

Factors Affecting Readmissions of Term and Late Preterm Infants in the Neonatal Period

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Abstract

Objective: To determine the incidence of hospital readmissions, the etiologies, and to analyze the risk factors for readmissions of Late Preterm infants (LPI) and term infants (TI) in the neonatal period.

Methods: It was a retrospective cohort study conducted at Nice Hospital for Women and Children, Hyderabad, India. The study protocol was approved by the institutional ethics committee. Late preterm and TIs ≥ 34 weeks of gestational age (GA), discharged alive either from the post-natal ward or NICU were included in the study. Neonates with congenital anomalies, who died before discharge, and who were readmitted >28 days of age were excluded from this study. The relevant demographic, antenatal, perinatal and neonatal data of the study infants as well as their mothers were recorded in the pre-designed proforma. Mann Whitney U test and Chi square tests were used for statistical analysis. A p value < 0.05 was considered statistically significant.

Results: A total of 1396 (100%) neonates were included in this study. Thirty-eight (2.72%) of the LPIs were readmitted and 3.87% (54) were in the TI category. When neonatal characteristics were compared, statistically significant difference was seen in both categories in birth weight, jaundice requiring phototherapy, sepsis and time to full feeding respectively. Poor weight gain was the leading cause of readmission in both categories; though not statistically significant. Maximum LPIs (23) and TIs (36) were admitted in the monsoon; though statistically no significant difference was observed.

Conclusion: Poor weight gain, respiratory infection, jaundice, poor feeding/lethargy and feeding difficulty/vomiting were identified as reasons for readmission. Metacentric studies with a large sample size are recommended.

Keywords: Readmission, Term, Preterm, Infant.

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Introduction

Due to their physiological immaturity, late preterm infants (LPIs) are more likely to be

admitted to NICUs soon after birth. [1] In recent decades, there has been an increase

in readmissions to LPIs and term infants (TIs) for jaundice and poor weight gain even among those who did not require admission to NICU soon after birth. [2, 3]

LPIs have more problems in the immediate neonatal period than their full-term counterparts. [4] This excessive morbidity exceeds the initial hospitalization at birth. According to the literature, the readmission rate for the LPIs was 1.5 to 3 times that for TIs. Jaundice and feeding problems are the reported reasons for rehospitalization. [5]

Against this back ground, a study was conducted with the aim of identifying the incidence of hospital readmissions, the common causes and also to analyze the risk factors for readmission in the neonatal period in the LPIs as well as TIs.

Methods:

It was a retrospective cohort study conducted at Nice Hospital for Women and Children, Hyderabad. It is a single centric research. As part of the institutional protocol consent was obtained from parents to use the data for academic and research purposes, and confidentiality was assured. The study protocol was approved by the institutional ethics committee. The study proforma was approved by the institutional

research committee. The study was conducted for 6 months.

Late preterm infants and TIs ≥ 34 weeks of gestational age (GA), discharged alive from either the post-natal ward or NICU were included in the study. Subjects with congenital anomalies, who died before discharge, and were readmitted >28 days of age were excluded from this study.

The relevant demographic, antenatal, perinatal and neonatal data of the study infants as well as their mothers was recorded in a pre-designed proforma. Clinical examination findings, reasons for readmission, risk factors, feeding habits, bilirubin levels were recorded in the proforma.

Statistical analysis: Data were analyzed using SPSS version 21, and presented in mean and percentages. Mann Whitney U test and Chi Square tests were used for statistical analysis. A p-value < 0.05 was considered statistically significant.

Results:

A total of 1396 (100%) neonates were included in this study. Thirty-eight (2.72%) of the LPIs were readmitted and 3.87% (54) were in the TI category (Table 1).

