

The Influence of Lateral and Supine Position on Bacterial Colonization of Endotracheal Tube in Neonates Admitted to Neonatal Intensive Care Unit

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Abstract

Objective: Recent data suggest that during mechanical ventilation, lateral patient position (in which the endotracheal tube is horizontal) decreases the incidence of bacterial colonization of ventilated neonates. The objective of this study was to evaluate the influence of lateral and supine position on bacterial colonization of endotracheal tube in neonates.

Methods: We conducted a prospective, randomized, clinical trial with 31 intubated neonates (intubated within 48 hours after birth); sixteen neonates were positioned supine (supine group), and fifteen were maintained in the lateral position (lateral group). Tracheal aspirates were cultured in second and fifth days of mechanical ventilation. Data were analyzed with SPSS version 16.

Findings: In the second day of ventilation, positive cultures were recognized in 6.2% of supine group and 6.7% of lateral group. After 5 days, tracheal cultures were positive in 25% (4 neonates) of supine group and 13.3% (2 neonates) of lateral group that wasn't statistically significant ($P=0.9$ in second day and $P=0.9$ in the fifth day). The most common organisms isolated from tracheal aspirates were Gram-negative rods (Klebsiella).

Conclusion: Since respiratory contamination is very common among ventilated neonates and the effect of lateral position on bacterial colonization of endotracheal tubes of intubated neonates wasn't established in our study, further studies are required to suggest ways to decrease bacterial colonization of intubated neonates.

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Key Words: Newborn; Intubation; Bacterial Infection; Infant; Patient Positioning

Introduction

Pneumonia is the second cause of hospital acquired infections after catheter site infection that leads to prolonged hospital stays, increased morbidities and higher expenses^[1,2]. Ventilator associated pneumonia (VAP) is the most common

kind (86%) of Hospital Acquired Pneumonia^[1]. According to CDC definitions, VAP is an episode of pneumonia that develops more than 48 hours after initiation of mechanical ventilation^[3,4]. Since the most important mechanism of VAP is aspiration of colonized secretions in the nasopharynx, many attempts have been done to

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reduce colonization in trachea and nasopharynx^[5-12]. In general, diagnosis of VAP is difficult in the newborns. Bronchoscopic techniques of adults are not applicable in neonates. Other diagnostic tools like clinical, laboratory, imaging findings and examining the sputum qualitatively and quantitatively are limited too. Thus neonatologists utilize a combination of these techniques to diagnose VAP according to their experience and setting.

Newborns are more prone to VAP because their mucosal layers are delicate, and their immune system is not completely functioning^[2,13]. It is stated that low birth weight, ventilators, frequent tracheal suctioning, sedation with opioids, and reintubation are directly associated with the incidence of VAP. Intravenous antibiotics are inversely associated with VAP^[14,15].

Recent data suggest that during mechanical ventilation, lateral positioning (in which the endotracheal tube is horizontal) may decrease the incidence of bacterial colonization of endotracheal tube^[16-19].

The objective of this study was to evaluate the influence of lateral and supine position on bacterial colonization of endotracheal tube in neonates.

Subjects and Methods

We conducted a prospective, randomized, clinical trial in the neonatal intensive care unit of 17 Shahrivar Children's Hospital of Rasht (Rasht Iran). This study lasted two years from 2010 to 2011. Thirty-one intubated neonates (intubated within 48 hours after birth) were included; 16 neonates were positioned supine (supine group), and 15 were maintained in the lateral position (lateral group). Sample size was chosen based on a similar study, indicating that 87% of neonates in supine position versus 30% of neonates in lateral position had bacterial colonization after 5 days^[16]. So, two groups of 10 neonates would suffice to draw a conclusion. To increase the accuracy of the study, by increasing attrition rate, 31 newborns (16 in the supine and 15 in the lateral group) were

enrolled. Participants were randomized by random fixed block method into two groups of A (neonates in supine position) and B (neonates in lateral position).

