Effect of Formula and Breast Milk Feeding on Random Blood Sugar Values in Healthy, Full Term Babies, in 1st 48 hours after Birth.

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الخلاصة

لقد حاولنا في هذه الدراسة مناقشة تأثير نوع الرضاعة على نسبة الكلوكوز في الدم لمعرفة فيما إذا كانت نوع الرضاعة ممكن إعتباره ا من العوامل المساعدة على إنخفاض نسبة الكلوكوز وقد تحقيالق.ك ،تم قياس نسبة الكلوكوز في الدم لمائة طفل حديث الولادة باستعمال جهاز قياس فحص السكر في الدم من نوع "كلوكوترينـد"، إنتاج شركة روش الألمانية لقد تم إختيار هؤلاء الأطفال الحديثي الولادة من الذين بصحة جيدة ، كاملي فترة الحمل الطبيعية ،وجميعهم أنجبوا بعملية قيصرية ، كون الولادة في هذه الحالة تتطلب بقاء الأم وكذلك الطفل في المستشفى لغرض العناية الطبية وهذا يسهل متابعة ومراقبة الطفل الحديث الولادة بين هؤلاء الأطفال الحديثي الولادة ،ثمانية وأربعون طفلاً أرضعوا حليب البقر الصناعي وإثنان وخمسون طفلاً أرضعوا رضاعة طبيعية. وقد قيست نسبة الكلوكوز في الدم في أوقات محددة بعد الولادة.

لقد أثبتت هذه الدراسة أنه لا توجد علاقة ذات أهمية بين نسبة الكلوكوز في الدم وبين كلا النوعين من الرضاعة. كذلك أثبتت الدراسة أهمية الرضاعة بغض النظر عن نوعها في الحفاظ على نسبة السكر في الدم. كذلك أثبتت هذه الدراسة أنه لا توجد علاقة ذات أهمية بين نسبة الكلوكوز في الدم بين الأطفال الذين أرضعوا رضاعة طبيعية وهؤلاء الذين أرضعوا حليب البقر الصناعي .

لقد وجدت الدراسة أيضاً أن نسبة السكر في الدم التي تمثل الأنخفاض تتراوح تقريباً ما بين 35-40 ماغم/100 مليلتر في الساعات العشرة الأولى، وعلى كل حال، فإن الدراسة وجدت أيضاً أن إنخفاض نسبة الكلوكوز في الدم ليس لها قيمة ثابتة تعتمد على الأعراض والعلامات ، حيث أن بعض الأطفال لم تظهر لديهم هذه الأعراض في القيمة المذكورة أعلاه .

Summary

In our study, we tried to discuss the effect of type of feeding on random blood sugar and whether it can be considered as a cause of hypoglycemia. To achieve this, we measured random blood sugar of 100 full term healthy newborn babies using, a blood glucose monitor device called Glucutrend® 2,all of them were delivered by caesarean section as such deliveries stay in the hospital for at least 48 hours and therefore this makes them easy to be followed-up. Among them, 48 babies were milk formula fed and 52 babies were breast-fed .The random blood sugar was measured at specific times after birth.

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*البحث مستل من رسالة دبلوم

It was found that whether in males or in females or all, there was no significant statistical difference in random blood sugar values at each specific time between babies who were formula-fed as compared to those who were breast-fed.

The study showed also that random blood sugar is increasing with time by the effect of feeding .Of the 100 babies studied, only 6 suffered from hypoglycemia presented by jitteriness. However, there was no significant statistical difference between random blood sugar values of hypoglycemic babies who were breast-fed as compared to hypoglycemic babies who were formula-fed.

The range at which hypoglycemia showed symptoms presented by jitteriness are around 35-40 mg/dl during the 1st 10 hours after birth. However, the study also showed that hypoglycemia has no standard level but depends on signs and symptoms because some babies did not present with jitteriness at this level.

Introduction

Neonatal hypoglycemia is a common phenomenon in the newborn infant diagnosed by an abnormally low level of blood glucose (sugar), the body's chief energy source (hence the term low blood sugar). Serum glucose levels less than 40 mg/dl (2.2 mmol/L) in the first 24 hours of life and 40-50 mg/dl (2.6 mmol/L) thereafter are considered low whereas 80-90mg/dl (4.4-5mmol/L) is considered normal [1]. Glucose is an essential nutrient for the brain. Abnormally low levels can cause an encephalopathy and have the potential to produce long-term neurological injury in infants. The level at which this potential for long-term injury is reached is controversial. There is a normal dip in blood glucose 2-4 hours postnatally so the challenge is to be able to recognize a normal dip from true metabolism errors [2].

