NUTRITIONAL STATUS AND FEEDING PATTERN IN NEONATAL INTENSIVE CARE UNIT GRADUATES

By

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ABSTRACT

Background*: Survival to discharge has improved across all gestational ages, although many survivors have residual disabilities requiring specialized care, expertise by providers versed in the needs of the fragile infants, and a provider who can intervene. Premature infants are at increased risk for poor feeding and growth failure, and at discharge typically are below their healthy tem counterparts in weight.*

Objective*s: The aim of this study was to identify the major risk factor in graduate neonate from (NICU) that need special care to decrease the incidence of rehospitalization and assessment of growth and development.*

Patients & Methods: *The study was observational prospective study. It included one hundred neonates who were followed in the first six months after discharge from NICU at Sayed Galal, Universal Hospital. The study was carried out in a period from January2017 to December 2017.*

Results: *Neonatal Jaundice was the most common diagnosis among the discharged neonates (55.0%), followed by respiratory distress (RD) (18.0%), neonatal sepsis (16.0%), congenital anomalies (6.0%) & HIE (5.0%). Cases of neonatal jaundice and RD growing wall while cases of congenital anomalies and HIE and neonatal sepsis showing slow rate of growth. The mean haemoglobin level at the age three months is 10.88 + 0.94 which is nadir for all cases. Cases of neonatal jaundice and RD have normal Z-score while cases of congenital anomalies and HIE showing failure to thrive and low Z-score. There is no relation between feeding pattern and weight growth .*

Conclusion: *Follow up of NICU graduates is essential to facilitate optimal care for the child and family. Special concern should be given to patients with congenital anomalies, HIE, and neonatal sepsis in contrary to patients with neonatal jaundice and respiratory distress that are growing well.*

Key words; *NICU graduate, Growth, Preterm, Z-score.*

INTRODUCTION

Improvement in medicine and nutritional care has resulted in an improvement in survival rate for infants born less than 36wks gestational age. Greater numbers of recuperating infants, shorter hospital stay, and complex health demands have increased the need for comprehensive post neonatal intensive care unit (NICU) care. (Saigal and Doyle, 2008).

Survival to discharge has improved across all gestational ages, although many survivors have residual disabilities requiring specialized care Premature infants are at increased risk for poor feeding and growth failure, and at discharge typically are below their healthy tem counterparts in weight. (Mulder et al., 2014).

Among the most important follow-up items are; monitoring for serious anemia and continuing assessment of retinopathy until its resolution. In-depth nutritional evaluation is mandatory for infants who received prolonged parenteral nutrition, who had GI anomalies, and who may have either an inborn error of metabolism or other metabolic/biochemical disorders (Kaaresenet al., 2006).

NICU graduates are at high risk of adverse neurodevelopmental outcomes and hence, carefully planned follow-up forms an essential part of NICU services. It is essential for maintenance of optimum health in order to achieve better potential for growth and development. Follow-up of NICU graduate is essential to facilitate optimal care and support for the child and family (Win and Mithilesh, 2016).

AIM OF THE WORK

- The aim of this study was to identify the major risk factor in graduate neonate from (NICU)that need special care to decrease the incidence of rehospitalization and assessment of growth and development.

PATIENT AND METHODS

This study was observational and analytical prospective study.It included one hundred neonate who were followed in the first six months after discharge from NICU at Sayed Galal, Universal Hospital. The study was carried out in a period from January2017 to December 2017.

Inclusion Criteria

All graduate neonates discharged from NICU irrespective to their final diagnosis.

Ethical consideration:

1. Approval of research by ethical committee of faculty of medicine, Al-Azhar University was obtained before conducting the study.

2. The authors declared no conflict of interest with respect to the research authorship and publication.

3. The parents has right to withdraw at any time of the study.

4. Verbal and/or written consent were obtained from all parents after explanation of the whole procedures.

5. All the data and the patients and results of the study are confidential and the patient has the right to keep it.

Financial disclosure/ funding: The authors received no financial support for the work or publication of this article.

