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Evaluation of delivery room resuscitation in late preterm and term newborns according to the intensity of resuscitation

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Abstract

The transition from intrauterine to extrauterine life is not achieved smoothly by all newborns; approximately 10% of all births require additional assistance to initiate breathing. We aimed to describe the frequency and extent of delivery room resuscitation in late preterm and term infants with short term neonatal outcomes and we also compared our results according to the intensity of resuscitation. In this single-centre retrospective study, maternal and neonatal data were collected from medical records at Malatya Turgut Ozal University Hospital between January 2021-2022. A total of 181 infants resuscitated at birth were included. The mean gestational age of 38 ± 2 week and mean birth weights of 3169±629 grams. The majority of the newborns were male , and 28 (15.5%) were late premature. Free flow oxygen / CPAP and bag mask ventilation were the most common maneuvers with a frequency of 45.3% and 35.3% respectively. There was no significant difference between the need for advanced delivery room resuscitation and gender, prematurity and presence of small for gestational age or large for gestational age ($p>0.05$). But when maternal factors were evaluated, the mode of delivery, chorioamnionitis, adolescent mother subgroup, and presence of maternal diabetes were significantly different between the two groups ($p<0.05$). In addition, the advanced resuscitation group had lower Apgar scores, and also the rate of asphyxia, birth trauma, pneumothorax and death were higher in this group ($p<0.05$). In late preterm and term newborns, neonatal outcomes worsen as the intensity of delivery room resuscitation increases.

Keywords: Newborn, resuscitation, delivery room

Introduction

Birth is one the most challenging episode in the human life. Transition from intrauterine to extrauterine life is one of the major physiological adaptation of newborns. While the majority of newborns maintain this transition period seamlessly, almost 10% breath after drying and stimulation and approximately 3% initiate respiration after positive pressure ventilation and fewer require further resuscitation at delivery room (DR) [1]. To ensure ‘’effective ventilation’’ by providing successful transition from plasental respiration to pulmonary circulation is the cornerstone of resuscitation procedures which performed immediately after birth. After the initial steps; newborns may need free flow oxygen, continious positive pressure, bag mask ventilation, intubation, chest compression (CC) and drug administrations for survival [2]. Due to immaturity, as the gestational week decreases, the need for resuscitation of preterm babies increases [3]. Additionally late preterm infants ($34^{0/7}$-$36^{6/7}$ gestational weeks) more often require DR resuscitation than term newborns ($37^{0/7}$-$41^{6/7}$ gestational weeks) [4].

The first ‘’golden minute’’ has important implications for early and long term outcomes, so determining the newborns most likely to require DR resuscitation before birth is critical to provide adequate neonatal care at delivery; however, it should be noted that poor neonatal adaptation cannot be predicted in some newborns [5]. For this reason, in our institution, at least one qualified person who skilled in the first steps of newborn care and positive presssure ventilation is present at every birth; and in the presence of risk factors , a full equipped team with full resuscitation skills is present in every birth in accordance with the proposal of Neonatal Resuscitation Programme (NRP) guidelines published by American Academy of Pediatrics [6].

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In the literature, studies on newborn resuscitation mostly focused on preterm infants, varied resuscitation techniques and equipments, but did not mention the intensity of resuscitation. We aimed to describe the frequency and extent of delivery room resuscitation in late preterm and term infants with short term neonatal outcomes and we also compared our results according to the intensity of resuscitation.

Materials and Methods

This cross sectional retrospective study included all late preterm and term newborns who required delivery room resuscitation in Malatya Turgut Ozal University Hospital between January 2021-2022. The data of all maternal-neonatal dyads reviewed from hospital electronical database and clinical medical records. Newborns born and resuscitated in our institution during the study period were included. Stillbirths, newborns with major congenital anomalies and who born at <34 gestational weeks were excluded. Newborns were evaluated for clinical characteristics such as gestational age which determined by assessment of last menstruel period or early ultrasound measurements, birth weight, gender, delivery mode, Apgar scores at 1st and 5th minutes, type of delivery room resuscitation, presence of birth trauma and pneumothorax, presence of small for gestational age (SGA) or large for gestational age (LGA), day of hospitalisation in neonatal intensive care unit (NICU), main diagnosis during hospitalization and outcome (discharge / exitus). Mothers age and parity, administration of antenatal steroid and magnesium, history of prolonged ruptures of membranes (>18 h), meconium stained amniotic fluid, preeklampsi, pre-existing medical conditions, presence of maternal diabetes, presentation, presence of cephalopelvic disproportion (CPD), cord prolopsus, acute fetal distress, oligo or polyhidramnios and type of anesthesia given to the mother were recorded.

