Original Article

Iran J Pediatr
Dec 2013; Vol 23 (No 6), Pp: 675-680

Neonatal Resuscitation in the Delivery Room from a Tertiary Level Hospital: Risk Factors and Outcome

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Received: *Nov 05, 2012*; Accepted: *Jun 28, 2013;* First Online Available: *Nov 27, 2013*

Abstract

Objective: Timely identification and prompt resuscitation of newborns in the delivery room may cause a decline in neonatal morbidity and mortality. We try to identify risk factors in mother and fetus that result in birth of newborns needing resuscitation at birth.

Methods: Case notes of all deliveries and neonates born from April 2010 to March 2011 in Mahdieh Medical Center (Tehran, Iran), a Level III Neonatal Intensive Care Unit, were reviewed; relevant maternal, fetal and perinatal data was extracted and analyzed.

Findings: During the study period, 4692 neonates were delivered; 4522 (97.7%) did not require respiratory assistance. One-hundred seven (2.3%) newborns needed resuscitation with bag and mask ventilation in the delivery unit, of whom 77 (1.6%) babies responded to bag and mask ventilation while 30 (0.65%) neonates needed endotracheal intubation and 15 (0.3%) were given chest compressions. Epinephrine/volume expander was administered to 10 (0.2%) newborns. In 17 patients resuscitation was continued for >10 mins. There was a positive correlation between the need for resuscitation and following risk factors: low birth weight, preterm labor, chorioamnionitis, pre-eclampsia, prolonged rupture of membranes, abruptio placentae, prolonged labor, meconium staining of amniotic fluid, multiple pregnancy and fetal distress. On multiple regression; low birth weight, meconium stained liquor and chorioamnionitis revealed as independent risk factors that made endotracheal intubation necessary.

Conclusion: Accurate identification of risk factors and anticipation at the birth of a high-risk neonate would result in adequate preparation and prompt resuscitation of neonates who need some level of intervention and thus, reducing neonatal morbidity and mortality.

Iranian Journal of Pediatrics, Volume 23 (Number 6), December 2013, Pages: 675-680

Key Words: Neonate; Delivery Room; Risk Factors; Resuscitation; Newborn; Respiratory Assistance

Introduction

Establishing an effective respiration at birth and transformation from fetal circulation to an independent extra uterine state is necessary to start and maintain life; a phenomenon that proceeds smoothly in 90% of neonates. However, approximately 10% of newborn babies fail to initiate effectual breathing; most of these start breathing after initial stimulation by the health personnel, about 3-5% need basic resuscitation, but <1% require advanced resuscitative effort to achieve efficient circulation to the vital organs[1-6]. According to recent estimates approximately 10 million of 136 million neonates born annually require some assistance to begin breathing at

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birth[5].

In order to prevent asphyxia which results in high morbidity and causes 19% of neonatal deaths, American Heart Association, (AHA) has issued guidelines that would identify babies needing respiratory assistance at birth[6].

According to recent authorities[5], neonatal resuscitation is categorized into 3 steps as follows:

1. Initial steps: Immediate assessment, providing warmth, drying the baby and tactile stimulation.
2. Basic resuscitation: Clearing airways, (suctioning if necessary), positioning the head and giving positive pressure ventilation via bag and mask.
3. Advanced Resuscitation: Basic resuscitation (as above) plus endotracheal intubation, chest compression and epinephrine/volume administration as required.

Recognition of risk factors, results in identification of high risk deliveries and attendance of the resuscitation team, before the baby is born.

Objective of this study was to identify perinatal risk factors in determining the need for resuscitation of newborn babies, and also to assess the effectiveness of prompt resuscitation in preventing neonatal mortality due to asphyxia.

Subjects and Methods

In this cross sectional retrospective study medical records of all deliveries and the newborns during a period of one year from April 2010 to March 2011 in a tertiary level hospital with Neonatal Intensive Care Unit (NICU) were selected. This center is a teaching hospital in south Tehran affiliated to Shahid Beheshti University of Medical Sciences, and referral center for high risk pregnancy and deliveries with about 5000 deliveries annually. Midwives, nurses and physians of the center are trained and qualified in neonatal resuscitation program (NRP).

In this center, in all low risk deliveries a midwife or nurse who has been trained to provide initial care to the newborn, including bag and mask ventilation (BMV) is present. Neonatology fellows are present in delivery room for all high risk deliveries and perform initial assessment and resuscitation of the neonate according to (NRP)[6], the process of cardio pulmonary resuscitation (CPR) documented completely in chart of neonates step by step according to algorithm of American Academy of Pediatrics and American Heart Association[6].

All live born infants (including those with major congenital anomaly) entered the study. We excluded only stillbirths.