All patients discharged from NICU were subjected to the following:

1. History taking includes:

- Complete medical, Perinatal and Nutritional history.
- Final diagnosis and history of stay in NICU.

2. Clinical examination:

- This includes vital signs (heart rate, respiratory rate, temperature and blood pressure).

- General and systemic examination with special emphasis on anthropometric measurements.

- Infant was weighed by spring digital scale sensitive to one gram.

3. Anthropometric measurements:

Were plotted on growth charts and Z score in reference to WHO growth charts (WHO multicenter growth reference study group, 2007).

The nutritional status of the studied patients was classified according to National Center of Health Statistics (NCHS) to:

- Above normal: equal or more than +2 Z score.

- Normal: from -2 to +2 Z score.

- Severely affected: less than -2 Z score.

4. Investigation:

Complete blood count was taken once at the age of three month, the expected age of nadir for every case to assess haemoglobin level and evidence of infection.

5. Follow up of the all cases every month recording:

-Nutriational state.

-Any new complaint.

-Hospital admission.

Statistical Design:

Data collected were reviewed. Coding of the collected data was done manually. These numerical codes were fed to the computer where statistical analysis was done using the statistic package for social science version 22 (SPSS 22) for windows.

RESULTS

Table (1): Characteristics of the studied neonates (N=100).

Variables		Mean ±SD	
Gestational Age (wks)		36.93 ±1.62	
Weight at birth(kg)		3.01 ±.57	
Variables		No.	%
Sex	Male	38	38.0%
	Female	62	62.0%
Mode of delivery	SVD	38	38.0%
	CS	62	62.0%

The mean gestational age in the studied groups was (36.93+1.62) weight at birth was (3.01+0.57) in addition to that (62.0%) of the studied neonates were females while (38.0%) males; regarding the mode of delivery (62.0%) were delivered by CS while (38.0%) were delivered by SVD.

Table (2): Final diagnosis in the studied neonates (N=100).

Final Outcome	No.	%
Neonatal Jaundice	55	55.0%
RD (RDS+TTN+meconium aspiration)	18	18.0%
Neonatal Sepsis	16	16.0%
Congenital Anomalies	6	6.0%
HIE	5	5.0%

Neonatal Jaundice is the most common diagnosis among the discharged neonates.

Table (3): Weight gain preterm and full term infants.

	At discharge	After 6months
Full term	3.19+0.49	8.40+787
Preterm	2.6621+0.549	7.95+1.14

Table (4): Feeding Pattern in the studied neonates Post discharge (N=100).

Feeding Pattern	No.	%
Breast Feeding	33	33.0%
Formula feeding	18	18.0%
Both	49	49.0%

Most of the studied newborn were combined fed (49%).

Table (5): Relation between feeding pattern and weight growth to all patients irrespective to final diagnosis

Final outcome	Weight at birth		Weight at3m		Weight at 6m		Paired t-test	P-value
	Mean	+ SD	Mean	+ SD	Mean	+ SD		
Artificial formula	2.98	0.47	5.66	0.68	8.34	0.90	-20.996	0.000**
Both	3.066	0.62	5.72	0.63	8.39	0.655	-53.39	0.000**
Breast feeding	2.953	0.55	5.45	0.9	7.99	1.25	-25.67	0.006**

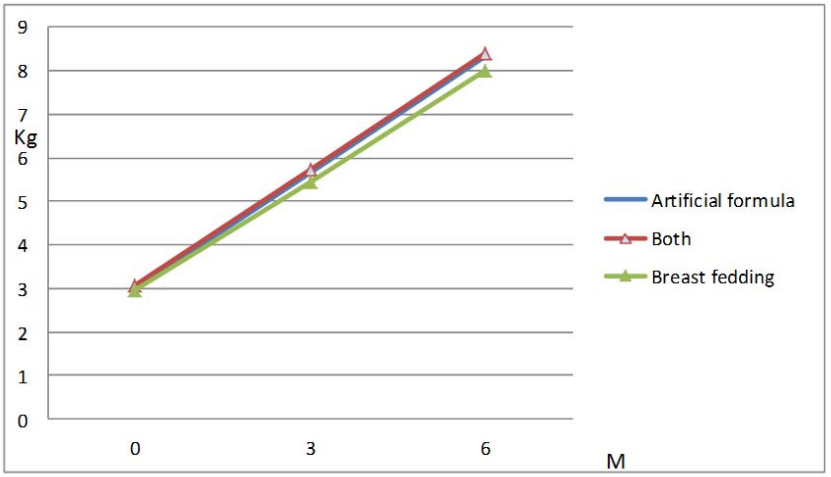

Figure (1): Babies who are on combined feeding growing well than breast feeder only.
The difference was statistically highly significant.

