Advanced maneuvers in neonatal resuscitation at a hospital in the amazon region: associated factors

Manobras avançadas de reanimação neonatal em um hospital da região amazônica: fatores associados

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ABSTRACT
Objective: To analyze among newborns that required resuscitation the probability of chances between the need for advanced procedures and demographic and obstetric characteristics, use

of substances and intercurrences during pregnancy. *Methods*: Descriptive and multivariate analytical study, carried out in a maternity hospital in the Amazon region. All medical records of newborns in 2018 were researched, and those with missing data and Cook's distance <0,20 were excluded. The remaining were divided by the intervention performed: positive pressure ventilation or advanced maneuvers (orotracheal intubation, direct laryngoscopy, cardiac massage, drugs or CPAP mask). The variables analyzed were demographic and obstetric characteristics, use of substances and intercurrences during pregnancy. Logistic regression was used to derive unadjusted and adjusted odds ratios and 95% confidence intervals. *Results*: 1611 infants went through resuscitation. Out of them, 217 were excluded, due to missing data and Cook's distance <0,20. 41,2% of the the remaining 1394 required advanced maneuvers. Adjusted odds ratio revealed significant association between needing advanced resuscitation and low gestational age (5 times higher chances), 5th minute Apgar <7 (28 times higher chances), tobacco (9 times higher chances), small for gestational age (6 times higher chances), low birth weight (4-5 times higher chances), meconium (double chances), not specified gestational intercurrences (3 times higher chances) and absence of gestational diabetes (6 times higher chances). *Conclusions*: Prematurity, low birth weight, 5th minute Apgar <7, small for gestational age, meconium and tobacco were associated with higher chances of advanced maneuvers.

Keywords: newborn, perinatal care, resuscitation.

RESUMO

Objetivos: Analisar entre recém-nascidos submetidos à reanimação a razão de chances entre a necessidade de manobras avançadas e características epidemiológicas, dados obstétricos, uso de substâncias e intercorrências durante a gestação. *Método*: Estudo descritivo de análise multivariada, desenvolvido em serviço público de atendimento materno infantil na Região Amazônica. Foram pesquisados prontuários de recém-nascidos em 2018. Foram excluídos aqueles com dados incompletos e distância Cook <0,20. Os restantes foram divididos conforme a intervenção realizada: somente ventilação com pressão positiva ou necessidade de manobras avançadas (intubação orotraqueal, laringoscopia direta, massagem cardíaca, drogas ou CPAP nasal). As variáveis analisadas foram características epidemiológicas e obstétricas, uso de substâncias e intercorrências durante a gestação. Foi utilizada a regressão logística para derivar odds ratios não ajustados e ajustados e intervalos de confiança de 95%. *Resultados*: 1611 recém-nascidos receberam reanimação, sendo excluídos 217 por dados incompletos ou distância Cook <0,20. 41,2% dos 1394 restantes receberam procedimentos avançados. O odds ratio ajustado revelou associação significativa entre a necessidade de reanimação avançada e baixa idade gestacional (5 vezes mais chances), Apgar 5º minuto <7 (28 vezes mais chances), tabaco (9 vezes mais chances), recém-nascido pequeno para idade gestacional (6 vezes mais chances), baixo peso ao nascer (4-5 vezes mais chances), mecônio (o dobro de chances), intercorrências gestacionais inespecíficas (3 vezes mais chances) e ausência de diabetes gestacional (6 vezes mais chances). *Conclusão*: Prematuridade, baixo peso, Apgar 5º minuto <7, pequeno para idade gestacional, mecônio e tabaco foram fatores de risco para manobras avançadas em reanimação neonatal.

Palavras-chave: recém-nascido, assistência perinatal, ressuscitação.

1 INTRODUCTION

Of all Brazilian neonatal deaths, 66% would be avoided by adequate assistance[1]. An important measure to reduce that rate is a proper management of neonatal resuscitation[2], a specific support at birth that varies from positive pressure ventilation to medication use. It is estimated that one in 10 newborns needs ventilation assistance to begin effective breathing, one in 100 requires tracheal intubation, and 1-2 in 1000 also need cardiac massage and/or drugs[3].

