Characterization and neuroprotective care for preterm newborns in an Intensive Care Unit

Caracterização do perfil neonatal como indicador de risco para hemorragia peri-intraventricular

Caracterización y cuidados neuroprotectores para recién nacidos prematuros en una unidad de cuidados intensivos

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Abstract

Objective: To characterize the clinical-epidemiological profile of premature infants admitted to the intensive unit of a public hospital in Paraná.
Methods: This is a retrospective observational study based on 170 medical records of newborns <32 weeks, born and staying at the study institution and without associated pathologies, hospitalized between 2017 and 2021. Data were collected between June and August 2022, after approval of the Ethics Committee, and, subsequently, a descriptive analysis was carried out, with simple and relative frequencies, mean, median, standard deviation and interquartile range, and inferential, using the chi-square test and the Mann-Whitney test.
Results: The majority were male, delivered by cesarean section, very premature, with very low birth weight, Apgar ≥7 at the fifth minute, needing immediate assistance at birth. There were 31 (18.2%) deaths and there was a higher frequency of peri-intraventricular hemorrhage in males preterm newborns, with lower gestational ages, birth weight and Apgar. Minimum care measures were recorded in 43 (25.3%) medical records, which guided neuroprotective care and reduced the risk of brain injury and subsequent problems.
Conclusion: Identifying the profile and factors that can be intervened can prevent premature dbirths and reduce the number of newborns affected by peri-intraventricular hemorrhage. The importance of developing public policies and effective programs aimed at maternal and child health is highlighted, in order to improve quality of care and reduce negative outcomes.

Keywords
Pediatric nursing; Infant premature; Neuroprotection; Intensive Care Units Neonatal; Neonatal nursing

Resumo

Objetivo: Caracterizar o perfil clínico-epidemiológico de prematuros internados em unidade intensiva de hospital público do Paraná.
Métodos: Estudo observacional retrospectivo com base em 170 prontuários de recém-nascidos <32 semanas, com nascimento e permanência na instituição de estudo e sem patologias associadas, internados entre 2017 e 2021. Os dados foram coletados entre junho e agosto de 2022, após aprovação do Comitê de Ética, e, posteriormente, foi feita análise descritiva, com frequências simples e relativas, média, mediana, desvio-padrão e intervalo interquartil, e inferencial, por meio do teste qui-quadrado e do teste de Mann-Whitney.
Resultados: A maioria era do sexo masculino, parto cesáreo, muito prematura, com muito baixo peso, Apgar ≥7 no quinto minuto, necessidade de assistência imediata ao nascimento. Ocorreram 31 (18,2%) óbitos e houve maior frequência de hemorragia peri-intraventricular no sexo masculino, em recém-nascidos pré-termo, com menores idades gestacionais, peso ao nascer e Apgar. As medidas de cuidado mínimo foram registradas em 43 (25,3%) prontuários, que orientavam o cuidado neuroprotetor e reduziam o risco de lesão cerebral e problemas subsequentes.
Conclusão: A identificação do perfil e de fatores passíveis de intervenção pode prevenir partos prematuros e diminuir o número de recém-nascidos afetados pela hemorragia peri-intraventricular. Ressalta-se a importância do desenvolvimento de políticas públicas e programas efetivos voltados à saúde materno-infantil, a fim de melhorar a qualidade da assistência e reduzir desfechos negativos.

Descritores
Enfermagem pediátrica, Recém-nascido prematuro; Neuroproteção; Unidades de Terapia Intensiva Neonatal; Enfermagem neonatal

Resumen

Objetivo: Caracterizar el perfil clínico-epidemiológico de prematuros ingresados en la unidad intensiva de un hospital público de Paraná.
Métodos: Estudio observacional retrospectivo basado en 170 historias clínicas de recién nacidos <32 semanas, nacidos y alojados en la institución de estudio y sin patologías asociadas, hospitalizados entre 2017 y 2021. Los datos fueron recolectados entre junio y agosto de 2022, previa aprobación del Comité de Ética, y posteriormente

Descriptores
Enfermería pediátrica; Recién nacido prematuro; Neuroprotección; Unidades de Cuidado Intensivo Neonatal; Enfermería neonatal

