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2025 Volume 10, Issue 4
Advances in Precision Medicine
ISSN: 2424-9106 (Online)
ISSN: 2424-8592 (Print)

The Impact of the "Golden Hour" Management Protocol on Clinical Outcomes in Preterm Infants: A Research Analysis

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Abstract: *Objective:* To explore the effectiveness of the "Golden Hour" management protocol in improving clinical outcomes for preterm infants and to provide clinical references for their treatment. *Methods:* Forty preterm infants delivered in the obstetrics department of Yiyang Central Hospital from January 2023 to January 2024 and managed under the "Golden Hour" protocol were selected as the observation group. Another forty preterm infants born from January 2022 to December 2022 without the "Golden Hour" management were chosen as the control group. The incidence of early complications, length of hospital stays, medical expenses, and long-term prognosis indicators were compared between the two groups. *Results:* The observation group showed significantly lower incidences of intracranial hemorrhage (5.00%), chronic lung disease (7.50%), and retinopathy of prematurity (2.50%) compared to the control group (20.00%, 22.50%, and 15.00%, respectively), with statistically significant differences ($p < 0.05$). The observation group also had a significantly shorter hospital stay (28.56 ± 5.32 days) and lower medical expenses (32,500 ± 8,600 yuan) compared to the control group (35.12 ± 6.45 days and 41,800 ± 10,200 yuan, respectively), with statistically significant differences ($p < 0.05$). Additionally, the observation group had a significantly higher pass rate in neonatal neurobehavioral assessment (90.00%) compared to the control group (70.00%), with a statistically significant difference ($p < 0.05$). *Conclusion:* The "Golden Hour" management protocol can effectively reduce the incidence of early complications in preterm infants, shorten hospital stays, decrease medical expenses, and improve long-term prognosis, making it worthy of clinical promotion and application.
Keywords: Golden hour management; Preterm infants; Clinical outcomes; Complications; Prognosis

Online publication: December 20, 2025

1. Introduction

With the comprehensive relaxation of the national fertility policy and the widespread adoption of assisted reproductive technologies, the birth rate of preterm infants has shown an upward trend year by year. Every year in China, approximately 2 million premature infants are born. In the neonatal intensive care units (NICUs) of tertiary hospitals, premature infants account for as high as 70–80% of admissions. The birth rate of premature infants at Yiyang Central Hospital has also reached 20%, and in recent years, the admission rate of premature infants in the neonatal department has risen to over 60%, with the youngest gestational age of admitted premature infants being only 26 weeks and the lowest birth weight being only 700 grams [1]. Due to the immature development of various organ systems, premature infants are prone to a variety of complications, such as intracranial hemorrhage, chronic lung disease (CLD), retinopathy of prematurity, etc., which seriously affect their quality of life and long-term prognosis, imposing a heavy burden on families and society [2]. The concept of the "Golden Hour" originated from adult trauma emergency care. In the field of neonatology, it refers to a critical intervention phase based on evidence-based medicine, where a series of precise rescue measures are taken within the first hour after the birth of a premature infant through interdisciplinary collaboration between the neonatal department and other departments, aiming to reduce early complications and improve long-term prognosis [3]. The 2007 European guidelines for the prevention and treatment of respiratory distress syndrome (RDS) first emphasized the importance of optimizing early management of premature infants. Studies have shown that standardized early management can significantly improve the survival rate of premature infants and reduce the incidence of potential adverse reactions [4]. Several maternal and child medical centers in China, such as Guangdong Women and Children Hospital and Nanjing Maternal and Child Health Care Hospital, have conducted research on early temperature stabilization and respiratory support in the delivery room for premature infants, achieving favorable clinical outcomes [5,6]. Based on this, this study took premature infants admitted to Yiyang Central Hospital as the research subjects to explore the impact of Golden Hour management on the clinical outcomes of premature infants, aiming to provide a higher-quality and more efficient intervention plan for the clinical treatment of premature infants. The findings are reported as follows.

