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Turkish Neonatal Society guideline on enteral feeding of the preterm infant

Türk Neonatoloji Derneği prematüre bebeğin enteral beslenmesi rehberi

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Abstract

Early initiation of enteral feeding with the own mother's milk and prevention of postnatal growth failure is the target of nutrition in preterm infants. Together with total parenteral nutrition, mouth care and minimal enteral nutrition is started with colostrum in the very early hours of life in small preterm infants. Expressed mother's milk is given via a gastric tube and gradually increased in accordance with the gestational age/birth weight and the risk factors. For infants born heavier than 1 000 grams, the aim is to reach total enteral feeding at the end of first week, and at the end of the second week for infants weighing less than 1000 grams. Supporting mothers in milk expression and kangaroo mother care, promoting non-nutritive feeding, appropriate fortification of mother' milk, and initiating and advancing breastfeeding as soon as the infant is ready are all crucial. Donor mother milk, and as a second choice, preterm formula is advised if the mother's milk is not available. Individualized post-discharge nutrition decisions can be taken in accordance with the actual growth at the time of discharge. The goal is optimal neurodevelopmental achievement together with the prevention of long-term metabolic problems. Late preterm infants, which constitute the majority of preterm infants, also need close nutritional attention and follow-up.

Keywords: Enteral, nutrition, preterm

Öz

Prematüre bebek enteral beslenmesinde, anne sütünün erken olarak verilmesinin sağlanması ve postnatal büyüme geriliğinin önlenmesi amaçlanır. Küçük prematüre bebeklere ilk saatlerden itibaren total parenteral beslenme ile birlikte kolostrumla ağız bakımı ve minimal enteral beslenmeye başlanır. Sağılmış anne sütü sonda ile beslenme toleransı yakından izlenerek artırılarak verilir. Beslenme miktarı bebeğin doğum kilosuna/haftasına ve risk durumuna uygun hızda artırılıp 1 000 g üzerindeki bebeklerde birinci, 1 000 g altı bebeklerde ise ikinci haftada tam enteral beslenmeye ulaşmak hedeflenir. Annenin süt sağmasının, kanguru bakımının desteklenmesi, anne sütünün uygun şekilde güçlendirilmesi, gıdasız emme, bebeğin hazır olduğunda emzirmenin denenmesi ve ilerletilmesi gerekir. Anne sütü yoksa, bulunabilirse donör anne sütü, ikinci tercih olarak prematüre formülü önerilir. Taburcu edilirken büyümenin durumuna göre bireyselleştirilmiş beslenme kararları verilir. Amaç nörolojik sistemin gelişimini sağlamak ve uzun dönem metabolik sorunlardan korunmaktır. Prematüreler içinde önemli bir oranı oluşturan geç prematüre bebeklerin beslenmesi de yakın dikkat ve izlem gerektirir.

Anahtar sözcükler: Beslenme, enteral, prematüre

In extremely preterm newborns who can not be breastfed, in addition to the total parenteral nutrition (TPN), a few drops of colostrum, which is given to the baby's mouth after the first hours, is of vital importance (1). It is aimed to reach full enteral nutrition with breast milk (BM) in the first week for preterm newborns weighing under 1000 g and in the second week for those over 1000 g (2).

Enteral nutritional requirements of preterm newborns are given in Table 1. Higher protein and protein/energy ratios are required to catch up growth in these infants.

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Table 1. Enteral feeding requirements of preterm infants (3, 32, 51, 52)

Ingredients	Dietary reference intakes
Energy (Kcal/kg/day)	120-140
Fat (g/100 Kcal)	4.4-6
Carbohydrate (g/100 Kcal)	10.5-12
Protein (g/kg/day)	<1200 g: 3.5-4.5
	>1200 g: 3.0-4.0
Protein/Energy (g/100 Kcal)	<1200 g: 3.0-4.0
	>1200 g: 2.5-3.6

Enteral feeding methods and follow-up criteria

Enteral (tube) feeding indications:

Preterm infants born at <32-34 gestational weeks, infants who cannot feed orally due to sucking/swallowing dysfunction or for other medical reasons, infants with a respiratory rate of 60-80 / min, and those whose oral intake is insufficient are supported by enteral feeding (3).

Enteral feeding contraindications:

Severe respiratory distress (RR >80/min), gastrointestinal (GIS) obstructions, necrotizing enterocolitis (NEC), hemodynamic instability, shock and multiorgan failure requiring high inotropic support (3).