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se realizó un análisis descriptivo, con frecuencias simples y relativas, media, mediana, desviación estándar y rango intercuartil, e inferencial, mediante la prueba de Chi-Cuadrado y la prueba de Mann-Whitney.
Resultados: La mayoría fueron varones, nacidos por cesárea, muy prematuros, con muy bajo peso al nacer, Apgar ≥7 al quinto minuto, necesitando asistencia inmediata al nacer. Hubo 31 (18,2%) muertes y hubo mayor frecuencia de hemorragia periintraventricular en el sexo masculino, en recién nacidos prematuros, con menores edades gestacionales, peso al nacer y Apgar. Se registraron medidas mínimas de cuidado en 43 (25,3%) historias clínicas, que orientaron la atención neuroprotectora y redujeron el riesgo de lesión cerebral y problemas posteriores.
Conclusión: Identificar el perfil y los factores que pueden intervenir puede prevenir nacimientos prematuros y reducir el número de recién nacidos afectados por hemorragia periintraventricular. Se destaca la importancia de desarrollar políticas públicas y programas efectivos dirigidos a la salud maternoinfantil, con el fin de mejorar la calidad de la atención y reducir los resultados negativos.

Introduction

Every year, around 15 million premature births occur, with Brazil being the tenth country with the highest number, almost twice as many as European countries.[1-3] In 2020, the number of live births in Brazil was 2,678,992, and prematurity had a percentage of approximately 11.3%. In Paraná, 146,291 births were registered, of which 15,837 (10.8%) were premature; of these, 13,624 (86.0%) were between 32 and 36 weeks of gestation, 1,439 (9.1%) between 28 and 31, and 774 (4.9%) with < 28.[4,5]

This condition is an important risk factor for child morbidity and mortality, representing a challenge for public health, and it is crucial to implement health care policies for women and children, especially regarding the early identification and intervention of risk factors through regular prenatal care.[1,2,6]

Premature birth is associated with several factors, such as a history of premature birth, anemia, maternal stress and behaviors, such as tobacco consumption, premature rupture of membranes, vascular complications (hypertension and transvaginal bleeding), interpregnancy interval ≤1 year, urinary tract infection (UTI), absent or inadequate prenatal care, maternal age <20 years or >35, oligohydramnios, history of induced abortion and twin pregnancy.[2,7]

Premature birth occurs before 37 completed weeks of gestation, being classified as extreme (<28 weeks), very premature (28 to <32) and moderate or late (32 to <37). Considering birth weight, the classification is as follows: low weight (<2,500g), very low weight (<1,500g) and extremely low weight (<1,000g).[1,8]

Scientific and technological advances in maternal-fetal medicine and neonatal intensive care, with professional qualification, have reduced the stressful impact of the Neonatal Intensive Care Unit (NICU) and promoted the survival of preterm newborns (PTNB), even at borderline gestational ages (GA); however, complications that can affect their development and recovery in the hospital environment can still occur. [9-12]

The development of the central nevous system (CNS) begins in the sixth week of gestation. Neuronal proliferation occurs between the second and fourth months of gestation, followed by the migration of nerve cells, which is complete after 24 weeks, when precursors from the germinal matrix migrate to the upper cortical layers. The organization of cortical columns begins in the fifth month and allows the development of synaptic connections. Myelination occurs from the second trimester of pregnancy until adulthood, simultaneously with the proliferation, differentiation and alignment of oligodendrocytes, but only in the last 5 weeks there is an increase in dendritic connections and formation of grooves.[13-15]

Nerve impulse transmission is regulated by neurotransmitters. The sensory experience caused by external stimuli influences the development of their receptors, altering neurofunctional and structural aspects that, added to the vulnerability and immaturity of cerebral self-regulation in premature babies and situations of hemodynamic instability, can lead to the development of hemorrhages and other injuries, caused by changes in blood flow resulting from cerebral hypoperfusion and reperfusion.[11,13,15,16,17]

Peri-intraventricular hemorrhage (PIVH) originates in the germinal matrix and ruptures through the lateral ventricle. It has a high prevalence in premature infants, with occurrence >90% in the first 72 hours of life, and individualized care approaches focus on minimizing stimulation, based on the responses observed in PTNB, assuming a neuroprotective perspective to reduce changes that predict hemorrhage as well as its possible consequences, length of stay and costs.[4,9,14,17]

The advancement of technical-scientific knowledge benefits society, improving quality of care and

reducing morbidity and mortality. For patients, the reorganization of care allows for humanized care and minimizes damage. This also impacts healthcare institutions, reducing hospitalization time and associated costs.

