

## Invasive vs. Non-Invasive CPAP Ventilations in RDS Covid-19 Patients

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**Abstract: Background:** When the first wave of the Covid-19 pandemic attacked Iraq, more than 80% of I.C.U admitted patients received mechanical ventilation, although half of them started with non-invasive ventilation, but after 24-72 hours, they required invasive ones. This study was done to compare the invasive to non-invasive ventilations between RDS pneumonia (respiratory distress syndrome) Covid-19 patients respectfully to prone positioning procedure for patients with invasive ventilation and turning the patients into invasive ventilations for those who have not to get benefit from non-invasive ventilation or get deteriorated clinically, revealing the best outcome. **Methods:** Seventy patients between (20-50) years old, randomly gender selected for this study, consent granted from the patients and their families, and institutional board approval after I.C.U. Admission and diagnosed them as RDS pneumonia Covid-19, half of them were selected for early invasive ventilation, the other half started with non-invasive CPAP ventilation, and both groups were closely monitored. The treatments were mostly the same for all patients. Otherwise, there was no difference mentioned in the management except for the ventilator setting as it differs from patient to patient. Following up on the patients, close observation, recording the response, and delicate weaning from the mechanical ventilation all were the parameters on which the study depends on. **Results:** The first group (I) with early invasive ventilation showed less death rate and early discharge from I.C.U. with positive clinical results, in contrast to the second group (N) showed more death rate and more than three-quarters of them converted into invasive ventilation as their non-invasive CPAP ventilation didn't meet their requirement. **Conclusion:** Although invasive ventilation requires sedation and has many complications, but it is still the only pathway for securing the airway, and it meets many modes of ventilations that might be comfort to the patient. The better outcome results for RDS pneumonia Covid-19 patients showed with early invasive ventilation.

**Keywords:** RDS Covid-19 pneumonia patients, invasive ventilation, non-invasive ventilation.

### INTRODUCTION

At the end of 2019, in China (Wuhan Province), there was an outbreak of a new coronavirus infection of which the new type of virus was named SARS-CoV-2 (COVID-19 [Quah, P. *et al.*, 2020]). It is known that the most common clinical manifestation of a new variant of coronavirus infection is pneumonia, and in 3-4% of patients, the development of acute respiratory distress syndrome (ARDS) was recorded [Belenguer-Muncharaz, A. *et al.*, 2011; Rodríguez, A. *et al.*, 2017]

During the fight against the epidemic, depending on the clinical picture, specialists developed and formulated the main indications for oxygen therapy, NIV (non-invasive ventilation of the lungs), CPAP and BPAP

Pulmonary lesions in COVID-19 are characterized by severe arterial hypoxemia, which is not consistent with a decrease in compliance. In contrast to acute respiratory distress syndrome, in these patients, as a rule, there are no other causes for endotracheal intubation - impaired consciousness, muscle weakness (diaphragm weakness in acute neuromuscular disease) [Rochweg, B. *et al.*, 2017], unstable hemodynamics, intra-abdominal hypertension, low compliance for the chest wall, respiratory

biomechanics are impaired. As a result, in a large part of these patients, hypoxia and ARF (acute respiratory failure) are compensated by non-surgical methods (without endotracheal intubation) - oxygen therapy and non-invasive mechanical ventilation, even with reduced The PaO<sub>2</sub> / FiO<sub>2</sub> index reaches 100 mm Hg [Alraddadi, B.M. *et al.*, 2019; Cinesi, C. *et al.*, 2020].

Dr. Ling Qin said after reviewing more than 400 patients with pneumonia of Coronavirus disease in Wuhan Union Hospital, China, in 2019, and I quote, "This disease is still too strange to us, and there are too many doubts." [7]

We should keep in mind that RDS causes diffuse alveolar damage with impaired surfactant formation followed by interstitial widening, oedema, and finally, fibroblast proliferation. [[www.covid19evidence.net.au](http://www.covid19evidence.net.au); Ranieri, V.M. *et al.*, 2012]

80% of Covid-19 patients suffer from mild to moderate symptoms, 15% need hospitalization, and 5% required I.C.U. Admission. Respiratory inflammation confirmed by chest X-ray (CXR) and CT scan reveal what is called "ground-glass appearance"[ Bellani, G. *et al.*, 2017; Puah, S.H. *et al.*, 2020] because it looks like the frosted glass on a shower door. Half of the patients rapidly

progressed into RDS and required O<sub>2</sub> and assisted ventilation. [Bellani, G. *et al.*, 2016; Wu, C. *et al.*, 2020; Bellani, G. *et al.*, 2017]