Table (6): Hemoglobin level according to final diagnosis

Final outcome	Hemoglobin Level	
	Mean	+ SD
Neonatal Jaundice	12.7836	1.01357
RD	10.90	0.91394
Neonatal Sepsis	9.99	0.85320
Congenital Anomalies	9.88	0.82158
HIE	10.89	0.57619

Cases of neonatal jaundice has the highest level of hemoglobin with mean level of 12.7836 +1.01357 while anomlies and sepsis group has the lowest level of hemoglobin with mean level 9.88+0.82158 and 9.99+0.85320 Respectively.

Table (7): Complete Blood count of the studied neonates (N=100).

Complete Blood count	Mean + SD
HB	10.88 + 0.94
WBC	7.96 + 1.73
PLT	292.11 + 73.93

The mean HB (10.88 + 0.94), WBCs (7.96 + 1.73), PLT (292.11 + 73.93).

Table (8): Causes of follow-up of the cases (N=100).

	No.	%
Not require hospital re admission	90	90%
Just follow-up	60	60%
Feeding problems	13	13%
Other complain	17	17%
Require hospital admission	10	10%

Ten cases required readmission mostly of neonatal sepsis followed by HIE and aspiration pneumonia and one case of congenital spherocytosis for blood transfusion.

Table (9): Comparison between weight at birth and after 6m according to final diagnosis in the studied neonates (N=100).

Final outcome	Weight at birth		Weight at3m		Weight at 6m		Paired t-test	P-value
	Mean	+ SD	Mean	+ SD	Mean	+ SD		
Neonatal Sepsis	2.72	.62	5.79	0.24	7.99	1.16	-20.996	0.000**
Neonatal Jaundice	3.12	.55	5.71	0.58	8.46	.51	-63.067	0.000**
HIE	2.92	.28	3.2	0.64	7.14	2.00	-5.374	0.006**
Congenital Anomalies	2.77	.72	2.85	0.45	7.25	2.02	-6.406	0.001**
RD	3.05	.56	5.0	0.60	8.51	.19	-47.153	0.000**

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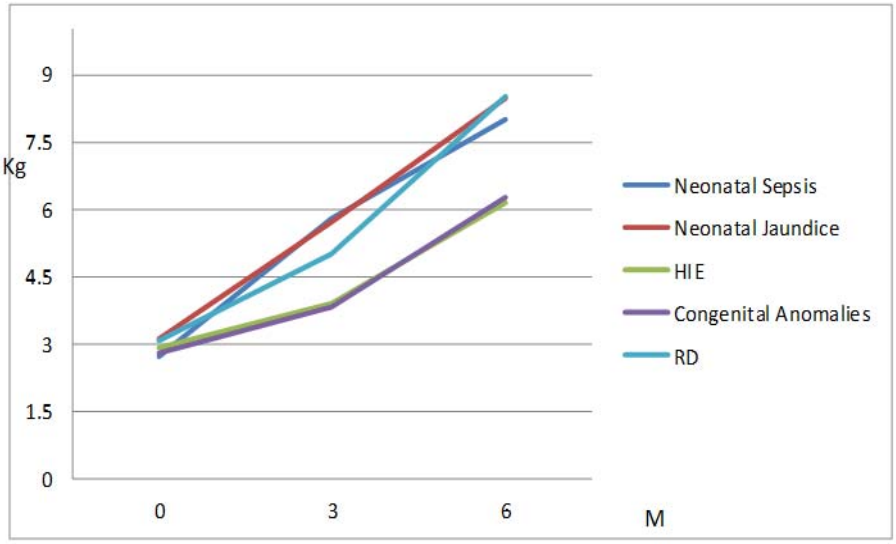

Figure (2): Cases of Neonatal Jaundice and RD growing well while cases of Congenital Anomalies and HIE Showing slow rate of growth while cases of Neonatal Sepsis showing faltering of growth.