This study aimed to characterize the clinical and epidemiological profile of extremely premature and very PTNB admitted to a NICU.

Methods

This is a retrospective observational study with a quantitative approach, structured according to the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) recommendations. It was developed at the NICU of a public hospital in the 2nd Health Region of Paraná, a hospital reference in health care for high-risk pregnancies.

The study used 170 hospital records, from 2017 to 2021, including PTNB with GA <32 weeks, with birth and stay in the institution during the first 72 hours of life and who did not present genetic syndromes or congenital malformations. Data collection took place between June and August 2022, using neonatal variables: date and time of birth, type of birth (vaginal or cesarean section); sex (male, female or undefined); Apgar in the first and fifth minutes (zero to ten); GA (weeks and days); birth weight (grams); need for resuscitation in the delivery room (yes or no); maneuvers used (oxygen, positive pressure ventilation [PPV], orotracheal intubation [OTI], cardiac compression or vasoactive drug); medical diagnoses (ICD-10); imaging tests (ultrasound); date and time of the test; development of PIVH (yes or no); PIVH degree (I, II, III or IV); minimum handling record (yes or no); type of departure (discharge, transfer or death); and date of departure. The following maternal variables were collected: age (years); education (no education, incomplete elementary school, complete elementary school, incomplete high school, complete high school, incomplete higher education or complete higher education); race/color (white, black, brown, yellow or indigenous); blood type (ABO system – A, B, AB or O) and Rh factor (positive or negative); obstetric clinical history (number of previous pregnancies, vaginal births, cesarean sections, abortions and fetal deaths); type of pregnancy (single or multiple); positive serology (yes or no) for cytomegalovirus (CMV), hepatitis B, hepatitis C, human immunodeficiency virus (HIV), rubella, syphilis and toxoplasmosis; number of prenatal appointments; clinical or obstetric complications in current pregnancy; and medications used in prenatal care, labor and birth.

Descriptive data analysis was performed with estimates of mean, median, standard deviation and interquartile range of quantitative variables and absolute and relative frequencies of qualitative variables with a 95% Confidence Interval. Variables were also analyzed in relation to PIVH, using the chi-square test to verify the association between qualitative variables. The adherence of quantitative variables to normal distribution was assessed using the Shapiro-Wilk test, in order to determine the approach to be used (parametric or non-parametric). Therefore, the Mann-Whitney U test was used to verify differences between two groups. The significance level used was 5%, and all analyzes were carried out in the R 4.0.4 environment.

The research was approved by the Research Ethics Committee of the *Faculdades Pequeno Príncipe* and the co-participating institution, under Opinions 5,360,439 and 5,439,919, respectively, respecting the ethical aspects of Resolution 466/2012 referring to research involving human beings.

Results

With regard to maternal variables, the total number of mothers was 162, since 11 (6.8%) pregnancies were multiple, with the exclusion of two twins, due to fetal death and transfer from the institution. Table 1 shows the maternal characteristics analyzed in the study.

Maternal age ranged between 14 and 43 years, with a mean of 26.46 (± 7.06) and a median of 26. The mean number of pregnancies was 2.14 (± 1.49), with a median of 2. The mean number of prenatal appointments was 5.18 (± 2.67), with a median of 5, and a minimum and maximum number of 0 and 14. Hypertensive syndromes were the most recurrent complications, totaling 58 (35.8%). Subsequently, there were UTI (49; 30.2%) and, in smaller proportions, endocrine diseases, such as diabetes mellitus and hypothyroidism, fetal centralization and intrauterine growth restriction

