Original Article

Effect of prone versus supine position on oxygen saturation in patients with respiratory distress in neonates

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ABSTRACT

Objective: To analyze the effect of prone versus supine position on oxygen saturation in neonates with respiratory distress.

Methodology: This comparative study was conducted in the department of paediatric medicine at Liaquat University Hospital Hyderabad during the period of six months. Total numbers of the patients enrolled were one hundred with age ranging three hours to 28 days. All the newborns with respiratory distress (RD) were kept in supine position for three hours after all necessary resuscitation measures and oxygen saturation was recorded with pulse oximeter. Then they were kept in prone position for six hours and oxygen saturation and respiratory rate was measured with two hour interval respectively for six hours.

Results: One hundred patients were enrolled in the study with age range 3 hours - 28 days, out of them 87 (87%) term, 9 (9%) preterm and 4 (4%) were post term respectively, male to female ratio was 1.2:1. The oxygen saturation in supine position was 84.84 $\pm$ 4.20. After 2 hour in prone position saturation was 91.05 $\pm$ 3.29, after 4 hour 91.62 $\pm$ 3.89 and after 6 hours it was 92.63 $\pm$ 3.02 respectively with P value of < 0.001 which is statistically highly significant. It shows that Oxygen saturation is increased by about 7%, and maximum oxygen saturation increases in first 2 hours. Similar trend was seen in respiratory rate with reduction of respiratory rate by 6 breaths / min in first two hours.

Conclusion: Prone position improves oxygenation saturation and decreases respiratory distress as compared to supine position in neonates with respiratory distress.

KEY WORDS: Respiratory distress, Neonates, Oxygen saturation.

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INTRODUCTION

Every year 0.27 million newborn die in Pakistan out of 5.3 million live births and this mortality rate is about ten times higher than the U.S.[1] Respiratory distress is common presentation of most common causes of neonatal admission and mortality like birth asphyxia, idiopathic respiratory distress syndrome, meconium aspiration syndrome and neonatal sepsis.[2-4]

Respiratory distress syndrome (RDS) is a common disorder encountered within first 48-72 hours of life. It occurs in 0.96 to 12% of live births and is responsible for about 20% of neonatal mortality[5-7] and responsible for 30-40% of admissions in the neonatal period. Respiratory distress syndrome in

the neonate is diagnosed when one or more of the following is present, tachypnoea or respiratory rate of more than 60/minute, retractions or increased chest indrawing (subcostal, intercostal, sternal, suprasternal) and/or noisy respiration in the form of a grunt, stridor or wheeze.[8]

In patients with RDS, several factors potentially influence the gravitational distribution of perfusion, including hypoxic vasoconstriction, vascular obliteration and extrinsic vessel compression. Compared to supine position, there is more homogeneous distribution of transpulmonary pressure, homogeneous ventilation perfusion distribution and less physiological shunt in prone positioning.[9-11]

Prone position placement improves oxygenation in patients with RDS.[12,13] There is better diaphragmatic movement, recruitment of formerly collapsed dependent lung regions, redistribution of pulmonary blood flow to better ventilated regions, enhanced drainage of airway secretions and increased negative pleural pressure in PP which improves oxygen.[14,15] Similarly, repositioning these patients back to SP has been associated with a noticeable deterioration in gas exchange.[16,17]

Most of the relevant studies published from developed countries regarding effect of prone position on oxygen saturation were on mechanical ventilation.[9,18]

We conducted this study in our neonatal unit where we have average admissions of about 200 babies /month. The purpose of this study was to see whether nursing newborns with respiratory distress in prone position will reduce the oxygen requirement and respiratory distress in our set up where there are limited facilities for intensive care, including trained staff, availability of mechanical ventilation and cost of oxygen therapy.

