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Research Article

Short term non-programmed hospital visits after NICU discharge

Joana Ramos[1]*, Ana João Mota[2], Ana Lopes Dias[3] and Adelaide Taborda[3]

[1]*Serviço de Pediatria, Centro Hospitalar Médio Tejo EPE, Portugal*

[2]*Serviço de Pediatria, Centro Hospitalar de Leiria, Portugal*

[3]*Maternidade Bissaya Barreto, Serviço de Neonatologia, Centro Hospitalar e Universitário de Coimbra, Portugal*

Abstract

Introduction

The growing technical and scientific developments allowed for an increase in the premature newborns' survival and an increase in the number of Neonatal Intensive Care Units (NICU) discharges. Several studies point short term readmissions as the type of readmission with the larger prevention potential.

Objectives

To examine the rate of short term non-programmed hospital visits in newborns with gestational age (GA) < 34 weeks (wk) and to identify factors associated with readmission.

Materials and methods

Unicentric, observational, retrospective longitudinal study in a specialized perinatal support hospital. Newborns with GA < 34 wk admitted in NICU, discharged home between January/2009 and December/ 2022 and who were re-hospitalized or visited the emergency department (ED) ≤ 30 days after discharge were included. The factors evaluated included characteristics of the mother, labour, birth, bronchopulmonary dysplasia (BPD), peri-intraventricular hemorrhage grade > 2, sepsis, or necrotizing enterocolitis in NICU, social risk and season at the time of discharge.

Results

298 newborns were identified. The ED visit rate was 15.8% and the re-hospitalization rate was 5.0%. The most common ED visits' causes were gastrointestinal conditions and the most common re-hospitalization causes were infectious respiratory pathologies. The birth weight (BW) < 1000 g and BPD were significantly higher in newborns that visited the ED but not in newborns that were admitted to the inpatient ward. No significant difference was found between the other evaluated factors.

Discussion and Conclusion

The re-hospitalization rate was inferior to the majority of the ones previously described. Factors associated to ED visits were BW< 1000g and BPD. The predominance of gastrointestinal pathologies may justify a larger investment in parents training prior to discharge and optimizing Primary Health Care's response, aiming to reduce emergency room visits, thus avoiding associated inconveniences.

Keywords: Emergency medical services; Patient readmission; Premature infants

***Corresponding author:** Joana Patrícia Pereira Ramos, Serviço de Pediatria, Centro Hospitalar Médio Tejo EPE, Torres Novas, Santarém, Portugal. Tel: +351 249810100. Email address: joana.ramos@chmt.min-saude.pt

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Introduction

The growing technical and scientific developments in neonatal care in recent years have led to an increase in the survival rate of premature newborns (NB) and a consequent increase in the number of NB discharged from Neonatal Intensive Care Units (NICUs) [1,2]. Hospital readmissions after discharge affect the quality of life of both the newborns and their families and imply increasing hospital costs and familiar costs related to parental absenteeism from work [1, 3-5].

Hospital readmissions have been the subject of several studies using different methodologies and evaluating different periods after discharge [1-2, 4-11]. Several studies have indicated that short-term readmissions are those that best reflect the appropriateness of medical decisions at discharge and those with the greatest potential to be prevented [1]. Emergency department (ED) observation rates have been described in the literature for different time periods, with an observation rate of 5.4% for NBs with a GA of 31-33 S in the period up to 30 days after discharge from the NICU [11]. Regarding readmission rates in the first 30 days, the reported figures vary widely, with rates of 5-30.7% [4, 6, 9-11].

The different clinical characteristics of NBs discharged from NICUs may be associated with different risk factors for readmission and may require more targeted approaches and planning at discharge [1, 7]. This study aims to identify the factors associated with unplanned hospital readmissions after discharge and how current clinical practice can be modified to reduce them. The objectives of this study are to examine the rate of short-term unplanned hospital visits in NB with gestational age (GA) < 34 weeks (wk) and to identify factors associated with readmission.