There are many causes behind neonatal hypoglycemia, for example: Hyperinsulinism or mal-adaptive hypoglycemia is most often caused by an over secretion of insulin from the pancreas triggered by stress, fasting, or disorders of the adrenal or pituitary glands, liver, or pancreas. In infants of diabetic mothers, it is not uncommon for the infant to remain in a hyperinsulinemic state after losing the maternal glucose supply. Fetal glucose levels correspond to maternal levels as glucose crosses the placenta. Insulin production in the fetus begins early in gestation; insulin does not cross the placenta. When the newborn is deprived of maternal glucose, the pancreas continues to produce insulin at the same fetal level and newborn glucose levels are rapidly depleted. This condition is usually transient and is treated either with early

initiation of carbohydrate feedings or, at times, intravenous dextrose provided at a rate of 4-8 mg/kg/min but until the infant's metabolic adaptation is able to supply adequate amounts of glucose.On the other hand, hypoglycemia persisting or occurring after 1 week of life requires an evaluation [3].

In preterm infants and those born small for gestational age (SGA), adequate fetal glycogen storage has been interrupted or impaired, placing these infants at risk for hypoglycemia in the first several hours and days of life. Other perinatal events that may cause an increase in energy utilization (above those levels at which the newborn is able to supply glucose) include perinatal asphyxia, cold stress, respiratory distress, and prolonged labor. The newborn may also be at risk for hypoglycemia as a result of inborn errors of carbohydrate metabolism and amino acid metabolism. Hyperinsulinism due to nesidioblastosis (pancreas islet cell dysmaturation syndrome) in the early neonatal period also is a cause for neonatal hypoglycemia. Persistent Severe Hypoglycemia - Mal-adaptive hypoglycemia can usually be clinically separated from pathological hypoglycemia by the amount of glucose need to maintain a normal blood sugar. Once a baby needs more than 7.5mg/kg/min of glucose a pathological cause becomes more likely. Most of these conditions are inborn errors of metabolism such as glycogen storage diseases [4].

To determine the effect of type of feeding (Formula and Breast feeding) on random blood sugar values in healthy, full term newborn baby during the 1st 48 hours after birth.

Materials and Methods

We have taken a sample containing 100 newborn babies .We have chosen these babies to be healthy, full term baby. So we excluded babies of diabetic mother or small gestational age babies. The study was done in different hospitals for Obstetric and Gynecology as Yarmook, Medical city, Al-Elweya, Habeebya hospitals and Al-Zahra'a Private hospital, Baghdad. The study was done during the time interval from February to July 2004.

For close follow-up, we have taken only those babies delivered by caesarean section as their mothers stay in the hospital post-operatively for follow-up and hence their babies will stay with them.

We have chosen 100 babies of 98 mothers; two of the latter gave birth of twin. We divided those babies into two groups:

Group1: 48 babies are formula-fed i.e. given milk formula usually Dialac or Kikoz.

Group2: 52 babies are breast-fed (including 2 twins from two mothers).

History was taken from mother and enquiries included the prenatal history (whether the mother has any disease during pregnancy as diabetes mellitus or hypertension), perinatal (fetal distress, premature labor, prolong labor) and postnatal history (cold stress, respiratory distress).

General examination was done for the neonate to exclude any congenital anomalies or coarse facies or macrosomia. Then, specific examination for any sign of hypoglycemia as jitteriness, drowsiness, irritability, lethargy or cyanosis.

Using a blood glucose monitor device called Glucutrend® 2, a type of an ACCU-CHEK® system devices, random blood sugar was measured for:

1- **The mother 30 minutes after birth.**
2- **The umbilical cord blood.**
3- **The baby after first feeding, 10 hours, 20 hours and 44 hours after birth.**

During the 1st 48 hours after birth, we continued to monitor any sign of hypoglycemia as jitteriness, drowsiness, irritability, lethargy or cyanosis.

Using the Paired T Test and Independent T test, we calculated standard deviation, mean, and significance (P) for statistical difference between the two groups. Note that significant results are obtained when $P < 0.05$ [23].

