

The Duration of Hospitalization and Readmission Rate of Low Birth Weight Infants in a Tertiary Referral Hospital in Isfahan, Iran

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ABSTRACT

Background: Currently, the number of premature deliveries has been increasing, resulting in early postnatal discharge due to shortage of beds in the neonatal intensive care units (NICU).

Methods: This descriptive-analytical study was conducted through investigating the premature infants' files for gestational age (GA), birth weight (BW) and duration of the first hospitalization. Furthermore, the readmission rate during the first year of life and their causes were studied.

Results: Overall, 495 infants were enrolled in this study. The range of GA and BW of infants who were admitted to NICU were 24-36 weeks and 470 - 2500 g, respectively. A total of 172 (34.74%) infants had a BW of less than 1500 g (VLBW), and 144 of them (29.09%) were severely premature (GA of between 24-31 weeks). The median (range) time of hospitalization in VLBW infants was 22 (1-75). Moreover, 76 (15.3%) infants were re-hospitalized during the first year of life, and 32 (6.4%) infants were readmitted during the first three months of life. The four most common causes of re-hospitalization during the first year of life were as follows: pneumonia (32.89%), icter (17.10%), treatment of retinopathy of prematurity (10.52%) and sepsis (9.20%).

Conclusion: Hospital policies are changing due to the high rate of preterm births and lack of neonatal beds. The results of this study suggested that premature neonates, who are able to regulate body temperature at room temperature, and gain weight by oral feeding with no recent apnoea or bradycardia, could be discharged regardless of their gestational age and body weight.

Keywords: Intensive Care Units, Neonatal; LBW; Premature

Introduction

The number of premature deliveries has been increasing over time (1). For instance, in Japan in 1997, 7.9% of postnatal infants weighed less than 2500 g, 0.6% of the total births had birth weight (BW) lower than 1500 g (VLBW) and 0.2% of the total births had BW lower than 1000 g (ELBW) (2); in 2007, the rate of preterm births and admission to NICU increased, i.e., 9.6%, 0.8% and 0.3% for LBW, VLBW and ELBW, respectively (3). Under these circumstances, early neonatal intensive care unit (NICU) discharge happens due to high rate of preterm births and shortage of neonatal beds.

Other reasons for early discharge are financial problems and the stresses exerted on infants and

their parents (4-7). In this regard, some studies have laid down some special conditions for early discharge of premature newborns (5). In general, it is recommended that newborns' discharge should be delayed until (10) the infants are able to meet their milk requirements directly from breastfeeding (7).

On the other hand, severe prematurity means there is no solution except a long stay. Phibbs et al. observed that with each week decrease in gestational age (GA), the duration of hospitalization and hospital costs increase (11).

Additionally, a study on 552 patients in Oxford hospitals reported the following criteria for newborns' discharge: infants acquiring the ability

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to be fed with milk and gaining proper weight, having stable breathing without apnea and showing the ability to maintain body temperature in an open environment. However, in spite of general agreement on the aforementioned criteria, it was found that stay duration varied in different hospitals.

The average length of postnatal hospital stay for VLBW infants ranged from 40 days to 80 days. These differences were due to differences in gestational age at birth, as well as some prematurity complications such as chronic lung disease (CLD), necrotising enterocolitis (NEC) and neonatal sepsis. However, there is a general consensus on the early neonatal discharge (7).

In another study, Doruti et al. concluded that an early discharge of VLBW preemies is safe and economic provided that they are cared for and supported at home by an experienced nurse (8). In another long-term study, published in 2006, Altmen et al. showed that hospital stay duration of a newborn with a gestational age of 30-34 weeks has decreased from 28 (11) days in 1983 to 14 days (7) in 2002; finally, they concluded that short hospital stay duration is not only to the benefit of the families, but also prevents overcrowding NICUs, and has positive economic outcomes (6).

In another study conducted by Andrud et al. in California, re-hospitalization of infants within the first year of life was found to be approximately 15%, this rate was 31% for neonates younger than 25 weeks (12).