Materials and Methods

Unicentric, observational, retrospective, and longitudinal study over a period of 14 years conducted at the Bissaya Barreto Maternity.

The inclusion criteria were PT NB with GA < 34 wk, admitted to the NICU between the 1st of January 2009 and the 31st of December 2022, discharged home and with an unplanned hospital visit up to 30 days after discharge.

Data were collected by reviewing the NBs' clinical records, hospital summaries and electronic health records (RSE®). The clinical and demographic characteristics of the two groups were compared according to whether they attended ER or not (Table 1) or were re-hospitalized or not (Table 3).

Fetal growth restriction was defined as an estimated fetal weight less than the 3rd percentile for GA or less than the 10th percentile for GA associated with altered dopplers [12]. Complete course of antenatal corticosteroids consisted of two maternal instramuscular injections of 12 mg betamethasone given every 24 hours or four instramuscular injections of 6mg dexamethasone given every 12 hours [13]. Peri-intraventricular hemorrhage was classified according to Volpe definition [14]. Bronchopulmonary dysplasia was defined by the need of supplementary oxygen therapy at 36 weeks of postmenstrual age (PMA) [15]. Sepsis was diagnosed in the setting of compatible symptoms associated with leucocyte count > 30.000/mm3 ou < 5.000/mm3 and/or C reactive protein >2mg/dL, with or without a positive hemoculture [16]. Necrotizing enterocolitis was classified according to the modified Bell's staging criteria [17].

Social risk was considered if there was a referral for social service assessment described in the patient's medical record or a referral for hospital consultation due to the identified social risk.

Firstly, NBs who were observed in the emergency department for up to 30 days after discharge from the NICU were analysed, and secondly, NBs who required hospitalisation were assessed.

The study was approved by the Ethics Committee of the Coimbra Hospital and Universitary Centre.

The data was statistically analysed using IBM SPSS Statistics Viewer® for Machintosh version 28.0.1.0. Normality of quantitative variables was assessed using the Kolmogorov-Smirnoff test. None of the variables examined showed normality, so they were expressed as median and interquartile range (IQR), followed by the Mann-Whitney U test. Qualitative variables were expressed as frequencies and percentages and analysed using the Chi-squared test or Fisher's test. A p value of < 0.05 was considered statistically significant.

Results

The study population included 298 NBs. These patients were assessed for observation in the ED and then for re-hospitalization.

In the 30 days after discharge, 47 patients (15.8%) were observed in the ED. The median number of days between discharge and observation in the ED was 14 days (IQR 1-30). Table 1 shows the demographic and clinical characteristics of the patients seen in the ED. Postmenstrual age at discharge was similar in NBs seen in the ED (median 35 years) and those not seen in the ED (median 36 years). A statistically significant association was found with birth weight (BW) <1000 g (p <0.001; OR 3.588) and ED observation. A diagnosis of BPD during the initial stay in the NICU was also statistically associated with short-term observation in the ED (p=0.012; OR 3.473). The other factors assessed in the study did not show a statistically significant association with short-term readmission.