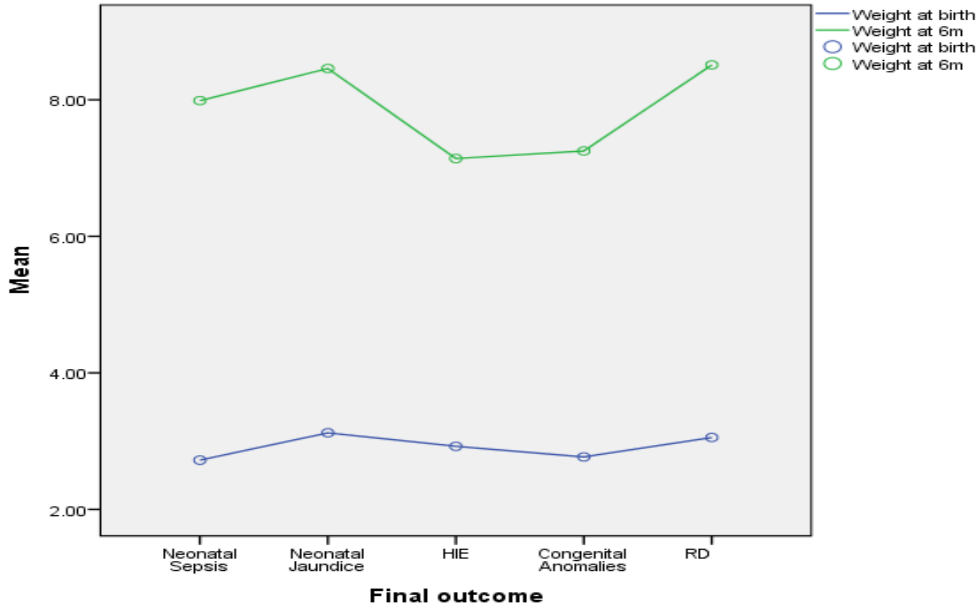

Figure (3): Comparison between weight at birth and after 6m according to final outcome in the studied neonates.

Table (10): Comparison between length at birth and after 6m according to final outcome in the studied neonates (N=100).

Final outcome	Length at birth in cm		Length at 6m in cm		Paired t-test	P-value
	Mean	+ SD	Mean	+ SD		
Neonatal Sepsis	49.00	1.03	64.13	2.80	-28.467	0.000**
Neonatal Jaundice	49.22	1.82	65.11	1.05	-72.843	0.000**
HIE	48.20	2.49	63.60	2.79	-30.202	0.000**
Congenital Anomalies	48.67	2.66	63.50	3.51	-24.684	0.000**
RD	49.39	.78	65.17	.71	-91.437	0.000**