Considering the aforementioned studies, and due to the high rate of admission of premature newborns and shortage of beds (12) in NICUs, the present study aims to investigate the ability of preemies to gain weight with oral feeding and regulate their body temperature in the open surroundings, with no recent apnoea or bradycardia and if they could be discharged regardless of their gestational age and body weight.

However, in many of these premature infants the aforementioned conditions might not be sufficient for discharge, leading to high rates of re-hospitalization (1). Thus, we aimed to determine the duration of hospitalization for LBW preemies and their re-hospitalization during the first year of life.

Method

This descriptive-analytical study was conducted on 510 LBW preemies who were admitted to NICU at Shahid Beheshti Hospital, Isfahan, Iran. Of these newborns, 495 cases who survived during the first year of life, participated

in the current study. The exclusion criteria were major congenital anomalies and delayed discharge due to multiple parities. With consent of the authorities in charge, the medical records of premature newborns hospitalized in the NICU were investigated.

We retrospectively surveyed the preemies' medical records for gestational age (GA), birth weight (BW) and duration of the first hospitalization. Prematurity complications during hospital stay were also investigated, e.g., respiratory distress syndrome (RDS), intraventricular haemorrhage (IVH), NEC, patent ductus arteriosus (PDA), CLD, neonatal sepsis and need for respiratory support, nasal continuous positive airway pressure (NCPAP) and need for surfactant and mechanical ventilation. Furthermore, re-hospitalization during the first year of life and its causes were identified through telephoning parents and reading newborns' files.

RDS was determined with the presence of clinical evidence of respiratory distress and a positive chest X-ray film along with Makinen's radiological classification (13). CLD was defined as oxygen dependency during the first 28 days of life (14). NEC was recognized according to modified Bell's staging (15-6). PDA and IVH were confirmed by echocardiography and brain ultrasonography, respectively (according to Papile's classification) (17).

If the infants met the following criteria, they were discharged from hospital: clinically stable in a room environment, no apnoea or bradycardia presented for five days, full enteral feeding and as a result, achieving favorable bodyweight, and suitable home situation (e.g., sufficient family support and sufficient educational level of the mother to care for her infant).

Data analysis

Normally and non-normally distributed quantitative data were presented as means (\pm SD) and median (range), respectively. The numeric variables were compared performing independent t-test or Mann-Whitney test. The qualitative variables were presented as frequency (per cent). Chi-Square test and, if required, Fisher's exact test analysis were employed, as well. The data were analyzed using SPSS, version 20 (SPSS Inc., Chicago, IL, USA).

Ethics statement

This paper is derived from the medical student thesis No.392221, Isfahan University of Medical Sciences. The study was approved by the regional ethical review board of the university.

Results

Overall, 495 infants were enrolled in this study. Table 1 provides a summary of the baseline demographic information of the infants. Minimum and maximum GA of infants admitted to NICU were 24 and 37 weeks, respectively. Minimum BW was 470 g; a total of 172 (34.74%) infants had a BW less than 1500 g and 325 (65.25%) a BW of between 1500 and 2500 g. It was found that 144 (29.09%) newborns were severely premature (GA of between 24 and 31 weeks), while 353 (71.31%) of them had a GA above 31 weeks.

Apgar score <6 at five minutes was found in 115 (23.1%) cases. Apgar score <6 at ten minutes was found in 15 (3%) newborns admitted to hospitals.

Table 2 provides a summary of the clinical characteristics of the infants. Overall, 375 (75.5%) infants had RDS; 340 (68.4%) of them were treated with early NCPAP. Moreover, 236 (47.5%) premies were administered surfactant (INSURE approach) and only 38 (7.6%) were supported with mechanical ventilation (MV).

In addition, 34 (6.8%) and 31 (6.1%) infants had PDA and IVH, respectively. Sepsis and NEC were observed in 98 (19.7%) and 35 (7%) infants, respectively, and 28 (5.6%) and 17 (3.4%) infants acquired CLD and ROP, respectively.

The median (range) hospitalization time of premies was 10 (1-75) days. The median (range) time of hospitalization in VLBW infants was 22 (1-75) days, while in infants with BW of 1500-2500 g it was eight (1-63) days ($P < 0.001$; Figure 1). The median (range) of discharge weight of all infants was 1770 (470-3000) g, but the median (range) discharge weight in VLBW infants was 1400 (470-2890) g (Figure 2).

