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# Clinical Experience With Numeta in Preterm Infants: Impact on Nutrient Intake and Costs

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## Abstract

*Background:* A new "ready-to-use" triple-chamber container, Numeta (Baxter, Deerfield, IL), is available for preterm parenteral nutrition (PN) to provide nutrients according to the recommendations of the European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) Guidelines for Pediatric Parenteral Nutrition. We investigated the clinical application of Numeta compared with individualized PN in preterm infants (≤1.500 g) and evaluated the effects on nutrient intake, costs, and preparation time. *Materials and Methods:* In a clinical observational study, prescriptions for preterm infants were performed with the new prescription software catoPAN (Cato Software Solutions, Becton Dickinson, Vienna, Austria). Individualized PN and Numeta prescriptions were mirrored, and nutrition content of the PNs was compared with each other and with ESPGHAN/ESPEN recommendations. Furthermore, costs and preparation time were assessed. *Results:* In total, 374 PN solutions (>1000 g [n = 333]/≤1000 g [n = 41]) were analyzed. Protein intake with Numeta was significantly lower compared with individualized PN and did not meet the recommendations for infants <1500 g during the first day and the period of transition after birth. Energy intake was significantly higher with Numeta. The costs for Numeta preparations were €18 (about US$20) higher than for individualized PN. However, the preparation time/solution was 2 minutes faster with Numeta. *Conclusion:* Numeta is an alternative to individualized PN for infants >1000 g in the period of stable growth when enteral feedings have already started. Protein intake is significantly lower than in individualized PN solutions. Numeta is more expensive in comparison to individualized PN but saves human resources. (*JPEN J Parenter Enteral Nutr*. XXXX;xx:xx-xx)

## Keywords

Numeta; preterm infants; individual parenteral nutrition; catoPAN; protein

## Clinical Relevancy Statement

The present study provides data on the clinical application of the recently launched "Numeta bags" (Baxter, Deerfield, IL) for the parenteral nutrition (PN) of preterm infants. These bags are the first ready-to-use bags designed for PN or partial PN of infants weighing <1500 g. However, data on adequate supplementation with nutrients according to European Society for Pediatric Gastroenterology, Hepatology and Nutrition guidelines and data on costs have been missing so far. Therefore, this study compared the intake of nutrients between Numeta and individually prescribed PN solutions. These calculations were performed with a new prescription software for PN solutions (catoPAN; Cato Software Solutions, Becton Dickinson, Vienna, Austria). This software is a useful PN prescription tool considering enteral intake and 24-hour medication. Therefore, the software provides exact data on fluid management and entire nutrition intake. The results of the study report on the clinical application of new PN tools and therefore contribute to an improvement in the PN of preterm infants.

## Introduction

Preterm infants with a birth weight <1500 g always need parenteral nutrition (PN) during their stay in the neonatal intensive care unit (NICU).[1] To date, no "ready-to-use" product has been commercially available for this group of patients.

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Therefore, PN solutions for patients younger than 2 years always had to be prescribed individually. Since 2011, a new triple-chamber bag, Numeta (Baxter, Deerfield, IL), has been available for PN of premature infants (Numeta 13%) and critically ill neonates (Numeta 16%). Numeta was designed to provide nutrients according to the recommendations of the European Society for Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) Guidelines for Pediatric Parenteral Nutrition.[1] The triple-chamber bag contains amino acids, glucose, lipids, and electrolytes. Only calcium, phosphorus, vitamins, and trace elements have to be added before application. So far, only a small number of studies investigating nutrient supply with Numeta in preterm infants have been published.[2] Neonatologists still have concerns if the product meets the requirements of very low-birth-weight (VLBW) infants (<1500 g) and especially extremely low-birth-weight (ELBW) infants (<1000 g) as stated by the manufacturer. Furthermore, the high costs of the product raise concerns about cost-effectiveness of the product in comparison to individualized PN. A new prescription software, catoPAN (Cato PN module by Cato Software Solutions, Becton Dickinson, Vienna, Austria), was developed to provide exact prescriptions for individual PN as well as Numeta. The software calculates nutrients administered by PN and enteral nutrition (EN) and relates them to reference values. Therefore, an exact calculation of nutrient intake of the patient is rendered possible.