Variables	Total n= 298	Non admitted n= 251 (%)	Admitted n= 47 (%)	p (IC 95%)	Odds ratio (IC 95%)
Maternal age					
< 20 years	4	4 (1.6%)	0 (0.0%)	0.494	
20-35 years	207	171 (68.1%)	36 (76.6%)		
> 35 years	87	76 (30.3%)	11 (23.4%)		
Multipara	139	117 (46.6%)	22 (46.8%)	0.980	
Twin pregnancy	72	62 (24.7%)	10 (21.3%)	0.615	
FGR	32	26 (10.4%)	6 (12.8%)	0.625	
Antenatal corticosteroids	194	164 (65.3%)	30 (63.8%)	0.842	
Type of delivery					
Vaginal	128	108 (43.0%)	20 (42.6%)	0.952	
Cesarean	170	143 (57.0%)	27 (57.4%)		
Gestational age					
< 29 wk	51	38 (15.1%)	13 (27.7%)	0.112	
29-31 wk	93	80 (31.9%)	13 (27.7%)		
> 31 wk	154	133 (53.0%)	21 (44.7%)		
Birth weigth					
< 1000 g	44	29 (11.6%)	15 (31.9%)	<0.001	3.588 (1.738-7.410)
≥ 1000 g	254	222 (88.4%)	32 (68.1%)		
Sex					
Male	171	144 (57.4%)	27 (57.4%)	0.992	
Female	127	107 (42.6%)	20 (42.6%)		
NICU diagnosis					
PIVH grade > 2	17	13 (5.2%)	4 (8.5%)	0.321	
BPD	22	14 (5.6%)	8 (17.0%)	0.012	3.473 (1.367-8.822)
Sepsis	31	25 (10.0%)	6 (12.8%)	0.563	
NEC	8	6 (2.4%)	2 (4.3%)	0.617	
Social risk	44	38 (15.1%)	6 (12.8%)	0.674	
Season of the year at discharge					
Spring/ Summer	158	136 (54.2%)	22 (46.8%)	0.864	
Autumn/ Winter	140	115 (45.8%)	25 (53.2%)		

PMA at discharge (median, min. e max.)	35 (33, 42)	35 (33, 42)	36 (34, 42)	0.056	
Lenght of inital NICU stay (median, min. e max.)	28 (2, 121)	28 (2, 121)	33 (4, 117)	0.082	

Table 1: Demographic and clinical characteristics in relation to observation in the Emergency Department up to 30 days after discharge from the NICU

Abbreviations: BPD - Bronchopulmonary dysplasia; FGR – Fetal Growth Restriction; NEC - Necrotizing enterocolitis; NICU - Neonatal Intensive Care Unit; PIVH - Peri-intraventricular hemorrhage; Postmenstrual age - PMA

Regarding the causes of observation in the ED, shown in Table 2, the overall sample showed a predominance of gastrointestinal/nutritional problems (n=18, 38.3%).

Observation in the ED up to 30 days n= 47	
Cause of readmission	n (%)
Gastrointestinal/nutritional	18 (38.3%)
Other non-infectious	9 (19.1%)
Respiratory infectious	8 (17.0%)
Surgical	8 (17.0%)
Other infectious	3 (6.4%)
Respiratory non-infectious	1 (2.1%)

Table 2: Causes of observation in the Emergency Department up to 30 days after discharge from the NICU.

Evaluating the subgroup of 44 PT NB with BW < 1000 g, it was found that 15 (34.1%) of them resorted to the ED in the short term. The main cause of observation in the ED in NBs with BW < 1000 g was gastrointestinal/nutritional problems (n=9, 60.0%), namely neonatal gastroesophageal reflux (n=5, 33.3%) and failure to thrive due to feeding difficulties, infantile colic, unspecified constipation and vomiting of the NB, both with n=1 (6.7%). The other pathologies recorded were other non-infectious (n=4, 26.7%), respiratory infectious (2 (13.3%) and surgical (n=1, 6.7%).

Evaluating the subgroup of 22 NB diagnosed with BPD during their initial stay in the NICU, it was found that 8 (17.0%) of them resorted to the ED in the short term. The main cause of observation in the ED for NBs with BPD was gastrointestinal/nutritional pathology (n=4, 50.0%), namely neonatal gastroesophageal reflux (n=2, 25.0%) and infantile colic and unspecified constipation, both with n=1 (12.5%). Other causes of observation were respiratory infectious pathology (n=2, 25%), surgical (n=1, 12.5%) and other non-infectious (n=1, 12.5%).

Within 30 days of discharge, 15 patients (5.0%) were re-hospitalized, all of whom had previously been seen in the ED. Table 3 shows the demographic and clinical characteristics of the sample of NBs who were re-hospitalized. The median number of days between discharge and re-hospitalization was 12 days (IQR 4-26) and the median length of hospital stay was 9 days (IQR 1-20).