2. Materials and methods

2.1. General information

Forty premature infants who were delivered in the obstetrics department of Yiyang Central Hospital from January 2023 to January 2024, met the inclusion criteria, and received Golden Hour management were selected as the observation group. Another forty premature infants who were delivered in the same department from January 2022 to December 2022, met the same inclusion criteria but did not receive Golden Hour management, were selected as the control group.

2.1.1. Inclusion criteria

(1) Gestational age ≤ 34 weeks;
(2) Birth weight < 1,500 grams;
(3) Absence of severe congenital malformations (such as congenital heart disease, neural tube defects, etc.);
(4) Informed consent obtained from family members, with signed informed consent forms.

2.1.2. Exclusion criteria

(1) Presence of severe genetic or metabolic disorders;
(2) Immediate death after birth;
(3) Refusal by family members to participate in this study.

2.2. Methods

2.2.1. Control group

The conventional management model for premature infants was employed, encompassing routine resuscitation after birth, thermal regulation (using incubators), respiratory support (including mechanical ventilation via intubation when necessary), circulatory support, blood glucose monitoring, and transfer to the Neonatal Intensive Care Unit (NICU), among other measures.

2.2.2. Observation group

The Golden Hour Management Model was implemented, establishing a comprehensive nursing system that encompasses "prenatal collaboration–precise postnatal intervention–seamless transfer". The specific measures are as follows:

(1) Prenatal preparation

Neonatology and obstetrics departments collaborated in advance to prepare dedicated resuscitation cots for premature infants, equipped with comprehensive emergency equipment (such as incubators, ventilators, monitors, suction devices, etc.) and ensuring that all equipment was in a ready-to-use state.

(2) Precise nursing interventions within one-hour post-birth

The temperature in the delivery room or operating room was maintained at 24–26 ℃ prior to delivery. Immediately after birth, premature infants were dried with sterile towels preheated to 38 ℃. Premature infants with a gestational age of less than 32 weeks were not dried but were instead wrapped directly in sterile cling film (specifications: 30 cm × 40 cm) covering the torso and limbs (excluding the head to avoid obstructing the mouth and nose), ensuring the cling film adhered closely to the skin without compressing the thoracic cage. Subsequently, the premature infants were placed in a preheated incubator and positioned on a bird's nest-style nursing pad, maintaining the head in a neutral position. Infrared thermometers were used to monitor body temperature, aiming to maintain it between 36.5–37.5 ℃ (for those with a birth weight < 1,000 grams, the target range was 36.8–37.2 ℃). The humidity in the incubator was maintained at 60–80% to minimize surface water loss and temperature fluctuations.

(3) Umbilical cord management

After delivery, delayed umbilical cord clamping is performed for 30–60 seconds. Once the premature infant establishes spontaneous breathing and has a stable heart rate (> 100 beats/min), the umbilical cord is clamped at a distance of 15–20 cm from the umbilical root using an umbilical clamp. Immediately after clamping, 10–20 mL of umbilical cord blood is collected using a sterile syringe (5 mL) for blood gas analysis, lactate measurement (to assess acid-base balance and oxygenation status), complete blood count (to monitor hemoglobin and platelet levels), blood glucose testing, blood culture, prenatal and postnatal care evaluations, and other examinations, thereby reducing iatrogenic blood loss. Subsequently, the umbilical root and surrounding skin are wiped with a 0.5% povidone-iodine swab and disinfected twice daily until the umbilical cord detaches, preventing umbilical infection.