The aim of this observational study was to evaluate the clinical application of the ready-to-use Numeta product system and the effect on nutrient intake and costs in comparison to individualized PN in preterm infants and the effect on nutrient intake, costs, and preparation time with support of the new prescription software catoPAN.

## Materials and Methods

### *Study Design*

This prospective observational study was conducted from January 2013 to June 2013 in the Division of Neonatology, Department of Pediatrics and Adolescent Medicine of the Medical University of Vienna. The study was approved by the local ethics committee of the Medical University Vienna (EC Nr: 1018/2013).

### *Patients and Inclusion and Exclusion Criteria*

Preterm infants with a birth weight ≤1500 g and a gestational age (GA) <37 weeks receiving PN or partial PN were included in the observational study. Infants with contraindications for the use of Numeta according to the product label were excluded: hypersensitivity to egg, soy, or peanut proteins or to any of the active substances; congenital abnormality of amino acid metabolism; pathogenically elevated plasma concentrations of sodium, potassium, magnesium, calcium, and/or phosphorus; or severe hyperglycemia, severe hyperlipidemia, or severe disorders of lipid metabolism characterized by hypertriglyceridemia.

### *catoPAN*

catoPAN is a prescription software facilitating prescription of EN and PN as well as 24-hour medication. The nutrition content of all 3 fractions is integrated in the total calculation of macronutrients and electrolytes, so the physician obtains precise information on each nutrient administered to the patient. catoPAN detects discrepancies from the recommendations by ESPGHAN and ESPEN[1] and cautions the physician in case of limit violation by a warning. Furthermore, the software provides information on total glucose concentration of bags and osmolarity of the PN solution. The software is able to integrate ready-to-use products into the calculations.

### *Individualized vs Ready-to-Use Prescription*

In daily routine care, PN was prescribed individually or as the ready-to-use product Numeta and administered to the patient. The prescription of the PN regimen was based on an individual patient's estimated volume and protein needs as well as enteral intakes. Afterward, the prescription was mirrored, so for each day, an individual and a Numeta prescription were calculated per patient. All prescriptions were calculated with the catoPAN software. Figure 1 shows a flowchart of the principle of the mirroring. The prescriptions were calculated on the basis of the following parameters: age of the patient (d), weight of the patient (g/d), total volume for parenteral and enteral intake (mL/kg), EN (mL/meal), venous access, and 24-hour medication. The following products were used for individual component prescription: dextrose 60% and distilled water as appropriate (Fresenius Kabi, Vienna, Austria), amino acids (Primene 10%; Baxter, Vienna, Austria), lipids (Clinoleic; Baxter), electrolytes (sodium chloride, potassium chloride, calcium gluconate, phosphorus, and magnesium sulfate; Fresenius Kabi), and vitamins and trace elements (Soluvit, Vitalipid, and Peditrace; Fresenius Kabi).

Nutrition values of all components and EN were included in the calculation. The calculated nutrient content of the individualized prescription was compared with the Numeta prescription and with the current ESPGHAN/ESPEN recommendations. Moreover, for each preparation method, the costs for expendable materials and nutrient solutions were calculated, and the preparation time was stopped (n = 30/each).

### *Numeta*

Numeta G13% is a triple-chamber bag, including amino acids plus electrolytes, glucose, and lipids, that is dedicated to the PN of preterm infants.