Transition from total parenteral to enteral feeding: When 75% of the total energy and protein requirements are provided by enteral route (100 mL/kg/day), TPN is discontinued. The fluid requirement is met by intravenous glucose-electrolyte solution.

Enteral feeding methods

Feeding with orogastric (OG) or nasogastric (NG) tube: Orogastric tube is the method of choice (2).

Gastrostomy: Performed if feeding requirements will be prolonged.

Transpyloric or postpyloric feeding: This does not have superiority over orogastric or nasogastric feeding (4). It can be used in upper GIS anomalies and in patients with high risk of aspiration.

Intermittent bolus, slow bolus or continuous feeding: Intermittent feeding is more physiologic and preferred. Intermittent or continuous feeding has not been found to have an effect on NEC frequency, nutritional intolerance, growth, transition time to full enteral feeding (5). In infants with extremely low birth weight (ELBW) (birth weights below 1000 g) who cannot tolerate intermittent feeding, a slow bolus feeding taking more than one hour with at least one-hour intervals, can be tried before exchanging to continuous feeding (6).

Continuous feeding can be used in newborns with gastrointestinal absorption problems, in transpyloric feeding or after intestinal surgery.

Minimal enteral feeding (MEF): The aim is not to feed the baby but the intestine, therefore it is also called as trophic feeding. The first choice is colostrum, which may be waited up to 24-48 hours. In the absence of colostrum, donor breast milk from a milk bank may be used. In our country, undiluted preterm formula (PF) is the second choice for MEF since there is no established human milk bank. It is not recommended to use the protein hydrolyzed formulas (7). MEF is applied for 1-3 days at 10-20 mL/kg according to the birth weight. When compared with infants in whom early enteral feeding is not given with concerns about the increased risk of NEC, MEF is preferred to increase gastrointestinal maturation, to reduce cholestasis and phototherapy requirement. However, a meta-analysis showed that MEF, when started within the first 96 hours and continued for at least one week, did not increase the feeding tolerance and did not decrease the risk of NEC (8).

Increasing enteral feeding

Evidence supports that starting early enteral feeding immediately after birth may be a good alternative to MEF in stable infants. Increasing the feeding amounts later (>5-7 days) does not reduce the risk of NEC; but prolongs the time to reach full enteral feeding. The transition to full enteral feeding and time to reach birth weight were earlier in infants whose enteral feeding were started earlier and feeds were increased more rapidly (9, 10).

Feeding increments should be initiated as soon as possible with particular care for very low birth weight infants (VLBW) and infants with intrauterine growth restriction (IUGR). A meta-analysis showed that a 15-20 mL/kg/day increase in enteral feeding volumes did not decrease the risk of NEC or death in infants with VLBW, ELBW, IUGR or having antenatal Doppler diastolic flow loss compared with a 30-40 mL/kg/day increase (11). Slower feeding increments prolong hospitalization and increase the risk of infection. However,

especially in the group under 29 gestational weeks, feeding should be carefully and slowly increased (12).

It is appropriate to determine the risk factors for NEC and start feeding according to these factors (3). Accordingly, babies can be classified into three groups:

1. High-risk infants: Preterm infants with gestational age <28 weeks and birth weight <1000 grams, preterms with SGA (<10% of birth weight according to the gestational age), infants with gestational age <29 weeks also having either loss or reversed pattern of umbilical artery end-diastolic flow, infants with increased middle cerebral artery flow (brain protective effect) in antenatal Doppler flow examinations, or having evident perinatal hypoxic-ischemic insult, infants being hypotensive and unstable during mechanical ventilation, and those with congenital bowel malformations.

2. Medium-risk infants: Those between 28-32 weeks with no high risk criteria.

3. Standard / low-risk infants: Infants >32 weeks and with no risk factors.

In some special circumstances, feeding may be interrupted. It was stated that interrupting the feeding during erythrocyte transfusion decreased the frequency of NEC; however controlled studies were required (13). MEF or enteral feeding is continued during indomethacin and ibuprofen treatment (14, 15). In a large retrospective study evaluating infants fed <60 mL/kg/day and >60 mL/kg/day, neither indomethacin treatment nor decreasing enteral feeding during treatment affected NEC incidence or feeding intolerance. Reduction of feeding for this reason delayed the transition to full enteral feeding (16).

