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Golden Hour Management of High-Risk Newborns

Events occurring during the transition from intrauterine to extra uterine life can have a significant impact on neonatal survival and outcomes. These include hypothermia, hypoglycemia, and hyperoxia in the short-term and intraventricular hemorrhage, bronchopulmonary dysplasia (BPD), and retinopathy of prematurity (ROP) in the long term, necessitating a protocolized management strategy.

The interventions during resuscitation and the first hour of birth, called the “golden hour” period should include strategies for thermal protection, establishment of functional residual capacity of lung in the least-invasive manner, avoidance of hyperoxia by titrating oxygen administration, timely administration of surfactant, and early initiation of parenteral nutrition. These interventions can be implemented smoothly only with an interdisciplinary team work, good communication, use of checklists and team briefings and debriefings. We shall review the management strategies during the golden hour under 3 care points: prior to delivery, during delivery and immediate postnatal period.

Prior to delivery

Organizing a team: Preterm neonates especially those (<32 weeks’ gestation) are at significantly higher risk of needing resuscitation at birth and hence need a neonatal team that is available in-house for resuscitation and management at delivery. The team should compose of 3-4 members including a neonatologist or senior neonatal fellow, one or two neonatal or pediatric residents and a nurse. The roles and responsibilities of each team member should be assigned a priori and equipments should be arranged in advance.

Communication with parents: Parents confronted with the delivery of a preterm neonate experience anxiety and fear. The

goal of antenatal counseling is to provide a reliable and detailed account of neonatal mortality and morbidity to parents in order to facilitate a truly informed and collaborative decision making. Antenatal counseling is best done by a team of both neonatologists and obstetricians. Social workers should be involved in counseling when appropriate. Center specific mortality data at different preterm gestations should be provided to facilitate family/medical decisions regarding type and extent of resuscitation and in-utero referral to a tertiary care center should be advised where appropriate.

Decision making at limits of viability: Gestational age of the fetus is an important determinant of viability and influences major interventions at birth. Hence every effort should be made to confirm the exact gestational age based on both LMP (last menstrual period) and first trimester ultrasound. Other factors that improve neonatal outcome at perivable gestation includes: female sex, singleton pregnancy, not being SGA, exposure to antenatal steroids, absence of perinatal complications like chorioamnionitis and being born in a tertiary care center.¹

There are no national guidelines in India, regarding resuscitation at limits of viability but survival of neonate 25 weeks' gestation is uniformly good across developed countries^{2,3} that full resuscitation is recommended. If the gestation is between 24 weeks^{0 days} to 24 weeks^{6 days} (gray zone)⁴, resuscitation depends on shared decision making with parents.

In our center, we offer comfort care for neonates with gestation 23 weeks and individualize decision at 24 weeks gestation and routinely provide care to infants of 25 weeks gestation or higher. Although survival of neonates less than 500 grams is less, decision making should not solely rely on birth weight alone as viable neonates with intra uterine growth restriction can have birth weights less than 500 grams.

One should always remember the inaccuracies associated with gestational age and fetal weight estimations; first trimester dating ultrasound has a variation of ± 7 days and estimates of

fetal weight can vary from the actual weight by $\pm 15\%$. Thus, in many situations the clinician should continually reassess the neonate's response to resuscitative efforts. For example, if a 24 weeker neonate is severely compromised at birth, provision of brief resuscitation and ongoing assessment of the patient's response to treatment is recommended. If the neonate is vigorous at birth or responds to initial resuscitation, ongoing evaluation and parental involvement in the decision-making process should continue after admission to NICU.

Antenatal magnesium sulfate ($MgSO_4$) for neuro-protection:

Effect of $MgSO_4$ induced neuro-protection is multipronged involving intracellular processes like inhibition of calcium influx into cell, anti-inflammatory effects, vasodilatation and decreasing free radical injury.⁵ It is indicated for pregnant women ≥ 31 weeks gestation with imminent preterm birth (active labour with ≥ 4 cm of cervical dilation, with or without PPRM and planned preterm deliveries for fetal or maternal indications).⁶

The drug is administered as 4 g IV loading dose, over 30 minutes, followed by a 1 g/hr maintenance infusion until birth. Therapy should be discontinued if delivery does not occur or a maximum infusion period of 24 hours is reached. The therapy is safe for neonates without increased need for resuscitation at birth; however mothers receiving $MgSO_4$ require monitoring for adverse effects like respiratory depression.