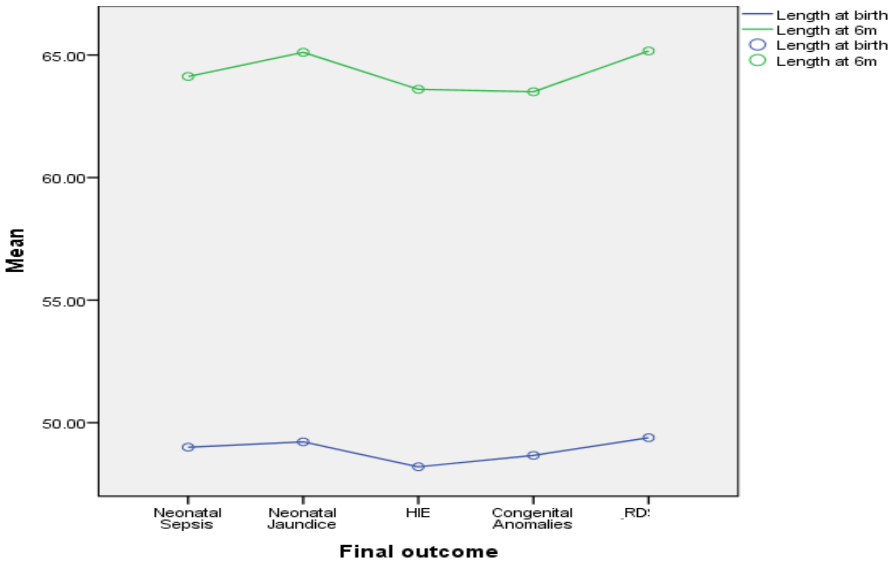

Figure (4): Comparison between length at birth and after 6m according to final outcome in the studied neonates

These was significant increase in length between at birth and after 6 months in the study neonates especially in cases of R.D and neonatal jaundice.

Table (11): Comparison between Head Circumference at birth and after 6m according to final outcome in the studied neonates (N=100).

Final outcome	HC at birth		HC at 6m		Paired t-test	P-value
	Mean	+ SD	Mean	+ SD		
Neonatal Sepsis	34.19	1.22	42.31	1.70	-27.632	0.000**
Neonatal Jaundice	34.78	.75	43.40	.91	-76.209	0.000**
HIE	33.60	1.98	41.60	2.88	-16.865	0.000**
Congenital Anomalies	34.67	.82	44.17	2.79	-9.580	0.000**
RD	34.47	.83	43.33	.84	-61.258	0.000**

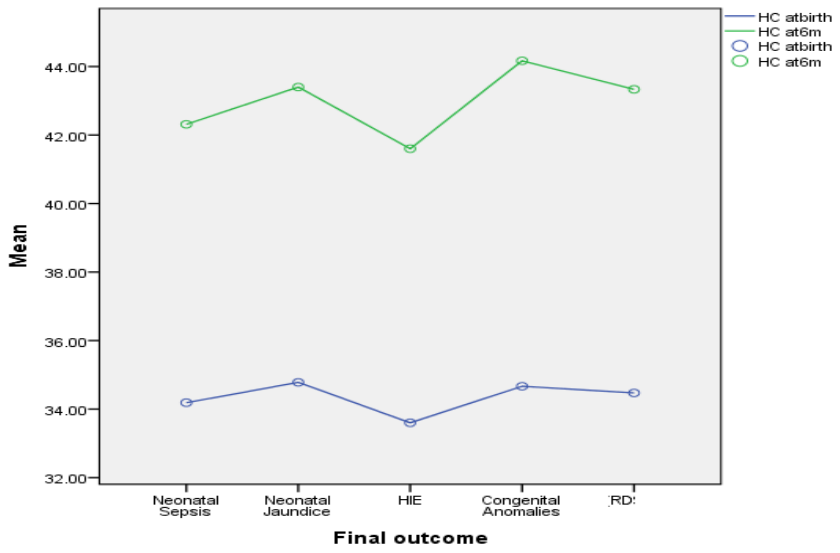

Figure (5): HIE group had significant decrease in HC measurements after 6m. But all group had normal increase in HC.

Table (12): Comparison between Weight Z score at birth and after 6m according to final outcome in the studied neonates (N=100).

Variables		Final outcome										Chi square	P-value
		Neonatal Sepsis		Neonatal Jaundice		HIE		Congenital Anomalies		RD			
		No.	%	No.	%	No.	%	No.	%	No.	%		
Z Weight at birth	Normal	16	100.0%	55	100.0%	5	100.0%	6	100.0%	18	100.0%		
Z Weight at 6m	-4.00	1	6.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	20.816 FE (#)	0.001**
	-3.00	0	0.0%	1	1.8%	2	40.0%	2	33.3%	0	0.0%		
	Normal	15	93.8%	54	98.2%	3	60.0%	4	66.7%	18	100.0%		

As regarding weight, one case of neonatal sepsis and neonatal jaundice groups has significant failure to thrive at 6 months with -4.00 and -3.00 zone Z score respectively.
HIE and congenital anomalies groups there are two cases of each group with failure to thrive with -3.00 zone Z score for each.
All cases of RD group developed well.

