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Original Research Article

Comparative Assessment of Vital Physiological Parameters Following Various Feeding Techniques in Preterm Neonates

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Abstract:

Background: Feeding preterm neonates poses unique challenges due to their immature physiological systems. Various feeding methods such as gavage, spoon, and paladai feeding are commonly employed in neonatal intensive care units (NICUs). These methods can have varying impacts on vital parameters like pulse rate, oxygen saturation (SpO_2), and respiratory effort. This study aims to evaluate and compare these physiological responses in preterm neonates based on different feeding techniques.

Objectives: To assess and compare the changes in pulse rate, oxygen saturation, and respiratory effort in preterm newborns after feeding via gavage, spoon, and paladai methods.

Methods: A prospective observational study was conducted at Neonatal Intensive Care Unit (NICU) of the Department of Paediatrics, Nalanda Medical College and Hospital, Patna, Bihar, over a period of 12 months from July 2018 to June 2019. involving 90 preterm neonates admitted to the NICU. The newborns were divided into three groups based on the feeding method used: gavage (n=30), spoon (n=30), and paladai (n=30). Pulse rate, SpO_2, and respiratory effort were recorded pre-feeding, during feeding, and post-feeding at defined intervals. Statistical analysis was performed using ANOVA and paired t-tests to assess intra-group and inter-group differences.

Results: All three feeding methods were associated with transient variations in vital parameters. Gavage feeding resulted in minimal changes, while spoon and paladai feeding showed statistically significant increases in pulse rate and respiratory effort, along with mild decreases in SpO_2 during feeding. Post-feeding, most parameters returned to baseline within 15 minutes. Gavage feeding was better tolerated in terms of physiological stability.

Conclusion: Among the feeding methods studied, gavage feeding caused the least physiological stress in preterm neonates. Spoon and paladai feeding, while more interactive, may transiently affect oxygen saturation and increase respiratory effort. Monitoring of vital signs during and after feeding is essential to ensure safety in preterm infants, and the choice of feeding method should be individualized based on the neonate's maturity and clinical condition.

Keywords: Preterm newborns, feeding methods, gavage feeding, spoon feeding, paladai feeding, oxygen saturation, pulse rate, respiratory effort, neonatal care, physiological parameters.

Introduction

Preterm birth remains a significant public health concern globally and is associated with a high risk of morbidity and mortality during the neonatal period. Feeding preterm newborns is one of the most critical aspects of neonatal care due to their underdeveloped neurological and gastrointestinal systems. The coordination required for effective suck-swallow-breathe actions is often immature in preterm infants, making direct breastfeeding or oral feeding a challenging task. As a result, alternative methods such as gavage (tube) feeding, spoon feeding, and paladai (a traditional Indian feeding utensil) feeding are widely used to ensure adequate nutrition and growth in neonatal intensive care units (NICUs) [1,2] .

Each of these feeding techniques has distinct advantages and potential physiological implications. Gavage feeding, although non-physiological, bypasses the need for oral coordination and is often used in very low birth weight or critically ill neonates [3]. Spoon and paladai feeding, on the other hand, allow for gradual transition toward breastfeeding but may pose a risk of aspiration or increased stress due to the active involvement of the baby in feeding. It is, therefore, essential to evaluate how these feeding modalities influence vital

physiological parameters such as pulse rate, oxygen saturation (SpO_2), and respiratory effort in preterm infants [4].

The autonomic nervous system of a preterm infant is immature, and subtle fluctuations in feeding-associated stimuli can cause significant changes in cardiovascular and respiratory parameters. Monitoring these vital signs offers a reliable, non-invasive method to assess the infant's tolerance and adaptation to different feeding methods. Ensuring physiological stability during feeding not only helps in avoiding immediate complications such as hypoxia and bradycardia but also facilitates smoother progression to full oral feeding and better long-term outcomes [5,6].

Despite the widespread use of different feeding practices in NICUs, there is limited literature from resource-limited settings like India that systematically compares the physiological responses of preterm infants to these methods. Understanding these variations is crucial for selecting the most appropriate feeding strategy tailored to the maturity and clinical status of the neonate.

This study aims to compare the changes in pulse rate, oxygen saturation, and respiratory effort following feeding via gavage, spoon, and paladai methods in preterm newborns. The findings are expected to provide evidence-based insights to aid neonatologists and nursing staff in optimizing feeding protocols and ensuring safe nutritional support for vulnerable preterm infants.

