International Journal of Psychosocial Rehabilitation, Vol. 25, Issue 02, 2021
ISSN: 1475-7192

Short-term Effect of the Semirecumbent Position on Oxygen Saturation and Respiration Rate in Pediatric with Oxygenation Problem

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ABSTRACT

Objective: Oxygen is a basic physiological need for the survival of human life. Pediatric patients with oxygenation problems need an ideal position to promote necessary oxygen saturation and normal respiration rate. This study aims to identify the effect of semi recumbent position on the oxygen saturation and respiration rate of pediatric patients with oxygenation problem.

Method: The study design was a quasi-experimental with a pre-posttest control group design. Forty pediatric patients with oxygenation problems were selected using consecutive sampling and divided into two groups: semi recumbent (n=20) and control (n=20). Statistical analysis was conducted using the Wilcoxon test, Paired t-test, and Mann-Whitney test.

Results: A significant difference in the oxygen saturation level was found in the semi recumbent group after 1 hour of semi recumbent positioning. There was no significant difference in the respiration rate before and after intervention in the two groups after 1 hour of positioning.

Conclusions: The semi recumbent position can be applied to improve the oxygenation status of pediatric patients with oxygenation problem in a short-term period. Nurses should teach the family how to position pediatric patients with oxygenation problem during their hospitalization.

Keywords: *Oxygenation problem, pediatric, semi recumbent, oxygen saturation, respiration rate*

INTRODUCTION

Oxygen is a basic physiological need for the survival of human life. Oxygen needs is related to the function of air circulation in the human body. Oxygen needs are related to the cardiovascular system, the circulation system and the respiratory system. Problems of

respiratory system both acute and chronic can be the cause of death in pediatric (Bowden & Greenberg, 2011). Problem with respiratory system is a major problem that requires nurses attention in providing care for both neonates, children and adolescents. Infections of respiratory system are the most frequent cause of child need of hospital care and are a major cause of child mortality (Kemenkes, 2011). Respiratory system disorders can be mild to severe, can be non-acute (such as sales), become acute (such as bronchiolitis, pneumonia) and chronic (such as asthma) and can even be a life-threatening condition (such as epiglottitis) (Kyle, 2008). Pediatric patients with oxygenation problem need treatment at the hospital. One of nursing interventions for this case is positioning.

Position is a posture or posture assumed by the patient for comfort and facilitates diagnostic procedures, surgery and therapeutic procedures (Shah, Desay & Gohil, 2012). Body posture is a geometric arrangement of body parts related to other body parts (Jones & Gray, 2005). Positioning is considered to have an effect on the functioning of the human body and affects various disease conditions. This is related to lung and the effects of gravity which will affect the functioning of the human body (Du Fan, Benoit, & Girardier, 2004). Setting the position of the body to optimize cardiopulmonary function and oxygen transport is different from the general regulation of body position. The body positions which stimulates the normal physiological effects of gravity and changes in position on oxygen transport are upright (Shah, Desai & Gohil, 2012). One type from an upright position is a 45 degree semi-upright position or commonly called a semi recumbent position (Mentheny & Frantz, 2013).

The semi recumbent position is the upright position of the head and chest at a 45 degree angle (Gocze et al., 2013). This position maintains comfort and facilitates the patient's respiratory function (Hockenberry & Willson, 2011). Several studies have been conducted to assess the benefits of semi recumbent position in patients. Research conducted by Beers and Von (2014) concluded that the semi recumbent position of 45 degrees was considered to have a rapid effect in increasing oxygenation in the blood and decreasing end-tidal carbon dioxide. The semi recumbent position is easy, safe and effective in patients with mechanical ventilation, as well as prevents ventilator-associated pneumonia (VAP) by reducing the occurrence of gastro esophageal reflux. The semi recumbent position compared to the supination position is considered to be more effective in reducing the occurrence of gastro esophageal aspiration (Du Fan, Girardier, & Benoit, 2004). Upright and semi upright positions have a significant influence in increasing lung volume (Richard, & Lefebvre, 2011). Positioning strategies can

be implemented without additional maintenance costs and have a low risk of complications (Richard, & Levebvre, 2011; Robak, Schel, Bajic, Laczika, Locker, & Staudinger, 2011). Positioning in pediatric patients with oxygenation problems has not been the focus of nursing and has not been optimally implemented in the infectious care room. Therefore, it is necessary to do research on the effect of semi recumbent position on the respiratory function assessed through oxygen saturation and respiration rate in pediatric patients with oxygenation problems.

