

# Ventilator Associated Pneumonia in Neonates: Do the Body Positions Really Have a Role in Prevention

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## ABSTRACT

**Background:** Ventilator associated pneumonia (VAP) is a relatively common and sometimes deadly complication of mechanical ventilation seen in neonatal ICUs around the globe.

**Objective:** The study aimed to analyze the effect of three different infant positions on the rate of ventilator associated pneumonia in newborns in NICU. And compare the bacterial growth on tracheal aspirates in all three groups.

**Study design:** It was randomized controlled trial study conducted for the duration of six months from 1<sup>st</sup> January 2021 to 30<sup>th</sup> June 2021 at Neonatal ICU department of Children Hospital PIMS, Islamabad.

**Material and Methods:** The sample size was calculated by WHO sample size calculator, with power of test 80% and level of confidence 05%. Population proportion for group 1 was 67% (rate of bacterial colonization in supine group). Population proportion for group 2 was 47% (rate of bacterial colonization in lateral group). Sample size was turned out to be 50 in each group and a total of 150 patients were included in the study. The patients were randomized to one of the three groups using lottery method. The ethical and review board committee of the hospital approved the study.

**Results:** First group patients were in supine position after the procedure of endotracheal intubation on the ventilator. The second group was the one in which infants were put in prone position by following protocol. And the third group contained patients in lateral positions. The goal of the study was to study the effect of these three positions on the incidence of ventilator associated pneumonia in case of infants admitted in hospital. The other goal was to do a comparison on the bacterial growth produced on tracheal aspirates in case of all these groups. Infants were kept in these positions and there was no information collected for 10 minutes as there could be any potential instability in respiration. After the patients were stable data was collected.

**Conclusion:** There was no difference found in the incidence of VAP in case of all three positions and the bacterial colonization was found to be increased in case of supine position as compared to other groups.

**Keywords:** Ventilator associated pneumonia (VAP), Neonatal ICUs, Respiratory tract.

## INTRODUCTION

Ventilator associated pneumonia (VAP) is a relatively common and sometimes deadly complication of mechanical ventilation seen in neonatal ICUs around the globe. Its exact incidence is hard to ascertain because of a lack of consensus regarding its definition and also the difficulties associated with obtaining lower respiratory tract samples for microbiological diagnosis in neonates.<sup>1</sup> One study conducted in our setup showed VAP as the second most common healthcare associated infection with a rate of 5.84/1000 ventilated days. The mortality rate is observed to be 6.8-32.2% of health care associated infection among neonates. VAP is associated with prolonged hospital stay on the individual basis but also result in an exponentially high yet preventable burden on the scarce resources, a particular problem faced by the developing countries<sup>2-3</sup>.

According to the CDC VAP in infants  $\leq$  1 year old is defined as pneumonia occurring after 48 hours of mechanical ventilation with consistent radiological, clinical and microbiological findings<sup>4-5</sup>.

VAP is a commonly encountered complication of mechanical ventilation in neonatal ICUs all over the world, especially in the premature babies. According to a study conducted in NICU PIMS it is the second most common health-care associated infection and an international study places it as the second most common cause of death among nosocomial infections in neonates. VAP is not only associated with an increased morbidity and mortality with a prolonged hospital stay on the individual basis but also result in an exponentially high yet preventable burden on the scarce resources, a particular problem faced by the developing countries<sup>6-7</sup>. According to the CDC VAP in infants  $\leq$  1 year old is defined as pneumonia occurring after 48 hours of mechanical ventilation with consistent radiological, clinical and microbiological findings. The goal of our study is to test the hypothesis that mechanically ventilated neonates positioned on their sides or prone would be less likely to develop bacterial colonization in their tracheae, as compared to those nursed supine<sup>8-9</sup>.

