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IMMEDIATE EFFECT OF PRONE POSITIONING ON RESPIRATORY RATE AND PEAK EXPIRATORY FLOW RATE AMONG YOUNG-OLD ELDERS

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Abstract

AIM- To study the effects of prone positioning on Respiratory Rate and Peak Expiratory Flow Rate in young-old elderly

OBJECTIVE-. To assess the effects of prone positioning on :

Respiratory Rate

Peak Expiratory Flow Rate in young-old elderly.

METHODOLOGY- The methodology for this experimental study involved a convenience sampling method with a sample size of 70 participants. The study was conducted at the LTCOP OPD and Girija Old Age Home in Kharghar, Navi Mumbai, with a duration of 6 months.

Inclusion criteria for participants were young-old individuals aged 60-75 years, including both males and females, who had no history of respiratory diseases within the 6 months preceding the study. Additionally, participants needed to demonstrate an understanding of the study's purpose and provide voluntary consent for participation.

Exclusion criteria encompassed individuals with recent rib cage fractures, any form of obstructive or restrictive lung disease, major surgeries related to ENT, ophthalmic, or cervical spine, significant neurological or neuromuscular disorders, uncontrolled hypertension, and obesity.

The instrumentation used for data collection included a PEFR (Peak Expiratory Flow Rate) Machine, a stopwatch, and demographic details. The outcome measures assessed in the study were respiratory rate (RR), oxygen saturation (SPO2), and peak expiratory flow rate (PEFR).

This research aimed to investigate the respiratory health of young-old individuals within the specified age range and without a recent history of respiratory diseases, utilizing the mentioned instruments and criteria in the LTCOP OPD and Girija Old Age Home over a period of six months.

RESULTS- This experimental study explores the impact of prone positioning on the respiratory wellbeing of the young-old elderly population, focusing on key parameters: Respiratory Rate

CONCLUSION-. The experimental study focusing on the effects of prone positioning in a healthy young-old elderly population has provided valuable insights into its positive impact on various physiological parameters, including respiratory rate, peak expiratory flow rate (PEFR), oxygen saturation (SPO2), blood pressure, and heart rate.

KEYWORDS: Benefits Of Prone position , PEFR, SPO2 , Respiratory rate.

INTRODUCTION

Ageing has been defined as the gradual biological impairment of normal functions as a resultof changes made in cells and structural components in all the systems of human body.[1]The aging population is rapidly growing worldwide, with a significant increase in the number of young-old elders, individuals aged 65 to 74 years, who are particularly susceptible to respiratory ailments. [2]

Among the many facets of aging, respiratory health plays a pivotal role in determining the overall quality of life for older adults.The aging process is accompanied by alterations in lung function, cardiovascular dynamics, and overall body mechanics. While these changes are partof the normal aging trajectory, they can have a significant impact on an older individual's ability to perform daily activities and maintain an active lifestyle. Moreover, these age-related physiological changes can influence a person's response to various interventions, including body positioning.3[3]

The bony structure of the thorax ,the ventilatory muscles, the lung parenchyma, the pulmonary vasculature and the heart are affected by aging process.[2]Due to muscle imbalance and structural changes in the musculoskeletal system, there is increased stooped
posture spine, chest wall stiffening and reduced elastic recoil of the lung, along with sarcopenia affects the respiratory muscle performance.[4]All this leads to static air trapping, increased work of breathing and reduces person's overall pulmonary functions including chestexpansion and peak expiratory flow rate.[4]

Lung function of our body is varied by the position of the body which in turn is influenced bygravity. [4]The combined effect of gravity on lungs, heart and peripheral circulation helps in establishing normal oxygen transport. [4]The use of body position is to enhance arterial oxygenation, reduce the work of breathing in patients with cardiopulmonary dysfunction,increase tidal volume and lung compliance. [4]

There are two common variants of prone position :-

-Prone abdomen restricted (refers to lying prone with abdomen in contact with the bed)

-Abdomen free (patients hips and chest are elevated so abdomen is free).[4]

In recent years, there has been a lot of interest in using a special way of positioning patientsin hospitals. This position is called "prone positioning," and it involves placing a patient face-down. It can help improve breathing in people who have trouble with their lungs. Prone positioning is especially important for patients with a severe lung problem called acute respiratory distress syndrome (ARDS) and others who have difficulty getting enough oxygen into their bodies.[5]