The strategy for assist breathing is either by nasal cannula (high flow), NIV non-invasive (CPAP or Bi-PAP), or IV invasive ventilation [Bellani, G. *et al.*, 2017; Puah, S.H. *et al.*, 2020]. Because of the highly widespread and viral transmission to other patients and health care workers, the use of high flow nasal cannula and NIV is highly dependent on the health care setting. The Australian Covid-19 guidelines strongly recommend against high flow nasal & NIV just in negative pressure single rooms. [Bellani, G. *et al.*, 2017; Puah, S.H. *et al.*, 2020]

Two weeks after the Covid-19 outbreak, we start to use non-invasive ventilation with CPAP mode, this strategy succeeded for many cases, but for others, their lungs pathology asked for invasive ventilation, and that what was happened [13,15]. Rapid deterioration and hypoxic complications induced us to sedate the patients and early start with invasive ventilation [Fan, E. *et al.*, 2021].

P/F ratio, chest CT and CXR were the parameters to confirm and determine the severity of RDS for Covid-19 pneumonia patients [Tian, S. *et al.*, 2020].

## MATERIAL AND METHOD

### Patient Sample

In this study, information and demographic data about patients were collected from different hospitals in Iraq were collected 70 patients were 20-50 years (to lower the co-morbidity aging factor in the study) after diagnosis of Covid-19 pneumonia and early assigned for RDS presentation. The patients were divided into two groups: the first group (I) who started with early intubation and mechanical ventilation, while the second group (N) started with a face CPAP mask and supportive ventilation.

### Study Design

The study was done just for I.C.U. Cases. After patients and relatives are informed, consent and signed, also permission is granted to the hospital administration board.

All patients were closely monitored for SPO<sub>2</sub>, heart rate, NIBP, ECG, fluids input & output, personal hygiene (mouth and body), diaper change, enteral enriched nutrition intake, analgesia, and required sedation (especially for the invasive ones). Serial investigations twice daily for

ABG, CBC, renal function, RBS, electrolytes, and JVP measurement. CXR & CT chest was done daily for following up and to observe any newly changes in the pulmonary pattern. Prone position was done at the 3rd day for the cases who had not improved clinically or had not an obvious response to the usual management.

In the 5<sup>th</sup> day of the group (N), they converted into invasive ventilation, as they did not have any benefit from CPAP and get deteriorated clinically.

### Study Period

The electronic record in the hospital was relied upon for the purpose of collecting patient information and data. Cooperated with the competent authorities and committees was conducted for the purpose of obtaining special licenses and withdraw information to patients; the study period was a full year from 2-9-2019 to 1-10-2020.

### Aim of Study

This study was done to compare the invasive to non-invasive ventilations between RDS pneumonia (respiratory distress syndrome), Covid-19 patients.

## RESULTS

In this study, 70 patients were collected and distributed into two groups (Non-invasive ventilation N=50) and (Non-invasive ventilation N=20), and the most common ages in the IV group were from 30-39 to 22 patients, with 44% of the population and from 40-50 years old. For 18 patients with 36%, followed by 20-29 years, for ten patients with 20%, for the non-invasive ventilation N group, which included 20 patients, and the most common ages were between 30-39 years for nine patients with 45%, From 40-50 years old for six patients with 40%, followed by 20-29 years for five patients with 25%.

Patients were distributed according to gender. In group IV, male patients were more important than women for 34 patients with 68%, and in the group NIV (12 male patients with 60%) (8 female patients with 40%) and a high body mass index was found. Very ranged between 30-33 kg/m<sup>2</sup> for 15 patients and from 26-29 kg/m<sup>2</sup> for 19 patients, from 22-25 kg/m<sup>2</sup> for 10 patients.

The most common comorbidities in group IV were asthma for 22 patients and diabetes for 11 patients, as shown in Table 1.

