

## Platypnea – Orthodeoxia as A Predictor of Severity in Covid Pneumonia – A Cross Sectional Observational Study in A Tertiary Care Hospital in Chennai

Dr. P. Paranthaman<sup>1</sup>, Dr. Ramya Venkatesan<sup>2</sup>, Dr. S. Chandrasekar<sup>3</sup>, Dr. Vasanthamani<sup>4</sup>, Dr. V. Balaraman<sup>5</sup>

<sup>1</sup> Professor and Head of Department of Medicine Kilpauk Medical College Chennai, <sup>2</sup> Junior Resident, <sup>3</sup> Professor of medicine, <sup>4</sup> The Dean, <sup>5</sup> The Medical Superintendent Government Kilpauk Medical College and Hospital Chennai, Tamilnadu

**\*Corresponding Author:**

**Dr. P. Paranthaman**

Professor and Head of Department Of Medicine Kilpauk Medical College Chennai

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### ABSTRACT

Platypnea-Orthodeoxia syndrome (POS) is defined as positional dyspnea and arterial desaturation while in the upright position. Corona Virus Disease (COVID-19) is the pandemic which has got the world in its clutches.

AIM: To identify the presence of Platypnea – Orthodeoxia in a patient with COVID pneumonia and to use the same in assessing the severity of COVID pneumonia at the earliest and to help in preventing the mortality associated with the disease.

METHODS: Cross sectional study which included patients admitted in the covid wards. The study excluded people with severe anemia, hemoglobinopathies, congenital cardiac pathologies and those with liver diseases.

RESULTS: Out of the total sample size of 131, 41 cases (31%) were critical, 34 cases (26%) severe, 48 cases (37%) moderate and 8 cases (6%) were mild. Out of the 131 cases under this study, 91 patients (69%) were males and 40 patients (31%) were females. The platypnea- orthodeoxia syndrome is well demonstrated and is of significance in patients with acute severe and critical COVID pneumonia.

CONCLUSION: Platypnea – Orthodeoxia is a demonstrable phenomenon in critical and severe cases of COVID -19 and is a simple clinical tool used in triaging the patients according to severity. This can help in tailoring the dose of drugs used in the intensive care and can also aid in early intervention that is needed to prevent the mortality. In the event of the second wave surging and the acute shortage of hospital beds and oxygen supply, simple positioning can help by increasing the comfort of the patient and oxygen saturation It can also act as a guide to upregulate the use of anticoagulants and anti-inflammatory drugs and can to some extent predict the duration of ICU stay.

**Keywords:** NIL.

### INTRODUCTION

A Pandemic is defined as an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people. The pandemic, in its wildest form, is taking shape of a war against human nature and there isn't a visible end as of date.

Clustering of cases of unknown nature were reported from the Huanan Market, Wuhan, Hubei province of China and was notified to the WHO. The World Health Organisation called it the novel corona virus because of its similarity to the corona virus causing the SARS epidemic. On January 30th 2020, the

WHO declared it as a Public Health Emergency of International Concern (PHEIC), owing to the wildfire like spread of the disease. On February 11, 2020, it was renamed as COVID-19 or CORonaVirus Disease. And finally on March 11, 2020, the nomenclature was changed from PHEIC to pandemic.

In view of the rising curve of the disease in exponential terms, the need and means to curb the disease spread is evident. The disease in itself, a relatively new one, is a challenge. In a country like India with a population so mammoth and the number of doctors minuscule, the need to triage and prioritize the in-hospital treatment, needs to be emphasised. Various methods in terms of imaging studies were put forward, but an observation of the phenomenon of platypnea – orthodeoxia in patients with COVID grabbed our attention.

Geak Poh Tan et al described Platypnea-Orthodeoxia syndrome (POS) as a rare clinical entity that is characterized by positional dyspnea (platypnea) and arterial desaturation of  $>5\%$  or a  $\text{PaO}_2 > 4\text{mmHg}$  (orthodeoxia) while in upright position.

Oxygen saturation, a simple tool that can be used to assess the severity in COVID pneumonia. It measures the percentage of hemoglobin that is bound to oxygen. It is often regarded as a fifth vital sign especially in the event of COVID – 19. Residing in a resource poor country like India, the use of feasible aids to triage and treat diseases, especially in the event of the pandemic, is welcome. In the event of the pandemic and constraints in the general condition of the patient like oxygen or ventilator dependency might make it less feasible for imaging., Under such circumstances, the use of POS can to some extent, if not definitely, predict the disease severity.

The proposed mechanisms for Platypnea – Orthodeoxia Syndrome, in general are:

1. Right to left intra cardiac shunting.
2. Ventilation perfusion mismatch
3. Pulmonary arteriovenous shunts.

If a reliable relationship was established between the phenomenon of Platypnea

Orthodeoxia syndrome and the severity in COVID – 19., an early triaging and effective treatment can be initiated in the early stages of the disease

pathogenesis. This can also help to reduce the mortality and morbidity associated with the disease.

#### PLATYPNEA – ORTHODEOXIA MECHANISMS:

POS is a rare condition, the prevalence of which is not known.

The proposed mechanisms for the POS in COVID-19 can be explained by a few theories. Venous admixture or intrapulmonary shunting is a recognised pathophysiological mechanism of hypoxemia in ARDS. The mechanism in COVID – 19 can be varied. The occurrence of predominant basal consolidation in COVID – 19 can possibly explain the occurrence of increased ventilation- perfusion (VQ) mismatch in sitting posture as opposed to the supine posture. When in the sitting posture, the basal regions of the lungs get highly perfused under the effect of gravity, but remain less ventilated due to the disease pathology, thereby, increasing the VQ mismatch. When supine, the perfusion gets equally distributed to all the parts of the lung and the VQ matching improves significantly.

