ORIGINAL ARTICLE

Causes of Later Discharge in Newborns: A Cost-Benefit Analysis

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Abstract

Introduction: Early postnatal discharge promotes family bonding and reduces hospitalization care and costs. In newborns, later discharge is usually due to hyperbilirubinemia, weight loss, or feeding difficulties. This study was conducted to assess later discharge causes and cost-effectiveness in newborns who are hospitalized in a tertiary neonatal care department.

Methods: Retrospective study (January to September 2019). Study group composed of newborns transferred with their mothers to the postnatal ward of a maternity. All neonates discharged later than 72 hours were included. Newborns admitted to neonatal intensive care unit were excluded.

Results: Four hundred forty six newborns, 55.2% male gender, median gestational age 39 weeks (34-41 weeks), median birth weight 3,128 g (1,950-4,475 g). The median length of stay was four days (4-16 days). The main causes of later discharge were weight loss (38.2%) and hyperbilirubinemia (27.14%). Among the other causes of later discharge, a statistically significant correlation was observed between hypoglycemia and small for gestational age newborns ($p = 0.026$), maternal disease and pre-eclampsia ($p = 0.005$), and social problems and maternal age below 23 years ($p < 0.001$). Later discharge represented a total cumulative of 709 days and an estimated cost of 138,964 euros.

Discussion: If we consider neonates who are later discharged because of weight loss, less than 10% of birth weight and those who received phototherapy without criteria and without being in the high-risk zone, approximately 27,048 euros could be saved for nine months. A quarter of all newborns were later discharged, most of them because of weight loss and hyperbilirubinemia. Early post-discharge evaluation at home, provided by primary care services, could help in the improvement of a discharge decision.

Keywords: Infant, Newborn; Cost-Benefit Analysis; Length of Stay/trends; Patient Discharge/trends; Portugal

Introduction

Postnatal hospitalization must be long enough to allow the identification of problems in the newborn and to guarantee that the family is prepared to care for their infant at home. While cardiopulmonary problems related to the transition from the intrauterine to the extrauterine environment usually become apparent in the first 12 hours after birth, other problems such as significant hyperbilirubinemia, ductal-related cardiac disorders and gastrointestinal obstruction may require a longer observational period.[1-3]

According to the American Academy of Pediatrics, early discharge is referred to as a postpartum hospital stay of 48 hours or less.[1] Early discharge promotes family bonding and reduces hospitalization care and costs. However, it may increase the rehospitalization rate, premature cessation of breastfeeding, and parental anxiety.[4] This can be avoided by a health policy of early postpartum follow-up visits to the families, mostly provided by primary care services.[5,6] In the center region of Portugal, it is difficult to assure these visits and, for that reason, in this maternity, newborns were usually discharged after 72 hours of life. This lack of support was exacerbated after the beginning of the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic.

This study was conducted to assess the causes of the later discharge of newborns hospitalized in a tertiary neonatal care department. A cost-effectiveness evaluation of later discharge was also carried out.

Methods

This study was conducted retrospectively over a period of nine months (January to September 2019) in a tertiary neonatal care department with a median of 2,470 births in the last 10 years.

The study group was defined based on a sample of newborns transferred with their mothers to the

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postnatal ward. All of the neonates who were later discharged were included. Neonates admitted to the neonatal intensive care unit were excluded from the study analysis.

The length of stay was defined as the interval between birth and discharge. Later discharge was defined as a postpartum length of stay above 72 hours.

Data recorded included maternal (age, blood type, parity, and presence of medical disease) and neonatal variables (gender, gestational age, mode of delivery, birth weight, length of postnatal stay, and cause of later discharge). Classification according to the birth weight of neonates was based on Fenton growth charts.[7] Small for gestational age was defined as birth weight below the 10th percentile for the gestational age, normal weight as between the 10th and 90th percentile for gestational age, and macrosomia as a birth weight greater than 4,000 g or above the 90th percentile. Hyperbilirubinemia was classified as being in the high-risk zone or as having criteria for phototherapy according to a Bhutani nomogram.[8]

Neonates were discharged from the postnatal ward based on newborn and mother clinical stability, ability, and mother confidence to care for the baby and primary care support to an appropriate follow-up care. Moreover, according to our maternity policy, the mother-infant dyad should be discharged together.