Some of the perceived barriers to implementation of $MgSO_4$ therapy in hospitals include its complex administration process, time constraints and unpredictability of preterm labor. Units trying to implement $MgSO_4$ use should develop a hospital policy on its use including inclusion criteria, treatment regimens, and monitoring in accordance with the available trials.^{6,7}

During delivery: Resuscitation and initial stabilization of a preterm neonate during the "golden hour" should follow the Neonatal Resuscitation Program (NRP) 2015 guidelines and

requires adequate preparation and team work. Preterm neonates are at high risk of hypothermia and each degree drop in admission temperature is associated with increased odds of mortality by 28% and late-onset sepsis by 11%. Preterm neonates have surfactant deficiency, poor respiratory drive, weak and compliant chest wall, fragile capillary network in the brain and higher sensitivity to oxygen-induced free radical damage. Hence specific interventions at birth should focus on 1) delayed cord clamping 2) thermoregulation 3) gentle respiratory support and 4) avoidance of hyperoxia (Table 4.1).

Table 4.1: Delivery room management of very preterm neonates

Situation		Recommendations
Delivery room management	Anticipatory preparation	<ul style="list-style-type: none"> o Prepare resuscitation kit. Check equipments and organize a team. Call for additional help if necessary. Use pre-resuscitation checklist.
	Delayed cord clamping	<ul style="list-style-type: none"> o In uncomplicated preterm birth, delayed cord clamping should be attempted for a minimum time of 60 seconds after delivery. DCC must be done even if the mother has HIV infection.
	Thermoregulation	<ul style="list-style-type: none"> o Maintain DR temperature of at least 26°C for all deliveries <32 weeks. Switch off air conditioner in the DR o Prewarm the radiant warmer to 100% heater output for at least 10 minutes prior to delivery o Use polythene bags/ wraps for all neonates <32 weeks gestation. Do not dry the neonate. Do not remove the bag until neonate is transferred to the NICU and normal temperature is recorded o Cover the head with the plastic bag. Use of hat is recommended o Use a transport incubator to transfer neonates from DR to NICU. Prewarm the baby boundaries and the transport incubator prior to use o Measure axillary temperature within 10 minutes of NICU admission
	Respiratory management and Oxygen targeting	<ul style="list-style-type: none"> o Neonates are resuscitated as per NRP guidelines. o Spontaneously breathing preterm infants <32 weeks' gestation at high risk of RDS should be supported with CPAP of 5 cm H₂O using T-Piece as soon as respiratory distress is noted.

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		<ul style="list-style-type: none"> o Infants needing positive pressure ventilation are to be provided with PIP and PEEP using T-piece device. Initial settings on the device being 15/5. If prompt improvement in heart rate or chest movement is not obtained, then higher pressures to achieve effective ventilation may be used. o Avoid use of self-inflating bags for delivering PPV in preterm infants <32 weeks to prevent uncontrolled delivery of tidal volume o Use pulse oximeter and blended oxygen to target oxygen saturation as per NRP recommendations in all preterm neonates. Begin resuscitation with FiO₂ between 21-30% and titrate every minute to target the NRP saturation targets.
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Delayed cord clamping: NRP recommends delayed umbilical cord clamping for at least 60 seconds for preterm infants not requiring immediate resuscitation after birth.⁸ At present there are no recommendations regarding delayed cord clamping in a non-vigorous infant, where resuscitative efforts take priority.

Cord milking is an alternate method for rapidly achieving placental transfusion and involves milking 20 cm length of the umbilical cord two to three times before clamping the cord. Cord milking has shown similar benefits as delayed cord clamping⁹⁻¹⁰ but is currently not recommended outside of a clinical trial due to the small numbers of enrolled neonates.

Thermoregulation: The neonate should be covered or placed inside the plastic bag without drying and head should be covered with a hat to prevent evaporative heat loss. If a small opening is created near the position of umbilical cord, all resuscitation interventions can be performed with the neonate inside the plastic bag. The plastic wrap should be removed only after ensuring a normal axillary temperature in the NICU.

Use of exothermic heat mattress also improves temperature stabilization but caution is needed when both plastic bags and exothermic mattress are used simultaneously due to the risk of hyperthermia. Monitoring the temperature of the neonate in the delivery room and use of prewarmed transport incubator further reduce heat loss at birth.