Table 1: Readmissions among the study infants; n (%)

Category	Not readmitted	Readmitted	Total
LPIs	436 (31.2)	38 (2.7)	474 (33.9)
Term infants	868 (62.1)	54 (3.86)	922 (66)
Total	1304 (93.3)	92 (6.6)	1396 (100)
Statistical analysis	Chi square value = 2.3728; P = 0.123		
	Statistically not significant		

When comparing the maternal base line characteristics, there was statistically significant difference in preterm labor between not readmitted and readmitted groups in the LPI category. In TI category, a statistically significant difference between the groups, was observed for parity (Primigravida) and chorioamnionitis, respectively (Table 2).

Table 2: Comparison of mother base line characteristic features among the study infants

Parameter	LPI			Term infant		
	Not readmitted	Readmitted	P value	Not Readmitted	Readmitted	P value
Maternal age	27.9	27.8	0.878	27.2	28.3	0.087
Primi	23	7	0.054	5	20	<0.01
Artificial conception	58	10	0.142	18	0	0.268
Multiple Pregnancy	23	0	0.147	23	0	0.209
Hypothyroidism	68	10	0.087	125	8	0.898
GDM	39	6	0.167	90	9	0.219
PIH	61	5	0.887	60	5	0.622
Chorioamnionitis	424	38	0.300	867	49	<0.01
PPROM	6	2	0.074	9	2	0.101
Preterm labour	5	4	<0.01	1	0	0.796
Antenatal steroids	301	27	0.796	292	22	0.504
LSCS	391	31	0.125	585	35	0.269
Delayed cord clamping >30 seconds	348	30	0.898	647	41	0.516

When neonatal characteristics were compared, statistically significant difference in both categories was observed for birth weight, jaundice requiring phototherapy, sepsis and time to reach full feeds, respectively. (Table 3).

Table 3: Comparison of neonatal characteristic features characteristic features among the study infants

Parameter	LPIs			Term infants		
	Not readmitted	Readmitted	P value	Not Readmitted	Readmitted	P value
Birth weight	2271.8(496.8)	2468.4(748)	0.02	3309.2(1281.3)	2904.0(391.07)	0.021
Gestational age	35.1(0.822)	35.15(0.82)	0.71	38.03(1.005)	37.85(0.833)	0.198
Gender						
Female	188(32.0)	11(1.9)	0.09	361(61.5)	27(4.6)	0.225
Male	248(30.7)	27(3.3)		507(62.7)	27(3.3)	
Birth asphyxia	5(20.0)	1(4.0)	0.432	18(72.0)	1(4.0)	0.911
Hypoglycemia	19(32.0)	18(1.9)	0.01	37(61.5)	0(0.0)	0.121
Hypocalcemia	3(11.1)	0(0.0)	0.60	24(88.9)	0(0.0)	0.216
Polycythemia	1(16.7)	0(0.0)	0.76	5(83.3)	0(0.0)	0.576
TTNB	174(23.0)	29(3.8)	0.01	522(69.0)	32(4.2)	0.898
Pneumonia	24(42.1)	4(7.0)	0.208	28(49.1)	1(1.8)	0.575
Surfactant	25(32.0)	12(1.9)	0.01	37(61.5)	0(0.0)	0.121
MAS	262(41.0)	9(1.4)	0.01	346(54.1)	22(3.4)	0.898
Oxygen supplementation	30(33.7)	5(5.6)	0.15	51(57.3)	3(3.4)	0.923
Noninvasive ventilation	39(41.5)	3(3.2)	0.49	47(50.0)	5(5.3)	0.235