The mean cost per day on the postnatal ward at our maternity is 196 euros.

Statistical analysis was performed with IBM SPPS Statistics® version 22. The level of significance adopted in the study was $p < 0.05$.

Results

During the study period, a total of 1,765 mother-infant dyad were hospitalized in the postnatal ward of the tertiary neonatal care center. Later discharge was observed in 446 newborns (25.3%).

These later discharged neonates match with 431 mothers, with a median age of 33 years (16-48 years) and a median parity of one (1-8). The most frequent blood type was A Rh+ (n = 198, 45.9%), followed by 0 Rh+ (n = 140, 32.5%). Most of them (n = 305, 70.8%) had no relevant past medical history, but 126 women (29.2%) had at least one previous medical condition. The four most frequent gestational complications were gestational diabetes (n = 39, 9%), hypothyroidism (n = 20, 4.6%), depression (n = 10, 2.3%), and pre-eclampsia (n = 9, 2.1%).

The newborns variables are described in Table 1.

The registered median of length stay was four days (4-16 days). Thirty newborns (6.7%) were later discharged because of more than one cause. The main causes of later discharge were categorized into a diagnostic group, as reported in Table 2.

Weight loss was the most frequent later discharge cause (n = 183, 38.2%). Median loss of birth weight was 9.56% (4.6%-12.8%). Most neonates who were later discharged because of weight loss were born at term (95.6%) and had a normal birth weight (90.2%). In 67 infants (36.6%), a birth weight loss of 10% or more was observed. Most newborns were exclusively breastfed unless significant weight loss was observed. In 116 newborns (63.4%) who were later discharged because of weight loss, breastfeeding support was given by the

Table 1. Characteristics of the neonates

Gestational age (weeks), median (min.-max.)	39 (34-41)
Gestational age, n (%)	
34 weeks – 36 weeks and 6 days	66 (14.8%)
≥ 37 weeks	380 (85.2%)
Birth weight (g), median (min.-max.)	3,128 (1,950-4,475)
Gender, n (%)	
Male	246 (55.2%)
Female	200 (44.8%)
Birth delivery, n (%)	
Vaginal	266 (59.6%)
Assisted by vacuum	72 (27.1%)
Assisted by forceps	18 (6.8%)
Cesarean	180 (40.4%)
Classification of birth weight, n (%)	
Normal birth weight	369 (82.7%)
Small for gestational age	54 (12.1%)
Macrosomia	23 (5.2%)

Max. - maximum; min. - minimum.

Table 2. Causes of later discharge

Diagnostic group	n (%)
Weight loss	183 (38.2%)
Hyperbilirubinemia	130 (27.1%)
Maternal disease	36 (7.5%)
Accompanying twin	16 (3.3%)
Social problem	15 (3.1%)
Need of complementary diagnostic test	15 (3.1%)
Feeding difficulties	14 (2.9%)
Parental anxiety	11 (2.3%)
Clinical instability related to prematurity	9 (1.9%)
Hypoglycemia	8 (1.7%)
Hypernatremia	5 (1.1%)
Other causes	37 (7.7%)

nursing staff and 67 (36.6%) needed supplementation with formula.

All neonates who were later discharged because of hyperbilirubinemia (n = 130, 27.1%) received phototherapy. Of these, 77 (59.2%) had absolute criteria for phototherapy, while 53 (40.8%) were below this threshold. Among these, five infants (9.4%) were not in the high-risk zone, but 48 (90.6%) were in the high-risk zone according to Bhutani nomogram. None of the cases needed exchange transfusion. There was a statistically significant correlation between neonates who did not need phototherapy and maternal blood type 0 (p = 0.041) and type 0 Rh+ (p = 0.039).

Maternal causes of later discharge are described in Table 3. Newborns whose mothers had pre-eclampsia were later discharged due to maternal disease (p = 0.005) and those whose mothers were younger than 23 years had longer postnatal hospitalization related to social problems ($p < 0.001$).

Regarding later discharge due to hypoglycemia, there was a statistically significant correlation with newborns who were small for their gestational age (p = 0.026), but no statistically correlations with macrosomia (p = 0.343), gestational diabetes (p = 0.101), or late prematurity (p = 0.611). All infants who were later discharged because of hypoglycemia had weight loss below 10%.