The prone position during respiration may not significantly alter chest wall and respiratory mechanics, but it does bring about crucial changes that impact lung function. Notably, it increases Functional Residual Capacity (FRC) by affecting diaphragm function, with reducedcompliance in the coastal and anterior regions. Additionally, being prone reduces the compression of lung tissue by the heart, enhancing ventilation and gas exchange. Improved gas exchange in this position results from a combination of factors, including increased FRC,reduced compression behind the heart, and better ventilation-perfusion matching due to moreuniform lung density. This positioning also provides added support to the ventral chest wall, making regional compliance more even and reducing the pleural pressure gradient between dependent and non-dependent lung regions. These combined effects make the prone position valuable in clinical settings, especially for patients with compromised lung.

While much research has focused on the effects of prone positioning in specific medical conditions, such as acute respiratory distress syndrome (ARDS) or ventilator management, few studies have examined its influence on the aging population, particularly in those without pre-existing respiratory or cardiovascular diseases. By studying this specific demographic, weaim to elucidate whether prone positioning can offer benefits or pose challenges to older adults who are aging healthily.[5]

NEED OF STUDY

Due to the effect of aging on the respiratory system, lung capacity declines. These changes can result in symptoms such as tiredness and shortness of breath. These changes can also leave an elderly at risk of respiratory infections like pneumonia, bronchitis. So there is a need to find out if positioning in prone is helpful in young oldage groups to slow down the effect of aging on lungs, with better chest expansion and less work of breathing.

- Many studies have been done to see various body positioning effects on mechanical ventilation, Covid-19 patients & ARDS patients. However, no such study is done to evaluate the effect of prone positioning on respiratory function among geriatric population.
- Therefore, there is a need to find out the effect of prone positioning on Respiratory rate,peak expiratory flow rate among young old elderly population.

AIM

To study the effects of prone positioning on Respiratory Rate and Peak Expiratory FlowRate in young-old elderly

OBJECTIVE

To assess the effects of prone positioning on :

-Respiratory Rate

-Peak Expiratory Flow Rate in young-old elderly.

HYPOTHESIS

- **ALTERNATE HYPOTHESIS-** There is an effect of prone positioning on RespiratoryRate, Peak Expiratory Flow Rate in young-old elderly.

- **NULL HYPOTHESIS-** There is no effect of prone positioning on RespiratoryRate, Peak Expiratory Flow Rate in young-old elderly.

METHODOLOGY

Study Design- Experimental study
Sampling Design- Convenience sampling
Sample Size- n= 70
Study Set-up- LTCOP OPD, Girija Old Age Home (Kharghar, Navi Mumbai)
Inclusion Criteria- Young-old individual with age 60-75 years.
-Both males and females are included.
-Patients with no history of respiratory diseases within 6 months before study.
-Individual with the ability to understand the purpose of study,
-Voluntary concern about participation.
Exclusion Criteria- Any recent fracture of the Rib Cage.
-Individuals suffering from any type of Obstructive or Restrictive lung disease.
-Major ENT, ophthalmic and cervical spine surgeries.

-Major Neurological or Neuromuscular disorder
-Uncontrolled Hypertension.
- Obesity

PROCEDURE

- Ethical clearance was obtained from the institutional Ethics Committee of TMV'sLokmanya Tilak College of Physiotherapy, Kharghar.
- The purpose and procedure of the research were clearly explained to the participants,and written consent was taken.

Geriatric population screening was carried out after obtaining their consent. Then thepeople falling in the inclusion criteria were chosen.

- The demographic details, comorbidities, and information regarding the current medication of the participants were collected.
- The age group of subjects taken was between 60-75 years.

- Pre-intervention measurements were taken in the prone position (prone abdomenrestricted position) which includes RR, Spo2 and PEFR.
- After that 20-25 minutes of prone-positioning was given.