## MATERIAL AND METHODS

The sample size was calculated by WHO sample size calculator, with power of test 80% and level of confidence 05%. Population proportion for group 1 was 67% (rate of bacterial colonization in supine group). Population proportion for group 2 was 47% (rate of bacterial colonization in lateral group). Sample size was turned out to be 50 in each group and a total of 150 patients were included<sup>10</sup>. Non-probability, consecutive sampling was done and patients were randomized to one of the three groups using lottery method. All those neonates who fulfilled inclusion criteria were eligible for enrollment in the study. An informed written consent was signed by participants. In supine group, patients were placed in supine for ventilatory support after endotracheal intubation. Head end of the baby was kept elevated 15° according to the unit protocol. While in the lateral group the patient was maintained in right or left lateral position, by placing soft towel roll to support their back. And in the prone group, baby was nursed in prone position. The positions other than supine were maintained for at least 8 hours a day. Treatment was provided according to the underlying disease diagnosis. Antibiotics, fluids were decided by treating neonatologist according our unit protocols. Ventilatory setting was decided by neonatologists. Baseline investigation was sent for all patients including Blood CP, CRP, CXR, ABGs, and blood cultures. Suction was done under aseptic measures, using gloves by open method at 4 hours interval or as needed. Strict hand hygiene was re-enforced. Daily mouth care of all the patients was provided by using normal saline and oral suction. Intubation and re-intubation was done only if strictly indicated, to avoid unnecessary re-intubations.

Tracheal aspirates culture was sent on day 2 and day 5 of ventilation. A suction catheter with an end hole, of size 6F or 8F will be for endotracheal tube size 3mm or 3.5mm respectively. CXR was repeated in cases of VAP to see for new or progressive infiltrates in the lung fields. All the data of the variables was entered on preformed proforma. **Inclusion Criteria:**

- All neonates from birth till 28 days of age was included in the study who have received mechanical ventilation for more than 48 hours
- **Exclusion Criteria:**
  - Neonates delivered at less than 28 weeks gestation (because in extreme preterms there is high risk of IVH with head in any other position except supine)
  - All neonates with any congenital lung malformation, chromosomal anomalies or dysmorphic syndromes
  - Neonates requiring mechanical ventilation for less than 48 hours
  - Those who refused consent

**RESULTS**

All the neonates who were fulfilling the criteria were selected for the study. The parents were informed and their written consent was taken from them. The patients were randomly put in three groups. First group, the patients were in supine position after the procedure of endotracheal intubation on the ventilator. The second group was the one in which infants were put in prone position by following protocol. And the third group contained patients in lateral positions. The goal of the study was to study the effect of these three positions on the incidence of ventilator associated pneumonia in case of infants admitted in hospital. The other goal was to do a comparison on the bacterial growth produced on tracheal aspirates in case of all these groups. Infants were kept in these positions and there was no information collected for 10 minutes as there could be any potential instability in respiration. After the patients were stable data was collected.

Treatment was given to the patients based on their diagnosis. The settings of the ventilator were adjusted according to the decisions of neonatologist. Basic health facilities like checking of Blood CP, CXR etc was carried out for all the patients when needed. The study was completed in six months, the data from patients was collected and analyzed using SPSS version 23. The categorical variables were shown in form of percentages and frequencies and the continuous data was expressed in form of average and standard deviation. For statistical significance evaluation Chi square test was used to compare the percentages and in order to measure the statistical significance of mean and standard deviation student's t-test was carried out.

Table 1: Radiological results n (%)

	VAP n=31	No-VAP n=6	Chi-square test
Chest X-ray studies			
Occurrence or bad consolidation/opacity	19 (63.5)	3 (33.3)	0.15
Pneumatocele or cavitation	0	0	-
Pleural effusion	0	0	-
Lung ultrasound findings			
Consolidations <0.2 cm	28 (87.1)	7 (100)	0.35
Consolidation > 0.5 cm	30 (100)	5 (66.7)	0.002
Unilateral consolidation	7 (19.3)	3 (33.3)	0.46
Bilateral consolidation	26 (80.6)	1 (33.3)	0.03
Anterior consolidation	7 (19.3)	2 (16.6)	0.8

Table 2: Mean of the SPO<sub>2</sub> in case of supine prone and lateral positions on ventilator.