In addition to the above mechanisms, the existence of extensive endothelial damage in COVID-19 can precipitate the formation of microthrombi in the vasculature, thereby increasing the pulmonary vascular resistance and decreasing perfusion to affected areas of the lung. Certain other theories that might contribute include the decreased cardiac output owing to secondary myocardial injury in the form of myocarditis, heart blocks and various other injuries inflicted both by the virus directly and by the drugs used in the treatment regimen. Hypoxia induced pulmonary vasoconstriction fails to occur in COVID because of the virus induced damage to the mitochondrial proteins. The mitochondrial proteins are involved in oxygen sensing mechanisms like oxygen sensitive  $\text{K}^+$  channels and voltage gated calcium channels, which control the hypoxia induced vasoconstriction. Failure of this mechanism is responsible for the happy hypoxia and could be probably cited as the reason for the increased VQ mismatching in COVID-19.

This can in turn contribute to the phenomenon of Platypnea – Orthodeoxia syndrome seen in severe disease.

The various other mechanisms proposed are as follows:

1. Cardiac POS, is the most common form of POS. It is mainly caused due to a right to a left shunt occurring at the level of the atrial septum. The right atrium undergoes a change in its shape and compliance when in upright position, which makes the septal defect more in line with the superior vena cava. This results in the preferential flow of the desaturated blood through the septal defect. This can be exacerbated with increasing age and after a few surgeries like pneumonectomy.
2. Hepatopulmonary syndrome (HPS) is another condition with demonstrable POS. The mechanism is because of the excessive pulmonary vascular dilatation which occurs in the setting of Hepatopulmonary syndrome. Platypnea and orthodeoxia occurs in HPS because of pulmonary vasodilation in the lung bases. This causes increased perfusion to the lung base and this along with the gravitational effect in upright position, results in mismatched ventilation. Thus the blood passing through the lung base remains inadequately oxygenated, thereby exacerbating the platypnea – orthodeoxia syndrome.

**OXYGEN SATURATION:** Oxygen saturation measures the percentage of oxygen bound hemoglobin. Hemoglobin consists of four globular protein subunits. Each subunit is associated with a heme group. Each molecule of hemoglobin has four heme-binding sites to bind oxygen. The pulse oximeter probe is a device used to measure the SPO<sub>2</sub>. It consists of a probe containing LEDs and a photodetector. The LEDs emit light at fixed, selected wavelengths. The photodetector measures the quantity of light transmitted through a vascular bed such as a fingertip or earlobe. The principle of the pulse oximeter is Beer Lambert law. The oximeter probe emits pulses of light, which is detected by the detector on the opposite side. The diodes switch on and off in rapid sequence and the measurements are fed into an algorithm where the oxygen saturation is calculated.

This thus serves handy in quick estimation of the oxygen saturation of the blood. **FALSE LOW READINGS:**

- Methemoglobinemia
- Sulfhemoglobinemia
- Sickle hemoglobin
- Abnormal inherited forms of hemoglobin.
- Severe anemia
- Venous congestion
- Shock and cold peripheries

Hence, the above limitations must be borne in mind when considering the use of Pulse oximeter for measurement of the oxygen saturation.

**BENEFIT OF STUDY:** The occurrence of platypnea and orthodeoxia in COVID pneumonia, if proved beyond doubt, can help to position the patient in the most comfortable position and come to an early provisional diagnosis of COVID. This if proved to occur in severe COVID patients will help early and convenient triaging of patients, thereby providing us golden time for initiating and channelizing appropriate treatment protocols.

#### AIMS AND OBJECTIVES:

1. To identify the presence of Platypnea – Orthodeoxia in a patient with COVID pneumonia.
2. To use the POS in assessing the severity of COVID pneumonia and helping in preventing the associated mortality.

#### MATERIAL AND METHODS:

**STUDY DESIGN:** Cross sectional study

**STUDY PERIOD:** 2 months (August – September)

**STUDY CENTRE:** Dept of General Medicine, Government Kilpauk Medical College, Chennai.

**TOTAL SAMPLE SIZE:** Since no previous studies are available to the best of our knowledge with similar aims and patient characteristics, this study is being done as a pilot study. We assume a sample size of 131 and recruit participants consecutively till we achieve the required sample size.

**CASES:** COVID Positive patients admitted in COVID TRIAGE ward in the Department of General Medicine of Govt. Kilpauk Medical College.

**INCLUSION CRITERIA:**

- Covid RTPCR positive
- Age above 18years
- Any symptomatology
- Any comorbidities other than the ones in exclusion criteria
- Informed consent

#### EXCLUSION CRITERIA:

- Individuals suffering from intracardiac shunt pathologies and severe left ventricular failure
- Patients with liver diseases.
- Patients with severe anemia and other hemoglobinopathies.

**METHODOLOGY:** With informed consent, finger pulse oximeter is used to record oxygen saturation in patients with suspected severe acute respiratory illness (SARI) at admission and categorise them as mild, moderate, severe and critical cases based on the clinical SPO2 readings as mentioned below in severity definitions. These patients are then followed up after stabilization and after RT- PCR reports and the extreme values of SPO2 is noted down in both

supine and sitting posture. A 5-minute interval is given between both the readings. Improvement or worsening in oxygenation is noted and the patient symptomatology is also noted. History regarding comorbidities obtained from the patient.

