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Factors Associated with Mortality in a Neonatal Intensive Care Unit

ORIGINAL

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Abstract

Aims: To describe the factors associated with mortality of newborns hospitalized in a Neonatal Intensive Care Unit in the period from 2012 to 2015.

Methods: This was a descriptive, quantitative study of secondary data, correlated with the causes of death and hospitalization according to classification by ICD-10. The categorical variables were presented in absolute and relative frequencies, with measurements of central tendency and dispersion. Evaluation of the factors associated with neonatal death was made by the logit model of analysis with correction of robust errors by the statistical program *Stata 12.0*, considering values of p<0.05 and interval of confidence of 95%.

Results: Of the 563 newborns, 58.6% were of the male sex; 89.0% were early newborns, 73.0% were premature. 181 newborns died (32.3%). The main causes of hospitalization were: difficulties during birth, conditions of birth and immaturity (45.0%), pathologies associated with the respiratory system (21.1%), congenital malformations (9.7%). The main causes of death were: septicemia of the NB (40.4%), respiratory discomfort of the NB (22.4%). The significant associations for mortality were the use of ventilatory supports: Mechanical Ventilation (p=0.001), Hallo (p=0.000), CPAP (p=0.000), VNI (p=0.005).

Conclusions: The major risk factors for neonatal mortality were associated with septicemia and use of mechanical ventilation.

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Newborns; Infant Mortality; Neonatal Intensive Care Unit; Risk Factors.

Introduction

Unquestionably, the technological evolution has changed the prognosis of survival of newborn (NB) infants who require specialized care. The Neonatal Intensive Care Unit (NICU) has appeared as a space destined for the treatment of these individuals who present some type of problem that places their lives at risk. By reason of the specificity of the clientele, NICUs are fitted with indispensable apparatuses and items of equipment for the care of these patients. In addition to the technological appliances, there is the specialized multiprofessional team, trained and dedicated to the humanization of this care, in an endeavor to provide the NBs with a satisfactory therapeutic environment.

For the majority of NBs hospitalized in a NICU, the morbidity is directly related to prematurity, a cause of serious problems, also related to respiratory disturbances and infectious, neurological and hematological disturbances [5]. These conditions that favor the permanence of NBs in NICUs have great influence on infant mortality rates, universal indicators used to measure the level of health and quality of life of a population. It is possible to infer that in spite of the entire technological apparatus and qualified labor found in these care environments, many deaths still occur [6].

In the year 2014, according to data from the Brazilian national health service - SUS ("Sistema de Informações do Sistema Único de Saúde") database, the infant mortality rate remained high, with death occurring, on an average of 52% in the early neonatal period, 30% in the late neonatal period, and 18% in the post-neonatal period. In relation to the localization, the Northeastern regions is ranked second in the number of infant deaths in Brazil, and the state of Pernambuco, in second place in the Northeast, falling behind the state of Bahia only, which is the largest geographic area, when compared with the previously mentioned state [7].

Therefore, to cope with the diseases that cause hospitalization of NBs in NICUs, the greatest challenge is to know about the morbidity-mortality in these sectors, and the devices used in the attempt to favor survival of these individuals, with the purpose of creating subsidies for restructuring the care according to the specificities and priorities of this group [8, 9]. In view of the foregoing, this research began based on the following question: which factors are associated with mortality in the NICU?

Therefore, the aim of this study was describe the factors associated with mortality of newborns hospitalized in a Neonatal Intensive Care Unit in the period from 2012 to 2015.

Methods

This was a descriptive study with a quantitative approach, conducted with secondary data obtained by means of analyzing the record charts of newborns admitted to the NICU of a public hospital situated in the municipality of Petrolina. The institution is a reference in mother-and-child care, functions in a regime of 24 hour shifts, with attendance to urgencies and emergencies referred to it, and the spontaneous demand on the medical, pediatric, surgical and obstetric clinics. These services are provided by a specialized multiprofessional team of doctors, nurses, speech therapists, physical and occupational therapists, and social assistants, among others.

The data were collected by means of a semi-structured formula that consisted of the sociodemographic and perinatal variables: sex, age of the NB on admission to hospital (early newborns: 0 to 6 complete days-of-life; and late newborns: from 7 to 28 days), and at the time of discharge, municipality of residence, place of birth, birthweight (on admission and discharge), gestational age (GA) (categorized into <24 weeks, 25 to 28 weeks, 29 to 32 weeks, 33 to 36 weeks, 37 to 41 weeks and >42 weeks), Apgar Score in the first and fifth minute (equal to or higher than seven considered good conditions of life), date of admission to hospital, date of discharge; and clinical variables: the causes

of hospitalization (ICD -10 and description of pathology affecting the infant), time of hospitalization, type of ventilatory support used during hospitalization (Mechanical Ventilation [MV], Hallo, Continuous positive airway pressure [CPAP], Noninvasive ventilation [NIV]), time of ventilatory support use, interventions performed (probing, venous access), time of use of interventions, nutrition, time of hospitalization (in days), reason for discharge (whether it was cure or death).