(4) Respiratory support care (within 1–5 minutes after birth)

After clearing the airway, nasal continuous positive airway pressure (NCPAP) ventilation is immediately administered. Initial parameters are set as follows: pressure at 4–6 cmH_2O and an inspired oxygen concentration (FiO_2) of 21–30%. The FiO_2 is adjusted based on oxygen saturation (target range: 88–93%) to avoid hyperoxemia (> 95%), which can cause retinal damage. If the premature infant exhibits respiratory distress (respiratory rate > 60 beats/min, positive three-depression sign, grunting), the Less Invasive Surfactant Administration (LISA) technique is employed. This procedure is performed by a neonatologist, with a nurse assisting in securing the premature infant's head (elevated 15° to maintain airway patency). Pulmonary surfactant (PS) at a dose of 200 mg/kg is slowly injected into the trachea through a specialized catheter. During administration, close monitoring of respiratory and heart rate changes is essential. Suctioning should be avoided within 10 minutes after administration to prevent drug loss. If respiratory failure persists despite NCPAP support (PaO_2 < 50 mmHg, $PaCO_2$ > 60 mmHg), non-invasive high-frequency ventilation is initiated to minimize early endotracheal intubation.

(5) Circulation and internal environment care (10–30 minutes after birth)

Establish a circulatory access through umbilical arteriovenous puncture, adhering strictly to aseptic techniques during the puncture process. After successful puncture, secure the catheter (covered with a 3M transparent dressing, labeled with puncture time and catheter depth), connect to an infusion pump, and initially administer a slow infusion of 10% glucose solution (dose: 2.5–3 mL/kg) to maintain blood glucose levels between 2.8–6.1 mmol/L. Monitor blood pressure every 10 minutes (systolic blood pressure targets: ≥ 45 mmHg for those with a gestational age of 34 weeks, ≥ 40 mmHg for 32 weeks, and ≥ 35 mmHg for < 32 weeks). If blood pressure falls below the target, first administer saline for volume expansion (10 mL/kg, to be infused within 30 minutes); if ineffective, add dopamine (3–5 μg/kg/min) intravenously via a pump. Monitor blood gas analysis every 30 minutes, promptly correcting acid-base imbalances (administer 5% sodium bicarbonate when pH < 7.20) and electrolyte disturbances (e.g., administer 10% calcium gluconate for hypocalcemia).

(6) Pain and comfort care (throughout the entire process)

Premature infants are sensitive to pain; therefore, procedures should be concentrated as much as possible (e.g., blood sampling, punctures, etc., with an interval of ≥ 15 minutes between operations) to avoid repeated stimulation. Implement "bird's nest" care to simulate the intrauterine environment and reduce stress responses in premature infants. Provide non-nutritive sucking (pacifier) after each procedure, lasting 5–10 minutes each time, to promote neural development. Use the CRIES pain assessment scale (score range: 0–10) to evaluate pain levels every 15 minutes. When the score is ≥ 4, alleviate pain through non-pharmacological measures such as adjusting position and gentle stroking; if necessary, administer fentanyl (1 μg/kg) intravenously as prescribed by the doctor.

(7) Transport management

Adopt an integrated in-hospital transport model, continuously maintaining warmth, respiratory, and circulatory support during transport to ensure stable vital signs and safe transfer of premature infants to the NICU.

2.3. Observation indicators

(1) Baseline data

Include gestational age, birth weight, gender, and 1-minute Apgar score of premature infants in both groups.

(2) Incidence of early complications

The occurrence of intracranial hemorrhage, chronic lung disease, and retinopathy of prematurity in the two groups was statistically analyzed.

(3) Hospitalization-related indicators

The length of hospital stays and medical expenses for premature infants in both groups were recorded.

(4) Long-term prognosis indicators

At 40 weeks of corrected gestational age, the neurobehavioral development of premature infants was assessed using the Neonatal Behavioral Neurological Assessment (NBNA) score (out of a total of 40 points, with a score of ≥ 37 considered as passing the standard). Additionally, fundus examination and hearing screening were conducted, and the incidence of abnormalities was calculated.

