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Original Research Article

Respiratory compliance of newborns after birth and their short-term outcomes

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ABSTRACT

Background: Worldwide approximately one million babies die per year due to asphyxia out of which about one third (approximately 3 lakhs) is contributed by our country. The objective of this study was to determine the requirement of respiratory support in newborn babies and their short-term outcomes.
Methods: This retrospective observational study was conducted over one year at PCMS and RC Bhopal. Babies who were delivered in PCMS and required respiratory support at birth were enrolled in the study. The medical records of all these babies for resuscitation measures, requirement of respiratory support after hospitalization to the neonatal intensive care unit and their short-term outcome were recorded on a pre-designed study proforma.
Results: During post-resuscitation care in neonatal intensive care unit, 55.5% (30/54) babies required respiratory support. Among them 7.4% (4/54) were supplemented with oxygen for a few hrs, 22.2% (12/54) required positive end expiratory pressure and put on high flow oxygen and air mixture for 24-48 hours. While 25.9% (14/54) newborns required mechanical ventilation for 3-7 days and then switched over to CPAP for the next 24-48 hrs. Out of 54 babies eight babies expired while ten babies went against medical advice. Remaining 36 babies were discharged, of which five babies developed hypoxic ishchaemic encephalopathy.
Conclusions: It is evident from the present study that half of the resuscitated babies further required respiratory support in the NICU. We also concluded that three fourth of the newborns were discharged and had normal short term outcome.

Keywords: Asphyxia, Newborns, Respiratory

INTRODUCTION

Worldwide approximately one million babies die per year due to asphyxia out of which about one third (approximately 3 lakhs) is contributed by our country. Neonatal resuscitation means to re-establish life of a newborn baby from the state of asphyxia. The National neonatology forum has defined perinatal asphyxia as a "failure to initiate and sustain breathing at birth at one minute of age".[1] Intrapartum related birth events are the third most common cause of neonatal mortality.[2] Problems may begin primarily with the mother, the placenta or the fetus, but present in the infant as ineffective or absent breathing efforts immediately after birth. If uncorrected, lack of oxygen and acidosis occur and eventually lead to damage of vital organs. It is well known fact that nearly 10% of the newborns require some assistance to initiate breathing at birth, and around 1% require extensive resuscitative measures.[3] The choice of intervention depends on the knowledge and experience of the attending paediatrician and the severity of the newborn's condition.[4]

After successful resuscitation baby needs either observational or post-resucitation care, for that newborn is shifted to the neonatal intensive care unit (NICU). Further requirement of respiratory support in NICU is the determinant of survival of the neonate.[5] After shifting to NICU few of these newborns may need either supplemental oxygen or continuous positive airway pressure (CPAP) or Noninvasive positive pressure ventilation (NIPPV) or mechanical ventilation (MV). Although further requirement of respiratory support cannot be attributed just because of perinatal asphyxia. Many of these newborn babies have other associated newborn problems like hyaline membrane disease (HMD), meconium aspiration syndrome (MAS), transient tachypnea of newborn (TTNB), congenital pneumonia (CN), congenital anomaly (CA) and septicaemia.[6] Here we focus on the evidence for neonatal resuscitation and their further requirement of respiratory support in NICU. Scanty data are available on the studies comparing the resuscitation and post-resuscitation requirement of respiratory support of newborns in the NICU.[7] Hence this study was conducted to evaluate the requirement of respiratory support in post resuscitated babies in neonatal intensive care unit.

The objective of this study was to determine the respiratory support of newborn at birth. Further requirement of respiratory support in these resuscitated babies in the early neonatal period. Outcome of resuscitated babies in terms of discharge, LAMA, death or neurological sequaelae.

METHODS

A retrospective study was conducted in the NICU, Department of Pediatrics, Peoples College of Medical Science and Research Center (PCMS and RC), Bhopal, Madhya Pradesh, India, over one year from January 2013 to December 2013. This hospital caters for a population which is mainly rural, semi urban and some urban patients with a significant number of below poverty line (BPL) income group patients. Deliveries are just under 1000 per year with a large number of un-booked mothers and mothers with complicated obstetric or antenatal history referred from district/rural hospitals.