- Participants were monitored throughout the procedure for any discomfort like pain,breathing difficulty or inability to tolerate the position.
- If the person feels discomfort, the procedure is discontinued at that moment

- Post-intervention measurements were taken in the prone position (prone abdomen restricted position), were noted and data was analysed.
- In this segment of the study, patients were comfortably seated in a chair for the measurement of their resting respiratory rate. The assessment was conducted using a stopwatch, which allowed for the counting of the number of breaths a patient took in one minute. To enhance the accuracy of the measurement, the procedure was performedmultiple times, typically ranging from 2 to 3 repetitions. This repetition helped accountfor any variations in breathing rates, ensuring a more precise assessment of the patient'sresting respiratory rate.
  - For the measurement of Peak Expiratory Flow Rate, patients were seated in a chair.

To measure their peak expiratory flow rate, specific equipment was employed, including a mouthpiece and a PEFR machine. The procedure was carefully explained and demonstrated to each patient. They were instructed to take a deep breath and then blow into the mouthpiece with maximum force. This measured their peak expiratory

DATA ANALYSIS AND RESULTS

This experimental study explores the impact of prone positioning on the respiratory well-being of the young-old elderly population, focusing on key parameters: Respiratory Rate (RR), Peak Expiratory Flow Rate (PEFR), and Oxygen Saturation (SPO2), Systolic and Diastolic Blood Pressure (BP), Heart Rate (HR). Seventy participants who met specific inclusion criteria were enrolled. Baseline measurements were collected for RR, PEFR, SPO2, HR and BP revealing initial means of 28.26, 213, and 97 respectively. Subsequently, each participant assumed a supervised prone- lying position for 20-25 minutes while their SPO2 levels were meticulously monitored. Post-intervention, participants transitioned to a seated position and their RR, PEFR, SPO2, HR and BP were reassessed.

1. Respiratory Rate (RR): The data from Table 1 and Graph 1 reveal a statistically significant decrease in mean respiratory rate after the intervention. The mean RR decreased from 28.26 before the intervention to 27.36 after the intervention ($p = 0.000$). This suggests that prone positioning has the potential to reduce respiratory effort and improve respiratory efficiency among the young-old

elderly population. The decrease in respiratory rate indicates that participants might have experiencedimproved ventilation and lung function.

Table 1: Comparative assessment of respiratory rate before and after intervention

Group	N	Mean	SD	T- value	p-value
Pre RR	70	28.3	30.3	0.3	0.005*
Post RR	70	27.4	37.3		

Test applied: Paired t test, RR=Respiratory rate, SD= Standard deviation, *indicates statistically significant difference

Graph 1: Comparative assessment of respiratory rate before and after intervention

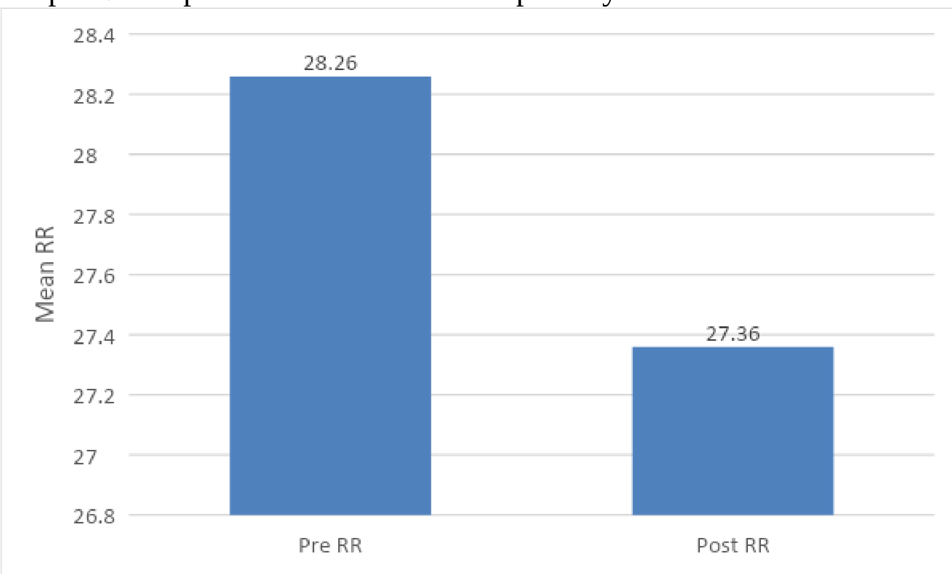


Table 1 and Graph 1 show a significant (p=0.000) decrease in mean Respiratory rate after intervention. The mean Respiratory rate of the study population before and after interventionwas 28.26 ± 30.34 and 27.36 ± 37.25 respectively.