Therefore, the need for resuscitation must be anticipated by checking risk factors[4], for example, low gestational age and birth weight, prenatal and labor complications[5]. After that, it is easier to provide adequate care during the "Golden Hour", the first 60 minutes after delivery, essential for immediate and long-term outcome[6].

As mortality's decrease depends on time optimization, the International Liaison Committee on Resuscitation publishes recommendations on neonatal resuscitation based on systematic reviews, the last of which was published in 2015. These suggestions are adapted to regional issues, giving importance to local resources and circumstances[7]. In Brazil, infant mortality rate can decrease by raising awareness in pregnancy and labor profiles in each region[8].

For that reason, this study took place at a maternity and neonatal referral hospital in the Amazon region and aimed to analyze among newborns that required resuscitation in the delivery room the probability of chances between the need for advanced resuscitation maneuvers and the following factors: demographic and obstetric characteristics, use of chemical substances during pregnancy and gestational intercurrences. Those results make improvement in neonatal care feasible in public health.

2 METHODS

This is a descriptive and multivariate analytical study. All hospital records of live births from January 1st to December 31st, 2018 were researched at a public maternity hospital in Belém-Pará (Brazil) after project approval (number 3.046.575) by the Research Ethics Committee of the institution. Those newborns gone through resuscitation were included in this research. Infants with missing data in one or more variables, no detail about resuscitation maneuvers and Cook's distance <0.20 were excluded. The remaining newborns were divided into two groups according to the type of procedure: ventilation, coded as zero (when only positive pressure ventilation was used) and advanced resuscitation, coded as one (when other procedures – orotracheal intubation, direct laryngoscopy, cardiac massage, drug administration or nasal CPAP mask – were performed). The variables demographic and obstetric characteristics, use of chemical substances during pregnancy and gestational intercurrences

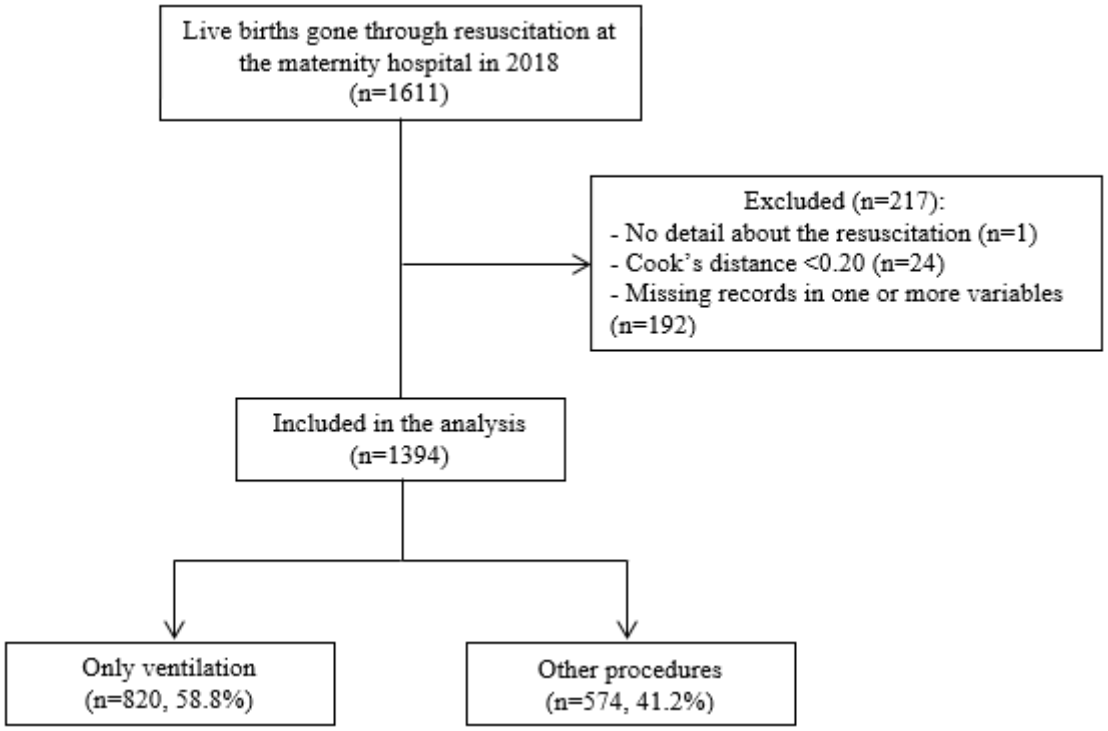
were described by frequency and percentage (categorical variables) or mean and standard deviation (quantitative variables).