Invasive ventilation	435(31.3)	38(2.7)	0.76	863(62.1)	54(3.9)	0.57
Sepsis	124(38.6)	11(3.4)	0.94	179(55.8)	7(2.2)	0.001
Antibiotic duration	10(41.7)	1(4.2)	0.89	12(50.0)	1(4.2)	0.777
Jaundice requiring Phototherapy	154(40.1)	22(5.7)	0.06	187(48.7)	21(5.5)	0.03
Duration of NICU stay	5.10(5.786)	4.89(9.648)	0.841	3.24(8.708)	4.68(8.756)	0.239
Exclusive breast feed at discharge	293(29.4)	28(2.8)	0.412	631(63.4)	44(4.4)	0.157
Time to reaching full feeds	2.52(3.194)	2.75(3.957)	0.677	1.90(2.35)	3.15(4.723)	0.001
Discharge weight loss	6(50.0)	1(8.3)	0.356	5(41.7)	0(0.0)	0.576

Poor weight gain was the leading cause of readmission in both categories, though statistically not significant. Maximum LPIs (23) and TIs (36) were admitted in the monsoon, though statistically not significant. (Table 4).

Table 4: Comparison of cause of readmission among the study infants; n (%)

Cause	LPIs	TIs	P value
Poor weight gain	27 (4.2)	22 (3.4)	0.043
Respiratory infection	4 (10.5)	1 (1.9)	0.071
Jaundice	22 (5.7)	4 (5.5)	0.001
Poor feeding/Lethargy	1 (4.3)	1 (4.3)	0.001
Feeding difficulties/Vomiting	1 (4.3)	1 (4.3)	<0.001
Season of birth/readmission			
Summer	11 (31.4)	24 (68.5)	0.132
Winter	22 (40.7)	32 (59.2)	0.896
Monsoon	23 (39.9)	36 (61.02)	0.545
Autumn	16	16	1

Discussion

Infants born between 34 to 36 weeks of gestation are considered LPIs and those born at ≥ 37 weeks of gestation are considered TIs. There is an increased risk of morbidity and complications with LPIs and 3-fold increased risk of readmission. [6] Hyperbilirubinemia, sepsis, and feeding difficulties are the common factors for increased readmission; the overall readmission rate progressively increases with decreasing GA beginning at 40 weeks. [7, 8]

Infant factors associated with an increased risk of readmission among LPIs are well described; the first-born child, male gender, maternal delivery complications, initial

discharge from the normal newborn nursery rather than an Intensive care unit, suboptimal breastfeeding, etc. [9, 10] This study aimed to determine the incidence of hospital readmissions in late preterm and term neonates, the most common reasons for readmission, and to analyze the risk factors for readmission in the neonatal period.

We analyzed 436 LPIs and 868 TIs in our study. The incidence of readmission 2.72% and 3.87%, respectively; statistically there was no significant difference (Table 1). Moyer et al. [11] reported that of 1861 LPIs born during the study period, 3.6% (67) were readmitted within 28 days of birth. In multivariable regression, each additional

day of hospital stay was associated with a significant reduction in the odds ratio (OR) for readmission; however, for infants delivered via normal vaginal delivery (NVD), there was no significant association between length of stay and readmission. An inverse relationship was observed in the subgroup analysis for hyperbilirubinemia and readmission. With the adjusted OR associated with longer length of stay was 0.40 for infants born via cesarean section, it was 1.14 for NVD.

The mean maternal age in this study were 27.9, 27.8 years for non-readmitted and readmitted infants in the LPI group, while it was 27.2 and 28.3 years for non-readmitted and readmitted in the TI group respectively. There were 23 and 7 mothers who were Primigravida in the non-readmitted and readmitted group respectively in the LPI group, compared to 5 and 20 mothers in the non-readmitted and readmitted group respectively in the TI group, which was statistically significant ($p < 0.01$). Fifty-eight and 10 infants were conceived by artificial conception in the non-readmitted and readmitted infants in the LPI group, while 18 infants were conceived by artificial conception in the non-readmitted infants and none in the readmitted group in TI. 23 infants in the non-readmitted group were products of multiple pregnancies, while there were none in the readmitted group under LPIs, and similarly, 23 infants in the non-readmitted group were products of multiple pregnancies, compared to none in the readmitted group in TI. 68 mothers had hypothyroidism in the non-readmitted group compared to 10 in the readmitted group among LPIs, while 125 mothers were treated for hypothyroidism in the non-readmitted group compared to 8 in the readmitted group among TI. 39 mothers had gestational diabetes (GDM) during pregnancy in the non-readmitted group compared to 6 mothers in the readmitted group among LPIs, whereas 90 mothers in the non-readmitted group had GDM compared to 9 in the readmitted group

