



Research Article

THE EFFECTS OF DIFFERENT POSITIONS ON PHYSIOLOGICAL MEASUREMENT AND PERFUSION INDEX IN PEDIATRIC INTUBATED PATIENTS

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Abstract: *The aim of this study is to determine the effects of four different body positions applied to pediatric intubated patients on physiological variables and perfusion index. The sample of this study, which was conducted as a quasi-experimental study in a single group in a pediatric intensive care unit, consisted of 44 intubated and monitored patients. The patients were given supine, right-lateral, left-lateral, and Semi Fowler positions at intervals of two hours, and each position's measurements were evaluated separately. In the analysis of data, number, percentage, mean, standard deviation, ANOVA, and post-hoc (Tukey HSD) tests were used. Fifty percent of the patients were under 1 year old, 56.8% were male, and the mean patient age was 20.61 ± 21.72 months. Peripheral oxygen saturation, systolic blood pressure, and perfusion index mean values in the supine and Semi Fowler positions given to the patient were found to be statistically significant ($p < 0.05$). It was determined that SPO₂, systolic blood pressure, and perfusion index values were higher in the semi-fowler position than in the other positions.*

Keywords: *position, pediatric intensive care, physiological parameter, perfusion index.*

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1. Introduction

Pediatric intensive care units (PICU) are units that include patients between the ages of 1 month and 18 who need critical care and require holistic nursing care with a disciplined approach [1]. To ensure patient safety and hemodynamic stability in these units, children are usually restrained and observed in bed-bound conditions. Ineffective position change and limited mobility may cause various vital problems, such as disruption of circadian rhythm, cardiovascular problems, delirium, pressure ulcer development, and ineffective respiratory pattern in the short and long term [2],[3]. Position changes of intensive care patients are among the independent functions and initiatives of nurses. The body position should be changed frequently in the bed to minimise damage from the effects of immobilisation and to ensure patient comfort during the treatment and care process [4]. Studies on the position changes of intensive care patients have reported effects on oxygenation, ventilator-associated pneumonia [5]. and the development of pressure sores [6]. Although supine and prone positions have different effects in mechanically ventilated patients, Ateş et al. (2021), in their study with patients diagnosed with Corona Virüs Disease 19 (COVID-19), stated that the supine and lateral positions, together with the prone position, affected compliance with the treatment [7]. Agustina et al. (2021) stated that the right-lateral position can increase oxygen saturation and respiratory rate based on their study of children under five years of age diagnosed with pneumonia [8]. Studies on position changes in pediatric intensive care units are relatively few, so more studies are needed to evaluate the effects of position changes [9]. Perfusion

index (PI) is the ratio of pulsatile blood circulation in peripheral tissue to non-pulsatile blood circulation measured by non-invasive pulse oximetry [10]. It is stated that changes in blood flow, physical conditions of the environment (such as temperature, coldness), and acid-base balance problems in critically ill patients may affect the peripheral perfusion index [10], [11]. Considering these situations, it is important to monitor the blood pressure, pulse, fever, respiratory rate, peripheral oxygen saturation (SPO₂), and perfusion index (PI) after different positions are taken to contribute to the development of more critical follow-up of pediatric patients and nursing care.

Purpose and Hypotheses

The main purpose of this study is to determine the effects of four different body positions applied to pediatric intubated patients on physiological variables and PI. Thus, the following hypotheses were created:

H1: Is there a difference between the physiological effects of different body positions of children on mechanical ventilators?

H2: Is there a difference between the perfusion index effects of different body positions of children on mechanical ventilators?

2. Material and Method

2.1. Study Design

The research was carried out as a quasi-experimental study in a single group.

2.2. Setting and Sample

The research was carried out in the paediatric intensive care unit of a tertiary hospital between September 2021 and January 2022. The sample size was determined as 44 patients with a 95% confidence interval and 0.05% significance level by G*power analysis. Patients who had parental consent and met the inclusion criteria were included in the study. The inclusion criteria were as follows: (1) children aged one month to 15 years, (2) patients who are intubated and followed up with monitoring, (3) patients without signs of acute respiratory distress syndrome (ARDS) or increased intracranial pressure (ICP) and (4) patients who did not have a medical problem that prevented them from being positioned. The exclusion criterion was (1) patients who were extubated during the study.

2.3. Data collection

Demographic data were recorded from patient files, and measurements were recorded via the monitor, pulse oximeter, and fever meter devices. Because the patients formed their own control group in the study, randomization was carried out through a simple random numbers table. From the random number in the selected block, patients who met the research criteria were placed in supine, right-lateral, left-lateral and Semi Fowler positions, with two hours between each position change, and blood pressure, pulse, fever, respiratory rate, SPO₂ and PI values were evaluated at the second hour after each position.