Results

Table (1): The random blood sugar measurement at different times according to the type of feeding in female newborn babies.

Measurement	Milk Formula Feeding	Breast Feeding	Significance
Mother's RBS	124.00±16.962 (97-155)	121.64±18.175 (92-150)	0.685
Cord RBS	70.50±8.512 (60-88)	73.05±9.378 (60-91)	0.351
First feed sugar	52.27±5.496 (42-60)	53.45±5.796 (42-63)	0.492
10 hours sugar	66.41±3.142 (61-72)	66.09±5.528 (60-79)	0.816
20 hours sugar	72.18±4.171 (64-78)	70.95±5.131 (63-81)	0.389
44 hours sugar	77.73±6.017 (67-87)	75.64±4.766 (67-83)	0.208

Table (1) shows the relation between the random blood sugar measurements at different times with the type of feeding in female newborn babies. Each measurement with the maximum, minimum, mean values with the standard deviation. There was no significant relationship between mean RBS values for both types of feeding in females.

Table (2): The random blood sugar measurement at different times according to the type of feeding in male newborn babies.

Measurement	Milk Formula Feeding	Breast Feeding	Significance
Mother's RBS	118.77±14.484 (92-144)	123.43±22.888 (90-172)	0.375
Cord RBS	70.77±7.240 (60-92)	71.80±8.172 (60-88)	0.622
First feed sugar	50.77±6.568 (42-64)	51.70±5.434 (42-60)	0.564
10 hours sugar	66.42±3.870 (56-75)	65.43±3.971 (58-76)	0.351
20 hours sugar	72.15±4.305 (62-79)	72.17±4.594 (63-82)	0.991
44 hours sugar	77.88±5.362 (67-87)	76.63±5.068 (67-88)	0.374

Table (2) shows the relation between the random blood sugar measurements at different times with the type of feeding in male newborn babies. Each measurement with the maximum, minimum, mean values with the standard deviation. There was no significant relationship between mean RBS values for both types of feeding in males.

Table (3): The random blood sugar measurement at different times according to the type of feeding in all newborn babies studied.

Measurement	Milk Formula Feeding	Breast Feeding	Significance
Mother's RBS	121.17±15.719 (92-155)	122.67±20.849 (90-172)	0.686
Cord RBS	70.65±7.764 (60-92)	72.33±8.636 (60-91)	0.310
First feed sugar	51.46±6.048 (42-64)	52.44±5.603 (42-63)	0.402
10 hours sugar	66.42±3.518 (56-75)	65.71±4.654 (58-79)	0.398
20 hours sugar	72.17±4.199 (62-79)	71.65±4.818 (63-82)	0.573
44 hours sugar	77.81±5.610 (67-87)	76.21±4.920 (67-88)	0.132

Table (3) shows the relation between the random blood measurements at different times with the type of feeding in all newborn babies studied. Each measurement with the maximum, minimum, mean values with the standard deviation. There was no significant relationship between mean RBS values for both types of feeding in all newborn babies studied.

Table (4): A paired sample test for different RBS readings of a two times interval by the type of feeding.

Paired sample	(P) For Milk Formula Feeding	(P) For breast feeding	(P) For total
Mother-RBScord	0.0001	0.0001	0.0001
RBScord-RBS1	0.0001	0.0001	0.0001
RBScord-RBS10	0.001	0.0001	0.0001
*RBScord-RBS20	0.198	0.611	0.669
RBScord-RBS44	0.0001	0.004	0.0001
RBS1-RBS10	0.0001	0.0001	0.0001
RBS1-RBS20	0.0001	0.0001	0.0001
RBS1-RBS44	0.0001	0.0001	0.0001
RBS10-RBS20	0.0001	0.0001	0.0001
RBS10-RBS44	0.0001	0.0001	0.0001
RBS20-RBS44	0.0001	0.0001	0.0001

Table (4) shows a paired sample test for different RBS readings of a two times interval by the type of feeding. There was significant change in RBS level with time, which indicates the effect of feeding in raising RBS levels * except the pair of values: RBScord and RBS of the baby measured after 20 hours shows no significant change.

Table (5): The random blood sugar values of formula-fed babies (jittery and non-jittery) and the total number of formula fed babies.