Feeding frequency: Preterm infants <1250 g are recommended to be fed every 2 hours and preterms >1250 g are fed every 3 hours (2).

Target feeding: The targeted amount is 150-180 mL/kg and not increased over 200 mL/kg/day; 150 mL/kg may be sufficient for infants fed with fortified BM (FBM) or PF.

The recommendations of the Turkish Neonatal Society Nutrition Group for starting and increasing enteral feeding are given in Table 2 (2, 3, 17, 18).

Table 2. Recommendations of Turkish Neonatal Society Nutrition group for initiating and increasing enteral feeding in preterm infants (modified from 2, 3, 17, 18)

Nutrition for infants under 32 weeks

1. Start TPN from the first day and MEF:

Oral care with colostrum every 3-hours (until enteral feeding progresses)

MEF with Colostrum/BM via OG/NG:

<1000 g 10-20 mL/kg/day (1-3 days) (Start from the lower boundary and increase. Start 1 mL every 3-4 hours. Give 1 mL every 2-3 hours, if the baby tolerates feeding on the 2nd day. Continue to increase the amount on the 3rd day).

1000-1500 g 15-20 mL/kg/day (for 1-2 days, every 2-3 hours)

1500-1800 g 20 mL/kg for 1 day (every 3 hours)

2. Reduce TPN while increasing enteral feeding carefully:

<1000 g or high risk: Increase 15-20 mL/kg/day, feed every 2 hours

1000-1500 g, medium risk group: increase 30 mL/kg/day, feed every 2-3 hours

1500-1800 g, standard risk group: increase 30 mL/kg/day, feed every 3 hours

3. Start BM fortification when feeding reaches 50-100 mL/kg (recommended 80 mL/kg)
4. Increase nutrition until full enteral intake.

Target 150-160 mL/kg, if growth rate is not adequate 180-200 mL/kg (if tolerated)

5. Kangaroo mother care and non-nutritional feeding continues through this process. Oral feeding trials are carried out according to the baby's willingness. It is attempted to switch from OG/NG to oral feeding. Responsive feeding is attempted when oral feeding increases.

Feeding in 32-34 weeks, standard risk babies

1. Start feeding at 30-50 mL/kg/day and feed every 3 hours, increase 30-50 mL/kg/day.
2. Increase up to 150-180 mL/kg
3. Switch to oral feeding according to the baby's willingness.

NOTE: The birth weight of the infant is not taken into account when daily calculations are performed after the first week.

MEF: minimal enteral feeding; NG: nasogastric; OG: orogastric

TPN: total parenteral nutrition

Feeding intolerance - diagnosis and follow-up: There is no evidence-based definition of feeding intolerance (FI). Clinical findings, stomach content, laboratory and radiologic findings may be helpful for the diagnosis.

Gastric residual volume follow-up: In recent years, there has been an outgrowing trend toward giving up routinely checking the gastric residual volume (GRV) in infants without clinical findings of NEC. This is because of the vague relationship reported in various studies between the GRV, (even with the green color residuals) and FI or NEC. The GRV taken back does not reflect the remaining amount in the stomach; there is insufficient information about the exact amount of pathologic GRV; and since the feeding amount itself is already small in the smallest high-risk infants, GRV will be misleading. There is a potential for gastric mucosal damage due to aspiration during GRV testing; and removal of gastric content may also cause a decrease in essential gastrointestinal peptide secretion and bile acids (19). The transition to full enteral feeding is delayed because of unnecessary cessation or reduction of feeding due to gastric residuals. The relationship between the sudden increase in GRV and NEC development is also not definite.

Therefore, routine GRV testing is not an evidence-based practice and may be harmful. If there are no clinical and radiologic findings of NEC in a clinically stable infant, feeding can be increased without GRV testing under close monitoring. However, in the presence of clinical findings, GRV is checked and if it is more than 50% of the previous feeding amount, feeding may be interrupted. If further examinations are normal, methods such as reducing feeding, switching to MEF or continuous feeding may be tried (20, 21).

Turkish Neonatal Society Nutrition Group Recommendations: It is difficult to make a definite recommendation until the benefit / damage of the GRV testing is proved. However, during MEF or in the process of increasing enteral nutrition, it is appropriate to evaluate the GRV only in the presence of clinical suspicion of FI and NEC and not to do a routine check of GRV in clinically stable infants.