#### DEFINITION OF PLATYPNEA– ORTHODEOXIA:

Positional dyspnea (platypnea) and arterial desaturation of >5% or a PaO2 > 4mmHg (orthodeoxia) while in upright position.

**SEVERITY CLASSIFICATION:** The saturation of the patients are monitored on admission in room air and the patients are categorised as follows:

1. Mild (SPO2>94%)
2. Moderate (SPO2 90% - 94%)
3. Severe (SPO2 80%-90%)
4. Critical (SPO2 <80%)

**CONFIDENTIALITY:** Informed consent will be obtained from all patients. Confidentiality and safety of the study subjects will be taken care of.

#### CONSENT FORM

### சுயஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு:

இடம்: பொது மருத்துவத்துவ துறை  
அரசு கீழ்பாக்கம் மருத்துவ கல்லூரி மருத்துவமனை  
சென்னை

பங்குபெறுபவரின் பெயர் :

பங்குபெறுபவரின் வயது :

பங்குபெறுபவரின் எண் :

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. நான் இவ்வாய்வில் தன்னிச்சையாக பங்கேற்கிறேன். எந்த காரணத்தினாலோ எந்த சட்டசிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக்கொள்ளல்லாம் என்றும் அறிந்து கொண்டேன்.

இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்கொள்ளும்போதும் இந்த ஆய்வில்பங்கு பெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ, முடிவையோ பயன்படுத்திக்கொள்ள மறுக்க மாட்டேன்.

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக்கொள்கிறேன். இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம்

ஆய்வாளரின் கையொப்பம்

இடம் :

தேதி :

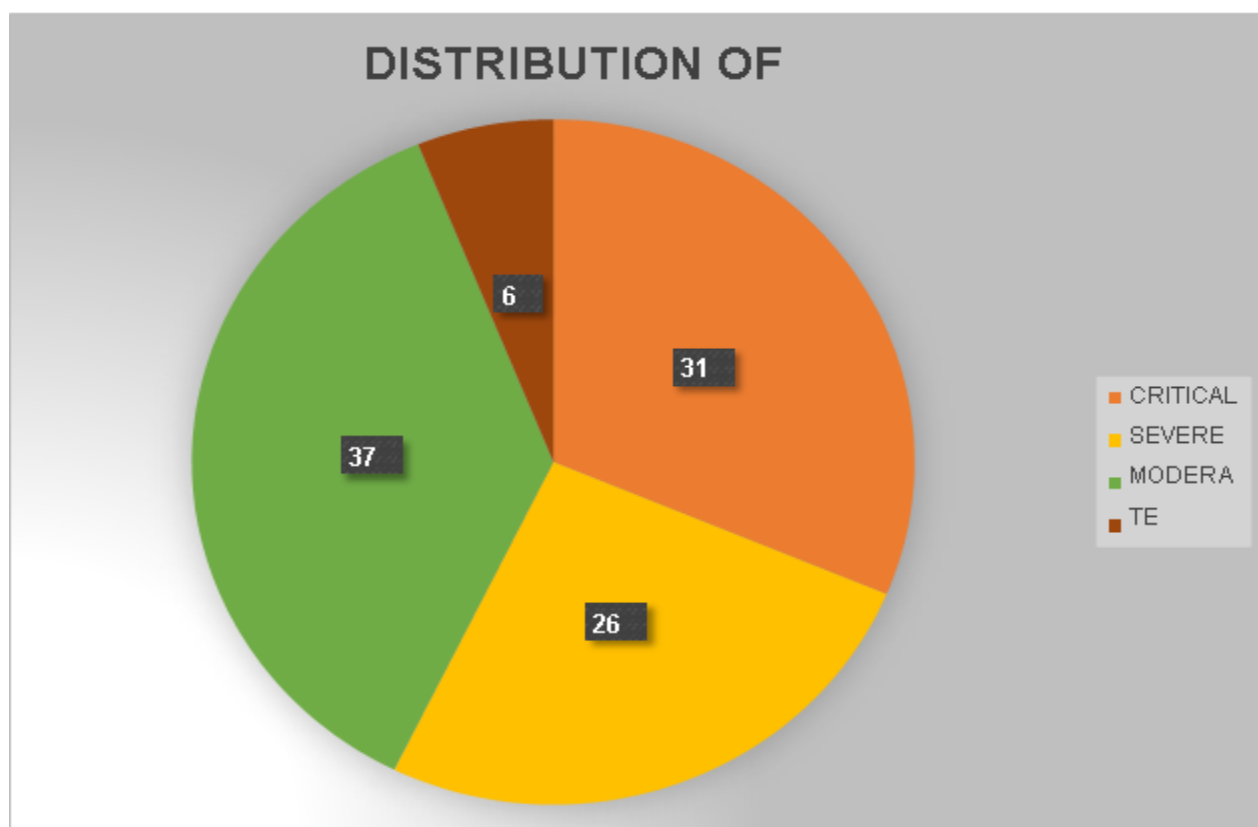
**RESULTS:** This cross-sectional study was conducted under the Department of Internal Medicine of Government Kilpauk Medical College with 131 patients with the aim of trying to prove the occurrence of the phenomenon of platypnea – orthodeoxia syndrome in patients with severe COVID. Patients were categorised into 4 different classes based on the levels of admission oxygen saturation in room air as follows:

1. Mild (SPO<sub>2</sub>>95%)
2. Moderate (SPO<sub>2</sub> 90% - 94%)
3. Severe (SPO<sub>2</sub> <90%)

#### 4. Critical (SPO<sub>2</sub> <80%)

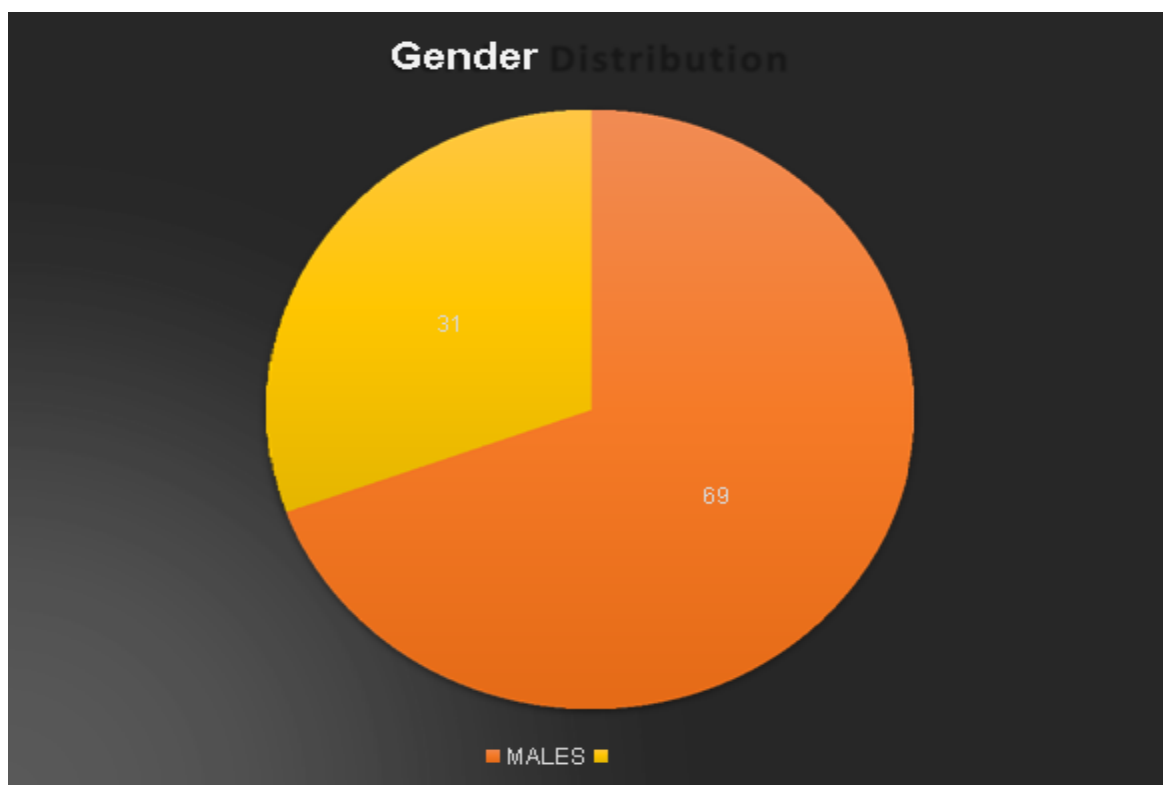
The patients with intracardiac shunts, liver diseases, previous lung parenchymal diseases, severe anemia and hemoglobinopathies were excluded.

Oxygen saturation were measured on a daily basis throughout their admission period both in supine and sitting postures and those with variations in SPO<sub>2</sub> of more than 5% were taken into consideration. Out of the total sample size of 131, 41 cases (31%) were critical, 34 cases (26%) severe, 48 cases (37%) moderate and 8 cases (6%) were mild.



**Figure 1: The distribution of the patients in terms of disease severity** Out of the 131 cases that were studied, 91 cases were male patients and the remaining 40 were females



