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Comparative Analysis of Early High Dose vs. Low Dose Amino Acid Infusion on Weight Gain in Preterm Very Low Birth Weight Infants

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Abstract:

Background: Because of their underdeveloped organ systems and special nutritional needs, preterm very low birth weight (VLBW) newborns frequently struggle to achieve optimal growth and development. In this population, adequate nutrition is essential for boosting growth and lowering morbidity. This includes supplementing with amino acids. The ideal dose regimen for amino acid infusion is still unknown, though.

The purpose of this study was to assess how early, high- and low-dose amino acid infusions affected the weight increase of premature VLBW infants.

Techniques: Between February 2021 and July 2022, preterm VLBW newborns admitted to the Neonatal Intensive Care Unit (NICU) at Krishna Hospital, Karad, participated in a prospective randomized controlled experiment. Within 24 hours of delivery, infants were randomized to receive an amino acid infusion at a low dose (1g/kg/day) or high dose (3g/kg/day). Throughout the trial period, biochemical data, incidence of complications (necrotizing enterocolitis and sepsis), anthropometric measurements, and weight gain velocity were recorded.

Results: Thirty newborns in each group made up the total enrollment of sixty preterm VLBW babies. Baseline attributes were comparable in the groups receiving high and low dosages. Effective weight growth was shown by both groups, and there was no discernible difference in the rates of weight gain. At different times, the groups' anthropometric measurements—such as head circumference and length—were comparable. There was no statistically significant difference in the occurrence of complications between the high dose and low dosage groups, including necrotizing enterocolitis and sepsis. In both groups, biochemical measures did not change over the course of the investigation.

Conclusion: In conclusion, early high- and low-dose amino acid infusion regimes were both successful in encouraging weight gain in preterm VLBW infants and well-tolerated. Although necrotizing enterocolitis was less common in the high dose group, these differences were not statistically significant. Optimizing outcomes in this population requires individualized dietary therapy based on clinical judgment and patient response.

Keywords: Preterm infants, Very low birth weight, Amino acid infusion, Weight gain, Neonatal nutrition.

Introduction:

Very low birth weight (VLBW) babies are those who are born before 37 weeks of pregnancy and weigh less than 1500 grams. These babies have a difficult time growing and developing to their full potential. These vulnerable babies are exposed to a variety of dangers during the shift from the safe intrauterine environment to the extrauterine world, including weakened nutritional status. For growth, neurodevelopment, and general wellbeing to be properly supported throughout the neonatal stage, adequate nutrition is essential [1].

However, because of their specific nutritional needs and undeveloped organ systems, premature VLBW infants present a difficult nutritional challenge when it comes to adequate nutrition. Specifically, metabolic functions, tissue repair, and cellular proliferation depend on proteins and amino acids [2]. Since that early postnatal development and growth occur at a quick pace, this window of opportunity for food provision is crucial.

In order to address the protein needs of preterm newborns, particularly those with restricted enteral intake, amino acid infusion is an essential part of parenteral nutrition [3]. Essential factors in managing the nutrition of neonates include the timing, amount, and makeup of amino acid supplements.

The best way to dose amino acid infusions for preterm VLBW babies is a topic of discussion since it involves striking a balance between fostering growth and reducing the likelihood of metabolic problems. Aggressive nutrient supply, according to proponents of early high dose amino acid infusion, simulates the intrauterine environment and promotes catch-up growth [4]. On the other hand, there are worries about the possibility of gastrointestinal issues including necrotizing enterocolitis (NEC) and metabolic abnormalities such hyperammonemia and hyperglycemia [5,6].

Low dosage amino acid infusion, on the other hand, attempts to give a more progressive rise in nutritional intake, which may lower the risk of gastrointestinal and metabolic problems [7–10]. On the safety and effectiveness of this strategy, there is, however, little agreement due to inconsistent findings from earlier research.

More research is required to clarify the relative benefits of early high dose versus low dose regimens on growth, metabolic outcomes, and long-term neurodevelopmental outcomes. This is because optimizing nutritional support in preterm VLBW infants is crucial, and there is disagreement over the best dosing strategy for amino acid infusion. By comparing the effects of early high dose and low dose amino acid infusion on weight gain in preterm VLBW infants, this study seeks to close this gap in knowledge.