Clinical findings of FI: Routine follow-up of abdominal circumference is not recommended in clinically stable infants. The results can be interpreted incorrectly. Prominent intestinal loops might be due to the continuous positive airway pressure/nasal synchronized intermittent mandatory ventilation (CPAP/nSIMV). Changes in defecation frequency, increase or cessation of bowel sounds, vomiting, (if checked) GRV >50% of the previous feed or a bloody residual are monitored. Routine follow-up for fecal occult blood test is not required in clinically stable infants. However, a positive test result is important in the event of clinical suspicion.

Follow-up recommendations when GRV is checked: GRV less than 5 mL/kg or less than 50 % of the previous feed is given back and the amount is decreased from the feeding volume. If GRV is more than 5 mL/kg or more than 50%, only 50% of the total amount is given back and the next feed is skipped. If it recurs, either slow bolus or a feeding interruption decision is given according to the clinical condition.

Recommendations for breast feeding, donor milk, and formula

Supporting breastfeeding in preterm infants: Breastfeeding reduces NEC, sepsis, retinopathy of prematurity rates, shortens time to reach full enteral feeding, and length of hospital stays, has positive effects on neurodevelopment, blood pressure, and on long-term lipid profiles.

After a preterm birth, for infants who cannot be breastfed, expressed fresh human milk is obtained and given even in very small amounts, right after delivery. The rest of the expressed milk should be stored under suitable conditions. Successful milk expression in the first two weeks determines the success of breastfeeding in the future.

The first breast milk expression process should be performed as soon as possible. Oral care and MEF should be started with colostrum from the first day. BM should be expressed at least 6 times, preferably 8-12 times a day. Non-nutritive sucking together with Kangoroo mother care is started (22). Breastfeeding trials should be started when the baby is clinically stable and ready to be nursed according to the observation of sucking-swallowing coordination.

Education of the healthcare professionals: All healthcare professionals should be aware of the importance of breastfeeding for preterm babies. Pregnant women and mothers of prematerm babies should be educated for breastfeeding and milk expression methods by an experienced lactation nurse. A comfortable environment should be provided for milk expression in the unit (3).

Education of the mother: In order to meet the needs of

the baby at the hospital and after discharge, mothers should be educated about expression, storage and transport conditions of BM starting from the first day (3).

Breast milk fortification for preterm infants: Insufficient feeding of VLBW infants due to accompanying serious clinical problems during the first few weeks of life leads to postnatal growth retardation and negatively affects neurologic development (23). The BM of mothers who delivered prematurely contain more calories, fats, and proteins than that of mothers delivered at term. However, the protein and sodium contents decrease after the first two weeks and may not meet increased requirements of the VLBW infants who are growing very fast (24). Therefore BM should be fortified for this group of infants to get better growth and mineralization.

Content and benefits of breast milk fortifiers: Breastmilk can be enriched with bovine-based or human-based fortifiers. Bovine-based fortifiers are provided either in powder or liquid forms and only powdered form is found in our country. Fortifiers contain glucose polymers, protein, Ca, P, Mg, Na, K and vitamins (A, C, E, K). Thus, VLBW infants are protected from osteopenia, hypoalbuminemia, and slow weight gain. A meta-analysis showed that breast milk fortification does not increase the risk of NEC, accelerates growth until the time of hospital discharge, but the positive effect on growth and mineralization does not continue in late infancy (25). The need for studies showing long-term effects is emphasized. It has been observed that BM-based fortification reduces NEC and other morbidity and mortalities comparing with bovine milk - based fortification (26).

It may be necessary to add extra protein to FBM; because ELBW babies fed with FBM grow more slowly than those fed with PF and also have lower BUN (blood urea nitrogen) values (27).

Fortification of breast milk can be made according to the following recommendations (3):

Indication: In all infants smaller than 1500 g and 32 weeks; optionally for infants between 1850-2000 g and less than 34-35 gestational weeks.

Timing for initiation: Generally, when enteral feeding reached 50-100 mL/kg.

Starting dose: Start with 1-2 scale/100 mL and increase to 4 scale/100mL within a few days or start directly with 4 scale/100 mL. In practice, 2 scales are added to 50 mL.

Storage of FBM: Due to the risk of infection and increased osmolarity over time, fortification should not be done in large milk amounts. It should be adjusted according to the baby's requirements and consumed within 24 hours.