Logistic regression was used to derive odds ratios and 95% confidence intervals (CI), providing access to the association between the type of resuscitation and the chosen variables. Initially, all patients and all variables were analyzed to identify those with atypical pattern of characteristics, using Cook's distance analogue. Incomplete records and records with Cook's distance <0.20 were discarded. Then, logistic regression was applied in two contexts: 1) each individual predictor associated with the type of resuscitation; 2) all predictors associated with the type of resuscitation in a single analysis. The first context derived unadjusted odds ratios (disregarding any interactions with other predictors). The second derived adjusted odds ratio (considering interactions with other variables). The data were analyzed using the statistical software SPSS version 20 (IBM Corp., Armonk, NY, USA).

3 RESULTS

Out of all 9956 neonates born at the maternity hospital in 2018, 1611 (16.18%) required resuscitation, but 217 were excluded due to missing records or Cook's distance <0.20. The remaining 1394 (86.53%) of them were analyzed. 41.2% of the analyzed newborns received advanced procedures, while 58.8% only needed ventilation (Figure 1).

Figure 1 – Resuscitated infants born in 2018 at the institution researched included in the study analysis.



The demographic and obstetric data of the two groups are shown in Table 1. Maternal ages were close in both, with median age about 25 years old. In both groups the following characteristics were the most frequent: number of prenatal care consults <6, caesarean mode of delivery, no meconium-stained amniotic fluid, not a twin birth, 1st minute Apgar score <7 and ≥7 in the 5th minute. Ventilation group was mainly appropriate for gestational age (AGA), while most of the advanced group was small for gestational age (SGA).

Table 1 – Demographic and obstetric characteristics of resuscitated newborns and mothers in the institution researched, Belém-Pará, in 2018.

Variable	Advanced Resuscitation (n = 574)		Only ventilation (n = 820)	
	n	%	n	%
Maternal age	25.3±7.0		25.4±6.9	
Gestational age (weeks)				
<28	64	11.1	3	0.4
28-33	221	38.5	54	6.6
34-36	119	20.7	224	27.3
≥37	170	29.6	539	65.7
Prenatal consults (nº)				
<6	540	94.1	714	87.1
≥6	34	5.9	106	12.9
Delivery				
Caesarean section	331	57.7	558	68.0
Normal vaginal	243	42.3	262	32.0
Sex				
Feminine	242	42.2	374	45.6
Masculine	332	57.8	446	54.4
Birth weight (g)				
<1000	140	24.4	12	1.5
1000-1500	147	25.6	31	3.8
1500-2500	135	23.5	270	32.9
>2500	152	26.5	507	61.8
Length (cm)	47.7±4.2		41.5±6.9	
Head circumference (cm)	33.3±2.7		29.2±4.7	
Meconium				
No	406	70.7	554	67.6
Yes	168	29.3	266	32.4
Twin birth				
No	518	90.2	745	90.9
Yes	56	9.8	75	9.1
Weight/GA				
Small for GA	347	60.5	288	35.1
Appropriate for GA	225	39.2	499	60.9
Large for GA	2	0.3	33	4.0
1st min Apgar				
<7	444	77.4	625	76.2
≥7	130	22.6	195	23.8
5th min Apgar				
<7	149	26.0	14	1.7
≥7	425	74.0	806	98.3

The variables are presented by frequency and percentage (categorical) or by median ± standard deviation (numeric), relative to the entire group. Only 10 newborns were classified as gestational age ≥42 weeks, therefore they were sorted along with the 37-41 weeks neonates. GA: gestational age.