NRP recommends that temperature of a neonate be maintained between 36.5°C and 37.5°C from birth till initial stabilization and admission temperature be recorded as predictor of outcomes as well as a quality indicator of good resuscitation.⁷

Respiratory support in the delivery room: The goal of respiratory support is to help establish functional residual capacity (FRC) in the lung to ensure adequate gas exchange. This is facilitated by assisting ventilation in the least invasive manner, and providing just the right amount of oxygen.

Devices for respiratory support in the delivery room: The T-piece device delivers peak inspiratory pressure and positive end-expiratory pressure (PEEP) more consistently as compared to a resuscitation bag¹¹ and many countries report usage rates of 45-50% in the delivery room.²¹

Advantages of the T-piece device include its ease of use and ability to deliver continuous positive airway pressure or PEEP. Its limitations are the need for a pressurized gas source to drive the device, need to repeatedly turn the pressure knob to increase the PIP and a possibility of delivering inadvertently higher levels of PEEP.

Setting up the device: While setting the device for preterm deliveries <32 weeks, we prefer flow rates of 5-8 lpm and PIP and PEEP of 15 and 5 cm H₂O respectively. The FiO₂ is set between 21 to 30%. The preferred level of delivery room CPAP is 5 cm H₂O. CPAP level of 8 cm H₂O or above is associated with a high risk of pneumothorax and should be avoided.

After completing the initial steps, a spontaneously breathing neonate with respiratory distress should be offered CPAP than intubation and positive pressure breaths.⁷ Prophylactic CPAP rather than intubation in delivery room among neonates <28 weeks' gestation has been shown to produce a small but clinically significant reduction in the incidence of BPD at 36 weeks postmenstrual age, the need for mechanical ventilation as well as surfactant.³

However, positive pressure breaths (PPV) should be delivered *if the neonate is apneic or gasping or if the heart rate is less than 100 bpm*. A trial of PPV should also be considered if oxygen saturation is below the target range despite free flow oxygen and or CPAP in a spontaneously breathing neonate with heart rate ≥ 100 bpm.

Role of sustained inflation: Sustained inflation refers to delivery of PIP for a longer duration, typically from 5 to 15 seconds with pressures varying from 20 to 30 cm H₂O for 1-3 breaths for preterm neonates exhibiting signs of respiratory distress (rescue) at birth. While studies showed short term benefits with SI like reduced need for mechanical ventilation in the first 72 hours of life, there was no effect on the incidence of major outcomes like BPD mortality.

Of note, pressure, time duration and frequency of SI breaths used differed greatly in various studies, and the interface as well (endotracheal tube, face mask, or nasopharyngeal tube). NRP does not recommend the use of SI for resuscitation except in individual clinical circumstances or research settings.⁷

Avoidance of hyperoxia: Oxygen blenders capable of delivering titrated oxygen and a pulse oximetry must be available for all high-risk deliveries. The pulse oximeter sensor should first be placed on the right hand or wrist and then subsequently connected to the monitor for acquiring the plethynography signal most rapidly. The blender should be set between 21 to 30% and subsequent oxygen administration should be based on the inter-quartile range of saturations targets as described for healthy term neonates.⁷

Initial stabilization in the NICU: Continuing care in the NICU should focus on thermoregulation, respiratory support and early initiation of nutrition. Spontaneously breathing preterm neonates with respiratory distress are most effectively treated with CPAP until criteria for surfactant therapy is met (refer to protocol on surfactant therapy).

Early (<2 hours) selective surfactant therapy that is given by “InSurE” approach (Intubation, Surfactant, Extubation) is

preferred to continued mechanical ventilation. InSurE strategy, however, still requires endotracheal intubation and a short period of PPV.

Neonates <32 weeks' gestation are administered caffeine therapy for treatment of apnea of prematurity or prior to extubation from mechanical ventilation. We initiate early caffeine therapy for neonates <28 weeks' gestation irrespective of their respiratory support (Refer to apnea protocol). Observational studies have shown that early initiation (0 to 3 days of life) of caffeine is associated with less incidence of BPD, patent ductus arteriosus and a shorter duration of mechanical ventilation.^{15,16}

Central line insertion and early nutrition: Umbilical venous cannulation is established at birth to initiate intravenous fluids or early parenteral nutrition in neonates <1000 grams (as per unit policy) with a goal of getting the lines in by 30 minutes of age. The first blood sugar is checked with line insertion along with other blood work up.