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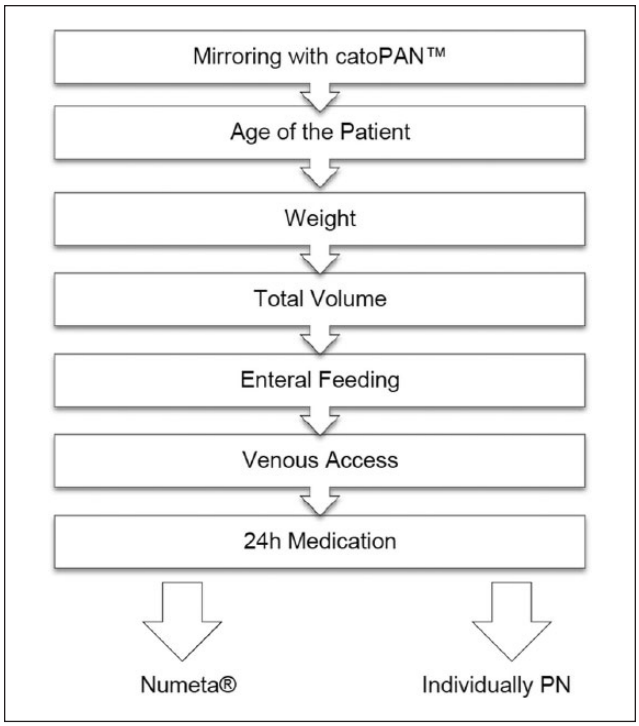


**Figure 1.** Flow diagram of catoPAN prescription: Numeta and individualized parenteral nutrition. The diagram includes detailed information of fixed parameters.

In the present study, the product was always used with 3 activated chambers. The prescription of Numeta is primarily defined via the protein component. The other nutrients adhere in a fixed composition, and the solution can be diluted with water. Due to the high osmolarity of the solution, application via a central line is recommended. To save resources and costs, we modified the recommendations for application/use as follows: the amount of Numeta calculated in the catoPAN prescription was extrapolated from the original triple-chamber bag into an extra bag. Then an individualized amount of vitamins, electrolytes, trace elements, and water was added to the extra bag. This procedure permitted sharing of the expensive Numeta bag among several patients. Furthermore, it enabled individualized prescription.

### *Statistical Methods*

We hypothesized that Numeta provides adequate nutrients according to the recommendations by the ESPGHAN/ESPEN[1] in comparison to individualized PN in preterm infants. Primary outcome parameter was calculated protein intake in g/kg/d. Secondary outcome variables were the intake of all other nutrients such as energy (kcal/kg), carbohydrates (mg/kg/min), fat (g/kg/d), sodium (mmol/kg), potassium (mmol/kg), calcium (mmol/kg), phosphorus (mmol/kg), magnesium (mmol/kg), osmolarity (mOsm/L), and glucose concentration (%). In addition, preparation costs in Euros (€) and preparation time in minutes/seconds were parameters of secondary outcome.

The American Academy of Pediatrics (AAP) defines references values for different postnatal periods in the premature infant's life: the first day of life, a period of transition, and a period of stable growth.[4] Furthermore, the AAP distinguishes ELBW infants (birth weight ≤1000 g) and VLBW infants (birth weight between 1000 and 1500 g). For the analysis, infants were divided into 2 groups (<1000 g and >1000 g) and 3 different postnatal periods: day 1 of life; days 2–6 of life, reflecting the period of transition; and days 7–35 (>1000 g)/7–33 (≤1000 g), reflecting the period of stable growth.[4]

Results of primary and secondary outcome variables were expressed as median and range in the tables and in the text. Given nonnormal distribution of data and due to a higher robustness, all comparisons were performed using nonparametric tests. The Wilcoxon test was used for pairwise comparison. Data on costs calculation are given in mean and SD. Data analysis was carried out using the software STATISTICA by StatSoft (Tulsa, OK) for Windows. $P < .05$ was considered statistically significant.

## Results

### *Baseline Characteristics*

In the present study, 374 prescriptions for PN solutions were mirrored and analyzed: 333 PN of 30 infants with a birth weight >1000 g and 41 PN of 4 infants with a birth weight ≤1000 g.