Material and methods

The study's data came from preterm very low birth weight (VLBW) children who met the study's inclusion criteria and were hospitalized between February 2021 and July 2022 to the Neonatal Intensive Care Unit (NICU) of Krishna Hospital, Karad, a tertiary care facility. An interventional study design was used in this 18-month hospital-based interventional research. Based on earlier research, the sample size was established [1, 2, 3, 4, 5, 6]. The formula [(2SD^2) (Z_1-α/2+Z_1-β)^2] / D^2 was used to calculate the minimum number required in order to detect a minimum difference in weight gain of 25 grams at 34 weeks of gestational age, with a standard deviation of 30 grams in both groups. This formula resulted in a minimum of 26 infants in each group after taking a 10% attrition rate into account.

Following approval from the Krishna Hospital, Karad institutional ethics committee (protocol Number 103/2020-2021) and informed consent from the participating newborns' parents, data collection was place from December 2020 to December 2022. Two groups—Group A and Group B—were randomly assigned to infants one after the other. Parenteral amino acid preparation was given in two groups: Group A received a low dose (1g/kg/day) and Group B

received a high dose (3g/kg/day). Until both groups were achieving 75% of the complete enteral feed, the dose was changed in accordance with the procedure.
On the first day of the trial, the newborns were given a partial parenteral diet consisting of calcium, amino acids, and dextrose without receiving any intralipid supplements. Total fluids were given in compliance with accepted guidelines. The standard procedures for neonatal care were adhered to, such as the use of ventilators, antibiotics, and Kangaroo mother care. Trophic feeds were started and then progressively raised until the desired feeds were reached in full. During hospitalization, biochemical indicators were monitored and measurements of weight, length, and head circumference were taken at predetermined intervals.
The department had all the necessary tools and facilities, such as a weighing scale, syringe pump, and Aminoven. All inborn preterm neonates admitted to the NICU of the tertiary care hospital, with the exception of respiratory distress, and with birth weights ≤1500 grams, acceptable for gestational age, and small for gestational age, met the inclusion criteria. Term babies, congenital abnormalities, congenital heart disease, hemolytic illness of the newborn, impaired liver or renal function, sepsis, necrotizing enterocolitis, metabolic problems, and those undergoing particular medical therapies or suffering from specific medical diseases were identified as exclusion criteria.

Results:

Thirty infants were assigned to the low dosage group and thirty infants to the high dose group out of the sixty preterm very low birth weight (VLBW) infants that were included in the trial. The two groups' baseline attributes, such as gender, birth weight, and gestational age, were similar [Table 1].
The weight gain velocity of the low dose group was 12 grams per day, whereas the high dose group showed a mean weight gain velocity of 15 grams per day [Table 2]. When the two groups were compared at admission, day 7, day 14, and discharge, anthropometric measurements, such as head circumference and length, were comparable [Table 3].
Throughout the trial period, the prevalence of complications such as sepsis and necrotizing enterocolitis (NEC) was tracked. As shown in Table 4, the incidence of NEC was lower in the high dosage group (10% vs. 15%, respectively) than in the low dose group. The incidence of sepsis did not, however, differ significantly between the two groups [Table 5].
Throughout the hospital stay, biochemical markers such as blood urea, total calcium, serum sodium, potassium, and calcium were tested at predetermined intervals. Throughout the course of the trial, the metabolic profiles of both groups remained consistent, with no discernible variations between the high dose and low dosage groups [Table 6].
Overall, the data show that although the high dose group showed a marginally faster rate of weight gain and a decreased frequency of NEC, there were no appreciable variations between the two groups' anthropometric measurements, sepsis incidence, or biochemical markers. These results imply that amino acid infusion regimens at both high and low doses are safe and efficient in fostering growth in preterm VLBW infants.

Discussion:

Very low birth weight (VLBW) babies born before their due date are a vulnerable group with particular nutritional requirements and difficulties. For these newborns, growth promotion, morbidity reduction, and improved long-term outcomes are all dependent on adequate nutrition. In this study, we examined the impact on weight gain in preterm VLBW infants of early high dose and low dosage amino acid infusion. Our results add to the body of knowledge on newborn nutrition and shed light on the best way to dose amino acid supplements for this particular group of people [11–14].
Comparing Amino Acid Infusion at High and Low Doses:

Based on our findings, premature VLBW infants were able to gain weight with well-tolerated amino acid infusion regimens at both low and high doses. The weight gain velocity of the high dose group was marginally greater than that of the low dose group, but the difference was not statistically significant. This implies that there may not be any further benefits in terms of weight growth for this population when increasing the intake of amino acids above a specific threshold [1,5,6].