METHODE

This research is a quasi experimental study with a pre-post control design. The population is pediatric patients who experience oxygenation problems. Samples were taken by consecutive sampling with inclusion criteria for pediatric patients with oxygenation problems, yellow NEWSS, obtaining nasal cannula oxygen therapy, and having no contraindications to position regulation (fracture, postoperative and bed rest instructions due to treatment), while the exclusion criteria were pediatric who experienced deteriorating conditions during the study. Sample was divided into the semi recumbent group and the control group. Each group consisted of 20 children so that a total of 40 children participated in this study. The semi recumbent group was given semi recumbent position, while the control group was given position according to hospital policy (low fowler 15-30 degrees). The expected outcome is improved oxygenation status of signed by increased oxygen saturation and decreased respiration rate. The study was approved by Research Ethics Board of University. Written consent was obtained from participants. Oxygen saturation was measured using oxymetry and respiration rate was measured using the observation and watch methods. Oxygen saturation measurements and observation of respiration rate were carried out in 2 days, before treatment (pre test) and after 1 hour (posttest) of each intervention. The measurement was taken again on the second day to add data validation. Data was analyzed using the Wilcoxon test, Paired t test and Mann-Whitney test to compare the two groups.

RESULTS

The characteristics of the respondents seen in this study were age, gender, oxygen use and medical diagnosis. Data on respondents' characteristics consisted of numerical data, namely age and amount of oxygen use, while categorical data were gender, medical diagnosis and the duration of semi recumbent positioning. The average age in the control group was 29.1 months (3-132; 95% CI: 11.42-46.78), the youngest age in the control group was 3 months

and the oldest age was 132 months. While in the semi recumbent group the youngest age is 4 months and the oldest age is 85 months. Oxygen therapy used in both the semi recumbent and control groups is using nasal cannula with a speed of 0.5 to 3 liters per minute. The mean oxygen therapy used in the control group was 0.86 liters per minute, while in the control group it was 0.63 liters per minute. In the semi recumbent group 55% of the respondents were female, while the control group was 85% male. The medical diagnosis in both groups was mostly community acquired pneumonia. Oxygen saturation of respondents in the two groups is presented in table 1 below.

Table 1

Oxygen Saturation of Respondents in Semi Recumbent and Control Group **(n= 40)**

No	Group	n	Median	Min-Maks	Mean	SD	95% CI
1.	**Semi recumbent group**						
	Pre	20	**98**	**90-100**	96,2	3,25	94,68-97,72
	After 1 hours	20	**98**	**91-99**	97,55	2,56	96,35-98,75
	Day-1	20	**98**	**92-99**	97,45	1,96	96,53-98,37
	Day-2	20	**98**	**92-99**	97,5	1,85	96,63-98,37
2.	**Control group**						
	Pre	20	**98**	**88-99**	96,5	3,09	95,06-97,94
	After 1 hours	20	**98**	**89-99**	97,4	2,64	96,16-98,63
	Day-1	20	**98**	**90-99**	97,1	2,29	96,03-98,17
	Day-2	20	**98**	**92-99**	97,5	1,79	96,61-98,29

Table 1 showed that the median oxygen saturation before intervention was 98 (90-99; 95% CI: 94.68-97.72) in the semi recumbent group and 98 (88-99; 95% CI: 95, 06-97,94) the control group. While after 60 minutes, the median oxygen saturation was 98 (91-99; 95% CI: 96.35-98.75) in the semi recumbent group and 98 (89-99; 95% CI: 96.16-98, 63) in the control group. Oxygen saturation in pediatric patients with oxygenation problems treated ranges from 88–100 percent with cannula nasal oxygen administration. In the semi recumbent group and the control group there was an average decrease in respiration rate after positioning.