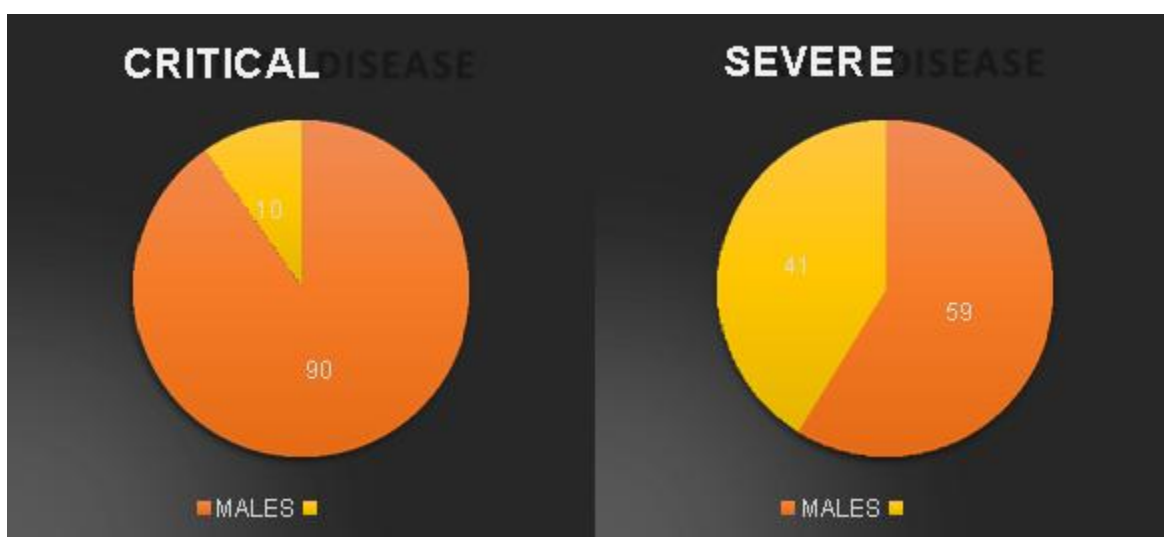


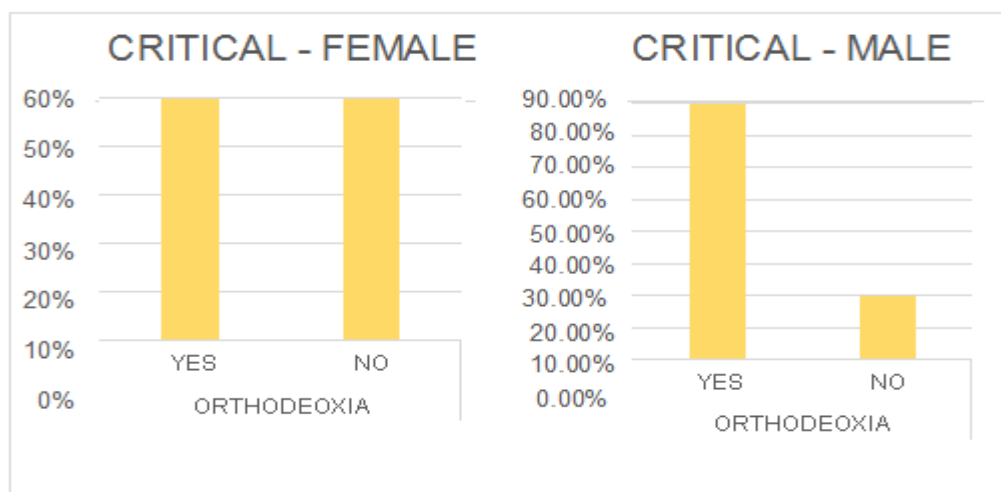
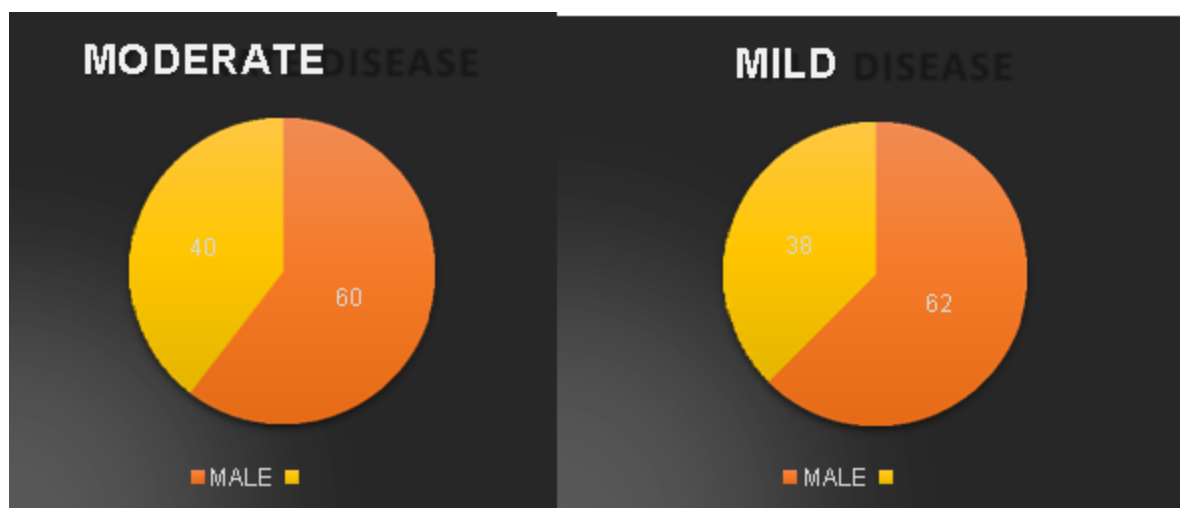
**Figure 2: The distribution of the patients in terms of gender**

TOT AL	MAL ES	FEMAL ES
131	91	40

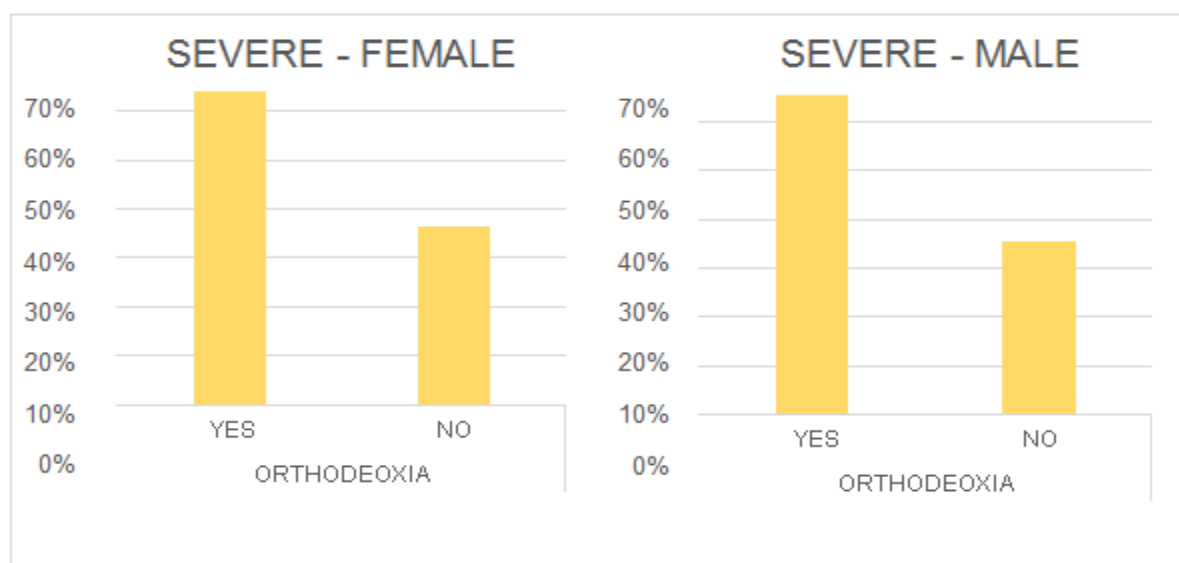
#### GENDER DISTRIBUTION IN DIFFERENT CLASSES