Methods: Breast milk can be fortified with three methods: standard, targeted, and adjustable fortification.

As the amount of BM protein cannot be increased high enough through standard fortification with the above suggested doses of fortifier, individualized fortification is suggested (28). An individualized fortification method of Targeted Fortification, is performed aiming the ideal protein content after measuring the protein content of BM, daily or twice a week. Another suggested individualized fortification is Adjustable Fortification, in which the fortification is adjusted according to the BUN levels once a week (29). In both individualized methods, extra protein is given if the desired milk protein content or BUN level can not be reached despite the addition of the suggested dose of BM fortifier.

Monitoring variables: Anthropometric measurements (body weight, height, head circumference), growth and blood biochemistry (BUN, prealbumin, albumin, sodium, calcium, phosphorus, alkaline phosphatase) are monitored at certain intervals. The target BUN level is over 10 mg/dL. If BUN level is <10 mg/dL, the added protein amount should be increased. For this purpose, extra protein supplementation can be increased such as 0.4-0.8-1.2 g/day, but not reaching more than 4 g/day protein intake.

Fortification is preferably carried out until the infant is 1800-2500 g or discharged from hospital. Infants who cannot catch up growth may be supported for a longer time.

Fortification of the hind milk: Using the hind milk, which has a higher fat content than initial milk, increases the energy intake of the baby.

The use of donor breast milk for preterm babies: If BM cannot be given, donor BM from milk bank is pre-

ferred as a second choice after pasteurization and fortification since donor milk also decreases NEC and late sepsis (24). However in our country we don't have milk bank yet.

Use of formula for preterm babies: When breast milk is not available, PF that is adjusted for the requirements of preterms can be used until the infant reaches 2.5 kilograms or is discharged. It contains more protein, energy, calcium, phosphorus than the standard term formula (SF) and supports growth and mineralization. Their content is enriched with taurine, long-chain fatty acids (LCPUFA), and iron. They provide faster growth than non-fortified BM and SF; however they do not have neurodevelopmental advantages. Compared to BM increased problems of FI, NEC, sepsis, and prolonged duration of TPN are seen (30).

Although benefits have been shown, the European Society for Pediatric Gastroenterology Hepatology and Nutrition (ESPGHAN) has not yet approved the addition of prebiotics and probiotics to PF. Nucleotides and LCPUFA which are found in breast milk are added to PF. However any visual and neurodevelopmental gains or losses were not detected when LCPUFA was given in pregnancy and to the neonate (31). According to the ESPGHAN recommendations, Arachidonic acid (AA) and docosahexaenoic acid (DHA) should be added whereas eicosapentanoic acid (EPA) should be restricted. DHA should be 12-30 mg/kg/day, AA 18-42 mg/kg/day, and the AA/DHA ratio should be 1.0-2.0/1 (32).

Preparation of preterm babies for breastfeeding: Some methods to accelerate the development of sucking/swallowing coordination are recommended (33). Starting non-nutritive feeding from the first day either with pacifier or empty breast accelerates oral feeding skills (22). Kangaroo mother care also supports the bonding of the mother and baby and helps the closer emotional relationship. It positively affects the success of breastfeeding and the growth of the infant. A meta-analysis showed that Kangaroo care reduced mortality, sepsis, hypothermia, at the time of discharge or at term age and also shortened the length of hospitalization (34).

Breastfeeding of preterm infants and evaluation of nutrition: Initiation of breastfeeding would be more successful in the presence of signs showing that a baby is awake and searching for sucking such as putting their hands to their mouth, (33, 35). If the baby does not powerfully suck, expressed BM may be given by cup feeding or by lactation aids.

If the amount of milk is thought to be insufficient, the amount of expressed BM can be measured. Daily weight measurements or a "test scale" of the infant before and after breastfeeding are evaluated in order to decide to add PF to the feeding schedule.

In a metanalysis weight gain was a little slower in feeding according to the baby's desire (responsive feeding) compared to feeding at fixed intervals; but the transition to oral feeding was reported faster. Again, there is insufficient evidence for a definite recommendation (35).

In the transition period, bottle feeding should be avoided (36). The unit's experience plays an important role in the mostly suggested cup feeding method since some adaptation problems may be observed in some infants (37).