among TI. 61 mothers had pregnancy induced hypertension (PIH) in the non-readmitted group compared to 5 in the readmitted group among LPIs, whereas 60 mothers were treated for PIH in the non-readmitted group compared to 5 in the readmitted group among TI. Pregnancy was complicated by chorioamnionitis in 424 mothers in the non-readmitted group and 38 in the readmitted group in the LPI group, compared to 867 mothers and 49 mothers in the non-readmitted and readmitted group among the TI. Labor was complicated by PROM in 6 mothers in the non-readmitted group and 2 mothers in the readmitted group in the LPI group, compared to 9 mothers and 2 mothers in the non-readmitted and readmitted group respectively, among the TI. Delivery was complicated by preterm labor in 5 mothers in the non-readmitted group and 4 in the readmitted group in the LPI group, compared with 1 mother and none in the non-readmitted and readmitted group under the TI. Antenatal steroids were covered in 301 mothers in the non-readmitted and 27 mothers in the admitted group under LPIs, compared to 292 and 22 mothers in the non-readmitted and readmitted group respectively, in the TI. 391 infants were born through LSCS in the non-readmitted group compared to 31 in the readmitted group among LPI, and 585 infants were born through LSCS in the non-readmitted group compared to 35 in the readmitted group respectively, among TI. Delayed cord clamping >30 seconds was practiced in 348 infants in the non-readmitted group compared to 30 infants in the readmitted group among LPI, compared to 647 infants in the non-readmitted group and 41 in readmitted group in the TI. (Table 2).

Ray et al. [12] found that odds of any hospitalization within the first year of life decreased with advancing GA, but the observed odds of any hospitalization exceeded the expected odds for infants at 35, 36 and 37 weeks of GA after discharge. Odds of hospitalization for

hyperbilirubinemia was highest in infants between 33 to 38 weeks and a relative peak in odds of any hospitalization for specific infections was observed in infants between 33 to 36 weeks' of GA.

Neonatal characteristics showed a statistically significant difference in birth weight, jaundice requiring phototherapy, sepsis and time to reach full feeds in all groups (Table 3). Similar results have been reported in the literature. [13,14] Poor weight gain was observed as a reason for readmission in 27 and 22 infants; respiratory infection in 4 and 1 infant, Jaundice, poor feeding/Lethargy in 1 infant each and feeding difficulties/Vomiting in 1 infant each in late pre- term and term infants; maximum PTIs (23) and term infants (36) were admitted in monsoon (Table 4). Shapiro et al. [15] compared the incidence of neonatal morbidity among healthy LPIs with and without infant, obstetric, and sociodemographic factors by calculating risk ratios adjusted for confounding; Of the 9552 late preterm healthy infants, 4.8% required readmission and 1.3% had an observation stay. Infants with neonatal morbidity were more likely to be firstborn, breastfed at discharge, have labor and delivery complications, receive a public payer source at delivery, or have an Asian/Pacific mother. Non-Hispanic blacks had a lower risk for neonatal morbidity compared to other racial/ethnic groups. Knowledge of the risk factors for neonatal morbidity in healthy LPIs can be used to identify infants who need close monitoring and early follow-up after hospital discharge. In a retrospective study by Perme T et al. [16], reported no significant difference for readmission of infants between summer and fall.

Conclusion

Poor weight gain, respiratory infection, jaundice, poor feeding/lethargy and feeding difficulty/vomiting were identified as reasons for readmission. Metacentric studies with a high sample load are recommended.

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