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# Initial resuscitation and stabilization of the periviable neonate: The Golden-Hour approach

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## ABSTRACT

There is a paucity of data to support recommendations for stabilization and resuscitation of the periviable neonate in the delivery room. The importance of delivery at a tertiary center with adequate experience, resuscitation team composition, and training for a periviable birth is reviewed. Evidence for delayed cord clamping, delivery room temperature stabilization, strategies to establish functional residual capacity, and adequate ventilation as well as oxygen use in the delivery room is generally based on expert consensus, physiologic plausibility, as well as data from slightly more mature extremely low gestational-age neonates. Little is known about optimal care in the delivery room of these most fragile infants, and thus the need for research remains critical.

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The impending birth of a periviable infant is associated with immense anxiety for family members and the medical care teams for mother and baby as well. Many complex decisions regarding maternal management and counseling of the family regarding the risks and benefits of a trial of intensive care for the infant must be made, often in a relatively short time period. Collaboration based in excellent communication between the obstetrical, anesthesia, neonatology, and family support services is vital. Once a decision has been made to proceed with a trial of resuscitation and intensive care for the periviable neonate, there is much to prepare and consider for the coming first hour of life, known as the “Golden Hour.”

## 1. Golden-Hour strategies

A Golden-Hour strategy is a philosophical approach that reinforces communication and collaboration (inter- and intra-team) using evidence-based protocols and procedures that standardize as many elements as possible for delivery and initial management of a very preterm birth. Golden-Hour strategies lay out how the neonatal team will receive

notification from the obstetrical service of an impending periviable birth and stress the importance of collaborative counseling of the family. Pre-resuscitation check lists are used for briefing the care team to the equipment that they will need to prepare both in the delivery room and neonatal intensive care unit (NICU) in the form of standardized check lists. Personnel have clearly assigned roles and responsibilities, and the work flow of the carefully choreographed and timed events that will need to occur is reviewed. This promotes training and adherence to the American Academy of Pediatrics/American Heart Association Neonatal Resuscitation Program (NRP) algorithm<sup>1</sup> and provides a framework for later debriefing in which the care teams can reflect on what went well and what factors could be changed to improve care for the next patient.

## 2. Periviable neonates can be difficult to stabilize in the delivery room

Periviable neonates are notoriously fragile and have many features that increase the difficulty of stabilization

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immediately following birth. They can quickly become hypothermic due to extremely immature skin with a minimally developed epidermal barrier that allows evaporative heat loss. They have minimal fat deposition that normally occurs during the last trimester, increased body-surface area to mass ratio, and ineffective non-shivering thermogenesis all of which puts them at risk for detrimental hypothermia.<sup>2</sup> In addition, periviable neonates have poor energy stores, immature tissues that may be damaged more easily by oxygen, weak chest muscles that can limit adequate ventilation, immature nervous systems that may lead to poor respiratory drive, surfactant deficiency that can contribute to poor lung expansion and difficulties with gas exchange. Periviable neonates are at an increased risk for infection due to their underdeveloped immune systems. They have fragile capillaries within the immature brain, which can rupture, and small total blood volumes that make them more susceptible to hypovolemic effects of blood loss. Caregivers must take all these things into consideration and at the same time offer compassionate support to highly stressed parents.

Given the rarity and complexity of the situation, it is essential that whenever possible, all efforts are made to deliver a periviable neonate at a tertiary care center with equipment, training, and experience for the care of such mothers and periviable neonates. Multiple studies demonstrate improved outcomes for very low-birth-weight (VLBW) infants born in tertiary care centers versus outborn infants who are subsequently transferred.<sup>3–5</sup> Binder et al.<sup>3</sup> recently reported odd ratios and 95% Confidence intervals of 3.86 (2.21–6.76) for death/major morbidity, 2.41 (1.49–3.90) for mortality, and 3.44 (2.09–5.68) for 500–999 g infants born at non-tertiary versus tertiary maternity hospitals in a large cohort of infants in Cincinnati. Reasons for the improved outcomes in tertiary care centers could be due to better maternal antepartum care (such as steroids and antibiotics), the presence of experienced neonatal resuscitation teams in the delivery room to initiate appropriate resuscitation, and improved resources for multidisciplinary care in the NICU.

The benefits of an experienced neonatal resuscitation team to initiate appropriate resuscitation and stabilization cannot be over-emphasized. Every baby needs at least one person immediately available to focus solely on the newborn to assess the need for and offer initiation of resuscitation interventions after birth; however, a periviable birth is best served by an entire neonatal resuscitation team. Prior to birth, the team needs to prepare the delivery room by increasing the environmental temperature, making sure warming devices are available and prepared, pulse oximetry and blended oxygen are available, ventilation devices with the ability to provide continuous positive airway pressure (CPAP) and positive end expiratory pressure (PEEP) are ready in addition to appropriately sized supplies for possible intubation. In the early minutes of life, the baby will need to be gently handled, delayed cord clamping may be considered, multiple temperature stabilization techniques implemented, functional residual capacity established along with effective ventilation, oxygen levels monitored and adjusted on a minute-by-minute basis, possibly receive the surfactant (depending on the team's Golden-Hour strategy), and decisions made about the appropriateness of more intensive

cardiopulmonary resuscitation if the infant does not respond to initial ventilation. The actions taken and infant's responses need to be carefully documented in real time (either through video recording or minute-by-minute documentation of a team member). The family needs to be kept apprised of the situation and supported emotionally. Each hospital may develop a unique team that works together to accomplish these complex tasks, but as an example in an academic setting such a team might include a neonatal attending/neonatal fellow to serve as the team leader, a neonatal nurse practitioner to help with any procedures, a neonatal nurse for assessing the neonate's responses to resuscitation, a neonatal respiratory therapist to focus on effective ventilation and oxygen management, an obstetrical circulating nurse to serve as recorder, and a family support nurse to help with communication and emotional support of the family. The important thing is that each team member precisely knows their role, has frequent opportunity to practice through simulation and debriefing, consistent delivery experience, and that the team constantly reflects on their performance and how to improve (thus the need for video or careful real-time documentation of the events).

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### 3. Delivery room resuscitation of the periviable neonate

Resuscitation should be done in accordance with the recommendations of the Neonatal Resuscitation Program.<sup>1</sup> The following are some steps specific to prematurity for which there is some evidence, although in general, few periviable infants were included in the study populations.

#### *Delayed cord clamping*

The question of the optimal time to clamp the umbilical cord after delivery is controversial. There are several small RCTs that have compared early (< 20 s) to late (> 30 s) cord clamping following preterm birth as well as several prospective observational studies.<sup>6</sup> Systematic reviews of the trials suggest that for the otherwise uncomplicated preterm birth, delaying cord clamping for 30–180 s following delivery improves blood pressure and decreases IVH and the need for blood transfusions.<sup>7</sup> However, there are limited data regarding the hazards or benefits of delayed cord clamping in the non-vigorous infant, and almost no data regarding the periviable neonate. Cord milking has been suggested as more rapid method to influence placental transfusion if the medical providers feel that resuscitation efforts should not be delayed.<sup>8,9</sup> Recently, elegant preterm lamb studies at the time of birth examined the effects of early versus late cord clamping on transitional hemodynamics.<sup>10</sup> These studies demonstrate that early cord clamping leads to a rapid decrease in preload to the heart that results in bradycardia and decreased cerebral perfusion, unless there is prior establishment of increased pulmonary blood flow via sufficient inflation and ventilation of the lung. Ventilation prior to cord clamping markedly improved cardiovascular function by increasing pulmonary blood flow before the cord was clamped in the late clamping group, which further stabilized

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