Interventions to minimize stress: At every opportunity, efforts should focus on minimizing pain and stress by providing developmentally supportive care. These include noise reduction, gentle handling, clustering of procedures, attention to skin care and early parental participation.

Implementation of quality initiatives to improve outcomes: Several institutions that have implemented a protocolized approach to management in the "golden hour" have demonstrated improved outcomes among preterm neonates like better admission temperature and blood glucose levels^{16,17}, a marked decrease in intraventricular hemorrhage and faster time for umbilical catheter insertion¹⁸ and surfactant administration.

References

1. Salihu HM, Salinas-Miranda AA, Hill L, Chandler K. Survival of pre-viable preterm infants in the United States: a systematic review and meta-analysis. *Semin Perinatol* 2013;37:389-400.

2. Stoll BJ, Hansen NI, Bell EF, et al. Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. *Pediatrics* 2010;126:443-456.
3. Fischer N, Steurer MA, Adams M, Berger TM, Swiss Neonatal N. Survival rates of extremely preterm infants (gestational age <26 weeks) in Switzerland: impact of the Swiss guidelines for the care of infants born at the limit of viability. *Arch Dis Child Fetal Neonatal Ed* 2009;94:F407-413.
4. Berger TM, Bernet V, El Alama S, et al. Perinatal care at the limit of viability between 22 and 26 completed weeks of gestation in Switzerland. 2011 revision of the Swiss recommendations. *Swiss Med Wkly* 2011;141:w13280.
5. Gathwala G. Neuronal protection with magnesium. *Indian J Pediatr* 2001;68:417-419.
6. Magee L, Sawchuck D, Synnes A, von Dad elszen P. SOGC Clinical Practice Guideline. Magnesium sulphate for fetal neuroprotection. *J Obstet Gynaecol Can* 2011;33:516-529.
7. American College of O, Gynecologists Committee on Obstetric P, Society for Maternal-Fetal M. Committee Opinion No. 455: Magnesium sulfate before anticipated preterm birth for neuroprotection. *Obstet Gynecol* 2010;115:669-671.
8. Perlman JM, Wyllie J, Kattwinkel J, et al. Part 7: Neonatal Resuscitation: 2015 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science With Treatment Recommendations. *Circulation* 2015;132 (Suppl 1): S204-41.
9. Rabe H, Jewison A, Alvarez RF, et al. Milking compared with delayed cord clamping to increase placental transfusion in preterm neonates: a randomized controlled trial. *Obstet Gynecol* 2011;117(2 Pt1):205-11.
10. Hosono S, Mugishima H, Fujita H, et al. Umbilical cord milking reduces the need for red cell transfusions and improves neonatal adaptation in infants born at less than 29 weeks' gestation: a randomised controlled trial. *Arch Dis Child Fetal Neonatal Ed* 2008;93:F14-19.
11. Katheria AC, Leone TA, Woelkers D, Garey DM, Rich W, Finer NN. The effects of umbilical cord milking on hemodynamics and neonatal outcomes in premature neonates. *J Pediatr* 2014;164:1045-1050 e1041.
12. Bennett S, Finer NN, Rich W, Vaucher Y. A comparison of three neonatal resuscitation devices. *Resuscitation* 2005;67:113-118.
13. Leone TA, Finer NN, Rich W. Delivery room respiratory management of the term and preterm infant. *Clin Perinatol*

- 2012;39):431-440.
14. Patel RM, Leong T, Carlton DP, Vyas-Read S. Early caffeine therapy and clinical outcomes in extremely preterm infants. *J Perinatol* 2013;33:134-140.
 15. Dobson NR, Patel RM, Smith PB, et al. Trends in caffeine use and association between clinical outcomes and timing of therapy in very low birth weight infants. *J Pediatr* 2014;164:992-998 e993.
 16. Lambeth TM, Rojas MA, Holmes AP, Dail RB. First Golden Hour of Life: A Quality Improvement Initiative. *Adv Neonatal Care* 2016;16:264-272.
 17. Manani M, Jegatheesan P, DeSandre G, Song D, Showalter L, Govindaswami B. Elimination of admission hypothermia in preterm very low-birth-weight infants by standardization of delivery room management. *Perm J* 2013;17:8-13.
 18. Reuter S, Messier S, Steven D. The neonatal Golden Hour—intervention to improve quality of care of the extremely low birth weight infant. *SD Med* 2014;67:397-403,405.