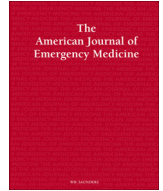




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Transport of awake hypoxemic probable COVID 19 patients in the prone position

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ABSTRACT

Objective: We aimed to investigate the effects of transport with prone position on hypoxemia in hypoxemic and awake probable COVID 19 pneumonia patients.

Methods: Hypoxic and awake patients with probable COVID 19 pneumonia who were referred to the Ankara City Hospital Emergency Department from 1 April to 31 May 2020 were included in this prospective study. Patients were transported in prone position and fixed on the stretcher. During the transport, patients continued receiving 2 l per minute oxygen with nasal cannula. Arterial blood gases were obtained from the patients before and after transport. The transport time was recorded as minutes. The primary outcome of the study is the increase of partial oxygen value in the arterial blood gas of patients after transport.

Results: It was found that pO₂ and SpO₂ end values were statistically significantly higher in the patient group compared to the initial values. In the group with transport duration of more than 15 min, a difference was found between the initial and end values in pO₂ and SpO₂ parameters similar to the whole group. However, there was no statistically significant difference between the initial and end values in the group with transport duration of 15 min or below.

Conclusions: Awake hypoxemic patients can be transported without complications in prone position during transport. Transports more than 15 min, prone position may be recommended because the partial oxygen pressure of the patients increases.

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1. Introduction

SARS CoV-2 pandemic, which started in China in December 2019 and spread all over the world in a short time, is characterized by Acute Respiratory Distress Syndrome (ARDS) and hypoxia leading to respiratory failure [1]. For the treatment of ARDS, 5% of the existing ventilators in a hospital should be used before pandemic. [2] With the Coronavirus Disease 19 (COVID) 19 pandemic, hospital crowding has gradually increased, and the intensive care unit (ICU) and ventilator capacities are quickly filled.

Prone position stands out as a saviour strategy in hypoxemic patients. [3] During the prone position, the pleural pressure gradient decreases due to the gravitational effect and the three-dimensional structure of the lung. As a result of this physiological change, lung ventilation and load distribution become more homogeneous. [4] Physiological studies in patients diagnosed with ARDS support that the lung

ventilation is more homogeneous with prone position. [5] It has been shown in several studies that the prone position improves oxygenation and reduces mortality in patients undergoing invasive mechanical ventilation. [6–8] There were a limited number of studies investigating the effect of awake prone positioning on oxygenation before the COVID 19 pandemic. [9,10] Studies on awake prone positioning gained momentum due to the need for efficient use of resources (i.e., ventilator and ICU beds) with the pandemic. [11–13] In the literature, there were case reports regarding patients with mechanical ventilation related to prone position during transport. [14,15] In our study, we aimed to investigate the effects of transport with prone position on hypoxemia in hypoxemic and awake probable COVID 19 pneumonia patients.

2. Methods

Hypoxic and awake patients with probable COVID 19 pneumonia who were referred to the Ankara City Hospital Emergency Department from 1 April to 31 May 2020 from second level hospitals were included in this prospective study. Ankara City Hospital Emergency Department (Ankara, Turkey), approximately 12,000 patients are referred from

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other hospitals annually. The study protocol has been approved by the local ethics committee. Written consent was obtained from the patients.

We included patients above 18 years of age, who could take prone position on the ambulance stretcher, who were hypoxic ($SpO_2 < 93\%$) despite 2 L/min of supplementary oxygen with nasal cannula, and probable COVID 19 pneumonia according to symptoms and tomography findings according to World Health Organization probable COVID 19 case definition [16]. Patients with contraindications for prone position (facial fractures, spinal cord injury, anterior trunk burns, increased intracranial pressure and unstable pelvic fractures) and patients receiving non-invasive or invasive mechanical ventilation were excluded from the study. [17] After the patients were taken to the transfer stretcher, they were told to move to the prone position and the patient was fixed on the stretcher. During the transport, patients continued receiving 2 L/min oxygen with nasal cannula during the entirety of the transport (Fig. 1). During transport, the oxygen level was kept constant at 2 L/min. Patients did not receive any other interventions during transport. Patients who changed position during transport or patients who needed intervention that could not be performed in prone position (intubation, cardiopulmonary resuscitation.etc) were excluded from the study. Arterial blood gases were obtained from the patients before transport. After



Fig. 1. Transport of the prone patient on ambulance stretcher with paramedic.

the transport, arterial blood gas were obtained again in the emergency department. The transport time was recorded as minutes. The patients were transported with teams consisting of a paramedic and an emergency medical technician. The primary outcome of the study is the increase of partial oxygen pressure (pO_2) value in the arterial blood gas of patients after transport.