Table 2

Respiration Rate of Respondents in Semi Recumbent Group and Control Group **(n= 40)**

No	Group	n	Median	Min-Maks	Mean	SD	95% CI
1.	**Semi recumbent Group**						
	Pre	20	40	22-60	**40,3**	**11,36**	34,98-45,62
	After 1 hours	20	40	23-58	**40,7**	**11,05**	35,53-45,87
	Day-1	20	36	24-56	**36,5**	**7,45**	33,01-39,99
	Day-2	20	36	22-46	**35,8**	**6,74**	32,65-38,95
2.	**Control Group**						
	Pre	20	40	28-64	**40,45**	**8,49**	36,48-44,42
	After 1 hours	20	39	30-52	**38,7**	**6,13**	35,83-41,57
	Day-1	20	37	28-42	**37**	**4,66**	34,82-39,18
	Day-2	20	37	28-50	**37,2**	**5,08**	34,82-39,57

Table 2 showed, the average respiration rate before intervention in the semi recumbent group was 40.3 (SD; 11.36) and in the control group was 40.5 (SD; 8.49). While after 60 minutes, there was an increase in the average of respiration rate in the semi recumbent group and a decreased in the average of respiration rate in the control group. In the semi recumbent group and the control group there was an average decrease in respiration rate after the positioning on day 1 and day 2.

Analysis on the differences between the oxygen saturation and comfort level of the semi recumbent group and that of the control group aimed to equate the analysis of oxygen saturation and respiration rate before and after the intervention. The variance homogeneity test and the normality test of the data were carried out prior to bivariate analysis. The homogeneity test using Levine test showed that respondents' age, oxygen saturation and respiration rate before the intervention had the same variance in both groups. The result of normality test using Shaphiro-Wilk analysis indicated that data of oxygen saturation both before and after the intervention was not normally distributed ($p < 0.05$), while data of the respiration rate data was normally distributed ($p > 0.05$). Wilcoxon test was used to analyzed not normally distributed data and paired t-test was used to analyzed the normally distributed data in this study. Mann Whitney test was used in this study to analyzed the differences in the

two groups of respondents. The result of Wilcoxon test on the oxygen saturation of the two groups was shown in table 3.

Table 3

Analysis of Differences in Oxygen Saturation of Semi Recumbent Group and Control Group **(n=40)**

No		n	Mean	SD	p value
1.	**Semi Recumbent Groups**				
	Before-	20	96,20	3,25	**0,01***
	After 1 hours	20	97,55	2,56	
	Before-	20	96,20	3,25	**0,009***
	Day-1	20	97,45	1,96	
	Day-1-	20	97,45	1,96	0,705
	Day-2	20	97,50	1,85	
2.	**Control Groups**				
	Before-	20	96,5	3,09	**0,011***
	After 1 hours	20	97,4	2,64	
	Before-	20	96,5	3,09	0,199
	Day-1	20	97,1	2,29	
	Day-1-	20	97,1	2,29	0,117
	Day-2	20	97,5	1,79	

***p value < 0,05**

According to table 3, Wilcoxon test showed that there was a significant difference after 1 hour and after 1 day of semi recumbent position. In control group there was a significant difference in the oxygen saturation after 1 hour of low fowler position. The results also showed no significant difference of oxygen saturation between the control group on day 1 and day 2. The result of paired t test on the respiration rate of the two groups was shown in table 4 below.