The medical records of all inborn babies who required either resuscitation at birth or minimal assistance to breathe were enrolled in the study. Their immediate requirement of respiratory support after being admitted to the NICU were reviewed. Data regarding birth weight, gestational age, type of resuscitation, reason for requirement of resuscitation and respiratory support were analyzed. Babies who were transferred to other hospital on the same day were excluded from the study.

All the babies were resuscitated according to the guidelines of American Heart Association 2010 guidelines.[4] All the delivered newborns were attended by the second or third year post graduate students who were in their learning phase. Newborn resuscitation was accomplished perfectly due to the availability of basic equipment like linens, a bag and mask resuscitator, laryngoscope, endotracheal tube and a suction device. Babies who required resuscitation were shifted to NICU for further management, and they were put on oxygen, CPAP or MV depending on their requirement. Ventilated infants were weaned when baby's condition improved and extubated to support them with CPAP or oxygen as early as possible. Infants were monitored for neonatal morbidities for a period of 30 days unless discharged or transferred to another hospital.

Various modalities given to support respiration of post-resuscitated new-born

- Oxygen (O2) - prewarmed and humidified O2 was administered via nasal cannula, face mask, or O2 hood. Goal was to achieve an O2 saturation of 90 to 94% in preterm infants and 92 to 96% in term infants.
- Continuous positive airway pressure (CPAP) - In this set-up CPAP was provided with humidified oxygen delivered by high-flow nasal cannulae using nasal prongs. CPAP was indicated when FIO2≥ 40% is required to maintain acceptable PaO2 (50 to 70 mm Hg) in newborns.
- Mechanical ventilator (MV) - synchronized intermittent mandatory ventilation mode was the main mode of ventilation in the neonates in our study. Arterial blood gases were analyzed regularly. The indications for commencement of mechanical ventilation were (i) intractable or recurrent apnea (ii) Gasping or poor respiration (iii) continuous positive airway pressure (CPAP) failure, defined as worsening respiratory distress, and/or hypoxemia (PaO2 <50 mmHg)/hypercarbia (PaCO2 >60 mmHg) despite CPAP pressure of 7-8 cm H2O and FiO2 of 0.8 or recurrent episodes of apnea.

RESULTS

During the study period 965 babies were delivered at Peoples college of medical sciences & RC. Out of these only 57 babies required assistance to begin breathing at birth. But three babies were shifted to other hospital due to non-availability of bed, hence excluded from the study. Data on 54 newborns were tabulated and analysed. Of the 54 babies, 27 were preterm and 8 were post-term remaining were full-term babies.

- Tactile stimulation and suction (oral or nasal) was needed in 10 out of 54 babies
- BMV was needed in approximately one fourth (12/54) neonates
- BTV was needed in half of the babies (30/54). Out of that 63.3% babies required either CPAP (6/54) or ventilatory support (13/54). Eight babies expired while 7 babies went LAMA. Out of these 7 LAMAS, 2 babies were on MV mode hence transferred to

another hospital by our postgraduate students. These babies were given positive pressure ventilation via bag and mask during transportation.

Table 1: Demographic details of newborn resuscitated at birth.

Variables	Newborn	54	5.6%
Sex	Male	32	59.2%
	Female	22	40.7%
Gestational age	Preterm	27	50.0%
	Fullterm	19	35.1 %
	Post term	8	14.8%
Birth weight	LBW	24	44.4%
	VLBW	13	24.0%
	ELBW	0	0
Weight for gestational age	Appropriate	41	75%
	Small	8	14.8%
	Large	5	9.2%
Mode of felivery	NVD	19	35.1%
	LSCS	35	64.8%
Ante-partum risk Factors	PROM	2	3.7%
	Severe oligohydramnios	3	5.5%
	Placenta previa	2	3.7%
	Pre-Eclampsia	5	9.25%
	Prolonged labour	4	7.4%
	Difficult extraction	1	1.8%
	Breech delivery	1	1.8%
	Foetal distress	5	9.2%
Foetal risk factors	HMD	6	11.1%
	MAS	15	27.8%
	Cong pneumonia	2	3.7%
	Cong anomaly	2	3.7%
	Delayed adaptation	2	3.7%
Unknown risk factors		4	7.4%

Table 2: Assistance required to initiate breathing or resuscitate newborn.