Table (13): Comparison between Length Z score at birth and after 6m according to final outcome in the studied neonates(N=100).

Variables		Final outcome										Chi square	P-value
		Neonatal Sepsis		Neonatal Jaundice		HIE		Congenital Anomalies		RD			
		No.	%	No.	%	No.	%	No.	%	No.	%		
Z Length at birth	-2.00	0	0.0%	0	0.0%	1	20.0%	1	16.7%	0	0.0%	10.123 FE (#)	0.011*
	Normal	16	100.0 %	55	100.0 %	4	80.0%	5	83.3 %	18	100.0 %		
Z Length at 6m	-5.00	1	6.2%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	23.690 FE (#)	0.005**
	-3.00	0	0.0%	0	0.0%	1	20.0%	2	33.3 %	0	0.0%		
	-2.00	0	0.0%	1	1.8%	0	0.0%	0	0.0%	0	0.0%		
	Normal	15	93.8%	54	98.2%	4	80.0%	4	66.7 %	18	100.0 %		

As regarding length, one case of neonatal sepsis and neonatal jaundice groups affected after 6months with -5.00 and -2.00 zone Zscore respectively.
While cases of HIE group had one case at -2.00 zone Z score at discharge which became at -3.00 zone Z score after 6months.

Congenital anomalies group had one case at-2 zone at discharge and after six months became two cases at -3 zone Z score complaining from exomphalous major and congenital diarrhea.
All cases of RD group developed well.

Table (14): Comparison between HC Z score at birth and after 6m according to final outcome in the studied neonates(N=100).

Variables		Final outcome										Chi square	P-value
		Neonatal Sepsis		Neonatal Jaundice		HIE		Congenital Anomalies		RD			
		No.	%	No	%	No.	%	No.	%	No.	%		
Z HC at birth	-3.00	0	0.0%	0	0.0%	1	20.0%	1	16.7%	0	0.0%	10.123 FE (#)	0.011*
	0.011*			55	100.0%	4	80.0%	5	83.3%	18	100.0%		
Z HC at 6m	-2.00	3	18.8%	0	0.0%	0	0.0%	0	0.0%	0	0.0%	23.690 FE (#)	0.005**
	Normal	13	81.2%	0	0.0%	1	20.0%	2	33.3%	0	0.0%		
	-4.00	0	0.0%	1	1.8%	0	0.0%	0	0.0%	0	0.0%		
	0.001**			54	98.2%	4	80.0%	4	66.7%	18	100.0%		

As regarding HC, three case of neonatal sepsis group had -2.00 zone Z score at discharge which normalized after 6months.
Two case of HIE group had -2.00 and -3.00 zone Z score at discharge which became at the same level after 6months.
One case RD group at -2.00 zone Z score at discharge which normalized after 6 months.
All the anomalies group had normal score at discharge while at 6 months there were two cases at 2.00 and 3.00 zone Z score because of hydrocephalus.

DISCUSSION

NICU graduates are at risk for inadequate growth due to their increased caloric and nutrient requirements and poor feeding. After discharge from the hospital, these patients require frequent monitoring of their growth and overall nutrition. (Ostberg and Hagelin., 2010).

Infancy and early childhood in particular are periods of high risk for growth failure. The successful attainment of optimum catch-up growth in these infants depends on birth weight, genetic potential, and continuing morbidity but can be

effectively modulated by optimizing nutritional intake. (Koletzko et al., 2012).

In our study we found that there is significant failure to thrive in about six percent of cases.

These cases include hypoxic ischaemic encephalopathy by two percent, congenital anomalies two percent, neonatal sepsis one percent and congenital spherocytosis one percent.