The sample studied was 563 newborns hospitalized in the institution during the period from January 2012 to December 2015. Record charts excluded were those with absence of information necessary for attaining the initial objective of the study.

Data were analyzed by means of descriptive and analytical statistics. The categorical variables were presented in their absolute and relative frequencies, and interval of confidence for the proportion assuming binomial distribution. Measurements of central tendency and dispersion (mean and standard deviation) and interval of confidence of 95% for the mean were calculated for the numerical variables.

The factors associated with neonatal mortality were evaluated by the logit model of analysis with correction of robust errors. The results of the above-mentioned were presented by the odds ratio of occurrence of the outcome. In this case, the dependent variable was the reason for discharge, with these being treated as a *dummy*, in which '1' were the NBs who were born alive and died afterwards; and '0' for the NBs who presented improved discharge from the NICU. Initially, bivariate analysis was performed between the dependent variable and the predictors, and those whose p-values were lower than 0.20 were included in the multivariate analysis. Factors associated with the occurrence of the outcome (death) were considered the variables whose p-values were lower than 0.05 in the adjusted model.

The statistical program Stata 12.0 was used for data analysis. The results were presented in tables constructed in the Microsoft Office Excel 2013 program.

The research project was approved by the Research Ethics Committee of the University of Pernambuco under Report Number 1.478.212, and because it was a research that used secondary data, there was no need to use the Term of Free and Informed Consent.

Results

The authors observed that 58.6% of the newborns were of the male sex, with the majority of them being early newborns (89.0%). Of these, considering the Apgar score of the first minute, the majority presented a score lower than 7 (52.6%). However, in the 5th minute, the majority of the NBs presented a score higher than 7 (77.4%) **(Table 1)**.

Table 1. Distribution of sociodemographic and clinical variables of newborn infants Petrolina.

	N	%	IC95%**	
Sex (n=551)				
Female	228	41.4	37.3	45.5
Male	323	58.6	54.5	62.7
Newborn				
Late	62	11.0	8.4	13.6
Early	501	89.0	86.4	91.6
Gestational Age (n=486)				
<24 weeks	1	0.2	-0.2	0.6
25-28 weeks	27	5.6	3.5	7.6
29-32 weeks	130	26.8	22.8	30.7
33-36 weeks	148	30.5	26.6	34.6
37-41 weeks	175	36.0	31.7	40.3
>42 weeks	5	1.0	0.1	1.9
Apgar 1 minute (n=563)				
Apgar 1 minute > equal to 7	267	47.4	43.3	51.6
Apgar 1 minute <7	296	52.6	48.4	56.7
Apgar in 5th minute (n=563				
Apgar 5 minute > or equal to 7	436	77.4	74.0	80.9
Apgar 5 minute <7	127	22.6	19.1	26.0

	N	%	IC95%**	
Reason for discharge				
Cure	379	67.7	63.8	71.6
Deaths	181	32.3	28.4	36.2
	Mean	**SD**	**IC95%****	
Age on admission to hospital (n=563)	2.3	4.7	1.9	2.7
Birthweight	2277.3	865.6	2202.3	2352.2
Weight on admission (N=547)	2320.9	878.0	2247.2	2394.7
Weight on discharge	2250.4	913.9	2171.2	2329.6
Time of hospitalization	7.4	8.8	6.7	8.2

*: Interval of Confidence 95% for proportion assuming binomial distribution; **: Interval of Confidence 95% for the mean.

Relative to gestational age at the time of birth, the majority were between 37 and 42 weeks of gestation (36.0%). Nevertheless, when the proportions of NBs born at fewer than 36 weeks were added, these represented the majority (63.1%). The mean time of hospitalization was 7.4 days (SD = 8.8). The reason for discharge, classified into cure or death, demonstrated that 32.3% of the newborns hospitalized died. The mean weight of newborns was 2,320.9 grams. **(Table 1)**.

Relative to performing procedures and use of devices, 98.8% of the newborns made use of venous access, on an average, for 7.2 days (SD = 8.7); and 97.0% of the newborns made use of some type of probe, with the mean standard time of probing was 7.2 days (SD = 8.5).

