

Improving nutritional intake in extremely preterm infants in the first week of life

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Introduction

In extremely preterm infants, optimised early energy and protein intake is associated with improved outcomes both in terms of morbidity¹ and neurodevelopment².

Barriers to the delivery of parenteral nutrition (PN) in the first days of life include:

- Relative fluid restriction in the first 24-48 hours
- Multiple drug infusions (e.g. heparin saline, morphine, inotropes) that take up a large proportion of the fluid requirement
- Hyperlipidaemia

It has been demonstrated that use of a more concentrated PN solution is associated with improved early nutritional intake, as well as a sustained increase in head growth, with no increased morbidity and mortality (SCAMP study, Morgan et al 2014)³.

In our unit, a 2012 audit demonstrated that targets for energy and protein intake in the first week of life in infants less than 28 weeks gestation were not being met. We aimed to improve in line with national guidelines by making changes to our PN formulation and to our PN prescribing guidelines.

Aims

To improve energy and protein intake in infants less than 28 weeks gestation in the first week of life, as suggested in the following national guidelines:

- The Provision of Parenteral Nutrition within Neonatal Services – A Framework for Practice. (BAPM 2016)⁴
- Joint ESPEN/ESPGHAN/ESPR/CSPEN Guidelines on Pediatric Parenteral Nutrition. (ESPEN 2018)^{5,6}

Methods

New standard bags of PN were formulated by a multi-disciplinary team including specialist dieticians and pharmacists. These were concentrated to run at a maximum rate of 100ml/kg/day, with lipids at 20ml/kg/day, allowing for a larger proportion of the fluid requirement to be taken by drug infusions without titrating from the PN volume. The phosphate to calcium ratio was also increased to allow for the higher phosphate requirement associated with improved growth.

Additionally, higher thresholds were introduced for reducing or stopping lipid infusions in the case of elevated serum triglycerides (e.g. with serum triglycerides 2.9-3.5mmol/L the lipid infusion was reduced by 5ml/kg/day, and when >4mmol/L or a lipaemic sample the infusion was reduced to 5ml/kg/day or stopped).

When these changes had been implemented, the impact was studied using a retrospective review of the notes of infants who had received the new PN regime. 25 inborn babies born at less than 28 weeks gestation between May 2018 and May 2019 were included (6 were excluded due to death or incomplete notation). Delivered volumes of PN, lipid, feeds and dextrose infusions were recorded for the first complete 7 days of life. Total calorie (kcal/kg/day) and protein (g/kg/day) intake were then calculated for each infant, and mean averages were calculated for the whole cohort.

Results

- Energy intake was increased compared to 2012, with a mean additional 10.2 kcal/kg/day on the first day of life, and 23.3 kcal/kg/day by day 7 (Fig. 1, table 2)
- Energy intake in the 2019 group falls within ESPEN^{5,6} recommendations by day 5, and is close to the BAPM recommendations⁴ for each day.
- Protein intake was also increased compared to 2012, with an additional 0.33 g/kg/day on day 1, and 0.66g/kg/d by day 7 (Fig 2, table 2)
- Protein intake in the 2019 group falls within the BAPM⁴ recommendations by day 3, and within ESPEN^{5,6} recommendations throughout the first week.

Conclusions

Our unit successfully implemented a combined approach of using a more concentrated parenteral nutrition solution alongside introducing higher thresholds for reducing or stopping lipid infusions when serum triglycerides are raised.

This resulted in improved energy and protein intakes for infants of less than 28 weeks gestation in the first week of life, which has the potential to have a lasting positive impact on growth, nutrition and other outcomes.

Table 1: Demographic details

	2019 cohort	2012 cohort
Sample size	25	30
Gestation at delivery	25.3 weeks (23-27)	25.4 weeks (24-27)
Male gender	60%	56.7%
Birthweight	732.7g (403-1226g)	720.6g (440-1126g)
Birthweight <9 th centile	24%	33.3%

Fig 1: Calorie intake compared to guideline recommendations

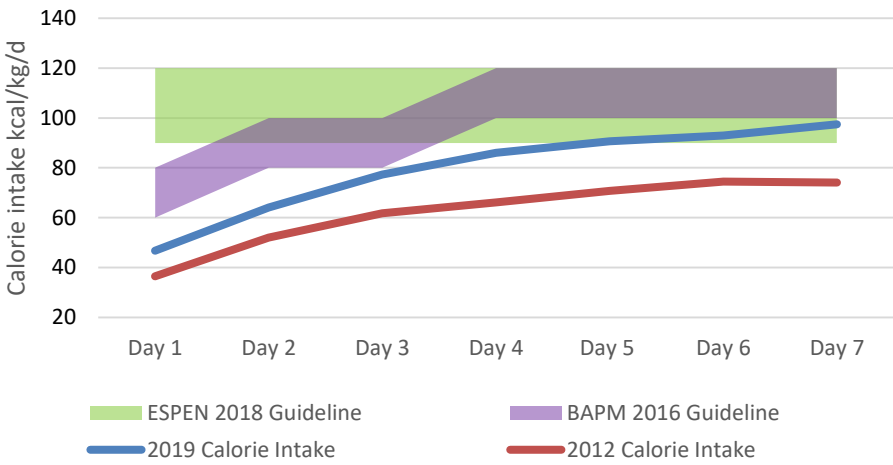


Fig 2: Protein intake compared to guideline recommendations

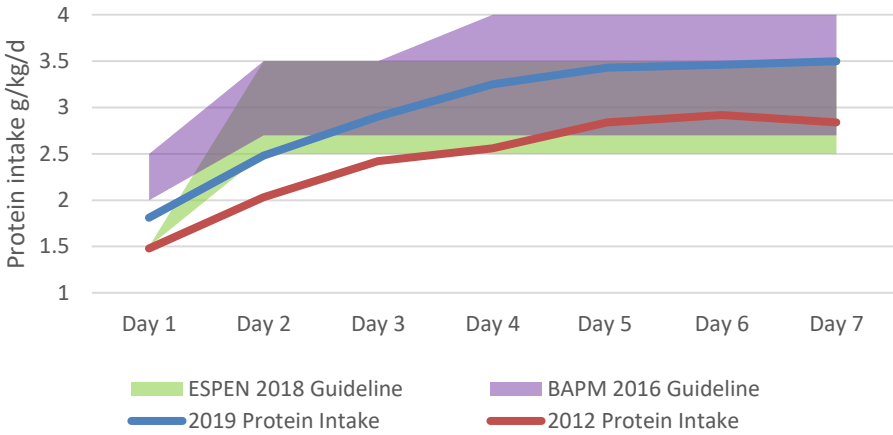


Table 2: Calorie and protein intake in the first seven days of life

Calorie intake (kcal/kg/d)							
Day	1	2	3	4	5	6	7
2019	46.73	64.09	77.32	86.06	90.68	93	97.48
2012	36.51	52	61.79	66.08	70.72	74.48	74.12
BAPM 2016 ⁴	60-80	80-100	80-100	100-120	100-120	100-120	100-120
ESPEN 2018 ^{5,6}	90-120	90-120	90-120	90-120	90-120	90-120	90-120
Protein intake (g/kg/d)							
Day	1	2	3	4	5	6	7
2019	1.81	2.48	2.9	3.25	3.43	3.46	3.5
2012	1.48	2.03	2.42	2.56	2.84	2.92	2.84
BAPM 2016 ⁴	2-2.5	2.7-3.5	2.7-3.5	2.7-4.0	2.7-4.0	2.7-4.0	2.7-4.0
ESPEN 2018 ^{5,6}	1.5	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5	2.5-3.5

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