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Review Article

Impact of lateral positioning and soft tissue manipulation on oxygenation and haemodynamic parameters in paediatric patients on mechanical ventilation

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ABSTRACT

Acute respiratory failure remains an important cause of morbidity and mortality in pediatric patient in last few years. Great attention was paid to the effect of changes in pediatric patient position other than the supine position during mechanical ventilation. Respiratory tract infection is one of the major prevailing respiratory illnesses in pediatric population. Soft tissue manipulation and positioning have been recommended for several decades to have a positive effect on hemodynamic, better sleep-wake cycle, enhanced neuromotor development, reduced rate of nosocomial infection and thereby reduces mortality in hospitalized patient. There is no study done to date which has seen the combined effect of right and left lateral positioning and soft tissue manipulation on oxygen saturation (SaO_2) and hemodynamic parameters in Paediatric patients with respiratory failure. Hence to form an evidence-based protocol by combining positioning and soft tissue manipulation present study needed to be conducted.

Keywords: Respiratory failure, Lateral positioning, Soft tissue manipulation, Haemodynamic parameters, Mechanically ventilated, Paediatric patients

INTRODUCTION

Respiratory failure is a critical condition characterized by the lungs' inability to adequately exchange gases, resulting in insufficient oxygenation of the blood or accumulation of carbon dioxide. It can be classified into two main types: type 1 (Hypoxemic), marked by low oxygen levels (PaO_2<50 mmHg) and often associated with acute pulmonary conditions, and type 2 (Hypercapnic/ventilatory), characterized by elevated carbon dioxide levels (PCO_2>50 mmHg). Acute respiratory failure can also be categorized into type 3 (Peri-operative) and type 4 (Shock), each reflecting different underlying issues such as surgical stress or cardiovascular instability.[2]

Symptoms of respiratory failure include severe shortness of breath, drowsiness, fatigue, and cyanosis of the extremities.[2] Effective management of respiratory failure often involves advanced interventions like mechanical ventilation, but non-invasive techniques can also play a crucial role. Body positioning and soft tissue manipulation are two complementary approaches used to improve patient outcomes.

Body positioning aims to optimize oxygen transport and ventilation by using gravity to enhance lung function and reduce atelectasis. Proper positioning, such as lateral or supine flexion, can significantly improve SaO_2 and decrease respiratory distress. For paediatric patients, positioning may also impact developmental outcomes and physiological stability.[5,6]

Soft tissue manipulation therapy, including techniques like effleurage and petrissage, supports respiratory function by relaxing the muscles involved in breathing and promoting

overall well-being. This method has been shown to reduce heart rate (HR) and increase SaO_2 in various studies.[7,9]

Although both body positioning and soft tissue manipulation are individually beneficial, research on their combined effects is limited. Investigating this combination could offer a simple and effective strategy for improving respiratory status in paediatric patients, particularly in critical care settings. Developing standardized protocols for these interventions could enhance physiotherapy practices and the patient outcomes in the intensive care unit.

Table 1: Summary of studies conducted on mechanically ventilated patients given positioning and soft tissue manipulation as intervention.

Author, year	Objective	Design	Sample size	Method	Outcome measures	Results	Limitations
Elamoudy, 2022[19]	Effect of positioning on oxygenation and hemodynamic among patients on mechanical ventilation	Descriptive exploratory study	n=93, patients were included.	A structured interview questionnaire and patient assessment record were employed to collect data related to this study	HR blood pressure respiratory rate SaO_2	Semi-recumbent positioning optimizes oxygenation, while left lateral and semi-recumbent positions significantly affect HR and blood pressure	The study included individuals with various pathological, different age groups and smokers due to which results may be affected. So, there is need for conducting a more precise study
Elshiekh, 2020[16]	The effect of change in new-born's position during mechanical ventilation on oxygenation.	Cross sectional	n=82 new-borns were included.	Two study groups: group A placed in supine position for 16 hours and group B in prone position for 16 hours, readings were measured after 8 hours and after 16 hours.	Lung fuction PaO_2	They concluded that group with supine position had statistically significant decrease in tidal volume, partial oxygen tension and positive end expiratory pressure after 8 and 16 hours in supine group	Only used two postions out of porn position in difficult to be maintaned mechanically ventilated patients.other positions are need to explored.
Elsagh, 2019 [12]	The comparison of soft tissue manipulation and prone position on HR and blood SaO_2 level in preterm neonates hospitalised in neonate. Intensive care unit.	Randomized three group control trails	n=75 preterm infants were included.	3 groups: Position group laid in prone for 1 hr and HR and SpO_2 noted every 15 mins Soft tissue manipulation group, infants were soft tissue manipulation through stocking for 10 to 15 mins and then placed in no specific position for 1 hr and spO2 were checked every 15 mins. Control group underwent pulse oximetry every 15 mins for 1 hr with no intervention	HR SaO_2	They concluded that soft tissue manipulation and prone position reduces the HR and increases the SaO_2	Limitations of the study is large sample size is needed to investigate the effect of position on infant HR changes and only prone position is being studied

Continued.