**Figure 3: The gender distribution in different severity**



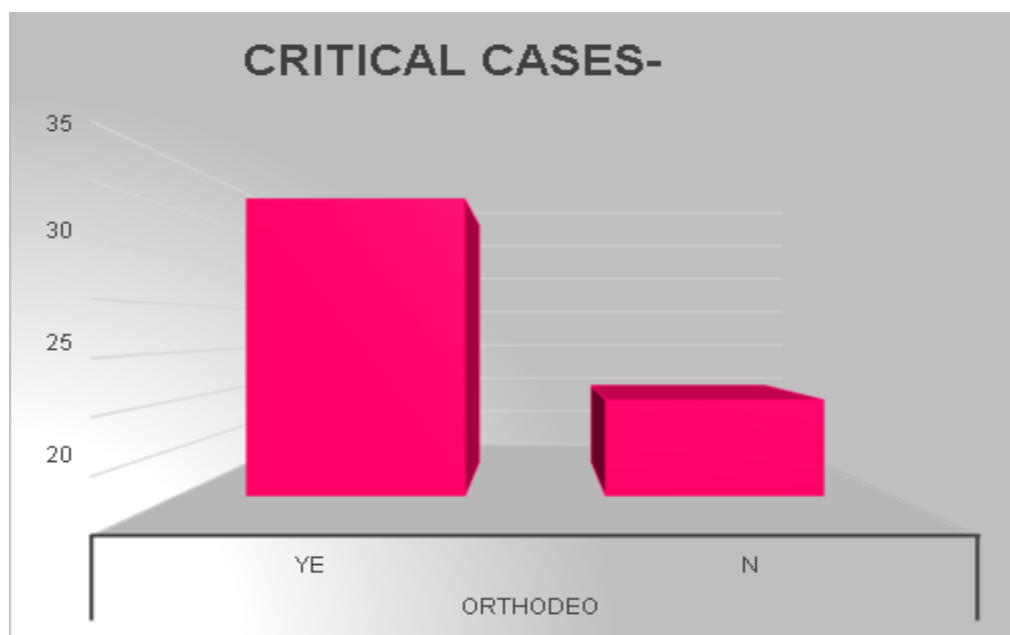


**Figure 4: Contribution of gender to POS in critical patients**



**Figure 5: Contribution of gender to POS in severe patients** Out of the 41 critical cases, 31 cases exhibited Platypnea-Orthodeoxia Syndrome (POS)

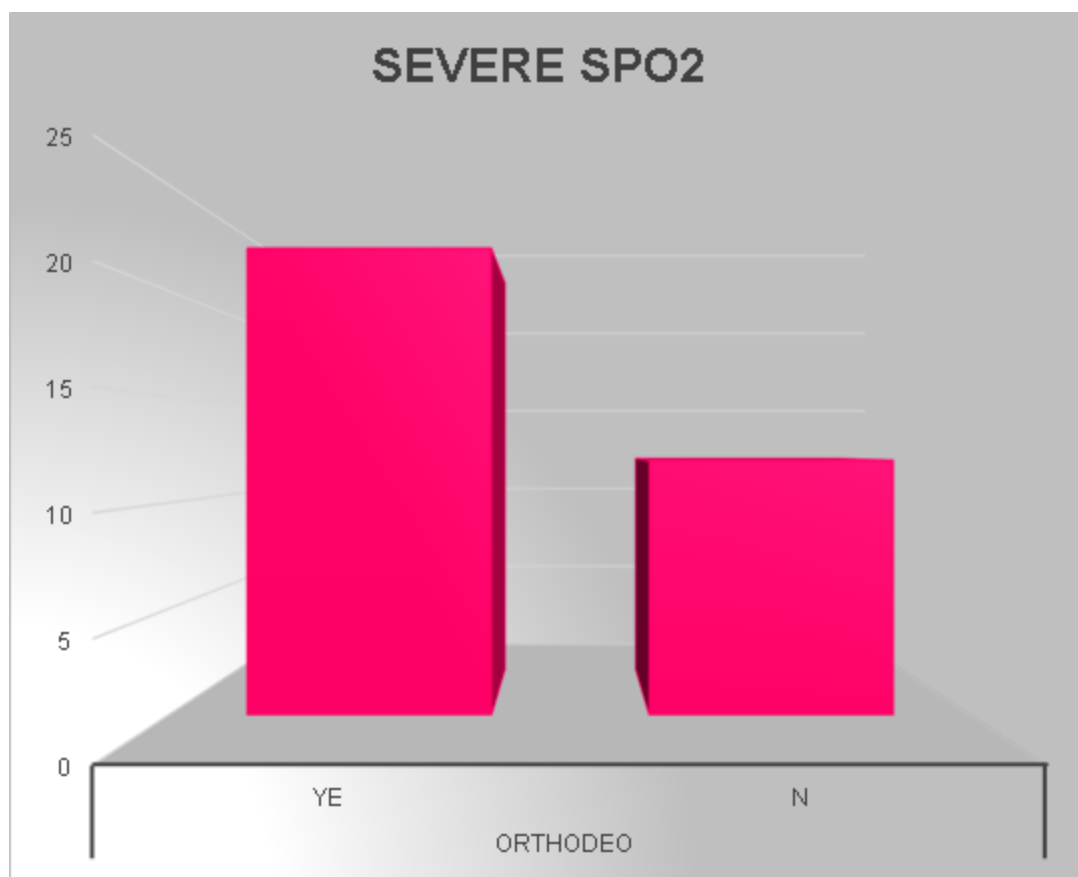
NO. OF CASES	ORTHODEOXIA	
	YES	NO
41	31	10