Variables	**Total n= 298**	**Non admitted n = 283 (%)**	**Admitted n = 15 (%)**	***p*** **(IC 95%)**
Maternal age				
< 20 years	4	4 (1.4%)	0 (0.0%)	0.139
20-35 years	207	200 (70.7%)	7 (46.7%)	
> 35 years	87	79 (27.9%)	8 (53.3%)	
Multipara	139	129 (4.6%)	10 (66.7%)	0.111
Twin pregnancy	72	69 (24.4%)	3 (20.0%)	1.000
FGR	32	30 (10.6%)	2 (13.3%)	0.668
Antenatal corticosteroids	194	184 (65.0%)	10 (66.7%)	0.896
Type of delivery				
Vaginal	128	122 (43.1%)	6 (40.0%)	0.813
Cesarean	170	161 (56.9%)	9 (60.0%)	
Gestational age				
< 29 wk	51	49 (17.3%)	2 (13.3%)	0.561
29-31 wk	93	90 (31.8%)	3 (20.0%)	
> 31 wk	154	144 (50.9%)	10 (66.7%)	
Birth weigth				
< 1000 g	44	41 (14.5%)	3 (20.0%)	0.386
≥ 1000 g	254	242 (85.5%)	12 (80.0%)	
Sex				
Male	171	161 (56.9%)	10 (66.7%)	0.456
Female	127	122 (43.1%)	5 (33.3%)	
NICU diagnosis				
PIVH grade > 2	17	16 (5.7%)	1 (6.7%)	0.595
BPD	22	20 (7.1%)	2 (13.3%)	0.305
Sepsis	31	30 (10.6%)	1 (6.7%)	1.000
NEC	8	7 (2.5%)	1 (6.7%)	0.342
Social risk	44	40 (14.1%)	4 (26.7%)	0.251
Season of the year at discharge				
Spring/ Summer	158	154 (54.4%)	4 (26.7%)	0.060
Autumn/ Winter	140	129 (45.6%)	11 (73.3%)	
PMA at discharge (median, min. e max.)	35 (33, 42)	35 (33, 42)	35 (34, 41)	0.452
Lenght of inital NICU stay (median, min. e max.)	28 (2, 121)	28 (2, 121)	21 (11, 104)	0.732

Table 3: Demographic and clinical characteristics in relation to re-hospitalization up to 30 days after discharge from the NICU.

Abbreviations: BPD - Bronchopulmonary dysplasia; FGR – Fetal Growth Restriction; NEC - Necrotizing enterocolitis; NICU - Neonatal Intensive Care Unit; PIVH - Peri-intraventricular hemorrhage; Postmenstrual age - PMA

Re-hospitalization up to 30 days (n= 15)	
Cause of readmission	n (%)
Respiratory infectious	5 (33.3%)
Other non-infectious	5 (33.3%)
Other infectious	2 (13.3%)
Gastrointestinal/nutritional	2 (13.3%)
Respiratory non-infectious	1 (6.7%)

Table 4: Causes of re-hospitalization up to 30 days after discharge from the NICU.

There was a tendentially higher, but not statistically significant relationship between discharge in autumn/winter and short-term re-hospitalization (p=0.060). The other variables studied also showed a similar distribution between short-term re-hospitalized and non-re-hospitalized NBs. Regarding the causes of short-term re-hospitalization, described in Table 4, the more prevalent were infectious respiratory pathologies (n=5; 33.3%), namely pneumonia (n=2), acute bronchiolitis (n=2) and acute nasopharyngitis with apnea (n=1), and other non-infectious pathologies (n=5; 33.3%).

Discussion

PT NBs have increased vulnerability and are at greater risk of re-admission after discharge. Hospital readmissions have already been evaluated in several studies, albeit with very different methodologies. These methodologies differ in terms of the definition of readmission, the time period between discharge and readmission and the characteristics of the patients included in the sample [1, 2, 4-11].

