

## Kertas Asli/Original Articles

### Energy Dense Feeding in Premature Infants and Its' Associated Outcomes (Pemakanan Tumpat Tenaga dalam Bayi Pramatang dan Kesan Berkaitan)

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#### ABSTRACT

*COVID-19 infection in pregnant mothers is associated with higher risk of intrauterine growth retardation and premature births. Very low birth weight infants are more susceptible to neurodevelopmental and chronic respiratory problems. An infant delivered at 33 weeks via caesarean section to a COVID-19 Stage 5A positive mother, weighing 1.43kg at birth. She was kept nil by mouth with parenteral nutrition (PN) support since day five of life until referred to dietitian on day 22 of life for enteral nutrition (EN) establishment. Feeding was administered intermittently via oro-gastric Ryles tube. She was kept under non-invasive ventilation (NIV) mode and had difficulty in weaning from ventilation, leading to slow feeding progress. Initially, enteral trophic feeding was administered using premature infant formula fortified with modular products. In the later stage of feeding, modular products were tapered off and the formula was concentrated. Frequency of bowel output when using fortified formula is lesser compared to when using concentrated and supplemented formula. There is no significant difference in renal profile observed in both stages of feeding. Increasing energy intake using easily digestible sources is preferable as opposed to concentrating feeds even further due to concerns about osmolality and excess administration of other solutes. Intermittent bolus feeding mode may have an effect on dependency on oxygen since intermittent feeds can decrease tidal volume, minute ventilation and dynamic compliance. Additional research is necessary to establish optimal caloric density and nutritional compositions of feedings, feeding mechanisms and its' effect on feeding tolerance.*

*Keywords: Premature Infant; Very Low Birth Weight; Infant Formula*

#### ABSTRAK

*Jangkitan COVID-19 dalam kalangan ibu hamil dikaitkan dengan risiko perencatan pertumbuhan dalam rahim dan kelahiran pramatang yang lebih tinggi. Bayi dengan berat badan yang sangat rendah lebih terdedah kepada masalah perkembangan saraf dan masalah pernafasan kronik. Seorang ibu positif COVID-19 Tahap 5A melahirkan seorang bayi pramatang pada usia 33 minggu kehamilan melalui pembedahan secara caesarean dengan berat bayi 1.43kg semasa lahir. Sokongan pemakanan parenteral (PN) dimulakan sejak hari kelima selepas kelahiran sehingga dirujuk kepada pegawai dietetik pada hari ke-22 selepas kelahiran untuk permulaan pemakanan enteral (EN). Formula bayi pramatang diberikan secara mod bolus intermittent melalui tiub pemakanan orogastrik. Bayi diberikan sokongan pernafasan tidak invasif (NIV) dan mengalami kesukaran untuk bernafas tanpa sokongan oksigen. Hal ini memperlahankan perkembangan tumbesaran dan kadar penyusuan untuk mencapai sasaran yang optimum. Formula bayi pramatang yang diperkaya dengan produk modular telah diberikan di permulaan pemakanan enteral. Namun, produk modular dihentikan secara beransur-ansur dan formula bayi telah ditumpatkan bagi mencapai sasaran kalori dan protein. Kekerapan pembuangan najis apabila menggunakan formula yang diperkaya dengan produk modular adalah lebih rendah berbanding apabila menggunakan formula yang ditumpatkan. Tiada perbezaan ketara dalam profil buah pinggang diperhatikan dalam kedua-dua peringkat penyusuan. Meningkatkan pengambilan tenaga menggunakan sumber yang mudah dihadap adalah lebih disarankan berbanding menggunakan formula yang ditumpatkan secara berlebihan kerana wujudnya kebimbangan terhadap kadar osmolaliti dan had bahan larut lain. Mod penyusuan secara bolus intermittent mungkin mempunyai kesan terhadap kebergantungan pada sokongan oksigen kerana mod penyusuan ini boleh mengurangkan jumlah udara yang bergerak masuk dan keluar dari paru-paru. Lebih banyak kajian dan penyelidikan diperlukan untuk mewujudkan garis panduan berkaitan ketumpatan kalori optimum, komposisi nutrisi penyusuan, mekanisme penyusuan dan kesannya terhadap toleransi dalam kalangan bayi pramatang.*