Table 1. Maternal data according to selected variables

Variables	n(%)
Maternal age, years	
≤19	32(19.75)
20-34	105(64.81)
≥35	25(15.43)
Type of pregnancy	
Twinning	11(6.79)
Singlet	150(92.59)
Not informed	1(0.62)
Positive serologies	
Syphilis	9(5.56)
Toxoplasmosis	2(1.23)
No	140(86.42)
Not informed	11(6.79)
Pregnancies	
1	71(43.83)
2	43(26.54)
3 or more	45(27.78)
Not informed	3(1.85)
Vaginal births	
0	102(62.96)
1	30(18.52)
2	17(10.49)
3 or more	10(6.17)
Not informed	3(1.85)
Cesarean sections	
0	128(79.01)
1	25(15.43)
2	5(3.09)
3 or more	1(0.62)
Not informed	3(1.85)
Abortions	
0	128(79.01)
1	24(14.81)
2	5(3.09)
3	2(1.23)
Not informed	3(1.85)
Fetal deaths	
0	156(96.30)
1	3(1.85)
Not informed	3(1.85)
Prenatal appointments	
0	4(2.47)
1 to 5	86(53.09)
6 to 10	57(35.19)
More than 10	4(2.47)
Not informed	11(6.79)

(IUGR), disorders of the membranes and amniotic fluid, such as anhydramnios and oligohydramnios, and placental abruption. Regarding the medications used, 90 (55.5%) used corticosteroids. Antimicrobials were mentioned 80 (49.4%) times, followed by antihypertensives and calcium channel blockers, which together accounted for 29 (19.1%), and magnesium sulfate, 19 (11.7%). One maternal death occurred. The study also offered an overview of the 170 newborns hospitalized during the data collection period, according to defined variables (Table 2).

Table 2. Descriptive analysis of preterm newborns

Variables	n(%)
Sex	
Female	75(44.12)
Male	94(55.29)
Not informed	1(0.59)
Type of birth	
Caesarean	97(57.06)
Vaginal	70(41.18)
Not informed	3(1.76)
Gestational age	
Extremely premature (<28 weeks)	55(32.35)
Very premature (28 to <32 weeks)	115(67.65)
Birth weight	
Extremely low weight (<1,000g)	64(37.65)
Very low weight (<1,500g)	78(45.88)
Low weight (<2,500g)	28(16.47)
Newborn classification	
Small for gestational age	34(20.00)
Suitable for gestational age	135(79.41)
Not informed	1(0.59)
Apgar at 1st minute	
0-3	49(28.82)
4-6	58(34.12)
≥7	61(35.88)
Not informed	2(1.18)
Apgar at 5th minute	
3-0	8(4.71)
6-4	37(21.76)
≥7	124(72.94)
Not informed	1(0.59)
Need for resuscitation	
No	45(26.47)
Yes	102(60.00)
Not informed	23(13.53)
Inhalation oxygen	
No	119(70.00)
Yes	16(9.41)
Not informed	35(20.59)
Positive pressure ventilation	
No	41(24.12)
Yes	94(55.29)
Not informed	35(20.59)
Orotracheal intubation	
No	27(15.88)
Yes	108(63.53)
Not informed	35(20.59)
Cardiac massage	
No	125(73.53)
Yes	10(5.88)
Not informed	35(20.59)

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Continuation.

Adrenaline	
No	128(75.29)
Yes	7(4,12)
Not informed	35(20.59)
Imaging tests	
Ultrasound	133(78.24)
No	14(8.24)
Not informed	5(2.94)
PIVH development	
No	121(71.18)
Yes	27(15.88)
Not informed	22(12.94)
PIVH grade	
I	15(55.56)
II	1(3.70)
III	8(29.63)
IV	3(11,11)
Minimum handling record	
No	122(71.76)
Yes	43(25,29)
Not informed	5(2.94)
Output type	
No death	139(81.76)
Death	31(18.24)