2.4. Evaluation of Data

Data were analyzed with SPSS package program 24. In the study, blood pressure, pulse, fever, SPO₂, and PI were accepted as dependent variables, whereas the supine, right-lateral, left-lateral, and Semi Fowler positions were considered independent variables. Number, percentage, mean, and standard deviation were used in the descriptive analyses. Post hoc (Tukey HSD) analysis was performed to determine the differences between physiological measurement and PI after the patient's position was given.

2.5. Limitations of the Research

The fact that the data of this study were collected from the same group provides reliability in terms of homogeneity. However, the limitation of the research is that the same person performed the application and measurement. The research results can be generalized to similar patient groups.

2.6. Ethical Statement

Before starting the research, approval was obtained from the ethics committee of the Health Sciences University Gazi Yaşargil Training and Research Hospital (Date: 03.09.2021, Number: 884). Necessary information was given to the parents of the patients, and their consent was obtained in line with their voluntary participation.

3. Results

The mean age of 44 children included in the study was 20.61 ± 21.72 months, the mean duration of being connected to a mechanical ventilator was 4.18 ± 3.39 days, and their mean weight was 9.32 ± 5.19 . In addition, it was determined that 50% of the children were under the age of 1, 56.8% were male, and 38.6% were diagnosed with respiratory diseases (Table 1).

Table 1. Introductory Characteristics and Clinical Information of Children

Feature		Number (n)	Percent (%)
Age	< 1 age	22	50
	1-5 age	17	38.6
	> 5 age	5	11.4
Gender	Female	19	43.2
	Male	25	56.8
Medical diagnosis	Respiratory diseases	17	38.6
	Cardiac diseases	9	20.5
	Metabolic diseases	7	15.9
	Neurological diseases	7	15.9
	Nephrological diseases	3	6.8
	Gastrological diseases	1	2.3
	X±SD	Minimum	Maximum
Intubation time (days)	4.18 ± 3.39	1	15
Age (month)	20.61 ± 21.72	1	80
Weight	9.32 ± 5.19	3.20	25

Vital signs, SPO2 saturation, and the perfusion index (PI) were measured in different positions of the children through at least three cycles two hours apart. The mean values of the post-position values were compared. There were statistically significant differences between the positions in the mean values of SPO2 saturation ($p=0.000$), systolic blood pressure ($p=0.007$), and perfusion index ($p=0.000$) (Table 2).

Table 2. Comparison of Vital Signs and Perfusion Indices of Different Positions of the Children

	Supine X±SD	Left lateral X±SD	Right lateral X±SD	Semi Fowler X±SD	P value
O ₂ saturation*	91.88 ± 4.78	94.93 ± 4.36	94.70 ± 4.35	96.72 ± 3.75	.000
Blood pressure (systole)*	92.70 ± 13.76	91.77 ± 13.59	92.04 ± 17.42	100.95 ± 12.03	.007
Blood pressure (diastole)	54.31 ± 7.76	52.93 ± 7.09	52.52 ± 11.91	56.52 ± 6.92	.130
Pulse	138.38 ± 22.84	138.00 ± 22.25	137.72 ± 24.24	139.93 ± 21.71	.970
Fever /Temperature	36.71 ± .48	36.77 ± .45	36.75 ± .49	36.77 ± .40	.945
Respiratory rate	32.75 ± 9.48	33.20 ± 9.82	32.95 ± 9.43	33.40 ± 10.45	.990
Perfusion index*	.81 ± .52	1.08 ± .92	.80 ± .51	1.50 ± .85	.000

*: Tukey test, one of the post hoc tests, was studied.

There was a statistically significant difference between the mean values of the supine position and the right lateral (p =0.014), left lateral (p=0.006), and Semi Fowler (p=0.000) positions for SPO2 saturation, but for the right lateral, left lateral, and Semi Fowler, there was no significant difference between the positions. There was a statistically significant difference between the mean values for blood pressure in the Semi Fowler, right lateral (p=0.021), supine (p=0.038), and left lateral (p=0.016) positions, but for the right lateral, left lateral, and supine positions, there was no significant difference. For the PI, there was a statistically significant difference between the mean values taken in the semi fowler, right lateral (p=0.000), supine (p=0.000), and left lateral positions (p=0.043), but there was no significant difference between the right lateral, left lateral, and supine positions (Table 3).