2.4. Statistical methods

Data processing was performed using the SPSS 27.0 statistical software package. Continuous data were expressed as ($\bar{x}$ $\bar{x}$ ± s), and comparisons between groups were made using the independent samples *t*-test. Categorical data were expressed as [n (%)], and comparisons between groups were made using the χ^2 test. A *p*-value of less than 0.05 was considered statistically significant.

3. Results

3.1. Comparison of baseline data between the two groups of premature infants

There were no statistically significant differences in gestational age, birth weight, gender, or 1-minute Apgar score between the two groups of premature infants ($p > 0.05$), indicating comparability. See **Table 1**.

Table 1. Comparison of baseline data between the two groups of premature infants

Indicator	Observation group (n = 40)	Control group (n = 40)	t/χ^2	*p*-value
Gestational age (weeks, $\bar{x}\bar{x}$ $\bar{x} \pm s$)	31.25 ± 2.13	31.36 ± 2.08	0.234	0.815
Birth weight (g, $\bar{x}$ $\bar{x} \pm s$)	1256.38 ± 189.52	1268.75 ± 192.36	0.287	0.775
Gender (Male, n (%))	22 (55.00)	23 (57.50)	0.082	0.775
1-min Apgar score (points, $\bar{x}$ $\bar{x} \pm s$)	7.25 ± 1.03	7.18 ± 1.05	0.302	0.763

3.2. Comparison of incidence of early complications between the two groups of premature infants

The incidence of intracranial hemorrhage, chronic lung disease, and retinopathy of prematurity in the observation group was significantly lower than that in the control group, with statistically significant differences ($p < 0.05$). See **Table 2**.

Table 2. Comparison of incidence of early complications between the two groups of premature infants [n (%)]

Complication type	Observation group (n = 40)	Control group (n = 40)	χ^2	*p*-value
Intracranial hemorrhage	2 (5.00)	8 (20.00)	4.114	0.043
Chronic lung disease	3 (7.50)	9 (22.50)	4.500	0.034
Retinopathy of prematurity	1 (2.50)	6 (15.00)	3.914	0.048

3.3. Comparison of hospitalization-related indicators between the two groups of premature infants

The length of hospital stay in the observation group was significantly shorter than that in the control group, and the medical expenses were significantly lower, with statistically significant differences ($p < 0.05$). See **Table 3**.

Table 3. Comparison of hospitalization-related indicators between the two groups of premature infants ($\bar{x}$ $\bar{x} \pm s\bar{x}$)

Indicator	Observation group (n = 40)	Control group (n = 40)	*t*-value	*p*-value
Length of hospital stay (days)	28.56 ± 5.32	35.12 ± 6.45	4.872	< 0.05
Medical cost (×10,000 RMB)	3.25 ± 0.86	4.18 ± 1.02	4.436	< 0.05

3.4. Comparison of long-term prognostic indicators between two groups of preterm infants

The attainment rate of the Neonatal Behavioral Neurological Assessment (NBNA) in the observation group was significantly higher than that in the control group, while the rates of abnormal fundus screening and abnormal hearing screening were significantly lower than those in the control group, with statistically significant differences ($p < 0.05$), as shown in **Table 4**.

Table 4. Comparison of Long-Term Prognostic Indicators Between Two Groups of Preterm Infants [n (%)]

Indicator	Observation group (n = 40)	Control group (n = 40)	χ^2	*p*-value
NBNA score meets the standard (≥ 35 points)	36 (90.00)	28 (70.00)	4.800	0.028
Abnormal fundus screening	2 (5.00)	9 (22.50)	5.165	0.023
Abnormal hearing screening	1 (2.50)	7 (17.50)	4.904	0.027

4. Discussion

Due to the immature development of various organ systems, preterm infants are prone to various risks in the early postnatal period, such as temperature imbalance, respiratory dysfunction, and circulatory instability. If timely and effective interventions are not provided, they are susceptible to severe complications such as intracranial hemorrhage and chronic lung disease, which can affect their quality of life and long-term prognosis [7]. As a key model for early precise intervention in preterm infants, the "Golden Hour" management provides crucial support for the smooth transition of preterm infants from intrauterine to extrauterine life through multidisciplinary collaboration and standardized measures.