Statistical analyzes were made with IBM SPSS for Windows 15.0 Package Program. First of all, demographic data were analyzed and the frequencies of ordinal data were given as a percentage. Distribution analysis of continuous data was done by Shapiro-Wilk test. The median and interquartile ranges were used for data that do not fit the normal distribution. Average and standard deviation were used for normally distributed data. Wilcoxon Signed Ranks test was used to compare median values between two dependent groups that do not conform to the normal distribution. Dependent Samples *t*-test was used to compare the averages between two dependent groups that conform to the normal distribution. *P* value was used for statistical significance and $p < 0.05$ level was considered significant.

3. Results

Twenty-one patients were included in our study. Demographic data and transport duration of the patients are given in Table 1.

Comparisons between the arterial blood gas parameters of patients before and after transport are given in Table 2. It was found that pO_2 and oxygen saturation (SpO_2) end values were statistically significantly higher in the patient group compared to the initial values. There was no significant difference between pH, partial carbodioxide pressure (pCO_2) and bicarbonate (HCO_3) parameters before and after transport.

The patients were divided into two groups as “15 minutes or below” and “above 15 minutes” according to their transport durations. These two groups were evaluated separately. In the group with transport duration of more than 15 min, a difference was found between the initial and end values in pO_2 and SpO_2 parameters similar to the whole group. However, there was no statistically significant difference

Table 1
Demographic data and transport durations of study population

Gender- n (%)	Female	11 (52,4)
	Male	10 (47,6)
Age (year)	Median (IQR)	71 (60–76,5)
	Min-max	20–83
Hypertension- n (%)		10 (47,6)
Diabetes Mellitus- n (%)		7 (33,3)
Congestive Heart Failure- n (%)		2 (9,5)
Chronic Obstructive Pulmonary Disease- n (%)		5 (23,8)
Chronic Kidney Disease- n (%)		2 (9,5)
Malignancy- n (%)		3 (14,3)
Coronary Artery Disease- n (%)		1 (4,8)
Positive PCR- n (%)		2 (9,5)
Transport Duration (min)	Median (IQR)	22 (12,5–36,5)
	Min-max	6–60
Transport Duration (min)-n(%)	≤ 15 min	7 (33,3)
	> 15 min	14 (66,6)

Table 2
Comparison of blood gas values before and after transport

Arterial blood gas parameters		Initial value	End value	<i>p</i> -value
pH	Mean ± SD	7,38 ± 0,09	7,42 ± 0,06	0,077 ^a
pO_2 (mmHg)	Median (IQR)	53,5 (46,1–71,0)	70,0 (60,7–88,1)	0,001 ^b
pCO_2 (mmHg)	Median (IQR)	37,8 (32,7–44,5)	35,6 (33,2–44,7)	0,566 ^b
SpO_2 (%)	Median (IQR)	89,6 (83,6–91,8)	92,8 (89,9–97,1)	0,001 ^b
HCO_3 (mEq/L)	Mean ± SD	24,7 ± 4,5	23,8 ± 4,0	0,287 ^a

^a Paired-Samples *t*-test.

^b Wilcoxon Signed Ranks Test.

Table 3
Comparison of initial and end blood gas values when grouped by transport durations.

Transport duration	Arterial Blood Gas Parameters		Initial value	End value	p-value
15 min or below (n = 7)	pH	Median (IQR)	7,37 (7,30-7,42)	7,43 (7,37-7,46)	0,128 ^b
	pO ₂ (mmHg)	Mean ± SD	64,5 ± 18,2	67,9 ± 13,4	0,691 ^a
	pCO ₂ (mmHg)	Median (IQR)	38,5 (29,7-51,2)	36,7 (34,1-47,1)	0,866 ^b
	SpO ₂ (%)	Median (IQR)	90,1 (82,3-92,5)	91,0 (89,1-93,4)	0,499 ^b
	HCO ₃ (mEq/L)	Mean ± SD	23,7 ± 3,6	24,9 ± 3,0	0,268 ^a
Above 15 min (n = 14)	pH	Mean ± SD	7,40 ± 0,09	7,42 ± 0,07	0,345 ^a
	pO ₂ (mmHg)	Median (IQR)	53,3 (45,4-67,4)	71,0 (63,1-104,1)	0,001 ^b
	pCO ₂ (mmHg)	Median (IQR)	37,4 (33,6-41,0)	35,3 (31,3-43,9)	0,363 ^b
	SpO ₂ (%)	Mean ± SD	87,9 ± 5,6	94,1 ± 3,5	0,001 ^a
	HCO ₃ (mEq/L)	Mean ± SD	25,2 ± 5,0	23,3 ± 4,5	0,091 ^a