Inclusion criteria of this study were: 1) gestational age 28 weeks from the last menstrual period, 2) tracheal intubation at postnatal age of <48 hours, 3) absence of congenital malformations such as tracheoesophageal fistulae, chest deformities or diaphragmatic hernia. Patients were excluded if they were diagnosed as congenital sepsis or pneumonia or they could not be maintained on mechanical ventilation for 5 full days. We recorded demographic data and the results of routine laboratory tests that were performed for all neonates at the admission time in NICU from their files such as CBC, platelets, CRP, ABG (Arterial Blood Gas), blood cultures, and CXR. Initial setup of ventilator was recorded too. Patients were ventilated in SIMV mode using Babylog 8000-plus Drager ventilator with heated humidification system. Open method of suction was used for suctioning secretions as needed and no prophylactic topical oropharyngeal antibiotics and selective gut decontamination was done in any of the patients. Neonates in group A were maintained on their backs and endotracheal tube was held upright in a vertical position and their bed was kept horizontal with 10 degree head tilt (routine care in our NICU). Group B subjects were positioned on their sides with the back supported by a rolled soft towel and they were alternatively rotated to left or right lateral position by trained nurses every two hours. Tracheal aspirates of both groups were cultured in second and fifth days of mechanical ventilation. For this purpose the researcher wore sterile gloves and suctioned the endotracheal tube, using feeding tubes no 5 or 6, without injecting any solution into the endotracheal tube and instantly transferred the samples into an EMB agar and blood agar medium. Cultures were incubated for 24 hours in 37°C. A single microbiologist blind to the grouping analyzed the dishes and studied the antibiogram. ABG variables and ventilator setup were recorded at second and fifth days of intubation from patients' files too (ABG was performed for all intubated neonates daily in our setup). Data were analyzed with SPSS version 16 by tests of Chi

Table 1: Comparison of interfering parameters between supine and lateral position groups

Variable	Group	n	Mean (SD)	Test value	P Value
Weight (gr)	Supine group	16	1789.4 (646.3)	t=0.523	P=0.6
	Lateral group	15	1931.3 (855.7)		
Gestational age (week)	Supine group	16	32.5 (3.4)	t=0.443	P=0.7
	Lateral group	15	31.9 (3.6)		
Age (hours after birth)	Supine group	16	24.9 (16.0)	t=0.102	P=0.9
	Lateral group	15	24.3 (18.7)		

SD: Standard Deviation

square, t-test and Repeated Measure ANOVA.

The study protocol was approved by the ethical committee of Guilan University of Medical Sciences. Informed parental consent was obtained for all neonates.

Findings

In the second day of ventilation positive cultures were recognized in 6.2% (1 neonate) of supine group and 6.7% (1 neonate) of lateral group. After 5 days tracheal cultures were positive in 25% (4 neonates) of supine group and 13.3% (2 neonates) of lateral group that wasn't statistically significant ($P=0.9$ in second and fifth day). The most common organisms isolated from tracheal aspirates were Gram-negative rods (*Klebsiella*).

Table one gives comparison of weight, gestational age, and hours after birth, in the two groups. There was not statistically difference between the two groups about initiation of feeding ($P=0.3$), use of H2 blocker ($P=0.9$) and rate of reintubation ($P=0.6$).

Because all the patients had respiratory distress at the time of admission, they all received antibiotic treatment according to unit policy.

Except one patient with pneumothorax, other patients were intubated because of hyaline membrane disease.

Table 2 shows the means of lab data of both groups in the first day of hospitalization. We compared some ABG variables and ventilator setup at the beginning, second day, and fifth day of mechanical ventilation in the two groups by t-test. We also compared the trend in change of ABG variables and ventilator setup in both groups using Repeated Measure ANOVA. These analyses showed no difference in ventilator setup and ABG variables in both groups. The only exception was the means of PO_2 of the second and fifth day of ventilation that was higher in the supine group (Table 3).

Discussion

In our study bacterial colonization in endotracheal tube was not different in the two groups after two days. Colonization increased by the fifth day in both groups (6.7% to 13.3% in group B and 6.2% to 25% in group A). This is in accordance with Friendland report^[20]. The rate of increase in colonization from the second to the fifth day is

Table 2: Means of lab data of both groups in the first day of hospitalization

Variable	Group	n	Mean (SD)	Test value	P Value
White Blood Cell	Supine group	16	9263.8 (4370)	t=0.76	0.4
	Lateral group	15	10527.4 (5017.0)		
Hemoglobin	Supine group	16	15.9 (1.6)	t=0.462	0.03
	Lateral group	15	14.4 (2.0)		
Platelet	Supine group	16	212065.0 (35667.8)	t=0.083	0.4
	Lateral group	15	266675.0 (60772)		

SD: Standard Deviation

Table 3: Means of ABG variables of second and fifth day after the initiation of mechanical ventilation

Variable	Group	n	Mean (SD)	Test value	P Value
pH	Supine group	16	7.26 (0.10)	t=0.125	0.9
	Lateral group	15	7.27 (0.07)		
Pco ₂	Supine group	16	50.14 (9.7)	t=1.48	0.1
	Lateral group	15	55.87 (11.69)		
PO ₂	Supine group	16	89.75 (34.6)	t=2.06	0.048
	Lateral group	15	65.71 (29.77)		
O ₂ saturation	Supine group	16	85.23 (14.12)	t=1.75	0.09
	Lateral group	15	75.72 (16.09)		