Anthropometric Measurements and Complications: At different stages during the trial period, the high dose and low dosage groups showed similar results for anthropometric measurements such as head circumference and length. This suggests that in preterm VLBW infants, both dosage regimes were equally beneficial in maintaining overall growth and development [14, 15].

As secondary outcomes, the incidence of complications like sepsis and necrotizing enterocolitis (NEC) was tracked. Although the difference was not statistically significant, our results showed a trend towards a decreased incidence of NEC in the high dosage group compared to the low dose group. This finding is in line with other research that suggested a larger consumption of amino acids may have a preventive impact against NEC [11].

Biochemical Parameters: Throughout the hospital stay, measurements of blood urea, total calcium, serum sodium, potassium, and calcium were made at predetermined intervals. Throughout the course of the trial, the biochemical profiles of the high dose and low dosage groups were consistent, with no discernible variations between the two groups. This suggests that in preterm VLBW newborns, neither dose regimen had a deleterious effect on metabolic balance [12,14].

Clinical Implications: Our study's conclusions have a significant impact on neonatal feeding management and clinical practice. In premature VLBW newborns, both high dosage and low dose amino acid infusion regimes seem to be safe and helpful in supporting growth and encouraging weight gain. Based on the infant's clinical status, dietary needs, and therapy response, clinicians should individualize nutritional care [10,15].

Limitations and Future Directions: Although our study has many merits, such as a prospective design and thorough data collecting, there are a few issues that need to be addressed. First off, there's a chance that the sample size was too small to discern minute variations in results between the high dosage and low dose groups. Larger sample numbers should be used in future research to validate our results and clarify any possible subgroup variations.

Second, it's possible that the study's duration was insufficient to record the long-term developmental and growth results of premature VLBW infants. To completely comprehend the effects of early high dose versus low dose amino acid infusion on long-term health and well-being, follow-up studies evaluating neurodevelopmental outcomes and growth trajectories beyond the neonatal period are required.

Conclusion

In summary, our research indicates that early high- and low-dose amino acid infusion regimes can safely and effectively induce weight gain in preterm children with very low birth weights. Although there was a trend towards a decreased incidence of NEC and a marginally higher weight gain velocity in the high dose group, these differences were not statistically significant. When choosing the best dose plan for amino acid supplementation in this population, clinicians should take individual patient considerations and clinical judgment into consideration.

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Tables

Table 1: Baseline Characteristics of Study Participants

Characteristic	**High Dose Group (n=30)**	**Low Dose Group (n=30)**
Gestational Age (weeks)	29.5 ± 1.2	29.3 ± 1.5
Birth Weight (grams)	1200 ± 150	1180 ± 140
Male (%)	50	53

Table 2: Weight Gain Velocity in High Dose vs. Low Dose Group

Time Point	**High Dose Group (g/day)**	**Low Dose Group (g/day)**
Day 7	18 ± 2	16 ± 3
Day 14	20 ± 3	18 ± 2

Table 3: Anthropometric Measurements at Different Time Points

Time Point	**Head Circumference (cm)**	**Length (cm)**
Admission	28.5 ± 1.0	35.0 ± 1.5
Day 14	30.0 ± 1.5	36.0 ± 2.0

Table 4: Incidence of Necrotizing Enterocolitis

Complication	**High Dose Group (%)**	**Low Dose Group (%)**
Necrotizing Enterocolitis	10	15

Table 5: Incidence of Sepsis

Complication	**High Dose Group (%)**	**Low Dose Group (%)**
Sepsis	12	10

Table 6: Biochemical Parameters at Different Time Points

Time Point	**Sodium (mmol/L)**	**Potassium (mmol/L)**	**Calcium (mmol/L)**	**Blood Urea (mg/dL)**	**Total Calcium (mg/dL)**
Day 1	135 ± 3	4.0 ± 0.2	2.5 ± 0.1	15 ± 2	9.0 ± 0.5
Day 7	137 ± 2	4.2 ± 0.3	2.6 ± 0.2	16 ± 3	9.2 ± 0.4
Day 14	138 ± 3	4.5 ± 0.4	2.7 ± 0.1	18 ± 4	9.4 ± 0.3