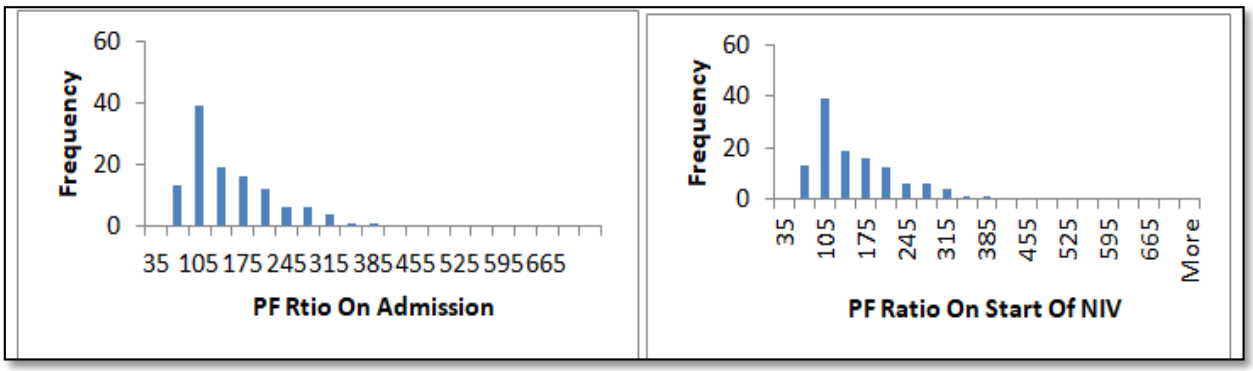
Treatment was same in both groups. p-value is co-morbidities – hypertension, diabetes mellitus, ischemic heart disease, CKD, asthma/COPD, initial level of CRP, LDH, ferritin treatment with tocilizumab and prone positioning has any significant effect or not? The result p-value shows calculated for hypothesis that – is there effect of significance between – Ischemic heart disease as co-morbidities, initial level of LDH and treatment with tocilizumab and prone positioning has significant effect in outcomes of covid19 patient.

Graph 1: Out Come Of Patients Depending On Severity Of Ards At The Time Of Admission



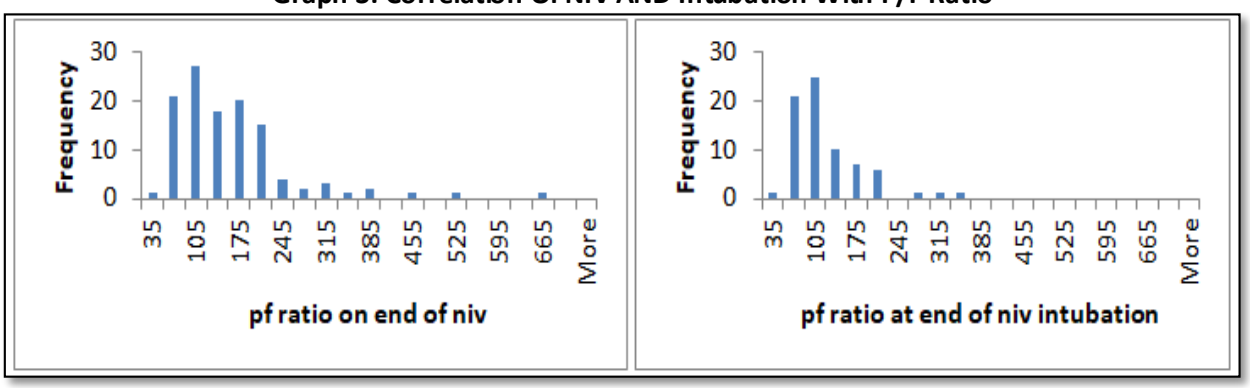
Atthe time of admission out of 119 patients 42 patients (35.29%) had severe ARDS out of which 29(69.04%) were shifted on IMV and 12(28.57%) were weaned off, 44(36.97%) patients had moderate ARDS out of which 27(61.36%) were shifted on IMV and 17(38.63%) were weaned off, 21(17.64%) patients had mild ARDS out of which 15(71%) were shifted on IMV and 6(28.57%) were weaned off and 13(10.92%) patients had no ARDS out of which 6 (46.15%) were shifted on IMV and 7(53.84%) were weaned off. This signifies that stage of ARDS at the time presentation play an important role in the success of NIV and outcome of patient.