As regard rehospitalization our study revealed that the incidence of rehospitalization is represented in ten percent of cases. That include hypoxic ischaemic encephalopathy, neonatal sepsis, congenital anomalies and congenital spherocytosis.(Table 8)

The direct causes of readmission include the following:

- Congenital spherocytosis readmitted for blood transfusion.
- Two cases of neonatal jaundice readmitted due to aspiration pneumonia.
- Congenital diarrhea readmitted due to failure to thrive.
- Two cases of HIE readmitted by neonatal convulsions.
- Exomphalus major, Hydrocephalus, RDS and Dandy walker variant readmitted due to late onset sepsis.

In agreement with the study that say, NICU graduates, including both term and preterm infants, are at increased risk for readmissions to the hospital, with reported rates of readmission from 10 to 20 percent. (Escobar G et al., 2006).

This was illustrated in a study that analyzed data from all premature infants born in nonmilitary hospitals in the state of California from 1992 to 2000. Fifteen percent of infants with a gestational age less than 36 weeks who survived to home discharge required at least one readmission to the hospital within the first year of life. NICU graduates who were extremely premature have the highest rates of hospital rehospitalization. patients below 25 weeks gestation had a readmission rate of 31 percent (Underwood MA et al., 2007).

Not in agreement with another multicenter from Quebec of 254 extremely premature graduates born from 2003 to 2004, the readmission rate was 57 percent and 49 percent for children with gestational ages between 23 and 25 weeks gestation, and those between 26 and 28 weeks gestation (Luu TM et al., 2010).

The majority of this cohort also utilized out-patient services including physical and

occupational therapy, and required prescription medications and medical home assistive devices (eg, apnea monitor, home oxygen, gavage pump, and hearing and visual aids).

Most common causes for rehospitalization include infections (especially respiratory syncytial virus infection), respiratory problems, feeding problems, and surgical issues. Parents should be made aware of the increased potential of readmissions for their premature infant. (Koivisto M et al., 2005).

NICU graduates with significant neonatal morbidities are at increased risk for rehospitalization, as illustrated by a retrospective national register study of all very preterm infants (gestational age below 32 weeks) born alive in Finland between 2000 and 2003The highest rates of rehospitalization were seen in infants with seizures and obstructive airway disease. Rehospitalization rates increased with the number of morbidities. . (Korvenranta E et al., 2009).

The cases with neonatal jaundice and respiratory distress are growing well. (Table 9) (Figure 2)

There is no relation between failure to thrive and pattern of feeding. Although babies who are on combined feeding growing well than breast feeder only. (Table 5) (Figure 1)

Full term babies are growing well than early preterm babies than late preterm babies. Combination of two morbidities or more is more hazards than one.

One case of our study with neonatal jaundice finally diagnosed as congenital spherocytosis at the age of three months and developed failure to thrive due to recurrent haemolysis.

Preterm and low birth weight infants develop anemia that occurs earlier and is more severe than the physiologic anemia seen in full term infants with appropriate and appropriate for gestational infants.

In our study the mean haemoglobin level at the age three months is 10.88+0.94 which is nadir for all cases. (Table 7)

Cases of neonatal jaundice has the highest level of haemoglobin with mean level of 12.7836 +1.01357 while anomlies and sepsis group has the lowest level of hemoglobin with mean level 9.88+0.82158 and 9.99+0.85320 respectively. (Table5)

According to Z score, in our study we found that:

As regarding weight, one case of neonatal sepsis and neonatal jaundice groups has significant failure to thrive at 6 months with -4.00 and -3.00 zone Z score respectively.

HIE and congenital anomalies groups there are two cases of each group with failure to thrive with -3.00 zone Zscore for each.

All cases of RD group developed well (Table 12).

As regarding length, one case of neonatal sepsis and neonatal jaundice groups affected after 6months with -5.00 and -2.00 zone Zscore respectively.

While cases of HIE group had one case at -2.00 zone Z score at discharge which became at -3.00 zone Z score after 6months.

Congenital anomalies group had one case at-2 zone at discharge and after six months became two cases at -3 zone Z score complaining from exomphalous major and congenital diarrhea.

All cases of RD group developed well. (Table 13)

As regarding HC, three case of neonatal sepsis group had -2.00 zone Z score at discharge which normalized after 6months.

Two case of HIE group had -2.00 and -3.00 zone Z score at discharge which became at the same level after 6months.