Author, year	Objective	Design	Sample size	Method	Outcome measures	Results	Limitations
Punthmatharith, 2018[6]	The effects of positioning on respiratory rate, HR, and SaO_2 in preterm infants	Cross-over	n=62, preterm infants were included	3 groups were made, each group was comprised of 3 different positions, namely right lateral, right anterior oblique and prone. Sequence of positions was changed in each of three groups. Each position will be maintained for 180 min and all outcome measures were recorded before, immediately after, and 15, 30 ,45, 60, 120, 150, 180 min after each positioning	Respiratory rate HR SaO_2	They concluded that positioning showed normal ranges of HR, respiratory rate, and SaO_2 with no significant difference	Limitations of this study were that mechanically ventilated patients were excluded. Also, the study was conducted on limited condition of the infants
Patil, 2015[5]	The effect of supine lying, side lying and prone positioning on SaO_2, in mechanically ventilated patient, acute respiratory failure	Experimental	n=33, subjects diagnosed with respiratory failure were included	Subjects were placed in each position namely supine lying, side lying and prone position for 1 hr and reading of SaO_2, blood pressure, HR, respiratory rate taken at start and at end of each position	Blood pressure HR Respiratory rate	They concluded that prone position has significant effect on SaO_2 than side lying than supine	Limitation of the study was heterogeneous patient of pulmonary disease in patient with respiratory failure
Martina, 2015[7]	The effectiveness of soft tissue manipulation therapy on respiratory status among toddlers with lower respiratory tract infection	Pretest, post-test control group design	n=60, toddlers were included (divided into intervention group and control group)	Soft tissue manipulation will be performed for 5 min which consisted of 4 steps (Effleurage., petrissage, Kneading and stroking) twice a day for 3 days and control group received routine care every day	Nasal flaring chest reaction HR Respiratory rate	They concluded that soft tissue manipulation therapy Will be effective on respiratory status among toddlers with lower respiratory tract infections	Small size and Intervention will be performed for a smaller period

Effect of lateral positioning and soft tissue manipulation on lungs and haemodynamic variables in mechanical ventilated paediatric patients

Mechanical ventilation is a vital intervention for patients with compromised respiratory function, involving positive pressure breaths that can impact both lung function and hemodynamic stability. Mechanical ventilation can significantly affect hemodynamic by increasing intrathoracic pressure, which reduces cardiac preload and can impair cardiac output.[8] Effective management involves positioning along with careful monitoring of hemodynamic status.

There are several possible mechanisms as to why oxygenation and hemodynamic parameters has improved following lateral positioning and soft tissue manipulation. Lateral positioning, along with soft tissue manipulation therapy, have significant implications in paediatric patient care, particularly for those who are mechanically ventilated. These techniques can enhance respiratory function, promote hemodynamic stability, and improve overall patient comfort. While lateral positioning offers benefits such as improved lung recruitment and reduced airway obstruction, soft tissue manipulation therapy contributes to stress reduction and promoting better outcomes during hospital stays.[5-12]

Right and left lateral positioning benefits

Lateral positioning is crucial in paediatric care, enhancing access during surgeries and improving respiratory mechanics. It aids in lung recruitment and ventilation, particularly beneficial for children with respiratory issues like atelectasis, by increasing functional residual capacity and improving oxygenation. This position also supports appropriate airflow and reduces airway obstruction risks, especially in very low birth weight infants, and helps prevent complications such as positional asphyxia and impaired gas exchange that can arise from supine positioning.[9,10]

Soft tissue manipulation therapy in paediatric patients

Soft tissue manipulation therapy is an adjunctive treatment in paediatric care that helps reduce stress and anxiety, particularly in children undergoing medical procedures. It can alleviate pain, improve comfort, and enhance outcomes during interventions like intubation or surgery. Additionally, soft tissue manipulation has been shown to improve respiratory function and peripheral oxygenation, and when combined with lateral positioning, it can further enhance lung function and relaxation, leading to better clinical results.[7,9,11]

Integrating positioning and soft tissue manipulation

Combining right and left lateral positioning with soft tissue manipulation therapy can create a holistic approach to patient care. Implementing soft tissue manipulation techniques while transitioning a patient to or maintaining them in a lateral position can enhance relaxation and promote therapeutic effects on lung capacity and respiratory mechanics. This integrated approach can help mitigate anxiety, reduce agitation, and promote overall well-being in paediatric patients undergoing mechanical ventilation or surgical procedures.

Cross-disciplinary strategies that include positioning, soft tissue manipulation, and continuous monitoring should be emphasized to optimize patient outcomes and ensure the comfort of young patients in acute care settings. Comprehensive training for healthcare providers on both techniques could enhance the effectiveness of these interventions, thereby supporting better respiratory dynamics and contributing to favourable health results for paediatric patients undergoing treatment.

Need for comprehensive evidence

While existing studies provide insights into the benefits of body positioning and soft tissue manipulation therapy, further research is warranted to evaluate their combined effects explicitly.[2-11] Future clinical trials should focus on long-term outcomes associated with these interventions to establish comprehensive protocols that can be widely adopted in critical care settings.

CONCLUSION

The review highlighted the significant impact of body positioning and soft tissue manipulation therapy on the health outcomes of preterm infants and mechanically ventilated patients. Notably, soft tissue manipulation therapy was found to reduce HR and increase SaO_2 likely due to enhanced vagal activity. This suggests that soft tissue manipulation therapy may be a valuable supportive care intervention for hospitalized preterm infants, potentially improving their developmental outcomes and overall health. In terms of body positioning, the study observed significant effects on SpO_2 with bilateral side-lying positions, underscoring the importance of selecting and timing body positions to optimize both oxygenation and hemodynamic stability. For patients who are immobile, debilitated, or under mechanical ventilation, precise positioning becomes critical due to their heightened sensitivity to positional changes. The findings emphasize the need for a careful balance between enhancing respiratory function and maintaining stable hemodynamic parameters to achieve the best outcomes. Overall, these insights underline the broader benefits of supportive care interventions, including both body positioning and soft tissue manipulation therapy, in improving the health and development of vulnerable paediatric patient populations.

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