METHODOLOGY

After taking approval from ethical committee, this comparative study was conducted at Department of Paediatric medicine at Liaquat University of Medical and Health Sciences Hyderabad Pakistan in 6 months from January 2010 to June 2010 in neonates with Respiratory distress. In 6 months duration we enrolled 123 neonates from >32 weeks of gestational age with >3 hrs to < 28 days of age with RD (tachypnoea or respiratory rate more than 60/minute, retractions or chest indrawing (subcostal, intercostal, sternal, suprasternal) and noisy respiration in the form of a grunting. 23 neonates were excluded from study because they were not able to tolerate the position either due to secretions,

presence of nasogastric tube, cephahematoma or sudden drop in saturation with change of posture. Patients with Congenital Heart disease and other major malformations were excluded from the study.

Patients who fulfilled inclusion criteria were enrolled for the study and detailed Performa was filled by interviewing mother or care taker after informed consent. All neonates were stabilised after needful resuscitation, then nursed in supine position for 3 hours before recording their Oxygen saturation and respiratory rate. Then patient was kept in prone position for 6 hours and oxygen saturation and respiratory rate was measured every 2 hours. Oxygen was administered through head box or nasal prongs. Oxygen saturation was monitored with Oxypleth Pulse Oximeter.

All data was entered by using SPSS software version 10.0. Data was analyzed according to the type of data. Frequencies were determined for categorical data like gender. For continuous variables like age, mean and standard deviation was determined. Discrete variables were expressed as percentage.

RESULT

One hundred patients were enrolled in the study with age range 3 hours - 28 days with >32 weeks gestational age. There were 60 (60%) male and 40 (40%) female and male to female ratio was 1.2:1. Distribution of clinical presentations are shown in Figure-I. Normal vaginal delivery was performed in 67% while 33% had lower segment caesarean section. Most common diagnosis was birth asphyxia 37% and other distributions are shown in (Table-I).

The oxygen saturation in supine position was $84.84 + 4.20$ and after 2 hour in prone position it was $91.05 + 3.29$, after 4 hour $91.62 + 3.89$ and after 6 hours it was $92.63 + 3.02$ respectively with P value of < 0.001 which is statistically highly significant. It
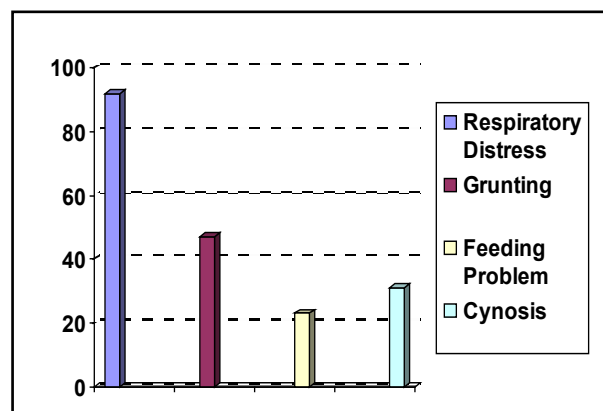

Figure-I: Showing distribution of clinical presentations with which neonates present.

Table-I: Diagnosis.

Birth Asphyxia	37%
M.A.S	20%
Neonatal Sepsis	12%
Neonatal Pneumonia	12%
R.D.S	19%

shows that Oxygen saturation is increased by about 7%, and maximum oxygen saturation increases in first 2 hours (Table-II). P values in obtained by applying T test.

After keeping patient in prone position for 6 hour, it was seen that respiratory rate decreased by 6 breaths/min approximately in first 2 hours with P value of < 0.001 which is statistically highly significant (Table-III).

DISCUSSION

Standard management of neonates with RDS is difficult in our setup due to lack of trained staff, non availability of mechanical ventilation, and cardiorespiratory monitors. Due to high rate of admissions and limited number of beds in nursery it is important to find strategies which can reduce hospital stay. National data show that common causes of neonatal mortality are birth asphyxia, idiopathic respiratory distress syndrome, meconium aspiration syndrome and neonatal sepsis[2-4] and all these conditions mostly present with respiratory problem.

