# Beneficial Effect of Prone Position on Oxygenation Level for Mechanically Ventilated High Risk Neonates

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## ABSTRACT

**Background:** High risk neonates with respiratory distress syndrome admitted to an intensive care unit usually need respiratory support as mechanical ventilation through endotracheal tube from nose or mouth to give different pressure and concentration of oxygen .High risk neonates position is very important during mechanical ventilation so the nurse should choose the effective and comfort position as prone position for the high risk neonates. Prone position is very effective in oxygenation and ventilation of high risk neonates. **Objective:** This study was to highlight the effect of prone position on oxygenation level for mechanically ventilated high risk neonates. **Methods:** PubMed, Google scholar and Science direct were searched using the following keywords: [Prone position on oxygenation level, ARDS, Mechanical ventilator, and Risk neonates]. The authors also screened references from the relevant literature, including all the identified studies and reviews, only the most recent or complete study was included between January 1999 and February 2020. Documents in a language apart from English have been excluded as sources for interpretation was not found. Papers apart from main scientific studies had been excluded: documents unavailable as total written text, conversation, conference abstract papers and dissertations. **Conclusion:** Prone position improve arterial blood gases, vital signs and parameters of mechanical ventilation of high risk neonates.

**Keywords**: Prone position on oxygenation level, ARDS, Mechanical ventilator, Risk neonates.

## INTRODUCTION

Neonatal morbidity and death are thought to be mostly caused by respiratory conditions in newborns. High risk newborns with abrupt respiratory failure brought on by acute respiratory distress syndrome are put on a mechanical ventilator. When a mechanically ventilated high-risk neonate shifts from supine to prone position, it improves clearance of airway secretion, reduces the incidence of ventilator-associated pneumonia through mobilisation of secretion, and reduces abdominal compression on the thorax and heart compression on the lung, which reduces dorsal alveolar collapse and improves ventilation and perfusion [(1)].

Paediatric nurses should choose the most appropriate position to improve oxygenation of mechanically ventilated high risk neonates because body positions are one of the care activities they perform for these infants, and because prior scientific studies have demonstrated that the prone position is very effective in oxygenation and ventilation of high risk infants [(2)].

As the neonate lies on their stomach, the weight of the heart shifts from the left lobe to the sternum, and the dorsal lobes passively expand as a result of gravity, which reduces dorsal alveolar collapse and enhances ventilation and perfusion matching [(2)]. In extremely low birth weight

infants, the prone position is also efficient in managing breath, reducing gastroesophageal reflux, and reducing ventilated related pneumonia [(3)].

Devices that mechanically transport air into and out of the lungs are known as mechanical ventilators (MVs). They are used to give high-risk newborns who are incapable of breathing on their own or who are not breathing enough a breathing mechanism [(4)].

In high-risk neonates with acute respiratory failure brought on by Acute Respiratory Distress Syndrome (ARDS), which is thought to be the main cause of mortality and morbidity in preterm and full-term neonates, particularly in preterm infants born before 30 weeks of gestation, infants of diabetic mothers, caesarean section patients, and patients who did not receive antenatal steroids, neonates with congenital pneumonia, meconium aspiration, congenital malformations like diaphragm [(5)].

Neonatal nurses play a crucial role in the care of high-risk neonates; nurses should be familiar with all skills and information related to caring for prone ventilated high-risk newborns, comprehend airway management concepts, and have basic life support training [(6)].

While providing care to prone ventilated high risk neonates, neonatal nurses should practise hand hygiene, wear protective equipment, assess airways, and assess high risk neonates during prone ventilation to avoid any hazards and complications such as tube displacement and secretion accumulation [(7)].

**Classification of High Risk Neonates**

High risk neonates are classified according to birth weight: Appropriate for gestational age; neonates weight between $10^{th}$ and $90^{th}$ percentiles an intrauterine growth curves, small for gestational age as neonates weight less than the $10^{th}$ percentiles on intrauterine growth curves and larger for gestational age as neonates weight over the $90^{th}$ percentiles on intrauterine curves [(8)].

According to gestational age; preterm neonate who born before completion of 37 weeks of gestation, full term who born between 37-42 weeks of gestation and post term who born after 42 weeks of gestation regardless neonates weight [(9)]. According to pre-dominant pathological problems; associated with the state of neonates' maturity as immature organs, respiratory distress syndrome and neonatal hypoglycemia. Preterm neonate with respiratory distress, hypoglycemia, poor feeding, jaundice and neurodevelopmental outcome liable for high rates of morbidity[(10)].

There are several factors that increase incidence of high risk neonates divided into factors related to mother and factors related to neonates. Factors related to mother as high risk pregnancies as toxemia, placental insufficiency, lack of antenatal care and low socioeconomic condition. Medical illness of the mother as diabetes mellitus, heart or kidney diseases. Complications of labor as premature rupture of membrane, obstructed labor and caesarian section [(11)].