Delivery room resuscitation was defined as any receipt of support after birth besides routine care that included warming, drying and tactil stimulation of the newborn. Neonates were divided into two groups according to the highest level of resuscitation they needed. The group receiving oxygen and / or CPAP and positive pressure ventilation was defined as basic resuscitation group and the group receiving endotracheal intubation, chest compression, epinephrine use, volume expander use was defined as advanced resuscitation group [7]. If necessary, ventilation support was provided by T-piece resuscitator, by bag mask or intubation and for all delivery room resuscitation procedures were performed according to the International Liaison Committee on Resuscitation (ILCOR) 2015 recommendations [8].

Ethical approval was obtained from Malatya Turgut Ozal University Clinical Research Ethical Committee with number 2022/8, informed consents were taken from parents and Helsinki Declaration rules were followed to conduct this study.

Statistical analysis

Data were summarized as mean ± standard deviation (SD), and count (percent). Conformity to the normal distribution was done using the Kolmogorov-Smirnov test. Mann-Whitney U, independent sample t-test and chi-square tests were used appropriate for statistical analysis. The statistical level of significance for all test was considered to be $p<0.05$.

Results

During the study period, 6194 live births took place in our institution, and 181 (2.92%) of these births who ≥ 34 gestational weeks were needed resuscitation in the DR ; 146 (2.35%) of these were basic resuscitated and the remaining 35 (0.57%) were received advanced resuscitation. The mean gestational week of the resuscitated babies was 38 ± 2, and the mean birth weight was 3169 ± 629 grams. The majority of the newborns included in the study were male, and 28 (15.5%) were late premature.

Twenty-two (12.2%) infants were SGA, and 23 (12.7%) were LGA. The mean maternal age was 29 ± 6 years and 14 (7.7%) mothers were in adolescent age and 41 (22.7%) mothers were in advanced maternal age. A total of 61(33.3%) pregnant women were primigravida, 30 (16.6%) mothers continued to smoke actively throughout their pregnancy and 44 (24.3%) mothers did not have regular pregnancy follow-up during their pregnancy. Antenatal steroid was administered to only 10 (5.5%) pregnant women and antenatal magnesium sulfate infusion was given to 7 (3.9%) of the pregnants. Maternal diabetes were present in 23 (12.7%) of the mothers, and the frequency of preeclampsia was 7.7%. There were no multiple pregnancies resulting in need for resuscitation during the study period.

When intrapartum features were evaluated, there were signs of acute fetal distress in 42 (23.2%) fetuses and CPD was present in 38 (21%) fetuses. 60 (33.1%) pregnant women had meconium stained amniotic fluid, 13 (7.2%) pregnant women had premature rupture of the membranes and 11 (6.1%) pregnant women had chorioamnionitis. Oligohydraamnios was detected in 9 (5%) pregnants and polyhydraamnios was detected in 6 (3.3%) pregnants. While 15 (8.3%) fetuses were in breech presentation, abruptio placenta was observed in 10 (5.5%) pregnants and cord prolapse was observed in only 6 (3.3%) pregnants. Considering the delivery types, 62 (34.3%) of the babies were born by normal vaginal delivery, 55 (30.4%) were born with elective cesarean section (CS) and the rest were born with emergency CS. While 49.7% of pregnant women with CS had regional anesthesia, 16% received general anesthesia.