The results of this study showed that the incidence of early complications in preterm infants in the observation group, who underwent "Golden Hour" management, was significantly lower than that in the control group. The reasons for this are analyzed as follows: In terms of thermal management, wrapping the preterm infant in plastic wrap or a disposable plastic bag can effectively reduce heat loss and maintain body temperature stability. Abnormal body temperature is a significant factor contributing to metabolic disorders, increased infection risk, and the occurrence of complications in preterm infants [8]. The study by Zhang Xinrui demonstrated that maintaining normal body temperature in preterm infants in the early postnatal period can significantly reduce the incidence of infection and organ damage, which is consistent with the findings of this study [9]. In terms of respiratory support, the early application of nasal continuous positive airway pressure (NCPAP) combined with less invasive surfactant administration (LISA) for administering pulmonary surfactant (PS) in the delivery room can effectively improve pulmonary ventilation function, reduce airway injury, and lower the incidence of chronic lung disease. The study by Sun Yi et al. also confirmed that improving the quality of respiratory support in the delivery room can significantly reduce the incidence of respiratory distress syndrome and the rate of intubation in very low/extremely low birth weight infants, which aligns with the conclusions of this study [10]. In terms of circulatory support, delayed cord clamping can increase the blood volume of preterm infants, reducing the risk of anemia and hypotension. Early establishment of circulatory access through umbilical artery and vein catheterization can promptly correct circulatory abnormalities and reduce the probability of complications such as intracranial hemorrhage.

In terms of hospitalization-related indicators, the observation group had a significantly shorter hospital stay and significantly lower medical expenses compared to the control group. This is because the Golden Hour Management effectively reduced the incidence of complications in premature infants through early and precise interventions, thereby decreasing the prolonged treatment cycles and medical resource consumption caused by complications. As a result, it shortened the hospital stay, reduced medical expenses, alleviated the financial burden on families, conserved medical resources, and improved the efficiency of medical resource utilization. Additionally, the long-term prognosis indicators of the observation group were superior to those of the control group, with a higher rate of achieving the standard NBNA (Neonatal Behavioral Neurological Assessment) score and lower rates of abnormalities in fundus screening and hearing screening. This indicates that the Golden Hour Management not only improves the short-term clinical outcomes of premature infants but also has a positive impact on their long-term neurodevelopment and sensory function. This may be related to the early stabilization of vital signs and internal environment, which reduces the risks of brain injury, retinal injury, and hearing impairment.

The strength of this study lies in its case-control research design, which ensures the baseline data of premature infants in both groups are balanced and comparable through strict inclusion and exclusion criteria. Moreover, the intervention measures are specific and standardized, and the observation indicators are comprehensive, covering short-term complications, hospitalization indicators, and long-term prognosis, resulting in highly reliable findings. Additionally, this study is supported by the clinical resources of Yiyang Central Hospital, which has well-equipped facilities and a professional medical team, providing a guarantee for the smooth conduct of the research. However, this study also has certain limitations, such as a relatively small sample size and being a single-center study, which may introduce selection bias. Future studies could expand the sample size, conduct multi-center research, and perform long-term follow-up to further validate the long-term effects of the Golden Hour Management.

In conclusion, the Golden Hour Management, through interdisciplinary collaboration between the neonatal department and obstetrics department, implements standardized measures such as warmth maintenance, respiratory support, and circulatory support within the first hour after the birth of premature infants. This approach effectively reduces the incidence of early complications, shortens hospital stays, reduces medical expenses, and improves long-term prognosis, providing an effective solution for the treatment of premature infants and warranting widespread clinical application.

Disclosure statement

The author declares no conflict of interest.

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