Graph 2: P/F Ratio And Need Of NIV And Intubation

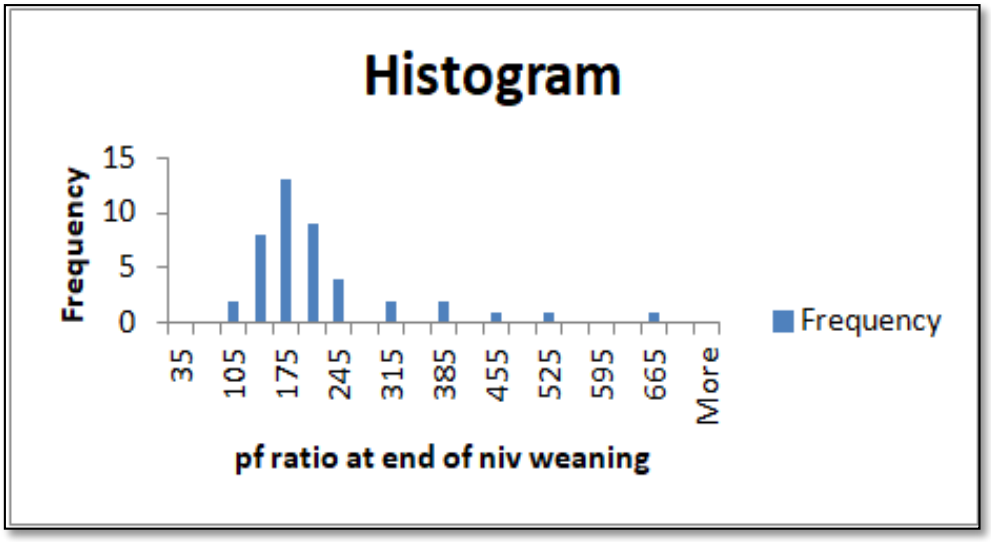


Pf ratio histogram on admission and start of NIV are almost similar which signifies that most of patient on admission require assisted ventilation.

Graph 3: Correlation Of NIV AND Intubation With P/F Ratio

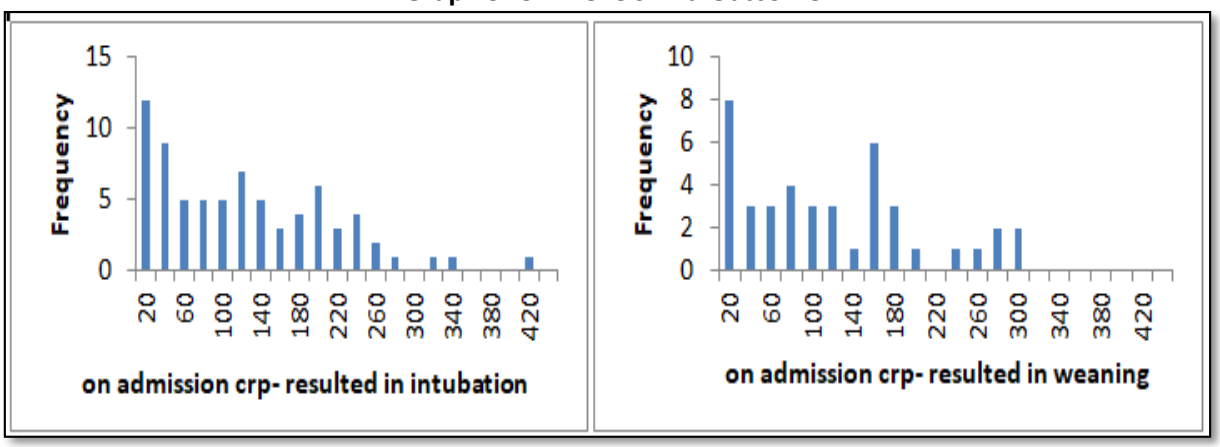


Graph 4: Correlation Of Niv Weaning With P/F Ratio



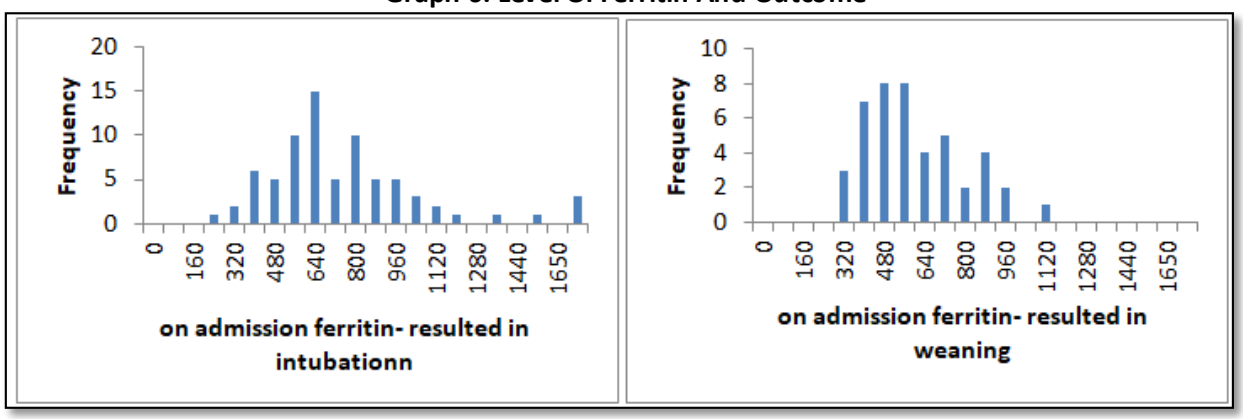
End of NIV (all patient irrespective of outcome) histogram shows improvement in pf ratio,Pf ratio histogram at end of niv resulting in intubation shows lower ratio, signifying need for intubation. Pf ratio histogram at end of niv resulting in weaning shows higher ratio, signifying improvement.