Neonatal factors as neonatal asphyxia, neonatal infection, congenital anomalies and pre or post maturity. The previous conditions often will result in premature birth, low birth weight neonate's or neonate suffering from hypothermia, hyperthermia, hypoglycemia, infant of diabetic mother, neonatal sepsis, hyperbilirubinemia and respiratory distress syndrome [(12)].

**Neonatal Respiratory Distress Syndrome**

Respiratory Distress Syndrome is also called hyaline membrane disease, the most common pulmonary disease among premature neonates. Respiratory distress syndrome known as ineffective respiratory function resulting from lack of pulmonary surfactant, which is a substance that lining alveoli to facilitate alveolar expansion and contraction. There for, the alveoli have diminished surface for gas exchange, as surfactant deficiency results in high alveolar surface tension and progressive atelectasis **(1).**

The risk of respiratory distress syndrome increase with decreasing gestational age; respiratory distress syndrome develops in about 5% of full term neonates, 30% of neonates lower than 30 weeks of gestation and 60% of premature neonates less than 28 weeks of gestation. Other risk factors for respiratory distress syndrome are maternal diabetes, male gender, cesarean delivery, perinatal asphyxia, multiple pregnancy and genetic disorders of surfactant production and metabolism **(13).**

The most common diseases that cause neonatal respiratory distress are transient tachypnea of the new born, respiratory distress syndrome, meconium aspiration, pneumonia, sepsis, pneumothorax and pulmonary hypertension of neonates. Extra pulmonary diseases involve congenital heart defects, air way malformations, inborn errors of metabolism, neurologic and hematologic causes are less common**(14)**.

RDS signs and symptoms appears immediately after birth or after four hours and manifested by tachypnea, chest retraction either subcostal, intercostal or subcostal retraction, nasal flaring, expiratory grunting and cyanosis. On auscultation crackles may be heard laterally over the lungs which represent lung edema and diminishing breath sounds.a Chest radiography show a diffuse ground-glass appearance with hypo expansion of lung. Blood gases show hypoxemia and acidosis. Other symptoms involve wheezing, hypoxia, inspiratory stridor, irregular breathing, apnea and bradypnea **(15).**

**Complications of Neonatal Respiratory Distress Syndrome**

Complications are divided into: Acute complications include perinatal asphyxia, pulmonary air leaks, patent ductus arterioles, pulmonary hypertension, cerebro-ventricular hemorrhage and necrotizing enterocolitis. Subacute complication as convulsions, pulmonary hemorrhage, lung edema, bowel obstruction, gut perforation, retinopathy of prematurity and airway secretions. Chronic complications as cerebral palsy, chronic lung disease, hydrocephalus, visual impairment and hearing loss **(15)**.

Respiratory support is an important component of care delivered to distressed neonates in neonatal intensive care unit. Preventing severe morbidity and optimizing neonatal respiratory function is the primary goal of care delivered for respiratory distressed neonates through reinforcement of regarding antenatal and prenatal care and good management using modern technology. Maintenance of adequate hemoglobin, electrolyte balance, fluids, calcium and glucose homeostasis are also important for supporting neonate with respiratory distress **(16).**

**Neonatal Intensive Care Unit (NICU)**

Neonatal Intensive Care Unit is a department of hospital that provide care for high risk neonates with sever and life

threatening illness, the unit contain equipments as incubator, cardiac monitor, mechanical ventilator and stuffed by high qualified nurses and health care team. The goal of neonatal intensive care unit is to identify high risk neonates before deterioration, preserve airway, breathing and circulation **(17).**

The main goal of neonatal intensive care unit is maintain airway, breathing and circulation. Identify high risk neonates and provide optimum care for them before deterioration to obtain best outcome. Neonatal intensive care unit provide high quality of care for low birth weight and extremely premature neonates which lead to increasing of survival rate of them **(18).**

Mechanical Ventilation is a form of life support. A mechanical ventilator is a machine that takes over the work of breathing when a neonate is not able to breath enough on their own. The mechanical ventilator is also called a ventilator, respirator, or breathing machine. There are many reasons why a neonate may need a ventilator, but low oxygen levels or severe shortness of breath from an infection such as pneumonia are the most common reasons **(19).**

Mechanical ventilator is indicated in neonatal respiratory distress as the neonate requires ventilation support in the first 24 hours, to deliver surfactant, Low $PaO_2$ (hypoxia) and/or high $PaCO_2$ (hypercarbia), in neonates less than 30 weeks of gestation with an x-ray consistent with RDS and increasing oxygen requirements, neonates who do not breathe because of severe neurological disorders **(20).**

Prone positioning is a non-invasive maneuver of positioning neonates in their abdomen. Prone position is the complete reposition of neonate involving turning from supine position. The goal of prone position is to improve gas exchange in neonates with respiratory distress syndrome through decreasing atelectasis, prevent ventilator associated pneumonia in mechanically ventilated high risk neonates and mobilization of secretions **(21).**

Figure (1): Prone position **(22)**.