**Table 1:** Demographic results of patient

Variable	early invasive ventilation N=50	Non- invasive ventilation N=20	P- value
AGE			
20-29	10 (20)	5 (25)	0.88
30-39	22 (44)	9 (45)	0.06
40-50	18 (36)	6 (30)	0.02
sex			
Male	34 (68)	12 (60)	0.01
Female	16	8 (40)	0.5
BMI in kg/m <sup>2</sup> , Mean (SD)			
22-25	10	5	0.4
26-29	19	7	0.076
30-33	15	4	0.05
34-37	6	4	0.6
Initial SpO <sub>2</sub> in %, mean (SD)	88±3	88±5	0.89
comorbidities			
Asthma	22	7	0.49
Diabetes	11	5	0.03
Heart failure, n	9	4	0.5
Hypertension, n	6	3	0.33
Antivirals, n	3	1	0.71

**Table 2:** Final outcomes results according to ICU stay days, Hospital stays days, ICU mortality

	NON-IV, N= 20	IV, N- 50	P- value
ICU stay days	5 (25)	6 (12)	0.001
Median Hospital stay days	29 (20-50)	12 (9- 17)	0.001
ICU mortality	4 (20)	2 (4)	0.05

**Table 3:** Assessment of logistic regression to patient outcomes

Primary analysis	Iv	NIV	OR (95% CI)
ICU	83/112 (81%)	28/49 (51%)	12 (2.9- 59)
Non-ICU	38/38 (100%)	145/483 (32%)	211 (33- 2689)
SpO <sub>2</sub> >84%	88/112 (82%)	129/473 (27%)	41 (18- 79)
SpO <sub>2</sub> 84%	37/40 (87%)	41/57 (67%)	13 (2.8- 111)

## DISCUSSION

Different strategies were followed in I.C.U. Patients with RDS signs due to Covid-19 disease with different results and outcome.

With respect for non-invasive CPAP mode to lower the work of breathing and decrease the oxygen demand, but is still recommended for pre and mild RDS signs. An article "Covid-19: CPAP reduces the need for invasive mechanical ventilation in patients requiring oxygen" by Elisabeth Mahase, published 05 August 2021 [Ye, Z. *et al.*, 2020], found the need for tracheal intubation was lower in the CPAP group than in the conventional oxygen therapy group, the researchers said that, and I quote "The decrease seen among the CPAP group was driven by a decrease in the incidence of tracheal intubation, with no statistically significant difference in the rate of 30-day mortality".

Another research published in 04 January 2022, "Non-invasive respiratory support in Covid-19" by Manel Lujan *et al.*, recommend CPAP mode without a comparison with invasive ventilation [Wang, J. *et al.*, 2020].

Many studies and researches discussed the non-invasive ventilation, especially CPAP mode, but without clear results with invasive ones. Early intubation with or without prone positioning, if required for similar RDS signs, lower the mortality rate and I.C.U. hospitality comparing to non-invasive ones [Song, F. *et al.*, 2019; Shi, H. *et al.*, 2020].

And by reviewing the previous studies of this study, the moment of the Bayer Corner study in 2021 retrospectively on Covid 19 patients, and the sample size was very small, as 40 were collected and the necessary analyzes were performed on them. The Median Hospital stay days ranged between 20-AH. Patients in the I've patients' group and it is considered a high rate if compared with the second group, and the mortality rate in the nov group was four patients with 20%.

as patients who underwent iv were found to have a statistically significant relationship at a p-value of 0.001 [Ye, Z. *et al.*, 2020; Wang, J. *et al.*, 2020; Bai, H.X. *et al.*, 2020]

The results were found to confirm the necessity of early intubation and invasive ventilation of mild to moderate respiratory distress syndrome from

patients with Covid-19 pneumonia to reduce the number of deaths and hospital stays.

Non-invasive ventilation is used, however, and it is recommended that if the patient is a candidate for invasive ventilation support, it should be started without delay. Indications for endotracheal intubation are clinical and gastrometric, saturation targets are generally 90-96%, and endotracheal intubation with mechanical ventilation should not be delayed if indicated. Further studies are needed in order to evaluate the clinical efficacy of supplemental oxygen devices for non-invasive respiratory support in these patients. However, it is recommended that if the patient is a candidate for invasive ventilation support, it should be started without delay

## CONCLUSION

Revealing results and clinical outcome, we conclude that early intubation and invasive ventilation for mild to moderate respiratory distress syndrome results from Covid-19 pneumonia patients has a more positive results and lower the mortality rate, although death may occur in the same proportion. Recommendation

## RECOMMENDATION

The inclusion of invasive respiratory support systems in the management of adult acute respiratory distress syndrome during the current pandemic has been lifesaving, given the lack of resources in the current international health situation.

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