Relevant information regarding mothers' present and past medical history, details of labor, general condition of the newborn at birth, Apgar scores at 1 and 5 minutes, specification of resuscitative measures and clinical course of the mother and baby were collected from the notes and documented.

All pertinent data was analyzed by PASW statistics 18. Bivariate analyses between independent variables and study outcome (initial steps, basic or advanced resuscitation) were performed by Chi-square or ANOVA. All independent variables with *P*-values <0.15 were selected for modeling in polynomial regression analysis (with backward stepwise method). *P*<0.05 was considered as statistically significant.

Findings

During one year (April 2010-March 2011) 4629 live born neonates were delivered in the hospital; of these 51.5% were males. Mean birth weight was 2984±667 grams and mean gestational age 37.4±2.6 weeks; 23.7% were preterm, 18.6% low birth weight (LBW) and 4.3% very low birth weight (VLBW).

Four thousand five hundred and twenty two (97.7%) neonates received only initial steps of CPR; 107 (2.3%) newborns needed BMV in the delivery unit; of these 77 (1.6%) babies responded, while 30 (0.65%) neonates needed endotracheal intubation and 15 (0.3%) were given chest compressions. Epinephrine/volume expander was administered to 10 (0.2%). Newborns. In 17 patients resuscitation was continued for >10 mins (Table 1).

Following high risk deliveries were identified: Pre-eclampsia 347 (7.5%), fetal distress 272

Table 1: Demographic and clinical characteristic of mother/neonate dyad

Variable	Characteristic	Frequency or Mean (N=4629)
Mode of delivery	Normal Vaginal Delivery	1959 (42.3%)
	Caesarian Section	2670 (57.7)
Gestational age (mean±SD)		34.7 (2.6)
	<37	1099 (23.7%)
	37-42	3525 (76.2%)
	>42	5 (0.1%)
Birth weight (gr)	Range	400-5130
	mean ± SD	2984 (667)
	<1500	201 (4.3%)
	1500-2499	672 (14.5%)
	2500-3999	3597 (77.7%)
	≥4000	159 (3.4%)
Sex	Female	2244 (48.5%)
	Male	2385 (51.5%)
Ante-Intrapartum risk factors	Maternal Addiction	40 (0.9%)
	PROM>18hr	211 (4.6%)
	MSAF	264 (5.7%)
	Multiple birth	140 (3%)
	Maternal diabetes	137 (3%)
	Chorioamnionitis	12 (0.3%)
	Preeclampcia	347 (7.5%)
	Abruptio placenta	27 (0.6%)
	Fetal distress	272 (5.9%)
	Prolonged labor	16 (0.3%)
	Infertility	128 (2.8%)
Apgar score	at 1 min (mean±SD)	8.8 (0.8)
	at 5 min (mean±SD)	9.8 (0.6)
Low apgar score	at 1 min:(<4)	26 (0.65)
	at 5 min: (<7)	31 (0.7%)
	Bag and mask ventilation	107 (2.3%)
	Intubation	30 (0.6%)
	Chest compression	15 (0.3%)
	Epinephrine/volume expander	10 (0.2%)
Duration of Resuscitation	<10 min	90 (1.94%)
	>10 min	17 (0.37%)

PROM: Premature Rupture of Membrane; MSAF: Meconium Stained Amniotic Fluid

(5.9%), meconium stained liquor 246 (5.7%), PROM 211 (4.6%), maternal diabetes 137 (3 %), history of infertility 128 (2.8%), maternal addiction 40 (0.9 %), abruptio placentae 0.6%, chorioamnionitis and prolonged labor each 0.3%.

There was a positive correlation between the need for resuscitation and the following risk factors: low birth weight, preterm labor, chorioamnionitis, pre-eclampsia, prolonged rupture of membranes, abruptio placentae, prolonged labor, meconium staining of amniotic fluid, multiple pregnancy and fetal distress (Table 2).

Multiple regression revealed that, low birth weight, meconium staining of amniotic fluid and chorioamnionitis are primary risk factors for endotracheal intubation; in addition, low Apgar scores were associated with need for respiratory assistance, each one point decline in the score was accompanied by a 1.74 increase in the risk for need for resuscitation (74% increase in the odds of need for basic and 163% increase in the odds for advanced resuscitation) (Table3).

Forty-seven newborns (10 per 1000 live births) died, 11 deaths were a direct result of asphyxia (23.4%) (Table4).

