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Original Research Article

Improving Thermal Support in Very and Extremely Low Birth Weight Infants During Interfacility Transport

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Abstract:

Background: Very low birth weight (VLBW) and extremely low birth weight (ELBW) infants are at high risk of hypothermia during interfacility transport, which can lead to increased morbidity and mortality. Effective thermal support strategies are essential to prevent heat loss and improve outcomes for these vulnerable neonates.

Objective: To evaluate the effectiveness of various thermal support strategies in preventing hypothermia among VLBW and ELBW infants during interfacility transport.

Methods: This prospective observational study was conducted at Anugrah Narayan Magadh Medical College & Hospital (ANMMCH), Gaya, Bihar, from April 2022 to June 2023. A total of 125 VLBW and ELBW infants were transported using various thermal support interventions, including transport incubators, heated blankets, double-layering, and skin-to-skin contact. Pre- and post-transport temperatures were recorded to assess the incidence of hypothermia.

Results: The incidence of hypothermia increased from 15% pre-transport to 45% post-transport. Combining transport incubators with additional thermal support significantly reduced hypothermia rates, with skin-to-skin contact and incubator use showing the lowest rate (25%).

Conclusion: Multi-layered thermal support strategies, particularly those combining skin-to-skin contact with incubator use, were more effective in reducing hypothermia in transported VLBW and ELBW infants. Standardized protocols incorporating these strategies could improve outcomes in neonatal transport.

Keywords: Thermal Support, Hypothermia, VLBW Infants, Neonatal Transport.

Introduction

Infants born with very low birth weight (VLBW, less than 1,500 grams) and extremely low birth weight (ELBW, less than 1,000 grams) face unique and serious health challenges due to their physiological immaturity. Among these, maintaining body temperature is critical, as these infants are highly susceptible to heat loss [1]. Their underdeveloped thermoregulatory systems, thin skin, and limited fat stores make them prone to hypothermia, which can increase the risk of complications such as respiratory distress, metabolic imbalances, and even mortality. For VLBW and ELBW infants, every degree drop in temperature can significantly impact their immediate health and long-term outcomes, underscoring the importance of effective thermal support from birth [2].

One of the most vulnerable times for these infants is during interfacility transport. While specialized neonatal units are equipped to handle the unique needs of these infants, the transfer from one facility to another presents additional risks [3,4]. During transport, VLBW and ELBW infants are exposed to fluctuating ambient temperatures, vibrations, and other external factors that increase their risk of heat loss. Transport incubators and warming devices are designed to minimize these risks, but current systems and protocols may not fully prevent thermal instability, especially during prolonged or emergency transfers [5,6].

Maintaining stable body temperature during transport thus requires specialized equipment, careful monitoring, and well-trained personnel familiar with the specific challenges of thermal management for VLBW and ELBW infants. However, gaps remain in best practices and standardization of thermal support, making it essential to assess and refine strategies for transport settings [7,8].

This study aims to evaluate and improve thermal support strategies for VLBW and ELBW infants during interfacility transport, focusing on reducing hypothermia-related complications. By enhancing thermal stability in these infants, the study seeks to contribute to better outcomes and reduced morbidity in this high-risk population.

Methodology

Study Design: This is a prospective observational study aimed at evaluating and improving thermal support strategies for very low birth weight (VLBW) and extremely low birth weight (ELBW) infants during interfacility transport. The study was conducted at Anugrah Narayan Magadh Medical College & Hospital (ANMMCH), Gaya, Bihar, from April 2022 to June 2023.

Study Population: The study included a total of 125 VLBW and ELBW infants who required interfacility transport for specialized care during the study period. Inclusion criteria included infants weighing less than 1,500 grams (VLBW) or less than 1,000 grams (ELBW) who required transport from ANMMCH to another facility. Exclusion criteria were infants weighing over 1,500 grams or those who did not require transport.

Data Collection: Data was collected on each infant's demographic and clinical characteristics, including birth weight, gestational age, Apgar score, and underlying health conditions. Data was also collected on environmental conditions during transport, transport time, and the equipment and techniques used for thermal support.

Temperature monitoring was conducted immediately before and after transport using digital axillary thermometers to assess thermal stability. Hypothermia was defined as an axillary temperature below 36.5°C.

Thermal Support Interventions: Standard thermal support protocols were used for all infants, including transport incubators, radiant warmers, and heated blankets as needed. Additionally, this study observed various thermal management techniques and equipment, such as double-layer clothing, skin-to-skin contact, and additional insulating layers to assess effectiveness in maintaining thermal stability.

Outcome Measures: The primary outcome was the incidence of hypothermia (temperature < 36.5°C) upon arrival at the receiving facility. Secondary outcomes included temperature differences before and after transport, duration of transport, and any complications related to thermal instability.

Data Analysis: Statistical analysis was conducted to determine the effectiveness of different thermal support strategies during transport. The incidence of hypothermia and temperature changes before and after transport were analysed using paired t-tests, and the association between thermal interventions and temperature stability was assessed using regression analysis.