Table 2 details the resuscitation maneuvers performed.

Table 2 – Resuscitation maneuvers performed on newborns in the institution researched, Belém-Pará, in 2018.

Resuscitation	**(n = 1394)**	
	n	**%**
Positive pressure ventilation	1311	94.0
Orotracheal intubation	514	36.9
Direct laryngoscopy	84	6.0
Cardiac massage	43	3.1
Drug administration	43	3.1
Nasal CPAP Mask	12	0.9

The percentages are relative to the total number of patients. The percentages may not total 100, due to patients who went through two or more maneuvers.

Table 3 reveals the use of chemical substances and intercurrences during pregnancy in both groups. Alcohol and tobacco were more often reported in advanced group. Urinary tract infection was the most frequent intercurrence. Pregnancy hypertensive disorders were more recurrent in ventilation group, and bleeding was more frequent in advanced group. Gestational diabetes was more often found in ventilation group than in advanced group.

Table 3 – Use of chemical substances and intercurrences during pregnancy in resuscitated neonates born at the institution researched, Belém-Pará, in 2018.

Variable	**Advanced Resuscitation (n = 574)**		**Only ventilation (n = 820)**	
	n	**%**	**n**	**%**
Chemical substances				
None	528	92.0	763	93.0
Alcohol	35	6.1	39	4.8
Tobacco	30	5.2	26	3.2
Illicit drugs	11	1.9	18	2.2
Abortion medication	4	0.7	6	0.7
Other	2	0.3	1	0.1
Gestational intercurrences				
Urinary tract infection	224	39.0	285	34.8
None	190	33.1	305	37.2
Pregnancy hypertensive disorders	129	22.5	219	26.7
Bleeding	114	19.9	112	13.7
Candida infection	30	5.2	35	4.3
Gestational diabetes	5	0.9	36	4.4
Syphilis infection	10	1.7	7	0.9
Consanguinity	5	0.9	6	0.7
HIV infection	2	0.3	7	0.9
Other	16	2.8	13	1.6

The percentages are relative to the total number of patients. The percentages may not total 100, due to cases with two or more intercurrences or chemical substances.

Adjusted odds ratio in risk analysis (Table 4) showed significant association between the type of resuscitation procedure and GA, 5th minute Apgar score, weight/GA, meconium and

twin birth, gestational diabetes and other not specified gestational intercurrences, nonuse of substances and use of tobacco.

Table 4 - Predictors associated with the type of resuscitation maneuver (only ventilation or other procedures) among neonates in the institution researched, Belém-Pará, in 2018.