Methods

This prospective observational study was conducted in the Neonatal Intensive Care Unit (NICU) of the Department of Paediatrics, Nalanda Medical College and Hospital, Patna, Bihar, over a period of 12 months from July 2018 to June 2019. The study included 90 preterm neonates with gestational age between 30 and 36 weeks who were hemodynamically stable, clinically appropriate for oral or gavage feeding, and not requiring ventilatory support.

The neonates were randomly allocated into three equal groups based on the feeding method to be administered: Group A (gavage feeding, n=30), Group B (spoon feeding, n=30), and Group C (paladai feeding, n=30). Written informed consent was obtained from the parents or legal guardians of all enrolled neonates.

Vital physiological parameters including pulse rate (beats per minute), oxygen saturation (SpO_2, measured by pulse oximeter), and respiratory effort (assessed clinically by observing chest movements and intercostal retractions) were recorded at three distinct time intervals: 5 minutes before feeding, during feeding, and 15 minutes post feeding. The same observer recorded all parameters to maintain consistency and reduce observer bias.

Standard feeding protocols were followed. The quantity and frequency of feed were determined as per the neonate's weight and age, based on institutional guidelines. For gavage feeding, a nasogastric tube was used; spoon and paladai feeding were carried out with the neonate held in a semi-upright position by trained staff.

Data collected were entered into Microsoft Excel and analyzed using SPSS software version 22. Descriptive statistics were used to calculate means and standard deviations. ANOVA was employed to compare the parameters between the three groups, and paired t-tests were used for within-group comparisons. A p-value of less than 0.05 was considered statistically significant.

Neonates with congenital anomalies, sepsis, respiratory distress syndrome requiring oxygen or ventilatory support, or major neurological impairment were excluded from the study.

Results

A total of 90 preterm neonates were enrolled and categorized into three groups: gavage (n=30), spoon (n=30), and paladai (n=30). Overall, gavage feeding showed the least disturbance in physiological parameters during and after feeding. Spoon and paladai feeding methods showed transient elevation in pulse rate and mild desaturation during feeding but returned to baseline levels post-feeding.

Table 1: Mean Pulse Rate (bpm) Before, During, and After Feeding

Time Interval	Gavage (n=30)	Spoon (n=30)	Paladai (n=30)
Before Feeding	136.2 ± 7.8	135.6 ± 6.9	137.4 ± 8.2
During Feeding	138.5 ± 8.4	145.3 ± 9.2	149.6 ± 10.1
After Feeding	136.1 ± 7.5	138.4 ± 7.8	139.3 ± 8.4

Table 2: Mean Oxygen Saturation (%) Before, During, and After Feeding

Time Interval	Gavage (n=30)	Spoon (n=30)	Paladai (n=30)
Before Feeding	96.4 ± 1.7	96.1 ± 1.9	96.3 ± 2.1
During Feeding	95.7 ± 1.8	93.6 ± 2.4	92.9 ± 2.7
After Feeding	96.5 ± 1.5	95.3 ± 2.0	95.0 ± 2.2

Table 3: Distribution of Respiratory Effort Score During Feeding

Score Description	Gavage	Spoon	Paladai
0 (Normal)	29	21	18
1 (Mild Effort)	1	6	7
2 (Moderate Effort)	0	3	5
3 (Severe Effort)	0	0	0

Table 4: Number of Desaturation Episodes During Feeding

Feeding Method	Episodes of Desaturation	Percentage (%)
Gavage	1	3.3%
Spoon	5	16.7%
Paladai	6	20.0%

Table 5: Mean Duration of Feeding Session (in minutes)

Feeding Method	Mean Duration ± SD	Range (min)
Gavage	6.3 ± 1.2	5–8
Spoon	8.2 ± 1.6	6–11
Paladai	9.1 ± 1.9	7–12

Table 6: Average Pulse Rate Rise During Feeding from Baseline

Feeding Method	Mean Increase (bpm)
Gavage	2.3 ± 1.0
Spoon	9.7 ± 2.2
Paladai	12.2 ± 2.8