A total of 76 (15.3%) infants were re-hospitalized during the first year of life (Figure 3), and 32 (6.4%) were re-admitted during the first three months of life. Moreover, 12 (2.6%) and three (0.6%) re-hospitalized infants were readmitted a second and third time, respectively. The re-hospitalization rate of VLBW infants was more significant than infants with BW > 1500 g (19.8% vs. 12.9%; $P = 0.04$). In very premature neonates (GA < 31 weeks) 28 (19.4%) infants were readmitted, while the number of readmissions was 48 (13.6%) for GA > 31 weeks ($P = 0.045$).

Pneumonia (32.89%), icter (17.10%), ROP (10.52%) and sepsis (9.20%) were the four most common causes of re-hospitalization during the first year of life. Other causes such as seizures (7.89%), heart surgery (5.26%), aspiration (3.94%) and urinary tract infection (1.31%) were also observed. The median (range) duration of

Table 1. Baseline demographic data of the infants

	min	max	mean	No. of BW < 1500 gr.	No. of BW > 1500 gr.	No. of GA < 31 weeks	No. of GA > 31 weeks
Birth weight (gram)	470	2500	1697.1570±489.66	172 (34.74%)	325 (65.25%)	-	-
GA (weeks)	24	36	32.06 ± 2.88	-	-	144 (29.09%)	353 (71.31%)

Table 2. Clinical characteristics of the infants.

Number of infants	No. of RDS	No. of PDA	No. of IVH	No. of Sepsis	No. of NEC	No. of ROP	No. of CLD
495	375 (75.5%)	34 (6.8%)	31 (6.1%)	98 (19.7%)	35 (7%)	28 (5.6%)	17 (3.4%)



Figure 1. Median of hospital stay based on birth-weight. (Although all infants with birth weight of 470 - 749 grams were dead)

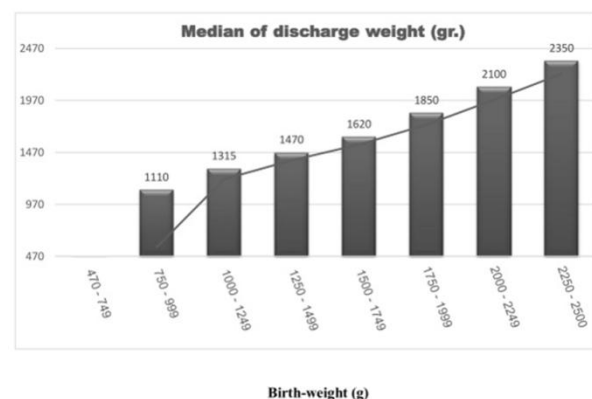
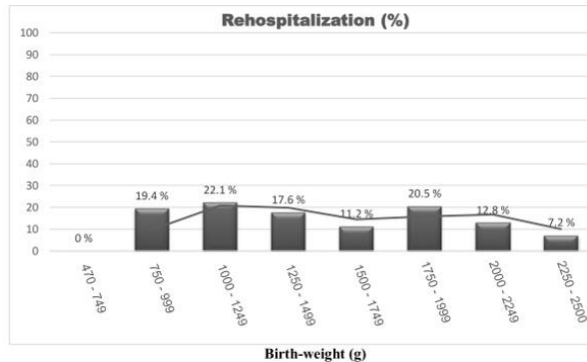


Figure 2. Median of discharge weight based on birth-weight. All infants with birth weight of 470 - 749 grams were dead

Table 3. Clinical findings based on gestational age

Gestational age (weeks)	Number of infants	Median (range) of Apgar at 5 Minutes	Median of Apgar at 10 Minutes	Median (range) of hospital stays (days)	Number (%) of infants readmitted
24 -26	21	4 (1 - 8)	7 (5 - 9)	29 (1 - 64)	2 (9.5%)
26 - 27	45	5 (1 - 8)	7 (5 - 10)	42 (2 - 75)	11 (24.4%)
28 - 29	67	6 (1 - 9)	8 (4 - 10)	23 (2 - 64)	13 (19.4%)
30 - 31	101	7 (1 - 9)	8 (5 - 10)	13 (2 - 47)	22 (21.8%)
32 - 33	139	8 (1 - 9)	9 (5 - 10)	8 (1 - 33)	18 (12.9%)
34 - 36	103	8 (2 - 9)	9 (5 - 10)	6 (1 - 63)	8 (7.2%)