PIVH - peri-intraventricular hemorrhage

GA ranged between 22 and 31 weeks and six days, with a mean of 28.46 weeks (± 2.34) and a median of 29 weeks and 2 days. Birth weight ranged from 330 to 2,145g, with a mean of 1,131.91g (± 375.49) and a median of 1,140g. The Apgar score had the lowest scores of zero and two in the first and fifth minutes, respectively. Following the same order, the means were 5.1 (± 2.53) and 7.47 (± 1.76), and the medians were 5 and 8. The mean number of imaging tests performed was 3.18 and the median was 3; 103 (60.6%) in the first week of life and 45 (26.5%) by the third day. Regarding medical diagnoses, the most recurrent were respiratory distress (162; 95.3%), present in practically all hospitalizations, and neonatal jaundice (125; 73.5%). Among all deaths, 16 (51.6%) occurred up to the sixth day of life, 12 (38.7%) from 7 to 28 days and 3 (9.7%) after more than 28 days. Regarding the influence of variables on PIVH occurrence, of the newborns with this diagnosis, 21 (77.8%) were male and six (22.2%) were female, presenting a statistically significant difference (p-value of 0.020). However, only seven (33.4%) of the newborns who developed severe forms were male, compared to the percentage of female newborns, which was almost double (4; 66.7%). Lower GA, birth weight and Apgar also presented a p-value <0.05. No relationship was found with other variables. Regarding the severity of PIVH, five (50.0%) of newborns born vaginally presented severe forms, compared to five (31.3%) of surgical births as well as nine (50.0%) of newborns who required resuscitation, while the four newborns unnecessarily developed, in their entirety, mild forms. Regarding the outcome, two (66.7%) of the newborns diagnosed with PIVH and death as an outcome presented grade IV hemorrhage.

Discussion

There was a slight prevalence of male newborns (94; 55.3%). The Brazilian Institute of Geography and Statistics (IBGE - *Instituto Brasileiro de Geografia e Estatística*) indicates a predominance of male live births in 2020 (51.2%).[4] The Birth in Brazil survey, carried out in 2011 and 2012, also showed 51.8% of male births.[18] Therefore, a greater number of hospitalizations of male newborns is expected.

In this study, 97 (57.1%) of births occurred surgically. Cesarean sections currently accounted for 21.1% of all births in the world and 55.7% in Brazil, which ranks second in the world with proportions higher than vaginal births.[19] This data agrees with a study carried out in Porto Alegre (RS), identifying that 56.2% of PTNB were born through surgical delivery.[20] However, it is noteworthy that these cesarean sections may have occurred due to necessity and/or urgency, with maternal records and the presence of gestational complications not being analyzed.[21]

For each period of pregnancy, there is variation in weight considered normal, with 34 (20%) of newborns classified as SGA, while 135 (79.4%) were classified as AGA. A similar percentage (78.9%) was found in another study with PTNB.[17] The shorter the intrauterine development time, resulting from premature birth or other conditions, such as restricted intrauterine growth, the lower the newborn's weight, which influences neonatal morbidity and mortality.[20]

A study carried out in a private hospital in the Federal District, between 2017 and 2019, also correlates this risk with very low weight and GA <30 weeks, in addition to other comorbidities, conditions and procedures performed in the NICU.[17] Newborns with extremely low birth weight have a significantly

higher incidence when compared to those with very low birth weight, 45 and 4.5%, respectively.[9]

Another variable that impacts the prognosis of PTNBs is the Apgar score, essential for identifying the need for interventions in the first minutes of life. When lower than 7, it indicates a poor prognosis.[22] The present study had 45 (26.5%) of PTNBs with a value below 7 in the fifth minute.

Resuscitation in the delivery room is closely related to the NICU admission process. It was identified that 102 (60.0%) PTNB needed some type of maneuver, with emphasis on OTI (108; 63.5%), carried out during resuscitation or after developing respiratory distress. Another study found that 71.4% of PTNB needed a maneuver. The most used is PPV plus oxygen, which must be started within the first 60 seconds of life.[23,24] The subsequent use of continuous positive airway pressure, not assessed in this study, when compared with OTI, reduces the need for mechanical ventilation and exogenous surfactant, oxygen dependence and hospital death.[24]

Respiratory problems, resulting from immaturity, related to short gestational time, are the most common complications of prematurity and were frequently observed (162; 95.3%). This data corroborates a study carried out in the NICU of a public hospital in Minas Gerais, between 2016 and 2018, demonstrating respiratory syndrome as the main cause of complications for hospitalization of newborns, the majority of which are PTNBs.[22] Another similar study also points to respiratory distress as the admission diagnosis in 89.2% of NICU admissions.[17]

Approximately 27 (16.0%) of PTNB had some degree of PIVH, 15 (55.6%) of which were grade 1. Another study found a higher percentage of PIVH (27.3%) and a higher occurrence of grade 1 PIVH (69%) as well as in this study.[17]

Of the total number of newborns included in the study, 31 (18.2%) deaths occurred. A similar percentage (12%) was found in another study with a similar population.[17] Deaths occurred mainly in the early neonatal period (zero to 6 days of life), and prematurity accounts for around a third of these events.[18]