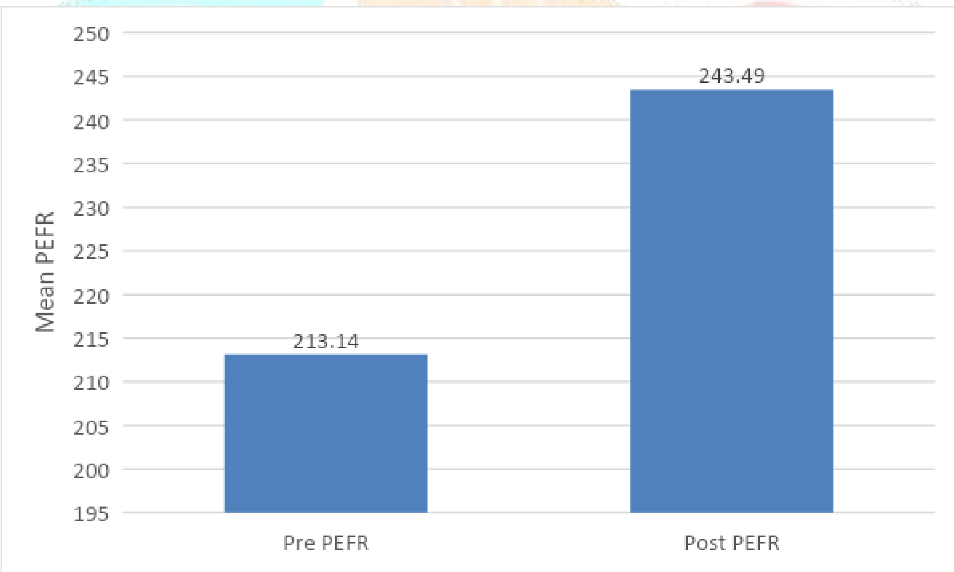
2. Peak Expiratory Flow Rate (PEFR): From Table 2 and Graph 2, it's evident that there is a significant increase in mean peak expiratory flow rate following the intervention. The mean PEFR increased from 213.14 to 243.49 (p = 0.000). This result suggests that prone positioning positively affects airway patency and expiratory flow, which could indicate betterlung function and reduced airway resistance. The increase in PEFR implies improved expiratory effort and air movement during exhalation.

Table 2: Comparative assessment of PEFR before and after intervention

Group	N	Mean	SD	T-value	p-value
Pre PEFR	70	213.14	65.41	11.939	<0.001*
Post PEFR	70	243.49	73.08		

Test applied: Paired t-test, RR=Respiratory rate, SD= Standard deviation, *indicates statistically significant difference

Table 2 and Graph 2 show a significant (p=0.000) increase in mean PEFR after intervention. The mean PEFR of the study population before and after the intervention was 213.14 $\pm$ 65.41 and 243.49 $\pm$ 73.08 respectively.



Oxygen Saturation (SpO2): Table 3 and Graph 3 demonstrate a significant increase in mean oxygen saturation after the intervention. The mean SpO2 rose from 97.33 to 98.31 (p =0.000). This finding suggests that prone positioning could enhance oxygen transport and utilization, leading to improved blood oxygenation. The increase in SpO2 reflects enhanced respiratory gas exchange, which is for overall physiological functioning.

Table 3: Comparative assessment of SpO2 before and after intervention

Group	N	Mean	SD	T	p-value
Pre SpO2	70	97.33	1.21	-7.911	0.000*
Post SpO2	70	98.31	0.84		

Test applied: Paired t test, SD= Standard deviation, *indicates statistically significantdifference