The mean cost per day on the postnatal ward of our maternity is 196 euros. In our study, there was a total extension of the hospital stay in 709 days, corresponding to 138,964 euros.

Discussion

A quarter of all neonates born in this tertiary neonatal center was later discharged, most of them due to weight loss and hyperbilirubinemia, in accordance with what has been described by other authors.[9,10] These are also diagnoses that are usually responsible for readmissions in the first 48 hours after discharge, e.g. jaundice, dehydration, and feeding difficulties.[9,11]

The major cause of later discharge was weight loss. Obviously, the risk of hypernatremic dehydration in these neonates is worrisome because it may lead to renal and liver failure or even disseminated intravascular coagulation, intracranial hemorrhage, seizure, and death.[12,13] Breastfeeding-associated neonatal hypernatremia is a well known risk in infants with weight loss over 10% in the first days of life.[12] Although 67 infants had a weight loss of 10% or more of their birth weight, only five newborns had longer postnatal hospitalization due to hypernatremia. This can be explained by the fact that not all newborns with significant birth weight loss had a serum workup, so the incidence of hypernatremia may be underestimated. However, some neonates were later discharged because of weight loss under 10%. These neonates could be earlier discharged if a home evaluation in the following 24 hours could be assured.

A surprising finding was the number of infants that rested at the hospital due to hyperbilirubinemia in the high-risk zone or even those without criteria for phototherapy according to Bhutani nomogram.[8] Bilirubin toxicity affects the central nervous system by damaging the basal ganglia and brainstem nuclei. While acute bilirubin encephalopathy corresponds to the clinical manifestations of bilirubin toxicity that occurs from the first days to weeks after birth, kernicterus is the chronic and irreversible neurologic sequelae of bilirubin toxicity.[14] The literature shows a rehospitalization rate due to hyperbilirubinemia of 34.3%-64%.[9,10,15,16]

In 2004, an American Academy of Pediatrics clinical practice guideline was published stating that if no appropriate follow-up could be ensured, later discharge could be an option for high-risk neonates, until an appropriate follow-up can be ensured or the period of greatest risk has passed (72-96 hours).[3] Unfortunately, in the central region of Portugal, only a small part of the population benefit from post-partum home follow-up visits. In neonates breastfed without criteria for phototherapy and outside the high-risk zone, supplementation with expressed breast milk or formula is appropriate if the infant intake seems inadequate, or weight loss is excessive. These measures could be taken at home if appropriate evaluation after discharge was guaranteed.

Other causes of later discharge included clinical instability related to prematurity and hypoglycemia. Hypoglycemia after 35 weeks of gestational age is an important cause of neonatal readmissions.[17] In this analysis, it seems like hypoglycemia severity is mostly related with newborns small for gestational age (p = 0.026) but not with macrosomia, gestational diabetes, or late prematurity. This can be used in risk stratification

Table 3. Maternal causes for later discharge

Maternal cause	*p* value
Pre-eclampsia	0.005
Depression	0.161
Gestational diabetes	0.254
Hypertension	0.505
Hypothyroidism	0.746
Thrombophilia	0.973

when considering earlier discharge for these newborns. In Switzerland, already in 1998-2000, a policy of early postnatal discharge combined with home midwifery support, in term neonates from uncomplicated pregnancies, had significantly lower costs than traditional postnatal care, without compromising the health and well-being of the mother and neonate. A nurse visited these families during the first 10 days after birth. These saved an average of over 1,200 francs per mother-infant dyad.[18] Another Spanish single-center randomized controlled trial reported that early postnatal discharge (24 hours or less) combined with close monitoring at home by qualified nurses allowed for savings from 18% to 20% when compared with traditional minimum 48 hours hospital stay.[16]

In the central region of Portugal, it is difficult to assure early postpartum follow-up visits to the families. For that reason, in this maternity, newborns were usually discharged after 72 hours of life. Newborn bloodspot screening performed in the primary care center until the sixth day of life could be an opportunity to reevaluate infants with weight loss or hyperbilirubinemia. However, sometimes this reassessment cannot be done in the day after postnatal discharge, which leads to the decision of longer hospitalization.