When the resuscitation attempts were examined, it was seen that free flow oxygen / CPAP and bag mask ventilation were the most common maneuvers with a frequency of 45.3% and 35.4% respectively. The vast majority of late preterms were in the basic resuscitation group (89.3%). Other procedures were applied with decreasing frequency as their intensity increased (Table 1). All of the babies who were resuscitated in the delivery room were hospitalized in the intensive care unit and the mean hospitalization duration were 7 ± 6 days. The most common hospitalization reason of the patients were routine care of resuscitated newborn (34.2%), asphyxia (21%) and meconium aspiration syndrome (18.2%). Birth trauma was detected in 14 (7.7%) patients and the most common trauma was clavicle fracture . In 6 patients, pneumothorax was detected on the first x-ray which taken immediately after NICU admission. A total of 17 (9.4%) infants died and two of them did not respond to resuscitation in the delivery room. Evaluation of maternal risk factors according to the intensity of resuscitation are summarized in Table 2.

We also grouped and compared the newborns according to

the intensity of the resuscitation attempts performed. In terms of basic neonatal demografic data, there was no significant difference between the need for advanced DR resuscitation and gender, prematurity and being SGA or LGA infant (p>0.05). But when maternal factors were evaluated, the mode of delivery, chorioamnionitis, adolescent mother subgroup, and presence of maternal diabetes were significantly different between the two groups (p<0.05). In addition, the advanced resuscitation group had significantly lower Apgar scores, and also the rate of asphyxia and death was significantly higher in this group, too. Again, the rate of birth trauma and pneumothorax was higher in the advanced resuscitation group (p<0.05). However, when hospitalization diagnoses other than asphyxia were compared, there was no statistically significant difference between the two groups (p>0.05) (Table 3).

Table 1. Resuscitation attempts applied to newborns

		Total (n) = 181
Oxygen and / or CPAP		82 (45.3)
	Late preterm	9 (5)
	Term	73 (40.3)
Bag mask ventilation		64 (35.4)
	Late preterm	14 (7.7)
	Term	50 (27.6)
Endotracheal entubation		21 (11.6)
	Late preterm	2 (1.1)
	Term	19 (10.5)
ETT+ Chest compresssion		9 (5)
	Late preterm	1 (0.6)
	Term	8 (4.4)
ETT + CC + Epinephrine		3 (1.7)
	Late preterm	-
	Term	3 (1.7)
ETT+CC+Epinephrine + Volume expansion		2 (1.1)
	Late preterm	-
	Term	2 (1.1)

Data presented as n (%) Abbreviations: CPAP; Continious positive airway pressure, ETT; Endotracheal entubation, CC; Chest compresssion

Table 2. Maternal risk factors according to the resuscitation intensity

	Basic resuscitation (n = 146)	Advanced resuscitation (n = 35)	p value
Antepartum risk factors			
Primiparity	46 (31.5)	15 (42.9)	0.28
Maternal age, < 18 years	6 (4.1)	8 (22.9)	0.04
Maternal age, > 35 years	32 (21.9)	9 (25.7)	0.8
Antenatal steroid administration	9 (6.2)	1 (2.9)	0.21
Antenatal MgSO4 infusion	5 (3.4)	2 (5.7)	0.53
Smoking	24 (16.4)	6 (17.1)	1.00
Regular follow-up	111 (76)	26 (74.3)	1.00
Preeclampsia	13 (8.9)	1(2.9)	0.24
Maternal diabetes	22 (15)	1(2.9)	0.02
Oligohydramnios	9 (6.2)	0	0.21
Polyhydramnios	5 (3.4)	1(2.9)	0.6
Intrauterin growth restriction	9 (6.2)	0	0.21
Intrapartum risk factors			
Chorioamnionitis	4 (2.7)	7 (20)	0.002
Breech presentation	12 (8.2)	3 (8.6)	1.00
Abruptio plasenta	6 (4.1)	4 (11.4)	0.24
Acute fetal distress	27 (18.5)	15 (42.9)	0.004
Cephalopelvic disproportion	32 (21.9)	6 (17.1)	0.69
Premature rupture of membranes	11 (7.5)	2 (5.7)	0.21
Meconium stained amniotic fluid	48 (32.9)	12 (34.3)	1.00
Cord prolapse	3 (2)	3(8.6)	0.09
General anesthesia	23 (15.8)	6(17.1)	0.002
Vaginal delivery	59 (40.4)	3(8.6)	
Elective CS	44 (30.1)	11 (31.4)	< 0.001
Emergency CS	43 (29.5)	21 (60)	