^a Paired-Samples t-test

^b Wilcoxon Signed Ranks Test

between the initial and end values in the group with transport duration of 15 min or below (Table 3).

4. Discussion

The use of non invasive mechanical ventilation (NIV) and high flow nasal cannula (HFNC) in hypoxic patients has been replaced by early intubation due to the risk of transmission by aerosolization in the COVID 19 pandemic. [18] This practical change in healthcare workers rapidly increased the use of intensive care beds and ventilators in hospitals and consumed these resources. Prone position, which is a maneuver that does not require any extra resources, has been previously shown to increase oxygenation in patients with hypoxemia. [3] Studies investigating the effectiveness of prone position in COVID 19 pneumonia patients with awake and hypoxic have been conducted to reduce resource use during pandemic. [13,19,20]

In the literature, there is not any study related to transport of awake patients in prone position. Our study examined the transport of awake and hypoxic patients in prone position. In the case report of an ARDS patient with mechanical ventilation published in 2018, SpO₂ and pO₂ values improved after transport. [15] It was observed that the pO₂ levels of awake and hypoxic patients who were hospitalized in the intensive care unit increased statistically significantly during the prone position. [9] Caputo et al., gave 5 lt / min oxygen with a nasal cannula or non-breather mask to forty COVID 19 patients after that patients asked for 5 min of proning. It was observed that oxygen saturation increased in patients. [19] In our study, hypoxic patients were evaluated with arterial blood gas before and after transport. When the transport of hypoxic patients in prone position lasted longer than 15 min, the SpO₂ and pO₂ values of the patients increased significantly. There was no significant increase in the transports which took less than 15 min.

DellaVolpe et al., performed a study with seven mechanically ventilated ARDS patients transported in prone position. [14] Only one of these patients was transported by land ambulance and the other patients were transported by air ambulance. In this study, temporary hypoxemia and increased secretion in the endotracheal tube occurred in 2 patients depending on the prone position. These problems have arisen due to the transport of patients as intubated. In a study on awake prone position, 17% of patients could not tolerate prone position for more than one hour. [13] Patients in the awake prone position disrupt the position as they often find it uncomfortable. Patients could made more comfortable with the placement of pillows and blankets [19]. In our observation, the maximum time spent on the ambulance stretcher was 60 min. Patients did not impair the prone position and there were not any complications. An ambulance stretcher can be developed in the future to transport patients to a more comfortable prone position.

The fact that the sample size is less, especially with a transport time of less than 15 min, is one of the limitations. Another limitation is that there was no control group in our study. Also we do not know the time spent at the first hospital prior to transport. In addition, not

knowing the diagnoses of patients after low PCR positivity rate are other limitations of the study. We think that this is due to the patients are transferred from other hospitals to our center as soon as possible before PCR test results are available.

5. Conclusions

Awake hypoxemic patients can be transported without complications in prone position during transport. Transports more than 15 min, prone position may be recommended because the partial oxygen pressure of the patients increases. With this simple maneuver, we think that since oxygenation improves in patients, it may reduce airway interventions, which may be difficult to apply during transport. In addition, studies on the oxygenation and prognosis of awake hypoxic patients can be carried out when the prone position is continued in the emergency room after transport. In the future, studies investigating the effects of prone position during interfacility transport on intensive care unit and ventilator days and mortality can be conducted with higher number of patients. Also further studies should be done on patients with more severe lung disease to determine efficacy at improving oxygenation.

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CRedit authorship contribution statement

İshak Şan: Conceptualization, Methodology, Resources, Formal analysis. **Çağdaş Yıldırım:** Data curation, Writing- Original draft preparation, Software. **Burak Bekgöz:** Visualization, Investigation, Validation. **Emin Gemcioğlu:** Supervision, Writing - Reviewing and Editing.

Declaration of Competing Interest

None.

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