There are no recommended guidelines for the length of time in which patients should remain in prone position (PP) and it is also unclear that the periods of PP should be longer, equal or shorter than periods of supine position (SP) because there is limited work done and most studies are on newborns or adults on mechanical ventilation.[19]

Monica S[19] et al showed improvement in oxygenation after keeping patients in PP for 12 hours rather than shorter periods. These findings were documented in ventilated subjects of different age groups, in our study oxygen saturation

Table-III: Respiratory Rate in Supine and Prone Position.

Respiratory Rate	Supine (n=100)	Prone (n=100)	P value
After 2 hours supine	69.39±4.20		
After 2 hours prone		63.06±5.73	<0.001
After 4 hours prone		62.10±5.63	<0.001
After 6 hours prone		61.25±5.41	<0.001

Table-II: Oxygen saturation in Supine and Prone Position.

Oxygen Saturation	Supine (n=100)	Prone (n=100)	P value
After 2 hours supine	84.84±4.20		
After 2 hours prone		91.05±3.29	< 0.001
After 4 hours prone		91.62±3.89	< 0.001
After 6 hours prone		91.63±3.02	< 0.001

increased maximum in first 2 hours in PP position rather than 4 and 6 hours.

Jordi et al[20] suggested that prone ventilation for prolonged periods is feasible, safe and reduced mortality in RDS patients. Same was observed in our study with improvement in oxygen saturation and decrease in the respiratory distress.

Sachin Sud et al[21] at Toronto interpreted that ventilation in the prone position in patients with acute hypoxemic respiratory failure improved oxygenation and reduced the risk of ventilator associated pneumonia.

According to Rossetti et al[22] although PP improve arterial oxygenation in most patients, it worsens the saturation in some, the reasons for this is not clear. The most important concern in these studies is maintenances of artificial airway as babies have higher tendency for extubation in prone position, but this would be irrelevant to our special care units where newborns are nursed in head box or given nasal oxygen.

It has been described that although ventilation in PP is potentially beneficial in patient with RDS but its impact on mortality is not significant.[23,24] We did not have the facility to study the difference in mortality rates but it was documented that nursing in PP reduces oxygen requirement by improving saturation and reducing respiratory distress.

CONCLUSION

In conclusion prone position improves oxygenation in the majority of patients with RDS and improves signs of respiratory distress thereby resulting in easier management and reduced requirement of oxygen in resource constraint environment of most public sector hospitals. Moreover it is easy, inexpensive and does not require any special training. We would suggest larger scale studies to show effect of prone positioning on oxygen requirements and duration of stay in hospital and mortality, which can help

us in modifying guidelines for newborn care in our hospitals.