Regarding maternal variables, age had a mean of 26.46 years and a median of 26 years, i.e., almost in concordance. They are young adult women, of reproductive age and with a small number of mothers at extreme ages (57; 35.18%). Most had an almost ideal number of prenatal appointments, on average five, and 61 (37.66%) performed six or more. Regarding prenatal care, the Ministry of Health recommends, at a minimum, six appointments, starting up to 16 weeks and, preferably, monthly up to 28 weeks and fortnightly, between 28 and 36, or one in the first trimester, two in the second and three in the third. Prenatal care inadequacy is mainly attributed to social issues, contributing to negative neonatal outcomes.[25,26]

In the Birth in Brazil survey, similar data were found regarding maternal age and prenatal care. The mean age was 25.6 years, 70.8% of mothers were between 20 and 34 years (range between 12 and 46), and 19.2% were under 20 and 10.5% over 35.[18,21] Furthermore, around 73.1% of women attended six or more appointments.[27] The results of a study that assessed maternal characteristics in prematurity demonstrated a prevalence of mothers outside the extreme age ranges, identified as being at greater risk. The mean age was around 27 years, with a minimum and maximum of 14 and 44 years. It also revealed percentages between 56.5 and 67.4%, depending on the age of the women, with six or more appointments.[20]

Information released by IBGE in 2020 points to a reduction in births to mothers aged 20 to 29 years and a percentage higher than 37.0% between 30 and 39 years, mainly in the South and Southeast regions, contrasting with what was exposed in this study.[18] Another study associated extreme prematurity and very low weight with mothers under 20 years of age, accounting for 22.94% of the mothers in the study.[26]

Pre-existing diseases and obstetric complications are predictors of maternal and perinatal morbidity and mortality. Regarding complications, 136 (80%) records indicated their occurrence, with a prevalence of hypertensive disease (58; 35.8%). Another study also links premature birth to hypertensive diseases, UTI, premature membrane detachment, premature rupture of membranes and diabetes mellitus. Furthermore, respiratory distress in newborns, neonatal jaundice, infection, among others, are predictors of perinatal morbidity and mortality.[23]

A study carried out in 2011 in six maternity hospitals in southeastern Brazil found an association between hypertensive diseases and syphilis infection with the indicator of neonatal near miss, defined as a situation of

near death in a newborn who survived the first 27 days of life.[26,28] Other research also pointed out hypertensive disorders of pregnancy (HPD) among the causes that led to premature birth and highlighted it (23.8%) among the most common pathologies during pregnancy.[17,22]

Regarding the medications used, 90 (55.5%) mothers used antenatal corticosteroids, strongly recommended for pregnant women at risk of premature birth for fetal lung maturation and reducing the occurrence of morbidities, such as PIVH, neonatal mortality, need for ventilatory support and NICU admissions.[29]

Immaturity and, consequently, dependence on care expose premature babies to unexpected sensory stimuli, altering the normal development of the brain, in addition to distancing them from their parents. The development and implementation of care plans adapting the environment minimizes stressful variations, especially in the first 72 hours after birth.[12,13,30]

The environment and interventions carried out in the NICU are stressors, which trigger physiological, cognitive and behavioral responses, from the processing of stimuli, with energy expenditure and, consequently, delay in growth and development, negatively interfering with newborn prognosis.[31,32]

Individualized care models advocate changing the environment and implementing measures that promote self-regulation, such as maintaining thermal balance, adapting humidity, light and noise, appropriate handling and positioning, care planning, preserving sleep and involving staff and parents in care and in the identification of physiological and behavioral signs of non-adaptation to reduce the repercussions of the neonatal unit on PTNB's health, while promoting comfort, growth and development.[31,33]

The Neonatal Integrative Developmental Care (NIDC) model guides neuroprotective care through strategies that aim to reduce the risk of brain injury and subsequent neurological development problems as well as psychosocial support for parents and families.[15] Chart 1 presents an adaptation of these strategies.