Prone position improve oxygenation and gas exchange as when the neonate lie on abdomen the weight of the heart comes off of the left lobe and on to the sternum and there is passive expansion of dorsal lobes due to gravity which lead to decrease in dorsal alveolar collapse and improve ventilation and perfusion matching **(2).** Prone position also effective in controlling breath, reduce gastro esophageal reflux and reduction of ventilated associated pneumonia in very low birth weight neonates **(23).**

Prone position facilitate clearance of airway secretions through mobilization of secretions when change neonate position from supine to prone position which lead to improving oxygenation and alveolar ventilation. Also reduce incidence of ventilator associated pneumonia as prolonged immobilization in supine position is associated with atelectasis and retained secretions in posterior lobes **(2).**

Contraindications for prone position on mechanically ventilated high risk neonates include cardiac abnormalities as life-threatening arrhythmias, newly placed

pacemaker, ventricular assist devices, balloon pumps, thoracic or abdominal surgeries, First 24 hours following tracheostomy, Facial trauma, Recent ophthalmic surgery or increased intraocular pressure [(24)].

**Nursing Care of Mechanically Ventilated High Risk Neonates in Prone Position.**

Nurses have very important effect in implementation of prone position for mechanically ventilated high risk neonates and detecting of any possible complication occurred from prone position as displacement of endotracheal tube and accumulation of secretions that lead to blockage of tube and hypoxia [(25)].

Nursing care divided into pre prone positioning care, care during performance of prone position and care after prone position. Before Prone positioning, nurse should make sure that all necessary therapeutic and diagnostic procedures have been performed with the high risk neonate in the supine position, as the duration of prone positioning is consist for 2 hours and all necessary materials must be prepared before prone position [(26)].

**Pre prone position** the nurse done certain steps as : Cleansing the eyes with sterile water solution, administering lubricant gel drops and closing the eyes with a wound closure strip across the eyelids (eye patches that could compress the orbit and cause edema should not be used). Performing oral hygiene and checking the fixation of the endotracheal tube, chest physiotherapy and endotracheal tube suction. Assessing the skin's condition and using hydrocolloid dressings to protect various anatomical points (forehead, cheekbones, thorax, iliac crests and knee) from pressure ulcers [(27)].

Aspirate gastric contents, and stop enteral feeding until the end of the prone position. Venous blood gas values must be analyzed before prone position and recorded to evaluate gas exchange and the Pao2-Fio2 ratio; these results will establish prospectively the effectiveness of prone position with regard to the high risk neonate's oxygenation [(28)].

Assess contraindication of prone position before implementation. Absolute contraindications as intracranial hypertension, unstable vertebral fractures, pelvic fracture. Relative contraindications as surgery, serious facial trauma or facial surgery as cleft lips or cleft palate, severe chest wall lesions and rib fractures, recent cardiothoracic surgery, recent abdominal surgery, chest tube with air leaks, difficult airway management and recent cardiopulmonary arrest [(29)].

**During Prone Positioning**

Nursing care during performance of prone position include assessment of respiratory status and neonate's tolerance to prone position via assessment of heart rate, respiratory rate and oxygen saturation. The high risk neonate should be placed in the "swimmer position," ensuring that the head is positioned so the face looks toward the ventilator and the limbs are positioned with 1 arm raised at the same side of the face and the other arm alongside the body, thereby preventing abnormal extension or flexion of the shoulders and elbows [(28)].

All nonessential monitoring equipment that had been removed before the maneuver must be reattached as (electrocardiographic electrodes should be placed on the high risk neonate's posterior chest) and enteral feeding resumed.

Nurse should assess complications that occur immediately after placing the

high risk neonates in the prone position, such as severe hypotension, bradycardia, or prolonged decrease of oxygen saturation Spo2<85% measured with pulse oximetry), require immediate cessation of prone positioning **(30).**

### After Prone Position

Nursing care after prone position include checking of endotracheal tube placement, assess lip, face and airway as edema can develop when a high risk neonate in prone position .While returning high risk neonate to the supine position, nurses align the limbs along the body to avoid joint damage and then turn the high risk neonate horizontally toward the ventilator and connect all monitoring equipment that had been removed. If the endotracheal develops a leak, a nurses should immediately recheck the position of the endotracheal tube to ensure that the tube has not moved and all appropriate intubation equipment should be immediately available to facilitate effective re-intubation of endotracheal tube **(28).**

Obtain ABG values after supination maneuver. Provide medical evaluation, nursing care and nurse evaluates condition of mouth and eyes, wounds and pressure areas, intravenous catheters, monitor gas exchange, maintain correct positioning, limbs and joints are mobile, $Spo_2$ does not deteriorate, check closed suction system, check intravenous sites, secure ETT, stop enteral feeding, ensure safe movement of chest drain tubes and vascular catheters, connect ECG electrodes **(31).**

## CONCLUSION

Prone position improve arterial blood gases, vital signs and parameters of mechanical ventilation of high risk neonates.

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