Time	Supine position		Prone position		Lateral position		P value
	Mean	SD	Mean	SD	mean	SD	
0	95.4	2.4	96.5	3.4	95	3.4	p=0.53
15	96.3	6.5	96.3	4.5	94.6	5.3	p=0.4
30	95.4	4.5	95.4	6.2	98	5.5	p=0.01
45	93.2	6.3	95.2	5.5	93.4	3.2	p=0.003
60	94.3	5.4	93.2	5	92	2.2	p=0.0001
75	95.4	4.8	98.2	4.9	94.5	3	p=0.0001
90	95	6.1	96.5	5.1	95.6	1.6	p=0.0001
105	94.8	5.4	97.2	3.3	94.5	1.6	p=0.0001

Table 3: Organisms cultured from infants in all three groups

Groups	Organisms cultured	Rate of bacterial colonization % (n=150)
Supine (n=50)	Klebsiella	
	Candida	
	Pseudomonas aeruginosa	67%
	E.coli	
Prone (n=50)	Staphylococcus aureus	
	Klebsiella	
	Candida	
	Pseudomonas aeruginosa	30%
Lateral (n=50)	E.coli	
	Staphylococcus aureus	
	Klebsiella	
	Candida	
	Pseudomonas aeruginosa	47%
	E.coli	
	Staphylococcus aureus	

**DISCUSSION**

In this study, the ventilator associated pneumonia in case of infants was analyzed. The effect of body positions in the prevention of the VAP was studied. The three positions were categorized. One group had patients who were placed in supine position on ventilator. In this position the head of the infant is kept slightly elevated. The second group involved infants in prone position, the baby is kept in prone position<sup>12-13</sup>. The third group had infants in lateral position, in which the infants were put in either right or left lateral position. This position was maintained by placing a soft towel so that their back is supported. In case of prone and lateral positions, the positions were maintained for a period of 8 hours per day. All the parents who refused to make their babies part of the study was excluded from the analysis. Moreover, the patients who were born at less than 28 weeks' period were also not included in this study. The radiology testing was carried out for the diagnosis of Ventilator associated pneumonia<sup>14-15</sup>.

The association between VAP and the position like lateral, supine and prone was checked and it was found that there was difference in the onset of disease in case of these three positions. The radiology testing was carried out to find the cavitation or pneumatoceles and the CDC requirements were met for the diagnosis of VAP<sup>16</sup>. Chest and lungs testing was carried out to analyze the infants and to diagnose the incidence of VAP. The incidence of ventilator associated pneumonia was checked in case of all three groups. It was found that the average of the SPO<sub>2</sub> was less in case of supine position, it increased slightly in case of prone position but still it was not showing any major sort of variation from that of supine position. Similar were the results in case of lateral position. The incidence of ventilator associated pneumonia had no effect in case of these three positions. The mouth care of all the infants was kept daily by making use of oral suction and saline solutions. The use of re-intubation was only carried out if needed or if advised by the doctors, otherwise unnecessary tubing was avoided. Hand hygiene was maintained by the staff of the nursery so that any negligence can be avoided<sup>18-19</sup>.

The protocols were followed just as done by previous studies. As per studies carried out on effect of position on ventilator associated pneumonia it was found that the infants if placed in prone position for a duration of more than 120 minutes, their SPO<sub>2</sub> level was increased. Other studies also show that there is no difference in the incidence of ventilator associated pneumonia in case of lateral, prone and supine positions. In another study carried out, it was found that in case of premature babies who are on ventilator and they had to depend on oxygen, they had high FRC and oxygen saturation level<sup>20-21</sup>. As per studies it was found that the colony count in case of supine was more than that found in other lateral and prone groups. As the baby was put in the supine position there are more chances of entering of new bacterial organisms in the trachea with the passage of time. One of the most common pathogen that was isolated from the trachea of

these infants was gram negative bacteria. Another study revealed that the use of mechanical type of ventilation is being used and the gravitational force can help enhance the entry of bacterial colonies inside the trachea of baby. However how that is happening and the detailed mechanism is needed to be further disclosed<sup>22</sup>.

Another study revealed that in case of majority of their patients there was occurrence of VAP. And the colonies more prevalent in case of those patients were klebsiella and Staphylococcus aureus. In these studies, the percentage bacterial colonization was also measured and it was found that the rate of colonization was found to be much enhanced in case of supine group as compared to other groups. Our findings are in accordance with the previous results where the bacterial colonization was prevalent in case of supine group<sup>23</sup>.

## CONCLUSION

The study was carried out to find the ventilator associated pneumonia in case of infants. And the role of positions was checked to have any impact on prevention of VAP. There was no difference found in the incidence of VAP in case of all three positions. And the bacterial colonization was found to be increased in case of supine position as compared to other groups. However further studies must be needed to find out the role of position in prevention of VAP.

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