In preterm infants with a birth weight >1000 g, median GA was 31+3 weeks (range, 28+0–36+0 weeks), median birth weight was 1390 g (range, 1033–2160 g), median height was 40.5 cm (range, 35.5–45.0 cm), and median head circumference was 28.0 cm (range, 25.0–31.5 cm). In daily clinical routine, 37% (124/333) of the PN solutions were primarily prescribed as Numeta and 61% (203/333) primarily as individualized PN.

In preterm infants with a birth weight ≤1000 g, median GA was 30+2 weeks (range, 27+0–31+1 weeks), median birth weight was 1000 g (range, 820–1000 g), median height was 35.5 cm (range, 35.5–38.0 cm), and median head circumference was 25.0 cm (range, 24.5–28.0 cm). None sustained Numeta primarily.

### *Primary Outcome Protein*

*Preterm infants >1000 g (333 prescriptions of 30 patients).* In all 3 periods, there was a significant difference ($P < .001$) in protein prescription between Numeta and individualized PN, with a higher anticipated intake by individually prescribed PN (Table 1). During the first day of life and the phase of transition, the minimal recommendations for protein intake could not be achieved with Numeta.

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**Table 1.** Numeta vs Individual Parenteral Nutrition in Preterm Infants >1000 g.

| | Day 1 of Life (n = 18) | | | | Days 2–6 of Life (n = 112) | | | | Days 7–35 of Life (n = 203) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Day 1 | Numeta | Individual | *P* Value | Transition | Numeta | Individual | *P* Value | Growing | Numeta | Individual | *P* Value |
| Volume, mL/kg | 70–90 | 99 (51–150) | 100 (51–150) | NS | 90–140 | 147 (100–170) | 148 (100–170) | <.001 | 120–160 | 159 (140–175) | 160 (140–175) | <.001 |
| Energy, kcal/kg | 40–50 | 49 (41–70) | 48 (33–109) | <.05 | 60–70 | 105 (120–127) | 95 (60–132) | <.001 | 90–100 | 117 (110–144) | 112 (100–144) | <.001 |
| Carbohydrates, mg/kg/min | 4.8 | 5 (3.2–6.7) | 5.2 3.2–5.4) | NS | 3.5–8.3 | 9.8 (5.4–12.2) | 8.6 (5.6–11.7) | <.001 | 6.7–10.4 | 10.4 (4.0 –14.7) | 10.4 (5.0–13.6) | NS |
| Protein, g/kg/d | 2 | 1.6 (1–2.2) | 2.1 (1.1–2.3) | <.001 | 3.5 | 3.1 (1.6–4.1) | 3.6 (1.7–5) | <.001 | 3.2–3.8 | 3.2 (2.0–4.9) | 3.8 (2.4–5.4) | <.001 |
| Fat, g/kg/d | 1 | 1.5 (0.2–2.2) | 1.5 (1–1.8) | NS | 1.0–3.0 | 3.5 (1.8–4.7) | 3.9 (1.3–6) | <.001 | 3–4 | 4.5 (2.8–5.4) | 4.5 (1.9–6.5) | NS |
| Sodium, mmol/kg | 0–1 | 1.1 (0.7–3.4) | 2 (0–5) | <.05 | 2.0–5.0 | 3.8 (1.1–4.5) | 3.3 (1–5) | <.05 | 3–5 | 3.0 (0.1–4.7) | 3.0 (0.0–6.1) | <.05 |
| Potassium, mmol/kg | 0 | 1 (1–1.5) | 0 (0–1.5) | NS | 0–2.0 | 1.7 (0.5–2.4) | 0.9 (0.0–2.5) | <.001 | 2–3 | 1.1 (0.1–4.5) | 1.0 (0.0–2.0) | <.001 |
| Calcium, mmol/kg | 0.5–1.5 | 1.7 (0.4–2.1) | 1.6 (0.9–2.1) | NS | 1.5 | 2.3 (1.2–3.9) | 1.9 (0.1–3.6) | <.001 | 1.5–2 | 2.3 (1.0–5.8) | 2.4 (0.0–5.3) | <.01 |
| Phosphorus, mmol/kg | 0 | 0.6 (0.1–1.9) | 1 (0–1.5) | NS | 1.5–1.9 | 2.1 (0.5–2.5) | 1.3 (0.3–2.0) | <.001 | 1.5–1.9 | 1.6 (0.1–2.5) | 1.3 (0.0–2.0) | <.001 |
| Magnesium, mmol/kg | 0 | 0.2 (0.1–0.8) | 0 (0–0.3) | <.001 | 0.2–0.3 | 0.4 (0.1–0.5) | 0.3 (0.0–0.8) | NS | 0.2–0.3 | 0.2 (0.0–0.5) | 0.2 (0.0–0.9) | <.001 |
| Osmolarity, mOsm/L | 800[a] | 805 (496–1107) | 719 (534–885) | NS | 800[a] | 999 (647–1138) | 843 (114–1348) | <.001 | 800[a] | 1027 (424–1155) | 1053 (76–1389) | <.05 |
| Glucose, % | 15[b] | 8.8 (5.4–12.3) | 8.2 (6–9.8) | NS | 15[b] | 11.1 (7.3–12.6) | 9.1 (6.0–15.8) | <.001 | 15[b] | 11.4 (5.6–13.3) | 11.2 (6.6–16.6) | NS |