Graph 5: CRP Levels And Outcome



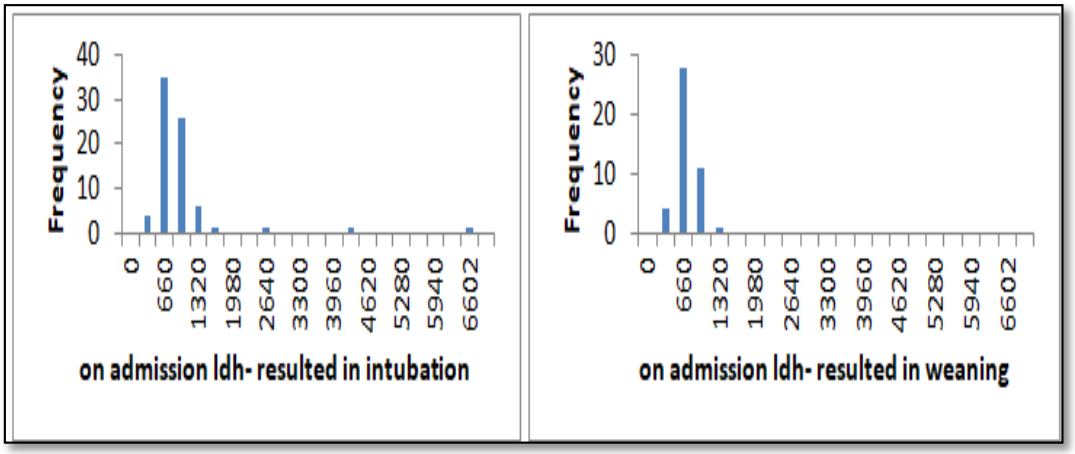
On admission CRP level histogram, resulting in intubation, shows initial crp level among higher range and, those who got weaned off has crp level among lower range.

Graph 6: Level Of Ferritin And Outcome



On admission, histogram of ferritin resulting in intubation or weaning shows similar levels, higher ferritin level for intubation.

Graph 7: Level Of LDH And Outcome



On admission, histogram of LDH resulting in intubation or weaning shows similar levels, higher LDH level for intubation.

Discussion: This study suggests that use of NIV in patient with COVID 19 decrease the need for IMV. About 64.70% of our patient failed NIV and require endotracheal intubation and mechanical ventilation and 35.29% patients successfully weaned off from NIV and discharged. Lower baseline P/F ratio is associated with failure of NIV support. Although, the mean P/F value in our patient were lower than those from the cohort study of non invasive ventilation for acute hypoxemic respiratory failure in COVID 19 patients by S.N.Adveel et al[4]. (144 vs 164).

In our study, out of 119 patients enrolled majority of patients (73) were from age 51 to 70 years and fever was the main symptom. It is seen that COVID infection requiring non invasive or invasive ventilation predominantly affected elder population. The patients having significant co-morbid condition like hypertension and diabetes had more incidence of failure of non invasive ventilation with p value of 0.973. The patients with ischemic heart disease and chronic kidney disease were more likely fail with non invasive ventilation with p value of 0.035 and 0.5 respectively. Low P/F ratio at the time of admission or at the start of NIV was directly proportional to need for invasive ventilation. High level of inflammatory markers like CRP, LDH, D-dimer and ferritin at start of NIV was strong predictor for need of invasive ventilation later in the course of disease with significant p values. The patients who received immunomodulatory and anticoagulant agents were more likely to succeed with non-invasive ventilation. The patients who were in mild, moderate or severe degree of ARDS at the time of admission were more likely to fail with noninvasive ventilation as compared to patients who did not suffer ARDS.

In study conducted by SergeryAvdeev et al[4], 61 patients were put on NIV support, out of which it was successful in 44 patients and failed in 17 patients. Those 17 patients were intubated and out of those 15 died.

In our study, CRP in success group was 108, compared to 126 and in failure group was 116 compared to 191.5 in S.N.Avdeev et al study[4].

In our study, D-dimer was 7.9 in success group, 9.3 in failure group and 8.81 in success group and 18.32 failure group in S.N.Avdeev et al study[4].

Other factors which are associated with failure of NIV are old age, associated comorbidity, elevated LDH and ferritin. In our study we found that prone positioning of patients during the NIV treatment improve the oxygenation and decrease the need for IMV.

Conclusion: NIV play an important role in prevention of IMV in patient with COVID-19. Although age, associated co-morbidity, stage of ARDS at the time of presentation, level of CRP, D-dimer, Ferritin, treatment option, prone position ventilation play an important role in the outcome of patient with COVID-19 infection. NIV is more useful in prevention of IMV in patient with mild respiratory distress than in patient with severe respiratory distress at the time of presentation.

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