Chart 1. Neuroprotective strategies for preterm newborns admitted to a Neonatal Intensive Care Unit

Minimal handling	Gentle and firm touch, slow movements and restraint during care to promote a healing environment and protect the sensory system. It is a multidisciplinary technique that brings together procedures to ensure minimal stimulation, stress and injuries.[30,31]
Parental support and involvement	Fundamental and indispensable for building a relationship of trust. Therefore, it is important to greet them, introduce themselves, inform and guide about the NICU routine and the care provided, repeat explanations when necessary, use lay language, listen to their concerns and facilitate skin-to-skin contact, an essential physiological regulator for normal development. Its limitation in the first 72 hours after birth, due to concerns about changes in cerebral blood flow and increased risk of PIVH, is not supported by evidence, so it must be carried out early to stabilize PTNB. [13,18,30,34]
Proper positioning	It should imitate the fetal position in the uterus, keeping the head in the midline, and the limbs and trunk in a flexed and bent position, still supporting four hands, during tests and painful procedures, and correct repositioning are recommended, always paying attention to signs of stress, such as stretching limbs.[18,30]
Sleep and rest	Important for PTNB recovery and development, their absence compromises the CNS and, therefore, the proper functioning of the body. Excessive handling directly influence its quality, a fact that can be minimized through joint and grouped assistance with other multidisciplinary team members, scheduling routine care coinciding with sleep/wake cycles, minimizing noise and light and uninterrupted or slow interruption, with a soft voice and associated touch.[12,30]
Noise and brightness	Considered stressful factors, with interference in PTNB growth and development and in their interaction with their parents.[12,32] Sound alarms are essential to alert professionals of clinical changes that have occurred; however, in excess, they result in sensory overload and desensitization, negatively impacting patient safety. Parameterization and control of threshold values provide a less noisy and safer environment.[35] Intense, constant light or continuous dim light also affect sleep and rest states. A hospital environment with acceptable levels of noise and periodic low-intensity lighting is beneficial for newborns' clinical evolution as well as covering the eyes during tests and procedures and covering the incubators, protecting newborns from the direct incidence of light.[12,30]
Thermoneutral environment	Maintained through heated incubators that control the body temperature of newborns, reducing oxygen consumption and the imbalance of heat production and elimination mechanisms; the latter is facilitated in premature infants due to transepidermal water loss and consequent weight loss, which increases the risk of PIVH. It is essential for protecting the skin until its keratinization (5 to 10 days after birth), promoting thermal stability, preventing cold stress and minimizing metabolic or energy expenditure, essential for its growth. Thermoregulation is closely related to adaptation to the external environment and survival[30,32,36]. PTNB's skin temperature is monitored using the incubator's skin sensor and also measured in the armpit, ranging between 36.5 and 37.5ºC. For PTNBs, the thermoneutral environment, in the first days of life, varies from 29º to 35.4ºC.[36] Humidification reduces evaporative loss and consequent thermal instability, improving water-electrolyte balance and maintaining skin integrity. It is suggested to maintain relative humidity at around 80% in the first week, gradually reducing it, depending on thermal stability, to 50 to 60%, during the second week until 30 to 32 weeks or a weight of 1,500 g.[32,36]
Nutrition	The benefits of early initiation of nutrition with human milk and its optimization outweigh the risks of introducing enteral feeding in very PTNB, acting as an important strategy in neonatal care, so professionals should encourage early and continuous expression.[13,30]

NICU - Neonatal Intensive Care Unit; PIVH - peri-intraventricular hemorrhage; PTNB - preterm newborn; CNS - central nervous system

As limitations of this study, we highlighted the use of secondary data, collected from medical records, and the scarcity of recent research in the area, limiting the discussion and, consequently, the reduction of injuries.

Conclusion

The identification of the profile and factors subject to intervention contributes to the planning and qualification of multidisciplinary care offered to newborns, avoiding or early identifying bleeding complications, promoting individualized and neuroprotective care, discussing strategies that reduce pregnant woman morbidity, premature birth and neonatal morbidity and mortality, providing survival and the possibility of social integration for these children. The multifactorial nature and the high number of premature births and associated complications contrast with advances in medicine and reiterate the need to propose health policies as well as effective programs, guaranteeing adequate access to services, qualified prenatal care and birth, referral specialized care when necessary and the development of educational and preventive actions, avoiding unfavorable outcomes.

Contributions

Pechepiura EP, Mendes JO, Monteiro CK, Makuch DMV, König FM and Pontes KVZ contributed to study design, data analysis and interpretation, article writing, relevant critical review of intellectual content and approval of the final version to be published.

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