Data are presented as median (range). All group comparisons were performed using the Wilcoxon paired group test. NS, not significant.

[a]Reference value for osmolarity for peripheral venous access.[3]

[b]Reference value for glucose concentration for peripheral inserted lines.[3]

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*Preterm infants ≤1000 g (41 prescriptions of 4 patients).* On the first day of life and during the transition period, Numeta prescriptions did not reach the recommended protein intake. Protein intake differed significantly between Numeta and individualized PN in the periods of transition and stable growth. When prescribed individualized, the PN solution provided more protein than did Numeta.

### Secondary Outcomes

*Nutrients.* Data of nutrients are given in Table 1 for infants with a birth weight >1000 g and in Table 2 for infants ≤1000 g. Due to the fixed proportion of nutrients, energy intake was significantly higher with Numeta. Minor significant differences were sometimes also observed for other nutrients and electrolytes, although the clinical relevance of these is negligible. Even the volume intake was significantly higher in individually prescribed PNs, although it was a fixed parameter in both groups. Fat intake was constantly higher in both groups compared with reference values. This was caused by the inclusion of enteral intake of nutrients into the calculations. The patients did not exclusively receive PN, and the reference values for enteral fat intake are much higher.

*Osmolarity and glucose concentration*. On the first day of life, both PN solutions met criteria for peripheral venous access of 800 mOsm/L (Tables 1 and 2). During the periods of transition and stable growth, insertion of a central line is necessary for both nutrition solutions due to the higher osmolarity of the solutions. The glucose concentration never exceeded the limit of 15% for peripheral inserted lines (Tables 1 and 2).

*Costs*. The cost calculation included all costs for parenteral solutions in milliliters per nutrient solution and consumable material per patient per day. Mean ± SD expenses were €37± 4 (about US$42±5) (n = 50) for one individually prepared nutrition solution and €55 ± 15 (about US$62±17) (n = 50) for Numeta. Mean ± SD expenditure of preparation time was 6 minutes 31 seconds ± 30 seconds (n = 30) for individually prepared solution and 4 minutes 6 seconds ± 1 minute 10 seconds (n = 30) for Numeta. The costs/min for a Numeta preparation were on average €7.74 (about US$8.73) more expensive than an individual PN (Numeta: €13.41 [about US$15.13]/min vs individualized PN: €5.67 [about US$6.39]/min).