In our study, if we consider neonates later discharged due to weight loss below 10% of birth weight and those who received phototherapy without criteria and without being in the high-risk zone, approximately 27,048 euros could have been saved during nine assessed months.

Although this is a single-center sample, the authors consider that a good approach to optimize the discharge decision is providing primary care center support at home, after discharge from the neonatal care department. Other similar studies could clarify this idea, but early post-partum follow-up visits have already demonstrated to be a cost-effective measure in other countries.

Concluding, a quarter of all newborns was later discharged, most of them because of weight loss and hyperbilirubinemia. The mean cost per day on the postnatal ward of our maternity is 196 euros. There was a total extension of the hospital stay in 709 days, corresponding to 138,964 euros. If we consider the neonates later discharged because of weight loss below 10% of birth weight and those who received phototherapy without criteria and without being in the high-risk zone, approximately 27,048 euros could be saved during the period of study.

It is imperative to optimize the discharge criteria to avoid unnecessary later discharge in healthy neonates. Early post-discharge evaluation at home, provided by primary care department, could help in the improvement of the discharge decision.

WHAT THIS STUDY ADDS

- In a significant number of neonates later discharged due to weight loss, this loss was below 10% of their birth weight. A considerable number of newborns with hyperbilirubinemia also had no criteria for phototherapy. These neonates could be discharged earlier if a home evaluation in the following 24 hours could be possible.
- Early post-partum follow-up visits provided by primary care centers, to allow early discharge and to minimize the risk of readmission, may be a cost-effective measure to be implemented in the central region of Portugal.

Conflicts of Interest

The authors declare that there were no conflicts of interest in conducting this work.

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Protection of human and animal subjects

The authors declare that the procedures followed were in accordance with the regulations of the relevant clinical research ethics committee and with those of the Code of Ethics of the World Medical Association (Declaration of Helsinki).

Provenance and peer review

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Confidentiality of data

The authors declare that they have followed the protocols of their work centre on the publication of patient data.

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Causas de Alta Tardia em Recém-Nascidos: Uma Análise de Custo-Benefício

Resumo:

Introdução: A alta pós-natal precoce promove o vínculo familiar e reduz os cuidados e custos hospitalares. Em recém-nascidos, a alta tardia deve-se habitualmente a hiperbilirrubinemia, perda ponderal ou dificuldades alimentares. Pretendeu-se determinar as causas de prolongamento de internamento e relação custo-benefício em recém-nascidos internados numa maternidade de nível III.

Métodos: Estudo retrospetivo (janeiro a setembro 2019). Grupo de estudo incluiu recém-nascidos transferidos com as mães para o puerpério. Foram incluídos todos os recém-nascidos com alta após as 72 horas e excluídos aqueles internados em unidade de cuidados intensivos neonatais.

Resultados: Quatrocentos e quarenta e seis recém-nascidos, 55,2% sexo masculino, mediana da idade gestacional 39 semanas (34-41 semanas), mediana do peso ao nascimento 3128 g (1950-4475 g). A mediana do tempo de internamento foi de quatro dias (4-16 dias). As principais causas de prolongamento de internamento foram a perda ponderal (38,2%) e a hiperbilirrubinemia (27,14%). Nas outras causas de prolongamento do internamento, observou-se uma correlação estatisticamente significativa entre hipoglicemia e recém-nascido leve para a idade gestacional (p = 0,026), doença materna e pré-eclâmpsia (p = 0,005), problema social e idade materna inferior a 23 anos (p < 0,001). O prolongamento de internamento representou um total cumulativo de 709 dias e 138 964 euros de custo estimado.

Discussão: Considerando os recém-nascidos com alta tardia por perda ponderal inferior a 10% do peso ao nascer e aqueles sob fototerapia sem critério ou sem se encontrarem na zona de alto risco, poderiam ter sido poupados cerca de 27 048 euros em nove meses. Um quarto dos recém-nascidos teve alta tardia, a maioria por perda ponderal e hiperbilirrubinemia. A avaliação domiciliária precoce pós-alta, efetuada pelos cuidados de saúde primários, poderia ajudar na melhoria da decisão de alta.

Palavras-Chave: Alta do Paciente/tendências; Análise Custo-Benefício; Portugal; Recém-Nascido; Tempo de Internamento/tendências