Feeding of late preterm infants: Feeding problems are common in late preterm infants. They are sleepier, weaker, and have difficulties in settling on the nipple. Their development is not complete enough for hunger, satiety, and calmness. Responsive breastfeeding is performed; but initially breastfeeding should be provided at least 10-12 times/day. Breastfeeding should be assessed at least 3 times a day. Changes in body weight, urine and stool frequency should be closely monitored (38).

After each breastfeeding period, manual expression of the milk is suggested (>5/day on the first 3 days). After hospital discharge, the baby should be closely monitored until term.

Assessment of nutrition and breastfeeding competence when preparing the infant for discharge: The mother should be given breastfeeding education and the mother/infant relationship should be observed in the hospital for two weeks before discharge (3). Nutritional status determines the decision to discharge. The nutrient content of the baby (BM, FBM, PF or mixed), the amount taken (in the breastfed baby without enough daily weight gain, amount of ingested breast milk can be calculated with the test scale), feeding method (oral: e.g. sucking, bottle feeding, cup feeding and others, gastric tube or gastrostomy), growth (weekly weight gain, height and head circumference

Table 3. Comparison of contents in breast milk, breast milk fortifier, fortified breast milk, preterm formula, postdischarge formula, and standard formulas marketed in Turkey (3, 24, 52)

	Breast milk (Mature/Premature) (100 mL)	Eoprotin (4 scale)	100 mL AS +4 scale Eoprotin	Preterm formula (100 mL)	Post discharge formula (100 mL)	Standard formula (100 mL)
Energy (Kcal)	67/70	15	80	80	75	67
Protein (g)	1.0/1.5	1.1	2.6	2.5	2	1.3-1.4
Carbohydrate (g)	7	2.7	9.6	7.6	7.5	7.6
Fat (g)	4.1	-	4.5	4.4	4.1	3.4-3.5
Calcium (mg)	34	65	91.4	120	94	35-54
Phosphate (mg)	14	38	52.2	66	50	32

increases are marked on the growth chart), and adequacy of nutrition (biochemical results are evaluated) are assigned (3).

Half of all VLBW infants are below the 10th percentile at the time of hospital discharge. A lack of protein and energy supplementation in the early postnatal period in the hospital leads to a cumulative deficiency and growth retardation. Higher protein intake in the early period promotes growth and mental development. However, during the rapid growth phase of preterms (percentile jumps), the body fat ratio and visceral fat amount increase. The highest growth rate without any neurodevelopmental and metabolic risk for these infants is not known (39).

Aim: An ideal diet should prevent babies from becoming over-weight while providing a return to normal growth rate. According to the American Academy of Pediatrics and ESPGHAN, it is ideal for a preterm baby to catch up the fetal growth curve compatible with the postconceptional age (40, 41).

Risk factors for nutritional deficiency after discharge: ELBW and VLBW infants who are discharged before reaching term, infants with intrauterine or extrauterine growth restriction, those with less than 20 g/day weight gain before discharge, infants discharged by solely breastfeeding, and infants having severe problems such as bronchopulmonary dysplasia (BPD), NEC, short bowel syndrome, and severe neurologic disorders.

Postdischarge nutritional options

Supporting the breast milk and breastfeeding are the main recommendations. Post discharge nutrition support decisions are individualized according to the compatibility of discharge weight with postconceptional age at the time of discharge, presence of BM and biochemical markers. Infants with growth retardation at discharge or having other above-mentioned risk factors should be monitored and supported more closely. However, excessive feeding should be avoided when an adequate growth rate is achieved.

On discharge, either BM or FBM (BM fortifier/protein supplement) may be given. Formula options are as follows:

a. Standard term formula (SF) 60-70 kcal/100 mL
b. Preterm formula (PF) 80 kcal/100 mL
c. Post-discharge formula (PDF) 70-79 kcal / 100 mL (contains higher energy, protein, vitamin and mineral than SF). Some high risk infants may benefit its higher protein and protein/energy ratio than SF to achieve an inreased lean body mass (42). However no difference was found in growth and mineralization at the 18th month compared with those fed with SF according to a Cochrane meta-analysis (43).

Table 3 shows the main components of BM, FBM, PF, PDF, and SF (24).

ESPGHAN recommends individualized dietary plans according to the weight at discharge (40):

Infant's weight is appropriate for postconceptional age: BM should be given, if not available SF is given.