In relation to ventilatory support, mechanical ventilation (MV) was used in 75.1% of the NBs, with the mean time of use being 6.4 days. CPAP was used in 41.5% of the newborns, with a mean time of use of 1.7 days. 36;8% made use of NIV as ventilatory support, with a mean time of use of 2.2 days. Whereas, 34.2% made use of the Hallo device, for a mean time of use of 1.5 days. These data showed that the mean time of ventilatory support in newborns was 6.8 days **(Table 2)**.

Table 3, presents the *logit* analysis for evaluating the predictors of mortality of the NBs hospitalized, based on the reason for discharge as the dependent

Table 2. Distribution of characteristics of procedures and devices used in newborns in Intensive Care Units.

	N	%	IC95%**	
Probing (n=560)				
No	17	3.0	1.6	4.5
Yes	543	97.0	95.5	98.4
Type of probe (n=541)				
Orogastric tube	534	98.7	97.8	99.7
Delayed bladder catheter	2	0.4	-0.1	0.9
Nasogastric tube	1	0.2	-0.2	0.6
Various	4	0.7	0.0	1.5
Venous access (n=559)				
No	7	1.3	0.3	2.2
Yes	552	98.8	97.8	99.7
Type of nutrition (n=527)				
Parenteral	25	4.7	2.9	6.6
Enteral	453	86.0	83.0	88.9
Both	49	9.3	6.8	11.8
Mechanical ventilation (n=562)				
No	140	24.9	21.3	28.5
Yes	422	75.1	71.5	78.7
Hallo (n=563)				
No	365	64.8	60.9	68.8
Yes	198	35.2	31.2	39.1
CPAP (n=562)				
No	329	58.5	54.5	62.6
Yes	233	41.5	37.4	45.5
NIV (N=562)				
No	355	63.2	59.2	67.2
Yes	207	36.8	32.8	40.8
	Mean	**SD**	**IC95%****	
Time of probing[a]	7.2	8.5	6.4	7.9
Time of venous access	7.2	8.7	6.5	8
Time of mechanical ventilation	6.4	8.6	5.6	7.3
Time of Hallo	1.5	1.1	1.3	1.7
Time of CPAP	1.7	1.4	1.6	1.9
Time of NIV	2.2	2.2	1.9	2.5
Time of ventilatory support	6.8	8.3	6.2	7.6

[a]: Temporal variables expressed in days. *: Interval of Confidence 95% for proportion assuming binomial distribution; **: Interval of Confidence 95% for the mean

Table 3. Predictors of newborn mortality in the Intensive Care Unit.

	Raw OR (IC95%)	p	Adjusted OR (IC95%)	p
Sex				
Male	0.8 (0.6-1.2)	0.254		
Female	1.0			
Apgar 5 minute				
Apgar < 7	1.6 (1.1-2.5)	0.019	1.1 (0.6-1.8)	0.796
Apgar < 7	1.0		1.0	
Apgar 1 minute				
Apgar < 7	1.1 (0.7 - 1.5)	0.721		
Apgar < 7	1.0			
Gestational age				
NB ≤32 weeks	1.0 (0.7-1.5)	0.959		
NB ≥33 weeks	1.0			
Newborn				
Early	0.5 (0.3-0.9)	0,011	0.6 (0.2-1.3)	0.185
Late	1.0		1.0	
Time of hospitalization				
≥7 days	0.6 (0.4-0.9)	0.009	0.8 (0.5-1.4)	0.478
< 7 days	1.0		1.0	
Probing				
Yes	0.9 (0.3-2.4)	0.790		
No	1.0			
Venous access				
Yes	2.9 (0.3-24.5)	0.322		
No	1.0			
Mechanical ventilation				
Yes	9.0 (4.6-17.6)	0.000	4.9 (2.0-1.2)	0.001
No	1.0		1.0	
Hallo				
Yes	0.03 (0.01-0.08)	0.000	0.06 (0.02-0.14)	0.000
No	1.0		1.0	
CPAP				
Yes	0.05 (0.02-0.09)	0.000	0.07 (0.04-0.14)	0.000
No	1.0		1.0	
NIV				
Yes	0.14 (0.08-0.2)	0.000	0.4 (0.2-0.7)	0.005
No	1.0		1.0	

OR: Odds ratio

variable. The model was presented by means of the odds ratio values in the raw analysis and adjusted with their respective intervals of confidence and p-values.

After adjustment of the model, the authors observed strong association of the use of mechanical ventilation, which was a factor of worsening in the NBs condition, increasing the chance of death by 4 times (OR = 4.9, p-value = 0.001). The NBs who used Hallo, CPAP and NIV presented lower chances of neonatal mortality (p = 0.000) **(Table 3)**.