Discussion

As far as we know this is the first report of neonatal resuscitation at birth from a tertiary level

Table 2: Bivariate analysis of risk factors for need to resuscitation

Characteristic		Level of neonatal resuscitation			*P.* Value (Chi-2 for categoricals)
		Initial steps	Basic (Bag entilation)	Advanced (intubation...)	
Birth. Weight(gr)		3020 (621)	1426 (608)	1642 (1168)	<0.001
Gestational. Age(w)		37.6 (2.3)	30.8 (3.5)	30.5 (5.4)	<0.001
Apgar score at 1 min		8.9 (0.6)	6.1 (1.7)	3.9 (1.7)	<0.001
Apgar score at 5 min		9.9 (0.4)	7.9 (1.3)	6 (1.7)	<0.001
Sex	Female	2203 (98.2%)	30 (1.3%)	11 (0.5%)	0.1
	Male	2319 (97.2%)	47 (2%)	19 (0.8%)	
Birth weight (gr)	>=2500	3744 (99.7%)	5 (0.1%)	7 (0.2%)	<0.001
	1500-2499	647 (96.3%)	20 (3%)	5 (0.7%)	
	<1500	131 (65.2%)	52 (25.9%)	18 (9%)	
Gestational age <37w	No	3514 (99.5%)	9 (0.3%)	7 (0.2%)	<0.001
	Yes	1008 (91.7%)	68 (6.2%)	23 (2.1%)	
Delivery. type	NVD	1937 (98.9%)	15 (0.8%)	7 (0.4%)	<0.001
	C/S	2585 (96.8%)	62 (2.3%)	23 (0.9%)	
Maternal addiction	No	4482 (97.7%)	77 (1.7%)	30 (0.7%)	0.7
	Yes	40 (100%)	0 (0%)	0 (0%)	
Chorioamnionitis	No	4516 (97.8%)	74 (1.6%)	27 (0.6%)	<0.001
	Yes	6 (50%)	3 (25%)	3 (25%)	
Preeclamcia	No	4191 (97.9%)	65 (1.5%)	26 (0.6%)	0.01
	Yes	331 (95.4%)	12 (3.5%)	4 (1.2%)	
Premature Rupture of Membrane	No	4323 (97.8%)	67 (1.5%)	28 (0.6%)	0.004
	Yes	199 (94.3%)	10 (4.7%)	2 (0.9%)	
Abruptio Placenta.	No	4507 (97.9%)	70 (1.5%)	25 (0.5%)	<0.001
	Yes	15 (55.6%)	7 (25.9%)	5 (18.5%)	
Infertility	No	4419 (98.2%)	57 (1.3%)	25 (0.6%)	<0.001
	Yes	103 (80.5%)	20 (15.6%)	5 (3.9%)	
Prolonged. labor	No	4509 (97.7%)	75 (1.6%)	29 (0.6%)	0.005
	Yes	13 (81.3%)	2 (12.5%)	1 (6.3%)	
Diabetes	No	4387 (97.7%)	76 (1.7%)	29 (0.6%)	0.7
	Yes	135 (98.5%)	1 (0.7%)	1 (0.7%)	
Aminotic. fluid	Clear	4277 (98%)	65 (1.5%)	23 (0.5%)	<0.001
	Meconium	245 (92.8%)	12 (4.5%)	7 (2.7%)	
Fetal distress	No	4266 (97.9%)	65 (1.5%)	26 (0.6%)	0.001
	Yes	256 (94.1%)	12 (4.4%)	4 (1.5%)	
Gravidity	Single	4420 (98.5%)	45 (1%)	24 (0.5%)	<0.001
	M.P	102 (72.9%)	32 (22.9%)	6 (4.3%)	
Apgar score at 1 min	7-10	4448 (99.2%)	33 (0.7%)	4 (0.1%)	<0.001
	4-6	69 (58.5%)	38 (32.2%)	11 (9.3%)	
	0-3	5 (19.2%)	6 (23.1%)	15 (57.7%)	
Apgar score at 5 min	7-10	4517 (98.2%)	68 (1.5%)	13 (0.3%)	<0.001
	4-6	5 (17.2%)	9 (31%)	15 (51.7%)	
	0-3	0 (0%)	0 (0%)	2 (100%)	

center in Iran, although workshops on CPR started nearly 20 years ago, there was no report to evaluate its effect on neonatal outcome.

Another important point is that, this study shows different problems regarding mothers and neonates in a perinatal center in this country.

Most neonates during the period of our study did respond to initial steps of resuscitation; however, about 2.3% needed basic resuscitation, the majority of this group responded to positive pressure ventilation with bag and mask. In advanced resuscitation 0.65% needed endotracheal intubation, chest compression was done in 0.3% and epinephrine/volume expander was administered in 0.2%. Majority of neonates did well by initial steps and most of them that needed basic resuscitation also recovered by BMV, but those with advanced resuscitation had different risk factors in less than 1% of our neonates.