Data presented as n (%) Abbreviations: $MgSO^4$; Magnesium sulfate, CS; Ceserean section

Table 3. Neonatal outcomes according to the resuscitation intensity

	Basic resuscitation (n = 146)	Advanced resuscitation (n = 35)	p value
Gestational week	38±2	39±2	0.3
Birth weight, gram	3128±665	3341±415	0.06
Prematurity	25 (17.1)	3 (8.6)	0.32
Male	97 (66.4)	21 (60)	0.6
SGA status	19 (13)	3 (8.6)	0.58
LGA status	17 (11.6)	6 (17.1)	0.4
Apgar score 1st minute	5 ± 2	3 ± 2	< 0.001
Apgar score 5th minute	8 ± 1	7 ± 2	< 0.001
Birth trauma	8 (5.5)	6 (17.1)	0.03
Pneumothorax	0	6 (17.1)	< 0.001
Respiratory distress syndrome	2 (1.4)	0	0.1
Transient tachypnea of newborn	12 (8.2)	6 (17.1)	0.12
Sepsis	17 (11.6)	3 (8.6)	0.77
Pneumonia	20 (13.7)	3 (8.6)	0.58
Meconium aspiration syndrome	24 (16.4)	9 (25.7)	0.3
Asphyxia	14 (9.6)	24 (68.6)	< 0.001
Hospitalization, days	5 ± 5	11 ± 9	< 0.001
Death	-	17 (48.6)	< 0.001

Data presented as n (%) and mean ± SD Abbreviations: SGA; Small for gestational age, LGA; Large for gestational age

Discussion

In this single-center retrospective study, we evaluated the demographic and clinical characteristics of resuscitated newborns at birth and compared the data according to the intensity of delivery room resuscitation. Consistent with previous studies neonatal mortality and short term morbidities worsen when the intensity of resuscitation increases.

During the study period, 2.92% of the all live-births who ≥ 34 gestational weeks were needed resuscitation in the DR ; of these 2.35% were basic resuscitated and the remaining 0.57% were received advanced resuscitation. In a prospective multicenter study including newborns at ≥ 34 gestational weeks, it was found to be 0.37% of newborns received advanced resuscitation [9]. Also, in a cohort study, which included 10774 late preterm and term participants, the authors found that any resuscitation requirement was 30.2%, but the majority of those were received free flow oxygen, while it was 6.4% for bag and mask ventilation and further procedures [10]. As study design heterogeneities are remarkable, various resuscitation rates have been reported in previous studies. Our study revealed that the most frequently performed resuscitation procedures were primarily those for respiratory support. In the literature, there are many reports emphasizing the importance of initial ventilation steps in the delivery room resuscitation process [5]. According to Foglia et al. [11], the most critical intervention for successful delivery room resuscitation is effective ventilation.

In our study, we did not find a significant difference between maternal antenatal steroid and magnesium administration and the need for basic and advanced resuscitation of newborns. Similarly, Jiang et al. [12] also found no statistically significant relationship between antenatal steroid administration and resuscitation intensity. However, the point that should never be forgotten in this regard is the absolute necessity of antenatal steroids for preterms. Drassinower et al. [13], in their study investigating whether magnesium exposure for neuroprotection affects delivery room resuscitation or not, showed that it does not affect immediate neonatal resuscitation. Bajaj et al. [14] showed that maternal hypertension and SGA status were also associated with intensity of resuscitation but in contrast we couldn't show any statistically significant difference between preeclempsia and SGA among groups.