Variables (n=1394)	OR (CI 95%)	aOR (CI 95%)
Demographic and obstetrics		
Gestational age <28 weeks	67.64 (20.98-218.06)	5.47 (1.30-23.12) *
Gestational age 28-33 weeks	12.98 (9.20-18.30)	4.12 (2.17-7.80) *
Gestational age 34-36 weeks	1.68 (1.27-2.23)	1.48 (0.95-2.31)
Gestational age ≥37 weeks	Reference	
Masculine sex	1.15 (0.93-1.43)	1.27 (0.95-1.71)
1st min Apgar < 7	1.07 (0.83-1.37)	1.06 (0.76-1.50)
5th min Apgar < 7	20.18 (11.53-35.35)	27.91 (14.51-53.68) *
Birth weight < 1000g	38.91 (21.00-72.11)	5.05 (1.57-16.20) *
Birth weight 1000-1500g	15.82 (10.31-24.26)	4.02 (1.75-9.22) *
Birth weight 1500-2500g	1.67 (1.27-2.20)	0.98 (0.60-1.61)
Birth weight > 2500g	Reference	
Small for gestational age	19.88 (4.73-83.56)	6.76 (1.10-41.52) *
Appropriate for gestational age	7.44 (1.77-31.27)	6.27 (1.06-37.00) *
Large for gestational age	Reference	
Length	0.83 (0.81-0.85)	0.95 (0.89-1.01)
Head circumference	0.74 (0.71-0.77)	0.96 (0.88-1.05)
Caesarean delivery	0.64 (0.51-0.80)	1.11 (0.80-1.54)
Presence of meconium	0.86 (0.68-1.09)	2.19 (1.56-3.07) *
Maternal age (years)	1.00 (0.98-1.01)	1.00 (0.98-1.02)
<6 prenatal care consults	2.36 (1.58-3.53)	1.56 (0.94-2.61)
Not a twin birth	0.93 (0.65-1.34)	2.42 (1.40-4.16) *
Gestational intercurrence		
No intercurrence	0.84 (0.67-1.05)	1.26 (0.74-2.16)
Presence of urinary tract infection	1.20 (0.96-1.50)	1.51 (0.98-2.33)
No pregnancy hypertensive disorder	1.26 (0.98-1.61)	1.22 (0.78-1.90)
Presence of bleeding	1.57 (1.18-2.09)	1.29 (0.82-2.03)
Presence of candida infection	1.24 (0.75-2.04)	1.40 (0.71-2.78)
No gestational diabetes	5.23 (2.04-13.40)	5.82 (1.46-23.29) *
Presence of syphilis infection	2.06 (0.78-5.44)	1.76 (0.52-5.92)
No HIV infection	2.46 (0.51-11.90)	4.21 (0.32-56.12)
Other intercurrences	1.36 (0.71-2.62)	2.91 (1.29-6.60) *
Use of chemical substance		
No use of any substance	0.86 (0.57-1.28)	6.03 (1.20-30.39) *
Use of alcohol	1.30 (0.81-2.08)	2.60 (0.71-9.49)
Use of tobacco	1.68 (0.98-2.88)	8.75 (2.27-33.71) *
No use of illicit drugs	1.15 (0.54-2.45)	3.19 (0.91-11.16)
Use of other substances	1.23 (0.41-3.67)	2.52 (0.30-20.94)

The response variable (resuscitation procedure) was adjusted to all other covariables. OR: non-adjusted odds ratio. aOR: adjusted odds ratio. CI: 95% confidence interval for odds ratio. *: Odds ratio different than one.

4 DISCUSSION

As a main result, 41.2% of the patients went through advanced procedures, such as orotracheal intubation, cardiac massage and/or medications. This number is way higher than cited by general literature, which says that 10% of the resuscitated neonates need advanced

maneuvers[9,10]. Inquiries conducted in Southern Brazil also showed high incidence of advanced neonatal resuscitation[11,12]. This can be explained by the fact that the present study and the cited ones took place in referral centers for high-risk pregnancy, receiving a great number of complex cases, frequently associated with intercurrences.

Although maternal age is a recognized risk factor for neonatal complications such as low birth weight and prematurity, and, consequently, higher need for resuscitation, many researches, including this study, showed adequate maternal age, with low prevalence of extremes of age. The present results were very similar to another study conducted in Belém, in 2015[13] and in Itajubá, Minas Gerais, in 2014[14]. The decrease in teenage pregnancy rates in Brazil could explain that[15].

Furthermore, this research showed the lack of prenatal assistance in both basic and advanced resuscitation groups, since only 10% of mothers had ≥6 prenatal consults. This number is extremely low when compared to other studies in Belém (27.4%)[13], Fortaleza, Brazil (34.2%)[16], in Southern Brazil (87%)[17] and in Minas Gerais (50%)[18]. Then, it is pointed the inequality in access to prenatal care along the country, a main risk factor for neonatal intercurrences, due to the lost opportunity to early diagnose and treat complications.

Another data associated with both groups was caesarean delivery. It represented more than 60% of cases in this study, way higher than both the 15% preconized by World Health Organization[19] and the average of 50% in Brazil[20]. Caesarean is well known as a risk factor for many adverse neonatal outcomes, such as: perinatal infections need for resuscitation procedures and less breastfeeding rates[21-23].