Graph 3: Comparative assessment of SpO2 before and after intervention

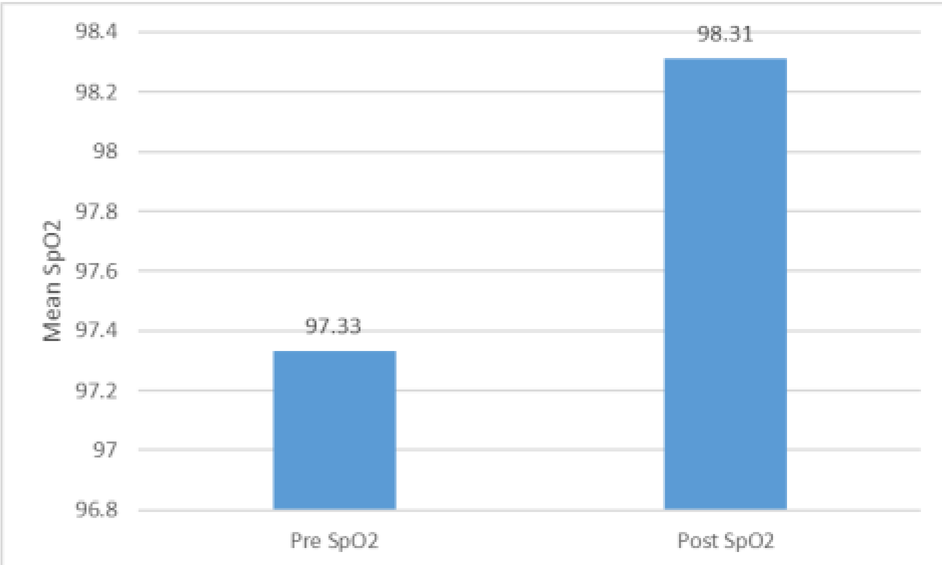


Table 3 and Graph 3 shows a significant (p=0.000) increase in PEFR mean SpO2 afterintervention. The mean SpO2 of the study population before and after intervention was 97.33 ± 1.21 and 98.31 ± 0.84 respectively.

Analysis of the data demonstrated noteworthy findings. After the prone positioning, there wasa marginal decrease in RR with a mean of 27.36, indicating a potentially positive impact on respiratory rhythm. Notably, the PEFR exhibited a noteworthy average increase of 30 units, reaching 243, potentially signifying improved airway clearance. Moreover, the average SPO2level post-intervention showed a minor rise to 98.31, suggesting enhanced oxygen saturation.

The findings collectively indicate that prone positioning has a positive impact on respiratory parameters among the young-old elderly population. The improvements in respiratory rate, peak expiratory flow rate, and oxygen saturation following the intervention suggest that pronepositioning can potentially enhance respiratory efficiency, lung function, and oxygenation in this demographic. These results align with the hypothesis that altering body positioning can influence respiratory outcomes, especially in individuals susceptible to age-related changes in lung function.

DISCUSSION

This experimental study focuses on comparing the effects of prone positioning on respiratory rate, peak expiratory flow rate, SPO2, blood pressure and heart rate in a healthy young-old elderly population. It has been found that prone positioning has shown a positive effect on theseparameters.

Prone positioning has a reduction in the respiratory rate after maintaining the position for 20- 25 minutes. This effect was seen due to improved lung expansion, improved breathing and decreased breathlessness.

There is improved lung expansion as proning reduces ventro-dorsal trans-pulmonary pressuredifferences and lung compression by the heart and the diaphragm, resulting in lung perfusion improvement.[4]

The use of a prone position shows improved breathing as it enhances arterial oxygenation andreduces the work of breathing in patients with cardiopulmonary dysfunction. It increases arterial oxygen tension, tidal volume and lung compliance leading to augmented gas exchange.[4]

When a patient is in a prone position accessory muscles are in a relaxed position which helps to reduce the rate of respiration and reduces the work of breathing leading to reducedbreathlessness & also gravity helps to distribute the weight of the chest and abdomen more evenly across the lungs. This can lead to better lung expansion and improved ventilation in areas that may have been less ventilated when lying on the back. As a result, the body may sense that it is getting enough oxygen, and the respiratory rate may decrease because there is less need for rapid breathing.[4]

In this study, we have seen there is an increase in Peak Expiratory Flow Rate after maintaining a prone position for 20-25 minutes as there is improved airflow, enhanced diaphragmatic function and reduced airway resistance. The prone position helps to improveairflow as there is redistribution of lung tissue and improved lung expansion in the prone position can lead to improved airflow. This can result in a higher PEFR measurement, as thepatient may be able to expel air from their lungs more forcefully and efficiently.