When we evaluated the patients according to the intensity of resuscitation, we found that maternal adolescent age and maternal diabetes were significantly different between groups ($p < 0.05$). While the infants with an adolescent mother required advanced resuscitation more frequently, the need for basic ressucitation was higher in infants with diabetic mother. In fact, maternal diabetes, advenced maternal age and prolonged rupture of membranes have been deleted from the ILCOR 2016 list as potential risk factors for high density resuscitation [15]. However, according to our data, there was a statistically significant difference between maternal diabetes and resuscitation intensity, although there was no difference if it was related to advanced maternal age and prolonged rupture of membranes. In a study investigating the associtaion between DR resuscitation intensity and neonatal outcomes in late preterms; infants who received higher levels of resuscitation were more likely to be born from diabetic mothers [12]. Likewise in our study, we demonstrated a significant difference between maternal diabetes and advenced resuscitation. We attribute these inconsistencies between the results to the heterogenity of the population sizes and characteristics of newborns.

Among the intrapartum risk factors we found that presence of corioamnionitis, acute fetal distress, mode of delivery and maternal general anesthesia were significantly different between groups ($p<0.05$). In a retrospective cohort study invastigating the prognosis of nearly one hundred thousand term babies with chorioamnionitis, it was reported that chorioamnionitis was significantly associated with DR intubation [16]. Afjeh et al. [17] found that corioamnionitis was not statistically different in the subgroup they compared basic bag ventilation vs advanced resuscitation; however they found statistically significant difference only in initial steps vs basic bag ventilation / advanced resuscitation subgroups. In a study which investigating predictive risk factors for intensive birth resuscitation, it was noted that breech presentation was a statistically different risk factor for intensive resuscitation but our results didn't reveal a similar result [18]. In a previous study, in which neonatal outcomes were evaluated according to DR resuscitation intensity, the authors noted that the rate of cesarean section was significantly higher in groups with more intensely resuscitated [19]. Again, in an another study revealed the same results in infants born at 33 to 36 weeks gestation in this regard [12]. In an another study on the advanced resuscitation of term and near term infants at birth, in parallel with our results, a significant statistical relationship was shown between maternal general anesthesia and emergency cesarean and advanced resuscitation [9]. Our results also revealed that the least resuscitation need was in the elective cesarean group; similarly Aziz et al. [20] and Hogston et al. [21] reported that elective CS was protective for neonatal resuscitation at term.

Newborns who require positive pressure ventilation at birth are recommended to receive post resuscitation care [22]. Consistent with previous studies, the results of this study showed that frequencey of birth trauma, pneumothorax and asphyxia were higher in the advance resuscitated group. Additionally, total hospitalization days were longer and death as a final result was more common in the advance resuscitated group. We could not show any difference between the groups in terms of sepsis and any association between gender and intensity of resuscitation and in line with our results Bashir et al. [19] didn't show any difference. Jiang et al. [12] found that pneumothorax and mortality rates were higher in the intense resuscitated group compared to those with no or minimal resuscitation. Again, in a retrospective study in which infants with birth weight ≤ 1500 g receiving DR resuscitation were included and neonatal outcomes were investigated, it was reported that sepsis, pneumothorax and mortality were higher in the more intensely resuscitated group; further, the duration of hospitalization was found to be longer in the more intensively resuscitated group [19]. In a national registry study evaluating survival after DR cardiopulmonary reuscitation and including newborns at all weeks of gestation, the discharge rate was found to be 64% [23]. In our study, our discharge rate was 90.6%, but we did not include < 34 weeks premature infants with the highest mortality rate in our study.

Our study has several limitations, such as the retrospective design and contains only small number of population. In addition, since limited data exists to date on the intensity of DR resuscitation,

therefore we think that our study contributes the literature in this context.

Conclusion

Based on the results of the present study, in late preterm and term newborns, neonatal outcomes worsen as the intensity of delivery room resuscitation increases. Also, the presence of maternal diabetes, chorioamnionitis and acute fetal distress were associated with an increase in the intensity of resuscitation. Further mode of delivery and maternal general anesthesia were also in relation to intensity of resuscitation. Considering the clinical variety of the neonatal resuscitation, further studies are needed to more clearly define and compare the neonatal outcomes and the risk factors in various contexts.

Conflict of interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical approval
Ethical approval was obtained from Malatya Turgut Ozal University Clinical Research Ethical Committee with number 2022/8, and Helsinki Declaration rules were followed to conduct this study.

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