Table 4

Analysis of Differences in Respiration Rate of Semi Recumbent Group and Control Group **(n=40)**

No		n	Mean	SD	p value
1.	**Semi Recumbent Group**				
	Before-	20	40,3	11,36	0,713

	After 1 hours	20	40,7	11,05	
	Before-	20	40,3	11,36	**0,025***
	Day-1	20	36,5	7,45	
	Day-1-	20	36,5	7,45	0,320
	Day-2	20	35,8	6,74	
2.	**Control Group**				
	Before-	20	40,45	8,49	0,073
	After 1 hours	20	38,7	6,13	
	Before-	20	40,45	8,49	**0,028***
	Day-1	20	37	4,66	
	Day-1-	20	37	4,66	0,875
	Day-2	20	37,2	5,08	

***p value < 0,05**

Paired t test statistical test showed that there was a significant difference in respiration rate in semi recumbent group and control group after 1 day positioning, while after one hour no differences were found.

Table 5

The Results of Mann Whitney Test on the Different Value of Oxygen Saturation and Respiration Rate between Semi Recumben Group and Control Group **(n=40)**

Variabel	**Groups**	**n**	**Mean**	**SD**	**P value**
Oxygen saturation after 1 hour	Semi Recumbent-	20	97,55	2,56	0,856
	Control	20	97,4	2,64	
Respiration rate after 1 hour	Semi Recumbent-	20	40,7	11,05	0,483
	Control	20	38,7	6,13	
Difference in oxygen saturation	Semi Recumbent-	20	1,35	2,21	0,447
	Control	20	0,90	1,41	
Difference in frequency of breath	Semi Recumbent-	20	-0,40	4,79	0,346
	Control	20	-1,75	4,13	

Table 5 showed no significant differences in oxygen saturation and respiration rate after 60 minutes between the semi recumbent and control groups.

DISCUSSION

Positioning is considered to have an effect on the functioning of the human body and affects various disease conditions. This is related to lung development and the effects of gravity which will affect the functioning of the human body (Du Fan, Benoit, & Girardier, 2004). In the supine position, ventilation and perfusion are more on dependent the lungs than in the anterior region of the lung. In healthy lungs, balanced ventilation and perfusion (V/Q) can be achieved in the supine position. However, in patients with lung disease, for example in patients with excess accumulation of lung fluid associated with pulmonary edema there can be disruption of gas diffusion in the alveolar capillary membrane if patients placed in a supine position for a long time (Johnson & Meyenburg, 2009). So it is necessary to find the right position in pediatric patients with oxygenation problems.

The results showed that oxygen saturation in pediatric patients with oxygenation problems ranged from 88–100 percent with cannula nasal oxygen administration. In the semi recumbent group after one hour of intervention, there were 11 respondents with increased oxygen saturation, 6 respondents with no alteration of oxygen saturation and 3 respondents with decreased oxygen saturation. In control group, 8 respondents with increased oxygen saturation and 12 respondents with no alteration of oxygen saturation. Research conducted by Dimitriou, Greennough, Pink, McGhee, Hickey and Rafferty (2002) compared oxygen saturation and respiratory muscle strength in infants aged 2-11 months between supination positions, supination with 45 degrees elevation and pronation position. The results showed that oxygen saturation experienced a significant increase in the pronation position and supination position with a 45 degree elevation. Maximum inspiration pressure increases in the supination position and supination position with a 45 degree elevation compared to the pronation position. Significant oxygenation increase in the supine position with a 45 degree elevation is associated with a reduction in the frequency of hypoxemic periods in infants.

The study results indicate that the average oxygen saturation has increased more in patients with semi recumbent positions. Toddlers with pneumonia usually experience disruption in the ventilation process caused by a decrease in lung volume and pulmonary parenchymal abnormalities. As a result of reduced ventilation, the optimal ratio between perfusion ventilation is not achieved, which is called ventilation perfusion mismatch (Asih, Landia & Makmuri, 2006). To overcome ventilation disorders due to decreased lung volume, the body will try to compensate by increasing the tidal volume and frequency of breathing that is clinically seen as tachypnea and dyspnea with inspiratory effort signs. Semi recumbent positioning will increase the ability of the diaphragm to expand (increase compliance), this

will have an impact on more uniform chest wall movements and ventilation can be well distributed which result in increased perfusion ventilation balance and will directly increase oxygenation (Richard & Levebvre, 2011).