As prone position increases arterial oxygen tension, tidal volume and lung compliance help toaugment gas exchange and reduce airway resistance.[4] It has a positive effect on respiratory function and oxygenation, which, in turn, can indirectly beneficially influence blood pressure.It improves lung function, when an individual is in a prone position, it can lead to better lung expansion, improved ventilation, and enhanced oxygenation. The weight of the chest wall and abdomen is distributed differently in the prone position, allowing for improved expansionof the posterior lung regions. This can lead to increased oxygen uptake by the lungs. prone position helps to increase Oxygenation, with improved lung function, there is a greater exchange of oxygen and carbon dioxide in the lungs. This results in higher oxygen levels in the bloodstream, which can positively affect oxygen delivery to the body's tissues, including the heart. Maintaining adequate oxygen levels in the body helps keep blood pressure stable and healthy.[2]

When oxygen levels are sufficient, the body does not need to compensate by increasing heartrate or constricting blood vessels, both of which can contribute to higher blood pressure.

Improved oxygenation also means that the heart and other organs are receiving the oxygen they need without excessive strain. This can lead to a more stable and normal blood pressureresponse during prone positioning. In healthy young-old and older adults, the effects on blood pressure due to improved oxygenation during prone positioning may be less pronounced because their baseline cardiovascular and respiratory systems are usually functioning well. Nonetheless, the positive influence of prone positioning on lung function and oxygenation can contribute to maintaining stable blood pressure levels in these individuals as well.[6]

There is a positive effect of prone positioning on heart rate due to improved oxygenation,decreased work of breathing and improved hemodynamics.

Prone positioning enhances oxygenation by optimizing lung function. In this posture, gravity assists in distributing the weight of the chest and abdomen more evenly across the lungs. Thisleads to improved ventilation in areas that may have been less ventilated when the patient wasin a supine position. Better ventilation results in improved oxygenation of the blood. When the blood carries more oxygen, the heart doesn't need to beat as quickly to deliver adequate oxygento the body's tissues. This leads to a more stable heart rate.[7]

Reduces the work of breathing as the prone position allows the diaphragm, the primary muscleresponsible for breathing, to work more efficiently. It can contract and expand more easily in this position. As a result, the effort required for each breath is reduced. When breathing is lessstrenuous, the heart rate tends to be more stable because it doesn't need to increase to compensate for the added respiratory effort.[7]

Being in the prone position also reduces the body's stress response. When patients are more comfortable and at ease, their heart rate tends to be more stable. Prone positioning can alleviatediscomfort associated with certain medical conditions and may contribute to a calmer physiological state.[8]

Prone positioning improved hemodynamics. It can improve blood flow and circulation, whichcan help maintain a stable heart rate. It reduces pressure on certain blood vessels and can optimize the body's overall blood flow dynamics, reducing the heart's workload.

CONCLUSION

The experimental study focusing on the effects of prone positioning in a healthy young-oldelderly population has provided valuable insights into its positive impact on various physiological parameters, including respiratory rate, peak expiratory flow rate (PEFR), oxygen saturation (SPO2), blood pressure, and heart rate.
Prone positioning demonstrated a notable reduction in respiratory rate, primarily attributed toimproved lung expansion, enhanced breathing efficiency, and decreased breathlessness. Thisposture's ability to redistribute pressure across the lungs and reduce ventro-dorsal trans- pulmonary pressure differences results in better lung perfusion and improved oxygenation.
The relaxed state of accessory muscles in the prone position further contributes to reducingrespiratory effort, ultimately leading to a lower respiratory rate.
Prone positioning has several good effects on the body. It helps with breathing, gets more oxygen into the body, and makes it easier to breathe without straining. This indirectly helps to keep the heart rate and blood pressure stable because the heart doesn't have to work toohard when there's enough oxygen.
Overall, the study shows that prone positioning is helpful for improving lung function and oxygen levels in the body. It can benefit a wide range of patients, from those with breathing problems to healthy individuals. This information is essential for doctors and nurses when taking care of patients and can be especially useful in situations where people need extra helpwith their breathing and overall health.

LIMITATIONS

- Sample Size and Generalizability: The study utilized a convenience sampling methodwith a relatively small sample size, which could limit the generalizability of the findings to a broader population of young-old elderly individuals.

- Setting: The study was conducted in a specific setting, which might not fully representthe diverse conditions and environments that this demographic experiences. This could affect the external validity of the results.

- Duration: The intervention was administered over a period of 20-25 minutes, whichmight not fully capture the potential long-term effects of prone positioning on respiratory parameters.

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