Table 3. Differences in O₂ Saturation, Blood Pressure (Systole), and the Perfusion Mean according to Positions (post hoc/Tukey HSD)

Variables	Position (i)	Supine	Left Lateral	Right Lateral	Semi Fowler
O ₂ saturation	Right Lateral	.014	.995		.130
	Supine		.006	.014	.000
	Left Lateral	.006		.995	.214
	Semi Fowler	.000	.214	.130	
Blood pressure (Systole)	Right Lateral	.996	1.000		.021
	Supine		.990	.996	.038
	Left Lateral	.990		1.000	.016
	Semi Fowler	.038	.016	.021	
Perfusion Index	Right Lateral	1.000	.259		.000
	Supine		.307	1.000	.000
	Left Lateral	.307		.259	.043
	Semi Fowler	.000	.043	.000	

4. Discussion

This study was conducted to evaluate the effects of different positions on the physiological parameters and perfusion index in intubated children. Although 88.6% of the children in the study were in the 0-5 age range, more patients were diagnosed with respiratory diseases (Table 1). Therefore, the demographic data of the study are similar to those in the literature [8],[12]. Thijsen et al. (2019) stated in their study that the accuracy of pulse oximetry in predicting arterial oxygenation, as well as moderate and increased perfusion index values, contributed little [12]. As a result, the parameters obtained during the position change may differ according to the type of position [12].

In this study, the mean values of SPO₂, systolic blood pressure, and PI were significantly higher in the semi-fowler position (Table 2). Augustina et al. (2021) reported that the right lateral position increased the SPO₂ value in children with pneumonia. Tor et al. (2019) did not detect any difference in systolic blood pressure values in the measurements they made in the supine and semi-fowler positions in intensive care patients. Emerson and Banasik (1994) emphasized in their study that different positions cause significant changes in systolic and diastolic blood pressure [11]. Thijsen et al. (2019) found PI < 1 at a rate of 52.8% in their study on intensive care patients. Based on these studies, it can be concluded that there is no consensus in the literature [12].

In the study, the SPO₂ value in the supine position and the systolic blood pressure and PI value in the semi-fowler position differed from the other positions (Table 3). In line with these data, it is evaluated that hemodynamic measurements can be made safely with the head of the bed at 45°, without placing the patients in the supine position of 0° [13].

Göcze et al. (2013), in their study with patients connected to mechanical ventilators, reported that their central venous pressure changed, arterial blood pressure decreased, and oxygen saturation was significantly reduced in the third-minute measurements of the semi-fowler position compared to different positions in which they placed the patients [14]. Brindle et al. (2013) stated that the hemodynamic parameters return to normal after five to ten minutes in different positions [15]. The difference in research findings may be due to the difference in measurement times. Tapar et al. (2018) stated that different body positions might affect the PI. Based on the literature, it can be concluded that the choice of the various positions is not made within the framework of a standard protocol [16].

5. Conclusion

It is important to evaluate the effectiveness of the positions applied to patients for critical patient follow-up in pediatric intensive care units [9]. Studies in this area are controversial [13], [14], [15]. When positioning patients by nurses, it will be beneficial to choose positions that allow comfortable breathing, do not increase pain, minimize the risk of aspiration, position the transducer correctly, and consider patient comfort. In addition, during treatment and care practices, for example, It is recommended to plan new studies that will investigate the effects of different positions given to patients in the operating room, during postural drainage, on hemodynamic measurements and create evidence for nursing practices [13].

This study determined that the systolic blood pressure, SPO₂, and PI values of the Semi Fowler position, in which patients are placed in two-hour cycles, are significantly higher than the supine, right lateral, and left lateral positions. According to these data, it can be concluded that the Semi Fowler position is more effective in pediatric patients with mechanical ventilator support. When nurses position patients, it is beneficial to pay attention to their respiratory, pain-free, and patient comfort. In addition, to create standard care recommendations in the literature, it is recommended to conduct studies in different patient groups, with repeated and different measurements at different time intervals.

Ethical Statement:

Before starting the research, approval was obtained from the ethics committee of the Health Sciences University Gazi Yaşargil Training and Research Hospital (Date: 03.09.2021, Number: 884). Necessary information was given to the parents of the patients, and their consent was obtained in line with their voluntary participation.

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Conflict of Interests:

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Authors' Contributions:

All authors contributed as follows:

E.T: Conceptualization, Methodology, Resources, Investigation (%40).

M.T: Conceptualization, Methodology, Formal analysis, Writing - Original draft preparation (%35).

G.B: Conceptualization, Methodology, Formal analysis, Writing - Original draft preparation (%25).

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