Hypoglycemia	RBS of cord blood	RBS after 1st feeding	RBS after 10 hours	RBS after 20 hours	RBS after 44 hours
Jitteriness N	2	2	2	2	2
Mean	73.5	47.5	39.5	68.5	72.5
S.D	14.849	7.778	2.121	0.707	2.121
Minimum	63	42	38	68	71
Maximum	84	53	41	69	74
No jitteriness					
N	46	46	46	46	46
Mean	70.52	51.63	67.48	72.33	78.04
S.D	7.595	6.049	2.96	4.217	5.609
Minimum	60	42	56	62	67
Maximum	92	64	75	79	87
Total N	48	48	48	48	48
Mean	70.65	51.46	66.31	72.17	77.81
S.D	7.764	6.084	6.36	4.199	5.61
Minimum	60	42	38	62	67
Maximum	92	64	75	79	87

Table (5) shows random blood sugar values (maximum, minimum, mean and standard deviation) of formula-fed babies (hypoglycemic, non-hypoglycemic) and the total number of formula fed babies.

Table (6): Comparison between RBS values for jittery and non-jittery formula-fed babies.

RBS measurement included for statistical difference between jittery and non-jittery babies	Significance
RBS cord	0.601
RBS after 1st feeding	0.353
RBS after 10 hours	0.0001
RBS after 20 hours	0.211
RBS after 44 hours	0.174

Table (6) is a concluded table from table (5). It compared hypoglycemic babies with non-hypoglycemic babies; both were formula-fed and found that there is no significant relationship between random blood sugar values at each specific time except at 10 hours at which there was significant difference between both.

Table (7): The random blood sugar values of breast-fed babies (jittery and non-jittery) and the total number of breat-fed babies.

Hypoglycemia	RBS of cord blood	RBS after 1st feeding	RBS after 10 hours	RBS after 20 hours	RBS after 44 hours
Jitteriness N	4	4	4	4	4
Mean	74.75	49.75	44.5	71.75	73.5
S.D	5.679	6.397	1.732	3.304	3.317
Minimum	70	43	39	68	69
Maximum	83	57	43	76	77
No Jitteriness N	48	48	48	48	48
Mean	72.13	52.67	67.83	71.65	76.44
S.D	8.85	5.548	3.39	4.949	4.989
Minimum	60	42	63	63	67
Maximum	91	63	79	82	88
Total N	52	52	52	52	52
Mean	72.33	52.44	65.81	71.65	76.21
S.D	8.636	5.603	7.81	4.818	4.92
Minimum	60	42	39	63	67
Maximum	91	63	79	82	88

Table (7) shows random blood sugar values (maximum, minimum, mean and standard deviation) of breast fed babies (hypoglycemic, non-hypoglycemic) and the total number of breast fed babies.

Table(8): Comparison between RBS values for jittery and non-jittery breast-fed babies.

RBS measurement included for statistical difference between jittery and non-jittery babies	Significance
RBS cord	0.564
RBS after 1st feeding	0.322
RBS after 10 hours	0.0001
RBS after 20 hours	0.967
RBS after 44 hours	0.255

Table (8) is a concluded table from table (7). It compared hypoglycemic babies with non-hypoglycemic babies; both were breast-fed and found that there is no significant relationship between random blood sugar values at each specific time except at 10 hours at which there was significant difference between both.

Table(9): Comparison between the effects of both types of feeding on mean RBS values in hypoglycemic and non-hypoglycemic newborns at 10 hours.

State of glycemia	Formula fed baby mean RBS at 10 hours	Breast fed baby mean RBS at 10 hours	P
Hypoglycemia (Jitteriness)	39.5	44.5	0.277
No hypoglycemia (no jitteriness)	67.48	67.83	0.591

Table (9) compares between the effects both types of feeding on mean RBS values in hypoglycemic and non-hypoglycemic newborns at 10 hours and shows that there is no significant relationship between both types of feeding.

Discussion

This study aimed to determine the effect of type of feeding on random blood sugar values in healthy, full term babies. So we classified babies included in our study into two groups:

Group (1): Babies who were breast-fed.

Group (2): Babies who were formula fed.

In our study, we compared the effect of formula and breast feeding on random blood sugar values, first in the males, then in the females, then in both.

It appears that breast feeding raises RBS values in parallel to the formula feeding. Such finding goes with the finding of other study in which 114 full term, healthy babies were included, 64 were breast-fed and 50 were formula fed.

Although statistically differences were found between the serum glucose concentrations in breast-fed and bottle-fed babies, the differences were not considered to be clinically significant [24].