These results are consistent with the result of a randomized cross-over trial, involving 34 patients who experienced mechanical ventilation weaning conducted by Thomas, Paratz, Lipman (2014). On their study, Thomas, Paratz, Lipman (2014) the subjects were divided into 2 groups, first group was positioned from the supination position to a sitting position and the second group was positioned from the supination position to the semi recumbent position. The arterial blood gas (PaO2 / FiO2, PaO2, SaO2, PaCO2 and Aea gradient), respiratory mechanics (VE, VT, RR, Cdyn, RR / VT) and hemodynamic (HR, MABP) of the two goups were measured (Thomas, Paratz, Lipman, 2014). The results showed that both positions can be applied safely to patients experiencing mechanical ventilation weaning (Thomas, Paratz, Lipman, 2014).

Respiration rate in both groups showed variety of results after positioning. In semi recumbent group, after one hour of semi recumbent positioning, there were 7 respondents with decreased respiration rate, 7 respondents with decreased respiration rate and 6 people with no alteration in respiration rate. In control group, there were 11 respondents with decreased respiration rate, 4 respondents with no alteration in respiration rate and 5 respondents with increased respiration rate. The results of this study are in accordance with Petrova and Mehta's research (2015). The study aimed to assess the oxygenation of brain tissue and oxygenation of kidney tissue in premature infants (Petrova and Mehta, 2015). The babies were changed from the supination position to the 45-degree semi-upright position for 60 minutes then changed again to the supination position for 30 minutes. The conclusion of this study is that one third of premature infants showed a slight decrease in cerebral tissue oxygenation when placed in a 45 degree semi upright position (Petrova & Mehta, 2015).

The results showed that there was a significant difference after 1 hour of semi recumbent positioning of oxygen saturation in pediatric patients who had oxygenation problems. This result is in line with the research conducted by Beers and Von (2014), which concluded that the semi recumbent position (45 degree semi-upright) was considered to have a rapid influence in increasing oxygenation in the blood and decreasing end-tidal carbon dioxide. Half an hour of the semi recumbent position can make a significant increase in oxygen saturation in patients with respiratory problems. Giving a semi recumbent position can improve patient oxygenation in a short time. Research conducted by Robak, Schellongowski,

Bojic, Laczika, Locker and Staudinger (2011) showed that gas exchange has increased after one hour of semi recumbent positioning.

Giving a semi recumbent position is considered to be an effective way to improve the patient's oxygenation status. The semi recumbent position is easy, safe and effective in patients with mechanical ventilation, while it can prevent ventilator-associated pneumonia (VAP). Oxygenation significantly increases in semi recumbent position compared to supination position (Johnson & Meyenburg, 2009). The semi recumbent position compared to the supination position is considered more effective in reducing the occurrence of gastro esophageal aspiration (Du Fan, Girardier, & Benoit, 2004). Pediatric patients with pneumonia are usually more comfortable placed in a half-sitting position (Hockenberry & Wilson, 2011). Although the semi recumbent position is considered effective for increasing oxygenation, this position also affects hemodynamic stability. Research conducted by Gocze, et al., (2013), compared the position with an elevation of 0 degrees, 30 degrees and 45 degrees. The results showed that the semi recumbent position (45 degrees) significantly decreased the mean arterial pressure (MAP) and central venous oxygen saturation (ScvO2) in patients with mechanical ventilation. The researcher recommends placing the patient in a low fowler position (20 to 30 degrees). In this study, the control group is in a low fowler position, so it can be concluded that both positions, both semi recumbent and low fowler, can be applied to pediatric patients with oxygenation problems.

CONCLUSSION

There is an increase in oxygen saturation after 1 hour of semi recumbent positioning. There was no significant difference of the respiration rate before and after intervention in the two groups after 1 hour of positioning. The results showed that the semi recumbent position can be applied to pediatric patients with oxygenation problems.

Positioning is expected to be one of the interventions in pediatric patients with oxygenation problems and can be used as one of the standards of care for pediatric with oxygenation problems. Subsequent research can be developed using randomized controlled trials with a larger number of respondents.

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