## Discussion

In this prospective observational study, we investigated the intake of nutrients in preterm infants receiving 374 PN solutions prescribed with Numeta in comparison to an individualized PN. Protein intake did not reach the recommended values during the first day of life and transition period when prescribed with Numeta. Furthermore, protein intake was significantly lower during the transition period and the period of stable growth in comparison to individually prescribed nutrient solutions. On the other hand, intake of energy and carbohydrates was higher with Numeta due to the fixed composition of ingredients. The costs for Numeta per patient were €18 (about US$20) more expensive in comparison to individualized PN, but Numeta saved human resources by being prepared 2 minutes faster per preparation. On the first day of life, both nutrient solutions had an osmolality below 800 mOsm/L and could be applied via peripheral venous access. However, a central line was required from the second day onward.

In 2011, the ready-to-use PN solution Numeta G13% for preterm infants was launched in Austria and other European countries.[5] Since November 2012, Numeta has been used in our hospital. By then, all parenteral nutrient solutions were prepared individually in our 44-bed NICU. The new, ready-to-use product Numeta seemed to be a useful alternative to individualized PN to save human resources, especially in "stable" neonates with a birth weight of 1000 g.

In the present study, the calculations of nutrients were performed with a new prescription software, catoPAN. Approximately one-third of our patients received Numeta primarily; the other two-thirds received the individually prescribed PN solutions. After mirroring the PN solutions, the potential intake of nutrients under the 2 different regimens was assessed. For the analysis, we divided patient data into 3 different periods of life: day 1 of life, period of transition, and period of stable growth. For each period, the ESPGHAN/ESPEN provides distinct reference values reflecting the nutrition needs of the preterm infant during this period.[1] Protein intake was defined as the primary outcome, because it is the key nutrient for growth and gain of fat-free body mass.[6] Moreover, protein is essential for brain growth, neurologic outcome, and development, especially during the vulnerable preterm period.[7] To avoid catabolism, VLBW infants receive PN immediately after birth at a minimum of 60–80 nonprotein kcal/kg/d and 2 g/kg/d protein to improve nitrogen balance, energy intake, and protein synthesis. Higher intakes up to 4 g/kg/d are needed to achieve physiologic protein accretion and establish stable growth.[8]

A recent study showed that each gram per kilogram per day in protein intake during the first week of life is associated with an 8.2-point increase in the Mental Development Index of the Bayley scales at 18 months.[9]

The calculations of the present study show that Numeta provides too little protein the first day of life and during the transition phase—a critical period of life. In general, protein intake with Numeta is significantly lower during all 3 periods of postnatal adaptation and growth compared with individualized PN. However, energy, carbohydrate, and fat intake was satisfying, so the protein-energy relation in Numeta seems to be not well balanced. Furthermore, Numeta provided inadequate high intake of electrolytes for the first day of life and also during the transition phase,[4,10] making Numeta a useful alternative in infants after the transition phase when EN has already started.

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**Table 2.** Numeta vs Individual Parenteral Nutrition in Preterm Infants ≤1000 g.