*Kata kunci: Bayi Pramatang; Berat Lahir Sangat Rendah, Formula Bayi*

## INTRODUCTION

COVID-19 infection in pregnant mothers is associated with higher risk of intrauterine growth retardation and premature births (Bobei et al. 2022; Smith et al. 2022). Very low birth weight (VLBW) infants born to these infected mothers are particularly vulnerable during the first few weeks of life and are susceptible to physiological and neurodevelopmental issues. Immaturity in gastrointestinal, cardiorespiratory, neuromotor functions combined with high dependency on oxygen support can result in delayed initiation of enteral feeding. This may require the need for parenteral nutrition, which can heighten the chances of developing infections, intestinal perforation, and necrotizing enterocolitis (NEC) if used for a long period of time (Yu et al. 2016; Savarino et al. 2021). Early enteral feeding in premature infants <37 weeks gestation is the preferred method of nutrient provision. The benefits of early enteral feeding in premature infants includes; prevention of villous atrophy and decreases intestinal permeability, promotes neurologic and physiologic gut maturity, favorably influences intestinal microbiome, reduce risk of developing systemic inflammation, usage of gastrointestinal tract is physiologic to the intrauterine environment, and enhances micronutrient provision (Shanahan et al. 2018; Dahlgren et al. 2019). Breastmilk (BM) is the preferred choice of nutrition for infants during the critical period of growth and initial months of life. In situations where BM is not readily available, usage of formula milk (FM) is justified (World Health Organization 2020; Grummer-Strawn et al. 2017). However, there are limited guidelines on the efficiency and safety of energy dense formula milk (>1.0kcal/ml) in premature infants (Baldassarre et al. 2022). Enteral feeding, irrespective of the delivery methods; either continuous or intermittent mode, may lead to stomach swelling and challenges with breathing, leading to changes in airflow and gas exchange. The optimal approach for initiating tube feeding in very low birth weight infants is still a topic of debate (Blondheim et al. 1993; Sadrudin Premji, Chessell, and Stewart 2021).

A 33-weeks old premature female infant weighing 1.43kg at birth was delivered via caesarean section to a COVID-19 Stage 5A positive mother. She was tested negative for COVID-19 infection but requires non-invasive ventilation (NIV) due to respiratory distress complicated with left pneumothorax. She was kept nil by mouth and parenteral nutrition (PN) was administered at day five until day 22 of life at a calorie infusion rate of 41kcal/kg/day to 83kcal/kg/day. Enteral nutrition (EN) was initiated on day 22 of life using premature infant formula, administered intermittently on bolus mode via oro-gastric (OG) Ryles tube feeding. PN was tapered off at day 25 of life. Calorie

administered via OG tube feeding was increased gradually from 66.5kcal/kg/day to 228kcal/kg/day and protein 1.3g/kg/day to 6.5g/kg/day by over the course of 43 days.

Premature infant formula was fortified with modular products; medium chain triglyceride (MCT) oil and glucose polymers in the early stage of feeding and subsequently tapered off due to patient condition. In the later stage of feeding, infant formula was concentrated and supplemented with MCT oil to ensure calorie and protein adequacy. When using preterm formula fortified with nonprotein supplementation, mean of bowel output frequency is three times a day compared to when using overconcentrated and supplemented preterm formula with average four times per day. Also, there is no significant difference in renal profile observed during both stages of feeding. Patient had several episodes of difficulties weaning from oxygen support throughout admission in neonatal intensive care unit (NICU) but was able to wean off oxygen at day 60 of life and discharged at day 65, weighing 2.07kg. The average weight increment throughout admission was 14.9g/kg/day.