**Figure 3.** Rehospitalization based on birth-weight. All infants with birth weight of 470 - 749 grams were dead in first hospitalization

re-hospitalization for these infants was 7 (1-42) days also observed. The median (range) duration of re-hospitalization for these infants was 7 (1-42) days. The median (range) of age of re-hospitalization in the first three months of life was 30 (7-87) days. Also, the median (range) of age of re-hospitalization in the three to 12 months of life was six (3-12) months.

Out of 115 infants with Apgar score of <math><6</math> at five minutes, re-hospitalization rate was 23 (20.0%). Infants with Apgar score of <math><6</math> at five minutes were readmitted more frequently ($P=0.04$), than those with Apgar score of <math><6</math> at ten minutes, which did not have a significant effect on readmission rate ($P=0.41$).

We observed that gender had a significant effect on the rate of readmission. Re-hospitalization rate was significantly higher in males than females (18.8% vs. 11.6%; $P=0.03$).

All the infants with BW of 470 to 749 g died before discharge (Figure 2). The majority of infants with a GA of between 24 and 26 weeks also died, but some of them were discharged.

Additionally, 9.5% of the preemies required readmission in the first year of life (Table 3).

Discussion

Among the approximately 500 studied preemies, 15.3% required re-hospitalization

during the first year of life. This was in line with results of other studies on the re-hospitalization rate of discharged premature infants; for instance, Underwood et al. in 2007 reported a rate of 15% for infants with GA of less than 36 weeks (12). Seki et al. (1) in 2011 observed a re-hospitalization rate of 7.4% for premature infants of 26-34 weeks during the first year of life.

It seems that the higher the GA and BW the lower is the rate of re-hospitalization (Figure 3). Ahmadpour et al. (18) concluded that 15% of VLBW infants required re-hospitalization. Underwood et al.'s results showed a re-hospitalization rate of 27% in infants younger than 29 weeks, but it was 4.3% in late preterm (34-36 weeks) infants in Tomashek et al.'s study (19). Bathie et al. ran an early discharge programme for preemies with the support of nasogastric tube (NGT) feeding. They observed that no infants had required re-hospitalization (20).

On the other hand, Smith et al. concluded that low Apgar score at five minutes had no clear effect on the re-hospitalization rate of premature infants ($P=0.32$) (21), whereas, in our study Apgar score of less than 6 at five minutes had a clear effect on increased re-hospitalization rate.

It seems logical that the lower the GA and BW, the more likely the neonates are to be at "high risk" and have longer stays in hospitals (Figure 1). In our study, hospitalization duration had an inverse relationship with GA; the median (range) time of hospitalization in infants with GA of 26-28 weeks was 42 (2 - 75) days, whereas it was eight (1 - 33) days in infants with GA of 32-34 weeks.

In some studies it has been found that gender has an impact on re-admission rates. Smith et al. reported that female gender had lower odds of re-hospitalization during the first year of life by 47% (21). Re-hospitalization rate was also higher in males than females (18.8% vs. 11.6%) in our study ($P=0.03$).

We did not evaluate cost of hospitalization, but in some studies such as Bathie J et al. it was shown

that early discharge of hospitalization (£ 64, 260 in first four months of 2012) (20).

Although our sample size was quite large, further studies with larger sample sizes are recommended. Limitations of our study included the difficulty of retrieving large volumes of information about the premature newborns.

Conclusion

Due to of the high rate of premature deliveries and shortage of beds in NICU, this paper investigated the ability of preemies to gain weight by oral feeding and to control their body temperature at room temperature, with no recent apnoea or bradycardia, and whether they could be discharged regardless of their GA and body weight.

Conflict of Interest

No conflicts of interest to disclose.

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