

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

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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 Mahdiah 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.

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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 physicians 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%)
	Preeclampsia	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%)
Duration of Resuscitation	Bag and mask ventilation	107 (2.3%)
	Intubation	30 (0.6%)
	Chest compression	15 (0.3%)
	Epinephrine/volume expander	10 (0.2%)
	<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%)	
Gestational age <37w	<1500	131 (65.2%)	52 (25.9%)	18 (9%)	<0.001
	No	3514 (99.5%)	9 (0.3%)	7 (0.2%)	
Delivery. type	Yes	1008 (91.7%)	68 (6.2%)	23 (2.1%)	<0.001
	NVD	1937 (98.9%)	15 (0.8%)	7 (0.4%)	
Maternal addiction	C/S	2585 (96.8%)	62 (2.3%)	23 (0.9%)	0.7
	No	4482 (97.7%)	77 (1.7%)	30 (0.7%)	
Chorioamnionitis	Yes	40 (100%)	0 (0%)	0 (0%)	<0.001
	No	4516 (97.8%)	74 (1.6%)	27 (0.6%)	
Preeclampsia	Yes	6 (50%)	3 (25%)	3 (25%)	0.01
	No	4191 (97.9%)	65 (1.5%)	26 (0.6%)	
Premature Rupture of Membrane	Yes	331 (95.4%)	12 (3.5%)	4 (1.2%)	0.004
	No	4323 (97.8%)	67 (1.5%)	28 (0.6%)	
Abruptio Placenta.	Yes	199 (94.3%)	10 (4.7%)	2 (0.9%)	<0.001
	No	4507 (97.9%)	70 (1.5%)	25 (0.5%)	
Infertility	Yes	15 (55.6%)	7 (25.9%)	5 (18.5%)	<0.001
	No	4419 (98.2%)	57 (1.3%)	25 (0.6%)	
Prolonged. labor	Yes	103 (80.5%)	20 (15.6%)	5 (3.9%)	0.005
	No	4509 (97.7%)	75 (1.6%)	29 (0.6%)	
Diabetes	Yes	13 (81.3%)	2 (12.5%)	1 (6.3%)	0.7
	No	4387 (97.7%)	76 (1.7%)	29 (0.6%)	
Aminotic. fluid	Yes	135 (98.5%)	1 (0.7%)	1 (0.7%)	<0.001
	Clear	4277 (98%)	65 (1.5%)	23 (0.5%)	
Fetal distress	Meconium	245 (92.8%)	12 (4.5%)	7 (2.7%)	0.001
	No	4266 (97.9%)	65 (1.5%)	26 (0.6%)	
Gravidity	Yes	256 (94.1%)	12 (4.4%)	4 (1.5%)	<0.001
	Single	4420 (98.5%)	45 (1%)	24 (0.5%)	
Apgar score at 1 min	M.P	102 (72.9%)	32 (22.9%)	6 (4.3%)	<0.001
	7-10	4448 (99.2%)	33 (0.7%)	4 (0.1%)	
	4-6	69 (58.5%)	38 (32.2%)	11 (9.3%)	
Apgar score at 5 min	0-3	5 (19.2%)	6 (23.1%)	15 (57.7%)	<0.001
	7-10	4517 (98.2%)	68 (1.5%)	13 (0.3%)	
	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			Total
		Initial steps	Basic (Bag ventilation)	Advanced (intubation)	
Ward	Rooming in	2725 (60.3%)	1 (1.3%)	0 (0%)	2726 (58.9%)
	SCN¹	1467 (32.4%)	0 (0%)	0 (0%)	1467 (31.7%)
	NICU²	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.