**Figure 6:** The bar graph representing the number of critical cases exhibiting and not exhibiting POS Out of the 34 severe cases, 22 cases exhibited Platypnea-Orthodeoxia Syndrome (POS)

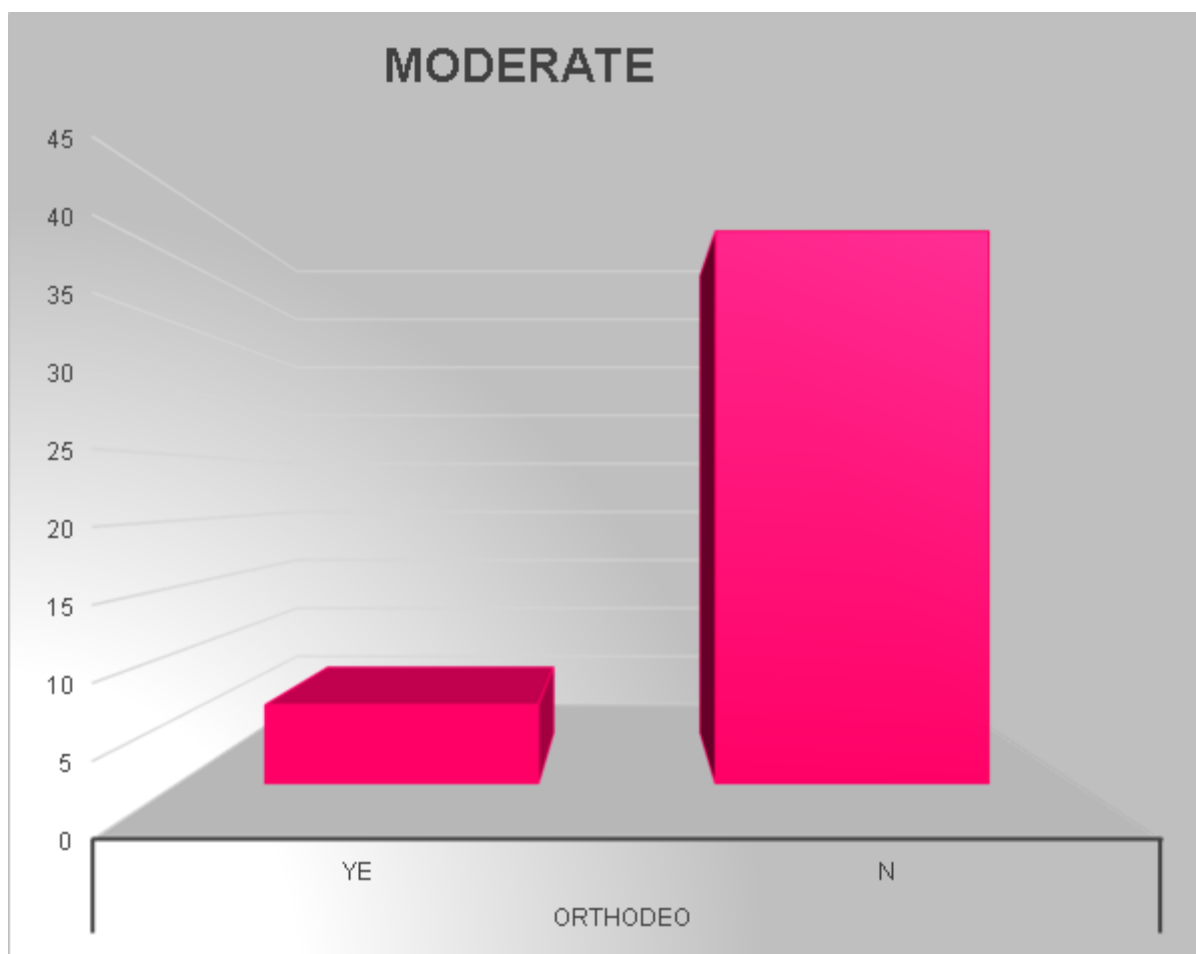
NO. OF CASES	ORTHODEOXIA	
	YES	NO
34	22	12





