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Editorial

Bubble Continuous Positive Airway Pressure: Hope for the Preterm Low Birth Weight Babies with Respiratory Distress

Prematurity is the term used to describe a baby born before 37 completed weeks of pregnancy. An estimated 15 million infants are born prematurely each year and about 1 million neonatal fatalities per year are caused by problems associated with preterm delivery. Preterm births account for 5% to 18% of all births around the world[1]. In Bangladesh, 14% of babies are born prematurely. About 29.7% of them die as a result of various prematurity-related complications[2]. Most premature newborns have low birth weight. A low birth weight is one that weighs less than 2500 grams. Globally, 14.6% of babies are born with low birth weight. Nearly 20.5 million low birth weight babies were born worldwide, which was 12.8 million in Asia, about 62% of the total LBW babies. The prevalence of low birth-weight babies is greater in developing countries, which is 27.8% in Bangladesh[3].

Respiratory distress is one of the common causes of hospital admission of preterm and low birth weight babies. A considerable respiratory morbidity affects about 29% of late-preterm infants hospitalised in the neonatal intensive care unit (NICU); the percentage is even higher for newborns delivered before 34 weeks of pregnancy[4]. Respiratory distress syndrome (RDS), congenital pneumonia, and septicaemia are the three most common causes of respiratory distress in preterm babies. Supplemental oxygen therapy is crucial in managing respiratory distress in these babies. These babies need ventilator support when nasal oxygen therapy fails to maintain oxygenation.

The first continuous positive airway pressure (CPAP) machine designed for newborn usage was released in 1971 by Gregory et al. The distending pressure was created by a resistor clamp on the system's expiratory limb. It is occasionally mistaken for a bubble continuous positive airway pressure (bCPAP) system due to its water submersion pop-off pressure valve, which was set at 30 cm of H_2O. Jen-Tien Wung at Columbia University's Children's Hospital of New York later created the bubble CPAP device employing short nasal prongs[5].

After the invention of bCPAP, the need for ventilator support was dramatically reduced. bCPAP is a non-invasive method of giving supplemental oxygen therapy to patients with severe respiratory distress who fail to maintain oxygen saturation by nasal oxygen therapy. This device has an oxygen blender at one end, and the other end is submerged in the water. In between these two ends, it is connected to the patient. The water submerge end generates pressure, so a positive pressure is maintained in the airway of the patient throughout the respiratory cycle. As a result, the alveoli do not collapse during expiration. Thus, it is more effective in the treatment of preterm babies with RDS, which develops because of surfactant deficiency in preterm babies. As surfactant is deficient in preterm babies, the alveoli collapse during expiration. So, more effort from the patient is necessary to open the alveoli. As the disease progresses, more alveoli collapse, and babies develop severe respiratory distress. bCPAP prevents collapse of the alveoli during expiration in these babies. At the same time, as it is non-invasive, the complications are also less than those of a mechanical ventilator. In a systematic review and meta-analysis, Schmölzer et al. showed that early CPAP is superior to general mechanical ventilation for preterm infants in terms of mortality and/or bronchopulmonary dysplasia[6].

Over prolonged periods of time, surfactant was the main prophylactic and rescue therapy for RDS in premature babies. Since 2013, European guidelines on the management of neonatal respiratory distress syndrome and since 2014, the American Academy of Pediatrics, have recommend continuous positive airway pressure (CPAP) as the first line treatment for RDS and surfactant replacement therapy only when CPAP fails[7,8]. A timely, uninterrupted, and well-delivered CPAP can often avoid the need for surfactant supplementation, even in extremely low-birth-weight newborns. This has a strong pathobiological background since preterm newborns need 4-5 days to create endogenous surfactant and during this time, CPAP may help to expand and maintain the lung[9]. Surfactant replacement was thereafter limited to those who were not responding to CPAP and was used as a second-line, rescue therapy.

Because patients on ventilator support have more complications than those on bCPAP, overall neonatal morbidity and mortality are lower after using bCPAP. Other causes of respiratory distress in premature babies like congenital pneumonia, septicaemia, and apnoea of prematurity can also be successfully treated with bCPAP, which ultimately reduces the need for mechanical ventilator. Additionally, it is affordable, simple to use, and requires little experience. The nurses and doctors on duty may utilise it in the ward. The use of mechanical ventilator assistance on a regular basis for all critically ill patients is still a dream in third world countries, which is why it offers new hope for preterm neonates in those nations. By using bCPAP in the newborn critical care unit and in the neonatal ward, the mortality rate for preterm infants can be reduced. In the end, it will contribute to the achievement of our country's sustainable development goals.

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