ABG: Atrial blood gas; SD: Standard Deviation

higher in the supine positioned group (group A). Aly et al also found an increased rate in the supine group yet it was statistically significant^[16]. They selected 50 newborns with day five colonization count of 87% in the supine group and 30% in lateral positioned group. Our selection was 31 newborns with five day colonization count of 25% (A) versus 13% (B). The reason of this discrepancy is probably due to difference in study setting in terms of hand washing routines, lab techniques and hygiene. It is to be noticed that some of our participants with the second day positive endotracheal cultures could not finish the study because of subsequent sepsis or pneumonia and death. These cases were excluded from the study. Therefore, the real rate of colonization is expected to be higher than we found.

When the endotracheal tube is in vertical position, respiratory secretions passively enter to the lower airways. Therefore, eliminating the effect of gravity by maintaining the endotracheal tube in horizontal position should make respiratory secretions less likely to move down the airway. In addition, we think that such positioning of the trachea facilitates sliding of respiratory secretions along the endotracheal tube wall and decreases the need for tracheal suctioning. Thus, these maybe the reasons of less colonization in the lateral group.

Aly et al stated that reintubation rate in the supine group was more in their study and they mentioned this as one of the limitations of their study. We took this factor into account. We had the same reintubation rate in the two groups.

We can consider our groups to be more homogeneous in terms of newborns' sex, hours

from birth, gestational age, weight, type of delivery, and all laboratory indices. The only exception was Hb level that was more in the supine group (group A) (mean Hb level in group A was 15.88 g/dl and it was 14.36g/dl in group B which was significantly different ($P<0.02$)). This may have an effect of PO₂ level in that group. In other words, positioning did not have any effect on PO₂ level because the supine group started the study by a higher level of Hb.

Differences in initiation of feeding and H2 blocker would adversely affect the result of the study^[21], our groups were homogeneous in terms of initiation of feeding and H2 blocker.

Balagur et al by a metaanalysis of 11 studies on the effect of safety in different positioning concluded that lateral position did not have any advantage over other positions, yet prone position had a better PO₂ level when compared with supine position^[22].

Ventilator setup was the same in both groups and FIO₂ was reduced as time passed and the trend was the same in both groups. This shows that lateral positioning did have any adverse effect on ventilator setup.

The most prevalent bacteria found in our study were Gram negative rods among which *Klebsiella* took precedence over *Pseudomonas* and *Enterobacter*. Of Gram positive bacteria *S. aureus* was more common than *S. epidermidis*. The frequencies of bacterial growth are presented in Table 4. Afjeh from Iran also reported that VAP related organism was gram negative rods (*E. Coli* and then *Klebsiella*) more than other bacteria^[23].

This was in accordance with Tripathi et al and Aly et al study^[3,16]. Friedland et al reported

Table 4: Frequency of bacterial growth in endotracheal tube in the two groups

Diagnosis	Organism	Supine group	Lateral group
Gram negative bacteria	<i>Klebsiella</i>	12.5%	6.6%
	<i>Pseudomonas</i>	6.2%	0
	<i>Enterobacter</i>	0	6.6%
Gram positive bacteria	<i>S. aureus</i>	6.2%	6.6%
	<i>S. epidermidis</i>	6.2%	0%
Total		31.2%	20%

S. epidermidis as the most prevailing organism^[20]. This reports indirectly confirm the importance of hand-washing in neonatal intensive care units, because the source of Gram-negative rods is mainly environmental^[16], primarily from the hands of staff members.

Although we chose the sample size according the statistical formulas used in a similar study by Aly et al, the frequency of colonization in our study was lower. So, further studies with larger sample size are necessary to determine physiologic or clinical benefits of lateral position. Because endotracheal cultures were performed qualitative, we could not show the correlation of position and intensity of colonization.

In our study we surveyed the effect of position on bacterial colonization but not VAP. Colonization of the endotracheal tubes is the main risk factors for VAP, but it may occur separately with no symptoms or signs of VAP.

Conclusion

Although the colonization rate in lateral position group was 2 times less than in supine position group, because the difference was not statistically significant it needs to be confirmed by a larger sample study. Incidentally there is a negative attitude toward lateral positioning because the traditional position in all NICUs is supine so some neonatologists were reluctant to cooperate with the intervention. Our study showed that lateral position has no adverse effect on neonates.

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Conflict of Interest: None

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