Infant's weight is low for postconceptual age and/or BUN is <10 mg/dL:

For breastfeeding mothers; fortified expressed BM or PF is added to breastfeeding 2-3 times a day. The fortification of BM after discharge can be continued up to 52 weeks, but it is impractical and also there is not

Table 4. Growth and biochemical follow-up criteriae of preterm infants (3, 28, 46)

Growth parameters and serum biochemistry	Alarm limits
Weight gain	<15- 20 g/kg/day
Height increase	<1 cm/week
Head circumference increase	<1 cm/week
BUN	<10 mg/dL
Phosphate	<4.5 mg/dL
Alkaline phosphatase	>450 IU/L
Prealbumin	<10 mg/dL
Sodium	<133 meq/L
Ferritin	<50 mcg/L
25(OH)Vitamin D	<50 nmol/L (20 ng/dL)

BUN: blood urea nitrogen

enough data showing its superiority to solely breastfeeding. The neurodevelopmental advantages of solely breastfed infants still continue even if they grow suboptimally (44).

If there is no BM; PF can be given until postconceptional 40-52 weeks. In a Cochrane meta-analysis comparing infants fed with SF or PF for 2-6 months, it was reported that the growth rate and lean body mass increase was significantly higher in the PF group. Therefore, PF can be continued for 3-6 months after discharge in the higher risk group (43). However, infants fed with PF should be monitored for the development of hypercalcemia and hyperphosphatemia. PDF may be another option for the ELBW, BPD, growth retarded group, although Cochrane metanalysis did not show a superiority to SF in crude growth parameters (42, 43)

Unlike term SGA infants, it was emphasized that the accelerated growth rate from birth to term and even up to 12-18 months had no negative effects for the development of metabolic syndrome and high blood pressure, whereas the rapid growth in late infancy and childhood was associated with visceral fatness and relevant adult diseases. In particular, the head circumference is intended to make catch up growth early (39). As soon as the infant catch up the birth percentile, PF is exchanged with SF (45).

High energy formulas may also be tried if there is a need for limited fluid intake (such as BPD) or for infants with inadequate weight gain after the infant reaches term age.

Evaluation of nutritional status

Preterm infants who are breastfed at discharge must be controlled in the first 48 hours and at first week. In the first 4-6 weeks, the infant should be controlled weekly/every 2 weeks. If the growth is normal, then the baby is monitored monthly/every 2 months. Alarm signs indicating inadequate growth are the head circumference not catching up at eight months, weight and height not catching up at the second age, and abnormalities of weight to height ratios (3).

Detailed feeding history is taken at outpatient clinic follow-ups. The babies' requirements, nutrient intake, anthropometric measurements, clinical and biochemical data are considered and appropriate nutritional support should be planned.

Anthropometric follow up: The Fenton Growth Chart (2013) is used until the 50th week without any correction for gestational age.

Then, applying the corrected postconceptional age, "Olcay Neyzi growth charts for Turkish Children" or "WHO growth charts" are used (3).

At first, head circumference catches up growth (up to 8 months) which is indicative of neurocognitive function. Then weight, and finally height catch up growth occur around 30-36 months of age. Catch up growth may be delayed in VLBW infants. Growth and biochemical follow-up criteriae are given at Table 4 (46).

Iron, vitamin D, and mineral supplementation in preterms

Iron is given 2-3 mg/kg/day starting from the 2nd to the 6th week. For ELBW infants, it is started at 2-4 weeks (47). If ferritin is >250 mcg/mL, iron is supplementation is delayed. If the baby takes 150 mL/kg/day iron-containing formula, then iron supplementation is only recommended for ELBW infants. Iron supplementation continues for 12-15 months. Complete blood count and ferritin checks are performed at six months of age.

Vitamin D: When VLBW infants are fed full enterally, vitamin D supplementation (400 IU/day, maximum 1000 IU/day) should be started. Solely breastfed babies can be given multivitamin supplementation up to six months of age or until reaching 2000 g of bodyweight. Multivitamins and minerals are unnecessary for babies fed with PF or FBM (48, 49).

Zinc supplementation: 1-2 mg/kg/day, for ELBW infants 3 mg/kg/day (50). Excessive zinc uptake suppresses copper absorption.

As a conclusion, meeting the nutritional needs and implementation of enteral feeding for a small preterm necessitate an urgent, meticolous and scientific approach starting from the first day of life. Therefore referring to recent scientific reports is always advisable (51-53).

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