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Conflict of Interest: None

References

1. Perlman JM, Risser R. Cardiopulmonary resuscitation in delivery room: associated clinical events. *Arch Pediatr Adolesc Med* 1995;149(1):20-5.
2. Barber CA, Wyckoff MH. Use and efficacy of endotracheal versus intravenous epinephrine during neonatal cardiopulmonary resuscitation in the delivery room. *Pediatrics* 2006;118(3):1028-34.
3. Kattwinkel J, Perlman JM, Aziz K, et al. special report neonatal resuscitation :2010 American Heart Association Guidelines for cardiopulmonary resuscitation and emergency cardiovascular care. *Pediatrics* 2010;126(5):1400-10.
4. Fanaroff and Martin's Neonatal-Perinatal Medicine, 9th ed. Diseases of the Fetus and Infant. Philadelphia; Elsevier. 2011; Pp :456-60.
5. Lee AC, Cousens S, Wall NS, et al. Neonatal resuscitation and immediate newborn assessment and stimulation for prevention of neonatal deaths: a systematic review, meta-analysis and Delphi estimation of mortality effect. *BMC Public Health* 2011;11(Suppl 3):S12.
6. American Academy of Pediatrics and American Heart Association. Textbook of neonatal resuscitation. 5th ed. Dallas, TX: American Heart Association 2006; Pp:14-22.
7. Aziz K, Chadwick M, Downton G, et al. The development and implementation of multidisciplinary neonatal resuscitation team in a Canadian perinatal center. *Resuscitation* 2005; 66(1):45-51.
8. Wall SN, Lee AC, Niermeyer S, et al. Neonatal resuscitation in low-resource setting: What, Who and How to overcome challenges to scale up? *Int J Gynaecol Obstet* 2009;107(Suppl 1):S47-62, S63-4.
9. Frazier MD, Werthammer J. Post-resuscitation complications in term neonates. *J Perinatol* 2007; 27(2):82-4.
10. Wyckoff MH, Prelman JM, Laptook AR. Use of volume expansion during delivery room resuscitation in near-term and term infants. *Pediatrics* 2005;115(4):950-5.
11. Trevisanuto D, Ferrarese P, Zanardo V, et al. Laryngeal mask airway in neonatal resuscitation: a survey of current practice and perceived role by anaesthesiologist and pediatricians. *Resuscitation* 2004;60(3):291-6.
12. Aziz K, Chadwick M, Baker M, et al. Ante- and intrapartum factors that predict increased need for neonatal resuscitation. *Resuscitation* 2008;79(3): 444-52.
13. de Almeiola MF, Guinburg R, Dacosta JO, et al. Resuscitation procedures at birth in late preterm Infants. *J Perinatol* 2007;27(12):761-5.
14. Molkenboer JF, Vencken PM, Sonnemans LG, et al. Conservative management in breech deliveries leads to similar results compared with cephalic deliveries. *J Matern Fetal Neonatal Med* 2007;20(8):599-603.
15. Vain NE, Szyld EG, Prudent LM, et al. Oropharyngeal and nasopharyngeal suctioning of meconium-stained neonates before delivery of their shoulder: multicenter, randomised controlled trial. *Lancet* 2004;364(9434):597-602.
16. Hole MK, Olmsted K, Kiromera A, et al. A neonatal resuscitation curriculum in Malawi, Africa: Did it change in-hospital mortality? *Int J Pediatr* 2012; 40:8689.
17. WHO. World Health Report, 2005. Make Every Mother and Child Count. Geneva Switzerland: WHO 2005.
18. Bang AT, Paul VK, Reddy HM, et al. Why do neonates die in rural Gadchiroli, India? (Part I): Primary causes of death assigned by neonatologist based on prospectively observed records. *J Perinatol* 2005; 25(Suppl 1): 29-34.
19. Jehan I, Harris H, Salat S, et al. Neonatal mortality, risk factors and causes: a prospective population-based cohort study in urban Pakistan. *Bull World Health Organ* 2009; 87(2):130-8.
20. Oestergaard MZ, Inoue M, Yoshida S, et al. Neonatal mortality levels for 193 countries in 2009 with trends since 1990: A systematic analysis of progress, projections, and priorities. *PLoS Med* 2011; 8(8): e1001080.
21. Lawn JE, Lee AC, Kinney M, et al. Two million intrapartum-related stillbirths and neonatal deaths: Where, why, and what can be done? *Int J Gynecol Obstet* 2009;107(Suppl 1):S 5-19.
22. Lawn JE, Cousens S, Zupan J. Lancet Neonatal Survival Steering Team. 4 million neonatal deaths: when? Where? Why? *Lancet* 2005; 365(9462):891-900.