REFERENCE

1. Ahmed K, Malik A, Yousef W. Perinatal morbidity and mortality in cases of preterm labour, an antegrade study conducted at Lady Willingdon Hospital, Lahore. Biomedica 2000;16:74-7.
2. Korejo R, Bhutta S, Noorani KJ, Bhutta ZA. An audit and trends of perinatal mortality at the Jinnah Postgraduate Medical Centre Karachi. J Pak Med Assoc 2007;57(4):168-72.
3. Khaskheli M, Baloch S, Khushk IA, Shah SS. Pattern of fetal deaths at university hospital of Sindh. J Ayub Med Coll Abbottabad 2007;19:32-4.
4. Nizamani MA, Nizamani SM. An audit of mortality in hospitilizaed neonates and young infants at paediatric department Peoples Medical College Nawabshah. Med Channel 2005;11(1):7-15.
5. K Hatua SP, Gangwal A, Basu P, Palodhi PK. The incidence and etiology of respiratory distress in newborn. Indian Pediatr 1979;16(12):1121-6.
6. Kumar P, Kumar R, Narang A. Spectrum of neonatal respiratory distress at PGI. Bull NNF 1999;13(4):8-11.
7. Neonatal morbidity and mortality. Report of the national neonatal perinatal database. India Med K, Pediatr 1997;34:1039-42.
8. NNF recommended basic perinatal-neonatal nomenclature. In: DK Guha. Neonatology- Principles and Practice. 1st ed. New Delhi: Jaypee Brothers, 1998: 131-2.
9. Stocker R, Neff T, Stein S, Ecknauer E, Trenz O, Russi E. Prone position and low-Volume pressure-limited ventilation improve survival in patients with severe respiratory distress syndrome. Chest 1997;111:1008-17.
10. Lamm WJE, Graham MM, Albert RK. Mechanism by which the prone position improves oxygenation in acute lung injury. Am J Respir Crit Care Med 1994;150:184-193.
11. Blanch L, Mancebo J, Perez M, Martinez M, Mas A, Betbese AJ, et al. Short-term effects of prone position in critically ill patients with acute respiratory distress syndrome. Intensive Care Med 1997;23:1033-39.
12. Pappert D, Rossaint R, Slama K, Slama K, Gruning T, Falke KJ. Influence of positioning on ventilation-perfusion relationships in severe adult respiratory distress syndrome. Chest 1994;106:1511–16.
13. Hormann C. Benzer H, Baum M, Wicke K, Putensen C, Putz G, et al. The prone position in ARDS: A successful therapeutic strategy. Anaesthetist 1994;43:454–62.
14. Albert RK, Leasa D, Sanderson M, Robertson HT, Hlastala MP. The prone position improves oxygenation and reduces shunt in oleic acid- induced acute lung injury. Am Rev Respir Dis 1987;135(3):628–33.
15. Nakos G, Tsangaris I, Kostanti E, Nathanail C, Lachana A, Koulouras V. Effect of the prone position on patients with hydrostatic pulmonary oedema compared with patients with acute respiratory distress syndrome and pulmonary fibrosis. Am J Respir Crit Care Med 2000;161:360–68.
16. Fridrich P, Kraft P, Hochleuthner H, Mauritz W. The effects of long-term prone positioning in patients with trauma-induced adult respiratory distress syndrome. Anesth Analg 1996;83:1206–11.
17. Marik PE, Iglesias J. A "prone dependent" patient with severe adult respiratory distress syndrome. Crit Care Med 1997;25(6):1085–87.
18. Martha AQ, Curley RN, Patricia L, Hibberd MD, Fineman LD. Effect of Prone Positioning on Clinical Outcomes in Children With Acute Lung Injury. A Randomized Controlled Trial. JAMA 2005;294:229-237.
19. Monica S. Relvas, Peter C. Silver and Mayer Sagy. ARDS Results in Improvement in Prone Positioning of Pediatric Patients With Oxygenation if Maintained > 12 h Daily. Chest 2003;124:269-74.
20. Jordi M, Ferna'ndez R, Blanch L, Rialp G, Gordo F, Ferrer M, et al. A Multicenter Trial of Prolonged Prone Ventilation in Severe Acute Respiratory Distress Syndrome. Am J Respir Crit Care Med 2006;173:1233-39.
21. Sud S, Sud M, Friedrich JO, Adhikari NKJ. Effect of mechanical ventilation in the prone position on clinical outcomes in patients with acute hypoxemic respiratory failure: A systematic review and meta-analysis. CMAJ 2008;178(9):1153-61.
22. Rossetti HB, Machado FR, Valiatti JL, Gomes JL. Effects of prone position on the oxygenation of patients with acute respiratory distress syndrome. Sao Paulo Med J 2006;124:15-20.
23. Guerin C, Gaillard S, Lemasson S, Ayzac L, Girard R, Beuret P, et al, Effects of systematic prone positioning in hypoxemic acute respiratory failure: A randomized controlled trial. JAMA 2004;292(19):2379-87.
24. Gattinoni L, Tognoni G, Pesenti A. Effect of prone positioning on the survival of patients with acute respiratory failure. N Engl J Med 2001;345(8):568-73.

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