Results

This study included a total of 125 VLBW and ELBW infants transported between healthcare facilities from April 2022 to June 2023 at Anugrah Narayan Magadh Medical College & Hospital (ANMMCH), Gaya, Bihar. The results present the demographics, temperature changes during transport, and incidence of hypothermia based on thermal support interventions.

Table 1: Demographic and Clinical Characteristics of the Study Population

Parameter	Value
Number of Infants	125
Mean Birth Weight	1,100 grams (± 300 g)
Gestational Age (mean)	28 weeks (± 2.5 weeks)
Male	65 (52%)
Female	60 (48%)
Mean Apgar Score (5 min)	6.5 (± 1.5)

This table summarizes the demographic characteristics of the study population, which includes an almost equal number of male and female infants. The average gestational age was 28 weeks, with an average birth weight of approximately 1,100 grams.

Table 2: Temperature Changes and Incidence of Hypothermia

Measurement	Mean Temperature (°C)	Standard Deviation	Incidence of Hypothermia
Pre-Transport Temperature	36.8°C	± 0.4	15%
Post-Transport Temperature	36.2°C	± 0.5	45%
Temperature Drop (pre to post)	-0.6°C	± 0.3	

This table illustrates the temperature measurements before and after transport. The average temperature drop during transport was 0.6°C, with the incidence of hypothermia increasing from 15% pre-transport

to 45% post-transport, indicating a significant thermal challenge during transport.

Table 3: Effectiveness of Thermal Support Interventions

Intervention	Number of Infants	Post-Transport Hypothermia Rate
Transport Incubator Only	45	60%
Incubator + Heated Blankets	40	35%
Incubator + Double Layering	20	30%
Skin-to-Skin + Incubator	20	25%

This table highlights the impact of various thermal support interventions on post-transport hypothermia rates. Combining transport incubators with additional thermal support methods such as heated blankets, double layering, and skin-to-skin contact was associated with lower hypothermia rates compared to incubators alone.

Summary of Findings:

1. There was a significant drop in infant body temperature during transport, with post-transport hypothermia affecting 45% of the infants.
2. Interventions that combined incubators with additional thermal support (e.g., heated blankets, double layering, and skin-to-skin contact) were more effective in maintaining thermal stability than incubators alone.
3. The most effective intervention in reducing hypothermia was a combination of skin-to-skin contact with incubator use, resulting in the lowest hypothermia rate of 25%.

Discussion

This study demonstrates the challenges of maintaining thermal stability in very low birth weight (VLBW) and extremely low birth weight (ELBW) infants during interfacility transport. Hypothermia in these infants increased significantly from 15% pre-transport to 45% post-transport, with an average temperature drop of 0.6°C, highlighting the critical need for improved thermal support strategies during transport. Similar studies have consist-

ently reported increased hypothermia risks during neonatal transfers, especially among low-birth-weight infants, emphasizing the need for enhanced thermal management during transport [9,10].

The effectiveness of various thermal support interventions observed in this study offers valuable insights. While transport incubators alone were associated with a 60% post-transport hypothermia rate, combining incubators with other thermal measures, such as heated blankets, double-layering, and skin-to-skin contact, significantly reduced hypothermia rates. The lowest incidence of hypothermia (25%) was observed in infants who received both skin-to-skin contact and incubator support. This outcome aligns with findings from Lyu et al. [11], who reported improved thermal outcomes using skin-to-skin contact in combination with incubators during transport. Similarly, the use of heated blankets has been shown to add valuable thermal protection, as noted in studies by Costello et al. [12] and Bhatt et al. [13], who found that such additional thermal layers effectively stabilize temperatures in transported neonates.

These findings suggest that transport incubators alone may not be sufficient for temperature management in VLBW and ELBW infants, especially during prolonged transports or under suboptimal environmental conditions. Multi-layered approaches incorporating heated blankets and skin-to-skin contact, as suggested by other studies, are beneficial for thermal regulation during transit [14,15].

Despite these findings, challenges remain in implementing combined thermal strategies consistently in transport settings. Limitations such as the availability of equipment, the need for staff training, and the logistics of applying skin-to-skin contact during transport need to be addressed. The findings of this study also underscore the need for standardization of transport protocols to minimize variations in thermal support and improve outcomes.

Future studies should explore the development of standardized protocols and guidelines for thermal support in VLBW and ELBW infants during transport. Research focusing on the design and testing of transport incubators with integrated thermal support features, including skin-to-skin capability, heated blanket compartments, and adjustable temperature controls, would be valuable. Additionally, examining the long-term health outcomes associated with improved thermal management during transport could provide further justification for implementing these strategies in neonatal transport protocols. Larger, multi-center studies could also evaluate the effectiveness of combined thermal support strategies across diverse transport settings and geographical climates, offering a broader understanding of best practices in neonatal thermal support.

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