Obstetric intercurrences are other known risks of needing neonatal resuscitation[3]. The most common events in this study were urinary tract infection, pregnancy hypertensive disorders and bleeding, but none of them were associated with higher chances of advanced resuscitation. Gestational diabetes was not a common intercurrence, but it was significantly associated with the need for only ventilation, and not advanced procedures, which was also found in a study conducted in Minas Gerais[18]. This association is probably explained by the fact that a few number of pregnant women developed this complication, which could have created a bias.

Use of substances during pregnancy is another factor associated with neonatal resuscitation[3]. Almost 93% of mothers in this study reported not having used any substances, and the most used ones were alcohol (5%), tobacco (4%) and illicit drugs (2%). These data were similar to the results of a study that analyzes the prevalence of illicit drug use and associated factors during pregnancy from São Luís, Maranhão, except for alcohol, which was used by

22.3% of the women in that study[24]. The only data significantly associated with advanced resuscitation in this category was “no use of any substance” (six times higher chances) and tobacco (nine times higher chances). The reason for increased chances in nonuse of substances is probably that this group represents more than 90% of the participants, so other factors probably worked as confounding variables. About tobacco, as nicotine is a placental vasoconstrictor, it induces fetal hypoxia and low vitality at birth, which explains the higher need for advanced resuscitation[25].

Prematurity, low birth weight and SGA were strongly associated with the need for advanced resuscitation (more than 5 times increased chances when <1000g or <28 weeks). These results are similar to national[9,11] and international researches, from Canada and South Korea, observed that pre term and low birth weight infants represented increased risk to intensive care unit admission[26,27]. The need for respiratory support is probably due to the metabolic and physiological immaturity of the preterm infant, with lower levels of pulmonary surfactant[22] as well as the potential placentary ischemia in SGA newborns[28].

Another condition highly associated with neonatal complications is hypoxia, which is related to Apgar score. This scale evaluates the newborn’s vitality and is applied within one and five minutes of life, at least. The first score indicates the conditions of birth, while the second indirectly shows the response to resuscitation. Less than seven points at five minutes indicates a poorer neurological prognosis[3]. Almost 80% of patients in this study had 1st minute Apgar <7 and nearly 90% had ≥7 at the 5th minute. Also, 5th minute Apgar <7 meant 28 times more chances of advanced resuscitation. These findings were similar to those observed in Ceará[16] and Rio Grande do Sul[17] states, which analyzed factors that impacts neonatal morbidity and risk of intense care unit admission that are related to advanced resuscitation. Although Apgar does not indicate any conduct in the delivery room, a low score means more risks of resuscitation, and if it remains <7 five minutes after birth, the newborn is not responding to the procedures, consequently requiring advanced maneuvers.

31.1% of newborns had meconium-stained amniotic fluid, and that duplicated the chances of advanced resuscitation. Other studies conducted along Brazil and the other one in Portugal, analyzing risk factors for neonatal resuscitation and morbidity, both showed lower rates of meconium[11,26], but this can be explained by the fact that the present study only analyzed the resuscitated neonates, and also because it took place at a referral hospital, with a natural great number of complications. It is well known that meconium is related to fetal suffering and to higher risk of resuscitation, including advanced maneuvers such as orotracheal intubation, which is a reasonable explanation to the present findings[3,29].

Some study limitations were the lack of detail and incorrect registration that may happen in medical charts. Also, it is a cross-sectional study, therefore, it is not possible to assure if the identified factors associated to advanced procedures really caused the need for advanced resuscitation or if there were confounding factors. It is important, thus, that more researches, including intervention designs, are conducted to better elucidate those factors.

5 CONCLUSIONS

The study found that prematurity, very low/extremely low birth weight, 5th minute Apgar <7, SGA, meconium and use of tobacco were associated with higher chances of advanced maneuvers. Since it is necessary to realize local circumstances and issues to ensure appropriate neonatal care, these results can help optimizing public health, especially in the Amazon region.

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