In our study, Paired-Sample test showed that RBS values increase with time by effect of feeding. First, Paired-Sample test was done for the total babies included and we compared each pair of RBS values at 2 times. Each pair of values showed statistically significant difference, which means that RBS values increase with time. Second, we compared each pair of va1ues in babies who were breast fed and then in babies who were formula fed .We found that there were statistically significant differences.

This means that both types of feeding were effective in raising RBS values with time. It is only the paired value [cord RBS-RBS value of the baby after 20 hours] that showed no significant difference, that means that each type of feeding raised the RBS value of the baby to a level close to cord RBS. In our study, only 6 babies suffered from hypoglycemia presented by jitteriness. However, hypoglycemia and jitteriness were relieved by feeding. These results go with the results of a Turkish study, in which thirty-five full term infants (38-41 weeks' gestation) were included in the study. All infants were fed (no specific type of feeding) during the first 3 hours of life and this was continued every 4 hours. In the first 3 hours of life there were 12 infants with glucose levels less than 30 mg/dl, but in only three of those did the hypoglycemic level continue and require treatment (9 per cent) [25].

As compared to our study that included both breast-fed and formula fed babies, another study included only breast-fed babies. Here, maternal and cord glucose estimation were carried out within 30 minutes of delivery. All newborn were weighed and glucose levels were measured at 24 and 48 hours of life. All mothers were euglycaemic

while seven neonates had plasma glucose level less than (1.7) mmol/l (=30.6 mg/dl) at birth. Only one neonate had persistent hypoglycemia from birth to 12 hours of age and required treatment. All other neonates had blood glucose level above 1.7 mmol/l (=30.6 mg/dl) at 24 and 48 hours of life. This means that the exclusively breastfed newborns have adequate glucose supply and are not at risk of having hypoglycemia in the first 48 hours of life. Again such finding goes with our study [26].

Another study done in Japan aimed to examine the incidence of symptomatic and asymptomatic hypoglycemia during the early days of life; the blood glucose levels were analyzed in 38 healthy, full-term, breast-fed neonates cared for by rooming-in immediately after birth. Blood glucose levels were measured randomly using a blood glucose analyzer from birth to discharge.

Preliminary results have shown that hypoglycemia (< 40 mg/dL) seldom occurred in healthy, full-term, breast-fed neonates when cared for in rooming-in

with frequent suckling immediately after birth. Although the above study mentioned included only breast fed babies, the results go with our study [27].

Other study done in United Kingdom measured RBS values only in the 1st hour .In this study, 75 healthy full term babies divided into 3 groups: a group who were breast fed, a group who were formula fed and the 3rd group was not fed.

RBS was measured only in the 1st hour. Statistical analysis found that mean RBS value have no significant difference between the 3 groups which means that the full-term infants are equipped with homeostatic mechanisms that preserve adequate energy substrate to the brain and other vital organs [28].

To see whether the type of feeding may be a predisposing factor in causing hypoglycemia, we divided the 1st group who were breast fed and also the 2nd who were formula fed into 2 groups: 1st group are those who presented with jitteriness and the 2nd are those who did not present with jitteriness. There was statistically significant difference in RBS values measured after 10 hours after birth between jittery and non-jittery which indicates that jittery babies were hypoglycemic. Then, we compared jittery babies who were breast-fed with those who were formula fed and we found that the difference was not statistically significant. This means that the state of hypoglycemia has no significant relation with the type of feeding.

Conclusions

1. Hypoglycemia in the newborn as a serious condition has been encountered in both types of feeding .So it must take enough attention of pediatricians.

2. Hypoglycemia in healthy full term baby has no relation with sex or type of feeding.

3.Hypoglycemia is symptomatic term rather than quantitative.

- Breast-feeding should be started immediately after birth. Babies of unconscious mother after caesarean section should be given an oral 30 ml of 5 % glucose to avoid hypoglycemia and dehydration fever until mother regains consciousness.
- Breastfeeding should be initiated as soon as an infant is ready, preferably within half an hour of birth. Immediately after birth the baby should be dried and held against the mother's chest with skin-to-skin contact to provide warmth and to facilitate the initiation of breastfeeding.
- Any baby shows signs and symptoms of hypoglycemia, should be admitted to the neonatal care unit for management and close observation.
- Mothers should be educated about signs and symptoms of hypoglycemia.

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