In the present study, the rate of observation in the ED (15.8%) was higher than reported in a 2012 Californian study with NBs without major congenital anomalies who were discharged from the NICU to their homes [11]. This difference may be due to the fact that the sample size was much larger and that the NBs in this study were all assessed by a pediatrician or home health service 2 days after discharge.

Regarding the re-hospitalization rate, a rate of 5.0% was obtained. A 2014 study with PT of 23-34 wk of GA data from California showed a similar median 30-day re-hospitalization rate (~5%) [10]. Another 2013 study with data also from California, had a 30-day re-hospitalization rate of 6.0% for PT with 23-33 wk of GA [9]. On the other hand, a 2016 study in Australia with NB of GA 24-33 wk showed rates of 30.7% for GA 24-27 wk, 19.9% for GA 28-31 wk and 10.1% for GA 32-33 wk [6].

Regarding the variables with a statistically significant association with re-hospitalization, none of the variables examined showed this association. Only autumn/winter discharge showed a tendentially higher, but not statistically association with short-term re-hospitalization (p=0.060). A 2016 study in Ohio also found no association between BW and re-hospitalization up to 30 days after discharge [4]. The same study found no association between BPD and re-hospitalization when patients with BPD were treated by a team specialized in this pathology [4]. Factors that have been associated with 30 days re-hospitalization in other studies were: longer duration of initial NICU stay [4-5] and lower GA [5, 9, 11].

The most common causes of re-hospitalization were infectious respiratory diseases (33.3%) and other non-infectious diseases (33.3%). The fact that infectious respiratory pathology is one of the most prevalent pathologies leading to re-hospitalization may be related to discharge in autumn/winter and this being the time of year when there is a higher prevalence of infectious respiratory pathology. A 2020 review by Hannan et al. [5] states that PTs with a GA < 33 wk are most commonly re-hospitalized for acute bronchiolitis in the first month after discharge. The same review also described acute bronchiolitis as a leading cause of re-hospitalization within 14 days of discharge in PTs with a GA < 32 wk [5]. A 2013 study with data from California in NBs with GA 23-44 wk described respiratory infections as the most common cause of re-hospitalization in all GA [9].

We consider the strength of this study to be the fact that it evaluated all PT NBs with a GA < 34 wk who were discharged home from the NICU of a specialized perinatal support hospital over a period of 14 years, and the fact that no NB lost follow-up during the period evaluated.

However, when analysing the results obtained, some limitations of the study should be taken into account. These limitations relate to the fact that as a retrospective study the data collection was limited to the information recorded in the clinical file. In addition, it was not possible to access patient examinations carried out in primary health care centres or private health care facilities. The social risk assessment did not specifically assess the socioeconomic power of the family [6-7, 9].

Conclusion

We concluded that gastrointestinal/nutritional problems were the most common cause of ED observation on the overall sample and in the subgroups of NB with BW < 1000 g and BPD. This alerts us to the importance of investing in caregiver training on these issues prior to discharge from the NICU, as well as improving the adequacy of the Primary Care services response. The readmission rate in this study was lower than that generally described in the literature. The majority of NBs seen in the ED did not present with severe pathologies that would have led to their re-hospitalization and should have been assisted in a Primary Care setting. We therefore emphasize the importance of reorganizing Primary Care to improve its accessibility and response to NBs and their families, with the aim of reducing the inappropriate use of ED associated with high costs and infectious risk in this vulnerable population.

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Author's contribution

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Availability of data and materials

The data set used during the study is available to the authors.

Ethics approval and informed consent

Ethics approval for the development of this study with informed consent waiving was obtained from Ethics Committee of the *Coimbra Hospital* and Universitary *Centre* (reference number OBS.SF.116-2023).

Consent for publication

The authors agree to submit this article to the journal and, if accepted, to its publication in this journal. The authors warrant that this article is original, dose not contravene on any copyright and any other proprietary right of any third party, is not under consideration by another journal, and has not been previously published.

Competing interest declaration

The authors express that they have no competing interests.

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