## DISCUSSION

Enteral feeding aims to facilitate the postnatal intestinal adaptation and to provide optimal nutrition for growth while eliminating the need for parenteral nutrition. Literature suggests that providing human milk fortified with appropriate nutrients or premature infant formula when human milk is not readily available is the standard care for VLBW premature infants (Nancy Wight et al. 2008; Cooke and Embleton 2000). Studies found that infants fed on human milk only gain less weight than those fed on fortified human milk or preterm infant formula (Kumar et al. 2017; Pillai et al. 2018). These discoveries are not unexpected due to lower calorie and protein contents in human milk. Premature infant formula contains all essential nutrients but fortification might be needed to meet the high requirement of VLBW premature infant.

Osmolality is a key factor to consider when fortifying preterm infant formula as it is frequently believed to be associated with negative effects on digestive system of preterm babies such as delayed gastric emptying, osmotic diarrhoea and greater risk of necrotising enterocolitis (NEC) (Kumar et al. 2017; Steele et al. 2013; Pillai et al. 2018). The 1976 guidelines from American Academy of Paediatrics recommended that the safe limit of osmolality for preterm infants should not be greater than 400 mOsm/kg (approximately 450mOsm/kg). The osmolality (mOsm/kg) of preterm formula fortified with nonprotein energy supplementation such as glucose polymers and medium-chain triglyceride is found not exceeding the safe limit (Pereira-da-Silva et al. 2008). Over-concentrated and

supplemented infant feeds with hyperosmolality exceeded 400 mOsm/kg might be relevant in cases of feeding intolerance (Steele et al. 2013; Ramirez, Wong, and Shulman 2006). This case report is supported by previous studies result whereby fortified formula milk with easily digestible sources is more preferable as opposed to concentrating feeds even further due to concerns about osmolality and excess administration of other solutes (Pereira-da-Silva et al. 2008).

There is limited evidence on the influence of mode of enteral feeding with oxygen dependency in very low birth weight infants but one study compared the effects of intermittent and continuous feedings on pulmonary function and the results demonstrated that intermittent feeding of very low birth weight infants can lead to airflow and respiratory instability (Blondheim et al. 1993). Brune and Donn (2018) mentioned that continuous feeding may improve weight gain and lead to earlier discharge in infants weighing less than 1250 g. Another study found that the impact on splanchnic oxygenation in healthy preterm infants differs between bolus and continuous feeding modes and suggested additional research is necessary to explore potential underlying mechanisms and assess potential impacts on feeding tolerance (Corvaglia et al. 2014)

## CONCLUSION

Fortification of premature infant formula with non-protein supplementation such as glucose polymers and medium-chain triglycerides is safe as long as does not exceed the safe limit of osmolality recommended. Overconcentrating preterm formula is not recommended as compared to fortification of premature infant formula with nonprotein supplementation in view of higher risk of exceeding the safe limit of osmolality and other solutes. Enteral feeding administered should administered early to prevent gastrointestinal issues and to achieve the recommended calorie and protein intake for preterm infants, ensuring optimal growth. A slower pace of feeding (continuous mode) may be more advantageous for infants prone to respiratory instability.

This case has several limitations, including the lack of communication between multi-disciplinary healthcare providers in conveying management and plans, some missing documentation on bowel pattern and feeding tolerance, as well as delay in referring to dietitian for feeding initiation. The lacking of guidelines on the safe limit of osmolality in premature infant warrants for future studies to establish the optimal caloric density and nutritional values of the feeding, enabling more comprehensive comparisons of the outcomes. It is also necessary for future lines of research to involve new randomized clinical trials with larger sample size and

extended follow-up durations to evaluate the impact of neonatal feeding modes in the long term.

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## CONFLICT OF INTEREST

The author declares no conflict of interest arising from the findings for the reported case and its management.

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