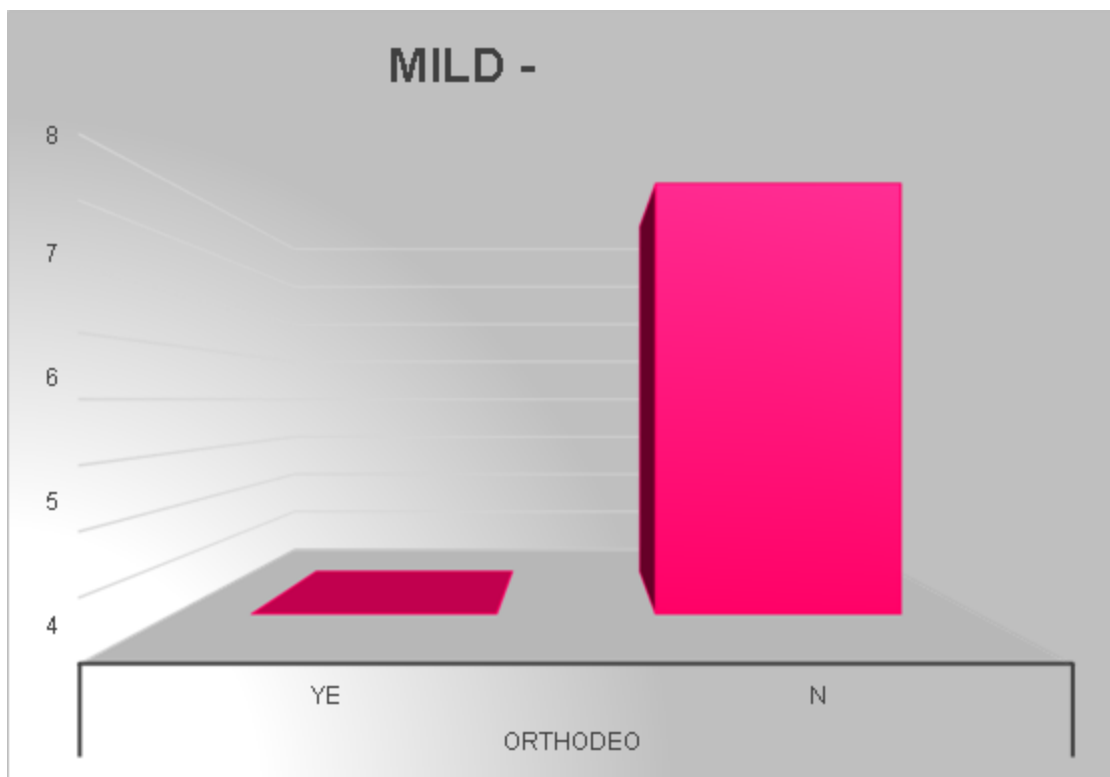
**Figure 7:** The bar graph representing the number of severe cases exhibiting and not exhibiting POS Out of the 48 moderate cases, only 6 cases exhibited Platypnea-Orthodeoxia Syndrome (POS)

NO. OF CASES	ORTHODEOXIA	
	YES	NO
48	6	42



**Figure 8: The bar graph representing the number of moderate cases exhibiting and not exhibiting POS**  
**Out of the 8 mild cases, none exhibited Platypnea-Orthodeoxia Syndrome (POS)**

NO. OF CASES	ORTHODEOXIA	
	YES	NO
8	0	8



**Figure 9: The bar graph representing the number of mild cases exhibiting and not exhibiting POS**

## DISCUSSION:

The above study was begun with an aim to demonstrate the phenomenon of platypnea – orthodeoxia syndrome in COVID patients and to correlate its occurrence with the severity of the disease. The test was begun with a sample size of 131 patients of which 41 cases (31%) had critical disease, 34 (26%) had severe,

48 (37%) had moderate disease and 8 (6%) had mild disease. From the total 75 cases of critical and severe intensity, a total of 45 cases were found to demonstrate the POS which approximates to 60%

Out of the 131 cases under this study, 91 patients (69%) were males and 40 patients (31%) were females. The gender distribution among different classes of severity were approximately in the ratio of 3:2 (Male:Female) except in the critical category where it was 9:1.

This male predominance is attributed to the increased presence of ACE2 receptors in males when compared to females.

On comparing the occurrence of POS, there is NO demonstrable difference of the presence of POS, in

both the genders. This suggests that no particular gender predisposes to the development of Platypnea-Orthodeoxia syndrome.

The platypnea- orthodeoxia syndrome is well demonstrated and is of significance in patients with acute severe and critical COVID pneumonia. The patients demonstrating POS were observed to need longer periods of ICU stay of approximately 15- 20 days and a further period of approximately 7-10 days in the wards prior to discharge. These patients were also in need for a higher dose of anti-inflammatory agents like steroids and also anticoagulants.

The entire disease being a new one to the medical fraternity, the mechanisms explained above are just possible proposals. Intense studies are required in future to establish the reasons and pathophysiology of POS in COVID-19.

**CONCLUSION:** Platypnea – Orthodeoxia is a demonstrable phenomenon in critical and severe cases of COVID -19 and is a simple clinical tool used in triaging the patients according to severity. This can help in tailoring the dose of drugs used in the intensive care and can also aid in early intervention that is needed to prevent the mortality. In the event of

the second wave surging and the acute shortage of hospital beds and oxygen supply, simple positioning can help by increasing the comfort of the patient and oxygen saturation. It can also act as a guide to upregulate the use of anticoagulants and anti-inflammatory drugs and can to some extent predict the duration of ICU stay.

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