Our findings are comparable to other studies in which chest compression was needed for resuscitation in 0.1–0.12% of live births and epinephrine was given in 0.08-0.1% of

Table 3: Multiple regression analysis results of risk factors for need to resuscitation

Characteristic	Initial steps vs. Basic Bag ventilation		Initial steps vs. Advanced Resuscitation		Basic Bag ventilation vs. Advanced resuscitation	
	OR (95%CI)	*P.* Value	OR (95%CI)	*P.* Value	OR (95%CI)	*P.* Value
Apgar-1	1.74 (1.22-2.48)	0.002	2.63 (1.57-4.40)	<0.001	1.51 (0.92-2.48)	0.1
Apgar-5	1.72 (1.05-2.81)	0.03	2.74 (1.48-5.09)	0.001	1.60 (0.90-2.82)	0.1
Birth weight (x100 gm)	1.19 (1.13-1.24)	<0.001	1.15 (1.08-1.22)	<0.001	0.97 (0.90-1.03)	0.3
MSAF	4.53 (1.93-10.63)	0.001	7.40 (1.75-31.25)	0.006	1.63 (0.40-6.69)	0.5
Chorioamnionitis	10.47 (1.14-96.41)	0.04	44.47 (2.57-768.32)	0.009	4.25 (0.44-41.02)	0.2
Multi-gravidity	1.98 (0.97-4.06)	0.06	0.82 (0.23-2.97)	0.8	0.41 (0.13-1.36)	0.1

CI: Confidence Interval; MSAF: Meconium Stained Amniotic Fluid

resuscitation in 0.1–0.12% of live births and epinephrine was given in 0.08-0.1% of neonates[1,2,7-9]. In a study by Wyckoff et al it was shown that 0.47% of 37972 neonates were resuscitated at birth, with 0.39% needing bag and mask ventilation and only 0.08 requiring endotracheal intubation[10]. In Trevisanuto's study 1.48% of their babies were intubated at birth and 0.25% required chest compression[11].

In our study, low birth weight (especially VLBW), meconium staining of liquor, and chorioamnionitis were major factors that placed neonates at risk of asphyxia. In different studies, preterm labor, meconium staining of liquor, breech presentation, maternal hypertension, multiple pregnancy, oligohydramnios, and cesarean section have been identified as risk factors for need for neonatal resuscitation at birth[12-15]. In Molkenboer's study it was found that the need for bag and mask ventilation was 4 times higher in newborns with breech presentation[14].

Since this study was performed in a Level III center that accepts pregnant women with various co-morbid conditions and high risk newborns, the mortality rate was significant at 10/1000, although it was considerably lower than the figure of 30/1000, which is the neonatal mortality rate worldwide as announced by the WHO[16,17]. Although during the last two decades, the global NMR has declined from 33.2 deaths per 1,000 live births to 23.9/1000; but greatest decline has been noticed in Europe and the USA. Similar to other studies, most common cause of mortality in our study was neonatal asphyxia[6,17-22].

Limitations of our study were its being retrospective and without long term follow up for those newborns with basic and advanced resuscitation.

Conclusion

Our study identified low birth weight, chorioamnionitis and meconium stained liquor as

Table 4: Outcome of neonates with and without needing resuscitation at birth

Characteristic		Level of neonatal resuscitation			
		Initial steps	Basic (Bag ventilation)	Advanced (intubation)	Total
Ward	**Rooming in**	2725 (60.3%)	1 (1.3%)	0 (0%)	2726 (58.9%)
	SCN[1]	1467 (32.4%)	0 (0%)	0 (0%)	1467 (31.7%)
	NICU[2]	330 (7.3%)	76 (98.7%)	30 (100%)	436 (9.4%)
Outcome	**survived**	4509(99.7%)	58 (75.3%)	15 (50%)	4582 (99%)
	expired	13 (0.3%)	19 (24.7%)	15 (50%)	47 (1%)
Causes of death	**Asphyxia**	0 (0%)	1 (5.3%)	10 (66.7%)	11 (23.4%)
	Others	13 (100%)	18 (94.7%)	5 (33.3%)	36 (76.6%)

SCN: Special Care Nursery; NICU: Neonatal Intensive Care Unit

the salient risk factors for birth of neonates who would require resuscitation in the delivery room. Accurate anticipation at the birth of a high-risk baby, presence of skilled personnel at the time of delivery of all neonates and adequate preparation would result in a significant decline in neonatal outcome.

Acknowledgment

The authors are grateful to the Director and personnel of the Pediatric Infections Research Center for their support and cooperation in implementation of this study. We thank the personnel of the neonatal unit of Mahdieh Hospital for their efforts in collection and documentation of the data. We also express thanks to Dr. Ahmad Reza Shamshiri for performing the statistical analysis.

Conflict of Interest: None

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