Newborns		Assistance
911	94.4%	NIL
2	0.2%	Oral suction
5	0.5%	Tracheal suction
5	0.5%	Tactile stimulation
12	1.2%	Bag and mask ventilation (BMV)
30	3.1%	Bag and tube ventilation (BTV)
965 Total		

Table 4: Resuscitated newborns requiring further respiratory (30 = 55.5%) support in NICU to sustain breathing.

	N= 54	Nil	Oxygen	CPAP	MV	p- value
Oral suction	2 (3.7%)	2 (100%)	0	0	0	Not Applicable
Tactile stimulation	5 (9.2%)	5 (100%)	0	0	0	Not Applicable
Tracheal suction	5 (9.2%)	2 (40%)	0	3 (60%)	0	0.08
BMV	12 (22.2%)	7 (58.3%)	1 (8.3%)	3 (25%)	1 (8.3%)	0.42
BTV	30 (55.5%)	8 (26.6%)	3 (10%)	6 (20%)	13 (43.3%)	0.04
Total	**54 (100%)**	**24 (44.4%)**	**4 (7.4%)**	**12 (22.2%)**	**14 (25.9%)**	**Not applicable**
Mortality	8 (14.8%)	Nil	Nil	2 (25%)	6 (75%)	0.13

Out of these 54 asphyxiated babies, approximately half of them required further respiratory support in NICU. Although further requirement of respiratory support cannot be attributed just because of perinatal asphyxia. Many of these newborn babies were having other associated newborn morbidities like HMD, MAS, TTNB, CN, CA and septicaemia (Table 4).

- Supplementary Oxygen was administered to few (4/54) of the babies and that also for one to two hours.
- One fourth (12/54) newborn babies required CPAP due to increasing distress. Twelve newborns babies achieved spontaneous breathing but due to distress they were given CPAP in NICU. They required CPAP for 48-72 hours then CPAP was weaned off. Eight of them didn't required intubation or ventilation during their further stay in NICU. While 2 were just put on oxygen for next few days. Two of them had CPAP failure hence put on MV
- Requirement of MV was predominantly in BTV babies (almost half of the BTV 13/30) and it was statistically significant p=0.04. Out of them approximately half (6/13) of them required prolonged (>7 days) MV support. Remaining of them were weaned after 72 hours and put either on CPAP or oxygen according to their conditions.

Table 4 shows that mortality was largely seen in babies who required MV but it was statistically insignificant (p = 0.13). They were additionally having HMD (4), MAS (1), CA (1), Sepsis (1) and others (1). Out of these eight babies five babies (62%) were on MV since day one of their life.

Table 4: Comorbidities and final outcome of the resuscitated newborns those who further required respiratory support at birth.

	Resuscitated	Further no requ	Oxygen	CPAP	MV	HIE N = 5	Discharge N = 36 (66.6%)	Died N = 8 (14.8%)	LAMA N = 10 (18.5)
HMD@	7	0	0	3	3	0	1	4	2
MAS $	16	5	2	4	4	3	11	1	4
TTNB^	1	0	1	0	0	0	1	0	0
CN#	2	0	1	1	0	0	2	0	0
CA*	2	1	0	0	1	0	1	1	0
Sepsis	24	18	0	3	3	1	20	1	3
Others~	2	O	1	1	0	1	0	1	1
N = 54	54	24	4	12	14	5	36	8	10

@ HMD-Hyaline membrane disease; $ MAS- Meconium aspiration syndrome; ^TTNB-Transient tachypnea of newborn; # CN-Congenital pneumonia; *CA- Congenital anomaly (heart, diaphragm); ~Others-Aspiration pneumonia.