| | Day 1 of Life (n = 3) | | | | Days 2–6 of Life (n = 15) | | | | Days 7–33 of Life (n = 23) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Parameter | Day 1 | Numeta | Individual | *P* Value | Transition | Numeta | Individual | *P* Value | Growing | Numeta | Individual | *P* Value |
| Volume, mL/kg | 90–120 | 99 (99) | 100 (100) | NS | 90–140 | 140 (115–169) | 140 (115–170) | <.05 | 140–180 | 170 (155–180) | 170 (150–180) | <.001 |
| Energy, kcal/kg | 40–50 | 49 (49) | 47 (45–47) | NS | 75–85 | 106 (55–130) | 80 (60–119) | <.01 | 105–115 | 130 (115–135) | 124 (103–154) | NS |
| Carbohydrates, mg/kg/min | 4.8 | 4.8 (4.8) | 4.9 (4.9–5) | NS | 5.5–10.4 | 10 (5.4–12) | 8 (6.1–11.8) | <.05 | 9–11.8 | 11.4 (10–12.6) | 11.6 (8.6–15.0) | NS |
| Protein, g/kg/d | 2 | 1.6 (1.6) | 2.1 (2.1) | NS | 3.5 | 3.1 (1.8–3.7) | 3.3 (2.7–3.9) | <.05 | 3.5–4 | 3.5 (2.8–4.0) | 4.0 (3.2–5.5) | <.001 |
| Fat, g/kg/d | 1 | 1.5 (1.5) | 1.5 (1.3–1.5) | NS | 3.0–4.0 | 3.4 (1.6–4.5) | 3.1 (2.0–4.7) | NS | 3–4 | 5.0 (4.5–5.4) | 5.1 (4.0–6.8) | NS |
| Sodium, mmol/kg | 0–1 | 1 (1–2.3) | 0 (0–3.2) | NS | 2.0–5.0 | 3.9 (1.1–4.1) | 2.1 (0.0–5) | <.05 | 3–5 | 3.5 (0.2–3.7) | 3.0 (0.0–5.5) | NS |
| Potassium, mmol/kg | 0 | 1 (1) | 0 (0) | NS | 0–2.0 | 1.8 (1.1–2) | 0.7 (0.0–1.9) | <.05 | 2–3 | 1.4 (0.2–1.6) | 0.0 (0.0–1.5) | NS |
| Calcium, mmol/kg | 0.5–1.5 | 1.7 (1.7) | 1.6 (1.4–1.6) | NS | 1.5 | 2.3 (1.7–2.6) | 1.7 (1.3–2.4) | <.01 | 1.5–2 | 2.5 (2.4–4.3) | 3.0 (2.4–4.5) | NS |
| Phosphorus, mmol/kg | 0 | 0.6 (0.6) | 0 (0–1.1) | NS | 0.1.5–1.9 | 2.1 (0.7–2.2) | 0.9 (0.0–1.6) | <.01 | 1.5–1.9 | 1.9 0.1–2.0) | 1.5 (0.0–1.5) | NS |
| Magnesium, mmol/kg | 0 | 0.2 (0.2) | 0 (0) | NS | 0.2–0.3 | 0.4 (0.2–0.4) | 0.3 (0.0–0.5) | <.05 | 0.2–0.3 | 0.3 (0.0–0.3) | 0.0 (0.0–0.3) | NS |
| Osmolarity, mOsm/L | 800[a] | 638 (638–664) | 634 (643–667) | NS | 800[a] | 954 (582–1078) | 755 (675–1104) | <.05 | 800[a] | 1012 (838–1068) | 1049 (703–1462) | NS |
| Glucose, % | 15[b] | 7 (7) | 7 (7–7.2) | NS | 15[b] | 10.6 (6.4–12) | 8.3 (7.3–19.6) | <.05 | 15[b] | 11.6 (8.4–12.3) | 11.6 (7.6–19.6) | NS |

Data are presented as median (range). All group comparisons were performed using the Wilcoxon paired group test. NS, not significant.

[a]Reference value for osmolarity for peripheral venous access.[3]

[b]Reference value for glucose concentration for peripheral inserted lines.[3]

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In 2013, 14 case reports of hypermagnesemia with Numeta G13% solutions were reported. Serum magnesium levels ranged from 1.025 to >1.5 mmol/L without any symptoms or serious adverse events,[5] but Numeta G13% was removed from the market.[5] In the present study, magnesium intake with Numeta was in the normal range except on the first day of life, and none of our patients receiving Numeta developed hypermagnesemia.

A high-dose antenatal magnesium therapy of the mother[5] influencing the serum magnesium level in the premature infant after birth was supposed to be a potential reason for the hypermagnesemia cases. This therapy is applied to improve long-term neurodevelopmental outcome of the infant but is not yet a standard therapy in our obstetric department.