One case RD group at -2.00 zone Z score at discharge which normalized after 6 months.

All the anomalies group had normal score at discharge while at 6 months there were two cases at 2.00 and 3.00 zone Z score because of hydrocephalus (Table 14).

CONCLUSION

- Follow up of NICU graduates is essential to facilitate optimal care for the child and family.
- Special concern should be given to patients with congenital anomalies, HIE, and neonatal sepsis in contrary to patients with neonatal jaundice and respiratory distress that are growing well.
- A well-coordinated multidisciplinary approach is essential in the follow up care of the child.

RECOMMENDATIONS

- Consistent care that provides continuity of information and psychosocial support to the family is important.
- The primary care clinician should be familiar with the more common medical problems that are found in the NICU graduate and be able to coordinate subspecialty care when needed.

- Review the infant's NICU course, current medications, and medical equipment.
- Continue assessment of the patient's growth. If growth is inadequate, evaluation of the infant's nutrition and initiation of corrective measures (eg, changes in the composition, volume, and caloric density of the feeds, and mode of feeding), and for contributing conditions (eg, gastroesophageal reflux or feeding disorders) are required.

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متابعة نمو وتغذية الأطفال خريجى رعاية حديثى الولادة

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الملخص العربي

يعاني خريجي رعاية حديثي الولادة في العالم مشاكل طبية فريدة ومعقدة بعد الإقامة في المستشفى لفترة طويلة ومعقدة. إن اتباع نهج متعدد التخصصات جيد التنسيق أمر ضروري في متابعة رعاية هؤلاء الرضع. تساعد المصادر الهامة بالنسبة لطبيب الأطفال الذي يعتني بهؤلاء الرضع في نمو اللحاق بالركب وعملية الشفاء المستمرة بالمكملات الغذائية الجيدة ، مع منع المزيد من المشاكل من خلال الكشف عن المرض وعلاجه مبكرا.

إن دور طبيب الأطفال في مساعدة هؤلاء الأطفال على تحقيق إمكاناتهم البدنية والنمائية العصبية والعاطفية والنفسية الاجتماعية الكاملة من خلال توفير الرعاية الكاملة لهؤلاء الأطفال. .يلعب طبيب الرعاية الأولية دوراً أساسياً في توفير الاستمرارية المثلى لهؤلاء المرضى عن طريق تنسيق انتقال الرعاية من طبيب حديثي الولادة ، وتوفير الرعاية الطبية المباشرة ، وتسهيل الرعاية المستمرة للرضيع من خلال المتخصصين في التخصصات الفرعية وغيرهم من المهنيين الصحيين.

فيما يلي نواحٍ مهمة في إدارة الرعاية الصحية الأولية للمرضى الخارجيين من خريجات الرعاية المركزة للولدان (NICU):

- مراجعه فتره تواجده بوحده رعايه حديثي الولاده والعلاجات الحاليه.
- مواصلة تقييم نمو المريض. إذا كان النمو غير كافٍ ، تقييم تغذية الرضيع وبدء التدابير التصحيحية (على سبيل المثال ، التغيرات في التركيبة والحجم وكثافة السعرات الحرارية ، وطريقة التغذية) ، وللظروف المساهمة (مثل الارتجاع المعدي المريئي أو اضطرابات التغذية).

- مطلوبـة بالنسبة لجميع الخدّج ، نوصي بإعطـاء أمصـال الطفولة بناءً على عمره الزمني بناء على نفس الجدول الزمني والجرعة الموصى بها للرضع الذين يعملون بالدورة الطبيعية.
- نوصي بالتحري عن مشاكل السمع والبصر والنمو العصبي ، والتي لها معدل انتشار مرتفع في خريجي رعاية حديثي الولاده.
- الرعاية المستمرة التي توفر استمرارية المعلومات والدعم النفسي والاجتماعي للعائلة أمر مهم.
- يجب أن يكون الطبيب على دراية بالمشاكل الطبية الأكثر شيوعًا التي توجد وأن يكون قادرًا على تنسيق رعاية التخصّصات الفرعية عند الحاجة.