DISCUSSION

The observations of the present study revealed that approximately 5.6% of the newborns required assistance to begin breathing at birth. These results are consistent with various previous worldwide published reports.[2-4]

In this setup babies who required BTV were regularly required ventilator in NICU, while BMV babies hardly ever needed Mechanical ventilator in NICU. We found the two most common causes for the requirement of bag and tube ventilation were HMD in preterm babies and MAS in term babies. These are similar to study done by Mathur et al who showed that HMD babies most of the time need mechanical ventilation in NICU.[8]

Tracheal suctioning was done only in non-vigorous meconium stained babies, majority of them were either post-term or intra-uterine growth retarded. In one third of these meconium stained babies, distress resolved spontaneously after sometime and they didn't required any support. While in remaining of them distress was persisiting and they had pneumonitis radiologically. They were put on CPAP but one–fourth had CPAP failure hence further put on MV while two of them successfully removed from CPAP after 4 hours and then put on oxygen for next 48-72 hours. These results were in agreement to the multicentric study done by Bhagwat et al.[9]

This study proved that one fourth babies who do not breathe at birth, initial ventilation with a self-inflating bag-and-mask was sufficient. These results were consistent to studies of various authors.[10-12] The majority of BMV babies didn't required ventilatory support in NICU, while one or two babies required CPAP or oxygen in NICU.

This study also revealed that out of all resuscitated newborns, mechanical ventilator was required frequently in HMD babies. A study from Kerala also showed similar results.[7]

Study results revealed that BTV was needed more often (> 55.5%) than bag and mask ventilation, this can be explained in a way that ours is a referral centre hence complicated cases are admitted more often. This is in contradiction to study done by Palme et al who found that eighty percent of the newborns in their study were satisfactorily ventilated by bag and mask.[10]

In this study along with asphyxia other related causes of respiratory insufficiency requiring further respiratory support were sepsis, MAS, HMD, CN and CA. While a study by Mathur et al from Delhi has given similar results although in their study they included all newborns who were admitted in their NICU while we included only resuscitated babies.[6]

Also it is found that newborn babies who required nasal CPAP at birth had a reduced need for further ventilatory support in their neonatal period. This is in agreement to the non-randomized trials conducted at various places by different authors Avery et al and Kampers et al.[13,14]

Our results showed that asphyxiated babies who required MV, more often succumb. These results are in agreement to previous work done by Nangia et al and Mathur et al who showed that Mechanically ventilated neonates have a high fatality.[5,8] Mortality was predominantly noted in fifty percent babies having HMD who required mechanical ventilation to support their breathing. Fulminant sepsis and ventilator induced pneumonia are two important co-associated causes of Mortality.

Our results showed that ninety percent of the babies do not had neurological symptoms on reassessment at 72 hours while a study from Nepal illustrated that thirty percent of asphyxiated babies showed various stages of HIE.[15] That may be because we included only hospital delivered newborns, data may be different if samples

were taken from home delivered babies. Although three fourth newborns were completely improved and discharged, while eight of them died and parents of ten babies were not willing for continuing further treatment because of various reasons, hence they left hospital against medical advice.

Limitations of the study was provider characteristics (provider type, years of experience, training on newborn resuscitation, number of newborn resuscitations performed in the past and confidence in performing newborn resuscitation) were not considered. Prolonged follow up of the asphyxiated babies were not done. In our study figures are of tertiary care center, data from peripheries may be different.

CONCLUSION

Out of all resuscitated newborns half of them required bag and tube ventilation. Half of the babies who required assistance to breath at birth required further respiratory support in the NICU. Hence to reduce infant mortality, infrastructure of neonatal intensive care should be strengthened. We advocate that more data to get published from centres all over the country. Further studies should be done at multicentric level so as to find the exact burden of resuscitated babies on NICU and mechanical ventilator requirement so that infrastructure can be improved especially in developing countries and in low resource settings.

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