Discussion

The majority of the NBs who were hospitalized in the NICU during the period of study were of the male sex, corroborating the results found in studies similar to the present study, in which the NBs of the male sex were shown to be more vulnerable to the need for intensive care [1-3, 12-13].

Of the NBs hospitalized, the majority were premature, with a mean age of two days on admission to hospital. When the multivariate test of significance was performed, the gestational age (GI) did not appear as statistically significant. In spite of many studies showing GI as a strong factor of morbidity-mortality among newborns [3-4, 15-18], an isolated study demonstrated that the gestational age had no joint influence on death [14].

Studies have indicated the Apgar score below 7 in the 5th minute as a predictor of infant mortality [4, 19]. However, in this research no level of significance was verified when the adjusted odds ratio was calculated, which showed that there was no association between this index and the mortality of the newborns studied.

Low birthweight is one of the data most used as cause of morbidity-mortality in other studies [4, 15-16, 20-22]. In the present research, the mean weight of NBs was lower than 2,500 grams, considered low birthweight. This datum corroborates the findings of studies in NICUs that pointed out low

birthweight as a complication that demonstrated greater vulnerability of NBs, leading to discussion of the need for measures that reduce premature birth, and consequently, diminish the rates of NBs with low birthweight [4, 15].

The elevated occurrence of respiratory distress may be associated with the high incidence of use of MV, also demonstrated in other studies [3, 5, 6, 8, 9, 23, 26]. In addition to MV, there was a high incidence of the use of Hallo, CPAP and NIV, considering that the majority of individuals remain in ICUs because of the need for ventilatory support. However, the time of use of these devices did not exceed 2.2 days, whereas the time of use of MV was 6.4 days.

The use of MV, in turn, was one of the important indicators of mortality found, increasing the chance of leading to the NBs death by almost 5 times. Other studies have also demonstrated that the use of this device is a strong indicator of death [4, 8, 15, 20]. MV is an invasive method of ventilatory support, in which care with manipulation must be done by an aseptic technique at all times. The lack of this care facilitates the possibility of infection of patients using this ventilatory support [27].

The care provided for NBs using MV must be centered on the prevention of infection, meticulous hand hygiene, use of Individual Protective Clothing, and care of the environment, in an attempt to prevent infection, since it configured as the most frequent cause of hospitalization in an ICU in Brazil and the United States [27], and in turn, is responsible for innumerable cases of mortality of individuals in these environments.

The proportion of deaths found in this study was 32.3%, a value considered high, and may be associated with the fact that this was a sample of potentially pathological NBs, with a high percentage of premature infants. When compared with studies conducted in the Southern regions in Brazil (10.3%), Pelotas (15.3%) and Rio de Janeiro (19,5%), the rate of the present study was shown to be high [1, 8, 22]. However, in a study conducted in the Northeast of the country the mortality rate was 29%, considered high [21], as in the case of the present study.

The authors point out that the data found in this study make reference to the local reality, which varies from municipality to municipality, since these results may vary according to diverse factors, such as the bacterial flora of the environment, preparation of the care team and the devices available for providing care.

The present study identified no influence on mortality, of some of the characteristics of NBs and procedures performed, such as the type of newborn (early or late), use of venous access, use of probe and type of nutrition. These results were shown to be contrary to those of other studies that showed that the use of these devices, even with adequate handling and change, were directly related to the number of deaths, thus demonstrating the complexity of the analysis in an attempt to explain neonatal death under different realities [4, 6, 14, 21].

Conclusions

The study of factors associated with death in the NICU allowed access to important information that could subsidize the idealization of care actions in the intensive care environment, which may favor the reduction in the number of cases of death in this environment. Moreover, in view of the elevated prevalence of neonatal deaths, the authors have shown the need for investigating possible factors of morbidity that may have been the causes of hospitalization in the NICUs, and which may be directly associated with the outcome of the existent cases.

It is important to emphasize that the results of this study do not necessarily portray the reality at national level, but allows the authors to make reference with respect to the neonatal morbidity-mortality in the municipality of Petrolina, which provides care in the regions of the States of Pernambuco and Bahia. These results may serve as subsidy, and

direct planning of measures that may improve the care provided for newborns at risk in these localities, and serve as basis for studies in other regions of the country.

The study presented some limitations, which emphasize the exclusive use of secondary data, in which there were some difficulties with analyzing the record charts, considering that the NICU was the only sector of the hospital in which the records were not yet available in electronic format. Nevertheless, because it was a study with secondary data, there were losses of information and samples due to record charts with incomplete filling out of data, and by elevated ignorability relative to data that were important for analysis of the problem.

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