Numeta seems to be a useful alternative to individualized PN when the infant receives partially enteral feedings and the infant has a birth weight >1000 g. In infants receiving half enteral feedings, the use of Numeta saved 7 workflow steps in comparison to individually prepared PN; in infants receiving three-fourths EN, only Numeta and the addition of water are necessary and save a lot of time.

However, Numeta is more cost-intensive than individually prepared nutrition solutions. The costs/minute for a Numeta preparation were €7.74 (about US$8.73) higher than for individualized PN. Another issue of Numeta is that the prescription is primarily protein steered, which is nonhabitual for a neonatologist. When prescribing Numeta, the physician has to calculate to protein amount he or she wants to administer to the patient and then adjusts total volume intake for body weight and checks macronutrients and electrolytes, which are given in a fixed composition. This is a novel workflow because usually the physician starts with the definition of the total volume for the patient in mL/kg/d and then calculates macronutrients and electrolytes.

The present study was conducted as an observational study, which is a limitation. The use of Numeta or individualized PN was decided by the physician in the daily clinical routine.

During the clinical course, no infant ≤1000 g received Numeta primarily as PN. Furthermore, no laboratory data can be provided documenting the detailed clinical impact on nutrient intake. However, this is the first report on the clinical application of Numeta in a clinical setting.

In conclusion, Numeta is an alternative to individualized PN in infants with a birth weight >1000 g and an enteral feeding volume of approximately one-third of the total daily intake. However, protein intake is significantly lower than in individually prescribed PN solutions and during the first days of life below the recommendations for daily supply. Numeta is more expensive but saves human resources in comparison to individualized nutrition solutions.

## References


1. Koletzko B, Goulet O, Hunt J, et al. Guidelines on Paediatric Parenteral Nutrition of the European Society of Paediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) and the European Society for Clinical Nutrition and Metabolism (ESPEN), supported by the European Society of Paediatric Research (ESPR). *J Pediatr Gastroenterol Nutr*. 2005;41(suppl 2):S1-S87.
2. Rigo J, Marlowe ML, Bonnot D, et al. Benefits of a new pediatric triple-chamber bag for parenteral nutrition in preterm infants. *J Pediatr Gastroenterol Nutr*. 2012;54(2):210-217.
3. Baxter. *Hinweise zur Handhabung von Numeta*. Vol ATMD-NUM-05/111214. Vienna, Austria: Baxter Healthcare GmbH; 2012.
4. AAP Committee on Nutrition. *Pediatric Nutrition Handbook*. 7th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2013.
5. EMA. *Numeta G13%E to Be Suspended and New Risk Minimisation Measures to Be Introduced for Numeta G16%E*. London, UK: EMA; 2013.
6. Agostoni C, Buonocore G, Carnielli VP, et al. Enteral nutrient supply for preterm infants: commentary from the European Society of Paediatric Gastroenterology, Hepatology and Nutrition Committee on Nutrition. *J Pediatr Gastroenterol Nutr*. 2010;50(1):85-91.
7. Isaacs EB, Gadian DG, Sabatini S, et al. The effect of early human diet on caudate volumes and IQ. *Pediatr Res*. 2008;63(3):308-314.
8. Koletzko B, Poindexter B, Uauy R. *Nutritional Care of Preterm Infants: Scientific Basis and Practical Guidelines*. Vol 110. Basel, Switzerland: Karger; 2014.
9. Stephens BE, Walden RV, Gargus RA, et al. First-week protein and energy intakes are associated with 18-month developmental outcomes in extremely low birth weight infants. *Pediatrics*. 2009;123(5):1337-1343.
10. Tsang RC, Koletzko B, Zlotkin SH. *Nutrition of the Preterm Infant—Scientific Basis and Practical Guidelines*. 2nd ed. Cincinnati, OH: Digital Educational Publishing; 2005.


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