Table 7: Average Decrease in SpO_2 During Feeding from Baseline

Feeding Method	Mean Drop (%)
Gavage	0.7 ± 0.4
Spoon	2.5 ± 0.9
Paladai	3.4 ± 1.1

Table 8: Incidence of Regurgitation During Feeding

Feeding Method	Cases of Regurgitation	Percentage (%)
Gavage	1	3.3%
Spoon	3	10.0%
Paladai	5	16.7%

Table 9: Post-Feeding Vital Parameter Stability (15 minutes after feeding)

Parameter	Gavage	Spoon	Paladai
Pulse Rate Normalization	29	27	26
SpO_2 Normalization	30	28	27
Respiratory Effort	30	28	27

Table 10: Comparison of Birth Weight and Gestational Age Between Groups

Parameter	Gavage (n=30)	Spoon (n=30)	Paladai (n=30)
Mean Birth Weight (kg)	1.76 ± 0.21	1.74 ± 0.23	1.75 ± 0.19
Mean Gestational Age (weeks)	33.1 ± 1.4	33.2 ± 1.2	33.0 ± 1.3

Discussion

The present study aimed to evaluate the physiological effects of different feeding methods—gavage, spoon, and paladai—on pulse rate, oxygen saturation (SpO_2), and respiratory effort in preterm neonates. Understanding the impact of feeding methods is crucial, especially in premature infants who are physiologically fragile and vulnerable to fluctuations in vital parameters.

The findings of our study reveal that gavage feeding had the least impact on the physiological parameters of preterm neonates. Pulse rate changes were minimal, oxygen saturation remained relatively stable, and respiratory effort was largely unaffected during gavage feeding. This reinforces the fact that gavage feeding is the gentlest method among the three, likely because it does not require the infant's active participation in sucking or swallowing.

In contrast, spoon and paladai feeding led to a transient increase in pulse rate during feeding. The rise was more pronounced in the paladai group, where the infants had to exert more effort to coordinate sucking, swallowing, and breathing. The increased respiratory effort and pulse rate observed suggest that oral feeding methods place a higher

physiological demand on the neonate, which may not be ideal for very immature or low birth weight infants [7,8].

The oxygen saturation data clearly supported this, showing a significant drop during feeding in the paladai group compared to spoon and gavage groups. While the SpO_2 returned to baseline after feeding in most cases, the transient hypoxia observed could potentially have cumulative effects if frequent feedings are done in a short span of time [9,10].

Moreover, the incidence of desaturation and regurgitation events was highest in the paladai group, further emphasizing its taxing effect on neonatal physiology. Spoon feeding, while slightly better than paladai, still showed more significant variations than gavage [11].

These findings are supported by previous studies. Malhotra et al. (2016) and Singh et al. (2017) reported similar patterns where gavage-fed neonates had more stable physiological responses, while oral methods induced temporary but measurable stress on cardiorespiratory parameters. Additionally, the feeding duration was longer in spoon and paladai groups, increasing the overall energy expenditure and handling time, which may contribute to neonatal fatigue [12,13].

However, it is also essential to consider the advantages of oral feeding methods. They promote oro-motor development, prepare the infant for breastfeeding, and have been linked to earlier transition to full oral feeds. Therefore, while gavage may be physiologically less demanding, spoon or paladai feeding might still be beneficial when used judiciously in more mature preterm neonates.

Our findings suggest that gavage feeding should remain the preferred method in neonates who are physiologically unstable or very premature, while spoon or paladai feeding can be introduced gradually as the infant matures and exhibits readiness for oral feeds.

Conclusion

This study demonstrated that among the three feeding methods evaluated—gavage, spoon, and paladai—gavage feeding had the least impact on the physiological parameters of preterm neonates. It caused minimal fluctuations in pulse rate, maintained stable oxygen saturation, and showed negligible respiratory effort, indicating it is the safest method in terms of physiological stability.

Spoon and paladai feeding, although beneficial for developing oral motor skills, were associated with transient tachycardia, desaturation, and increased respiratory effort, particularly in the paladai group. These findings highlight the need for cautious use of oral feeding methods in early preterm neonates and reinforce the importance of individualized feeding strategies based on gestational maturity and physiological tolerance.

In clinical settings, it is advisable to use gavage feeding in early preterms or those with respiratory compromise, while gradually transitioning to spoon or paladai as the infant matures. Continuous monitoring of vital signs during feeding is essential to ensure safety and guide appropriate feeding practices. Further longitudinal studies are recommended to assess the long-term impact of feeding methods on neonatal outcomes.

Results

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