CE 2.5 HOURS Continuing Education

The Golden Hour

Improving the Stabilization of the Very Low Birth-Weight Infant

Val Castrodale, MSN, RN, NNP-BC; Shannon Rinehart, RNC-NIC, BSN

ABSTRACT

A term borrowed from emergency and cardiovascular medicine, the phrase "Golden Hour" refers to the first hour of an infant's life following delivery. The impact of implementation of a Golden Hour Protocol in a level III neonatal intensive care unit (NICU) for infants delivered at less than 28 weeks gestation was examined, with a focus on admission temperature, admission glucose, and time to the initiation of an intravenous glucose and amino acid administration. As part of a quality initiative project, data were collected before and after the implementation of the Golden Hour Protocol for infants born at less than 28 weeks gestational age from May 2008 through December 2011. Desired outcomes were admission axillary temperature within a range of 36.5°C to 37.4°C, admission glucose more than 50 mg/dL, and the initiation of a glucose and amino acid infusion within 1 hour of birth. Key components of the Golden Hour included the use of a protocolized script, which clearly defined the roles of the delivery room personnel, placing the infant in a polyethylene bag to prevent heat loss, the application of the isolette skin temperature probe within 10 minutes of age, and insertion of umbilical catheters before moving the infant from the resuscitation area to the NICU. Data were collected on 225 infants born less than 28 weeks gestation: 106 in the preprotocol group and 119 in the postprotocol group. Differences between the 2 groups were not statistically significant for birth weight and gestational age. There was a statistically significant difference in the number of infants with an admission temperature in-range (36.5°C–37.4°C) between the preprotocol and postprotocol infants (28.3% vs 49.6%; $P = .002$). There was a statistically significant difference in the incidence of admission glucose greater than 50 mg/dL between the pre- and postprotocol groups (55.7% vs 72%; $P = .012$). There was a highly statistically significant difference in the number of post–Golden Hour Protocol infants who received an intravenous administration of glucose and amino acids within 1 hour of life compared with the preprotocol group (61.3% vs 7%; $P = 0.001$). Our results suggest that the implementation of the Golden Hour Protocol can significantly improve the stabilization of infants delivered less than 28 weeks gestation.

Key Words: delivery room management, Golden Hour, low birth weight, prematurity

The phrase "The Golden Hour" is a term borrowed from emergency and cardiovascular medicine and refers to the first hour of an infant's life following delivery.[1] During this time period of an infant's life, there is a profound and critical transition period of adaptation that takes place. Analyses of videotaped resuscitations suggest that management during this period of transition in very low birth-weight infants may impact long-term outcomes, and that care during this time frame should be optimized.[2] A *high-risk neonate* is any neonate who, because of circumstances or conditions associated with the birth process, has an increased risk of mortality or morbidity.[3] The stabilization of these vulnerable infants is complicated even further by other special considerations such as hypothermia, poor energy stores, and surfactant deficiency. Hypothermia is common in low birth-weight infants (<2500 g) and has been associated with an increase in morbidity and mortality rates. The body temperature of the neonate may be affected by heat loss

Author Affiliations: *Department of Neonatology, St Vincent Hospital (Ms Castrodale), and Newborn Intensive Care Unit, St Vincent Women's Hospital, Indianapolis, Indiana (Mrs Rinehart).*

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Correspondence: *Val Castrodale, MSN, RN, NNP-BC, 8091 Township Line Rd, Ste 207, Indianapolis, IN 46260 (vpcastro@stvincent.org).*

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through evaporation, radiation, convection, and conduction, and measures must be instituted to counteract these effects. The preterm infant's higher surface area–to–weight ratio and their limited ability to generate heat make heat loss prevention in this population a challenge. Studies have shown that the use of hats and polyethylene wrap or food grade bags after birth can reduce the decrease in postnatal temperatures of very immature infants compared to more conventional drying methods.[4] Other efforts to limit heat loss in the delivery room during resuscitation include increasing the temperature in the delivery room and the use of skin temperature probes with radiant warmers in the servo control mode.

At birth the premature infant has very limited energy stores. In utero, the placenta provides the energy needs of the fetus through the transport of glucose, amino acids, free fatty acids, and ketones, and the majority of glycogen accretion takes place during the third trimester.[5] Following birth and the clamping of the umbilical cord, the neonatal glucose concentration decreases quickly.[6] Glucose is the main energy substrate in the neonate and the major source of glucose utilization is the neonatal brain. Extremely premature infants (<1000 g) have a primary failure to produce or store glycogen and may lack the cerebral defenses against hypoglycemia that exist in term infants.[7] In addition, early protein administration is required to prevent catabolism and to help buffer the occurrence of hyperglycemia by stimulating endogenous insulin secretion.[8]

The objective of this study was to determine whether the implementation of a Golden Hour Protocol had a significant effect on admission temperature, admission glucose, and time to an intravenous administration of glucose and amino acids. A protocolized script was created, which designated the personnel who were required to attend the delivery of a preterm infant and the tasks that needed to be performed within a time line starting before delivery through the first hour of life. Through planning and teamwork, evidence-based practices were implemented to prevent the complications of hypothermia and hypoglycemia. This study describes how a standardized approach to the resuscitation of preterm infants in the NICU immediately after birth can impact patient outcomes.

METHODS

A retrospective review of the electronic medical record was performed from May 2008 through December 2011, for inborn infants delivered at less than 28 weeks gestation in a level III, 75-bed NICU. This study was part of a quality improvement initiative targeting the admission process of preterm infants. The Golden Hour Protocol was implemented in August 2010.

Study Population

Data for inborn, preterm infants (<28 weeks gestation) were reviewed. Data were collected on admission axillary temperature, admission glucose, and the time to placement of umbilical lines and initiation of a glucose and amino acid infusion. The range for acceptable admission temperature was 36.5°C to 37.4°C and a blood glucose concentration greater than 50 mg/dL was considered an acceptable low value of euglycemic range for a premature infant.[9] The goal for intravenous access was to be achieved within 1 hour after birth.

STATISTICAL ANALYSIS

Descriptive statistics were conducted. Discrete categorical variables were compared using the Fisher exact test. Continuous variables were compared using a Student *t* test or Mann-Whitney *U* test, dependent on the parametric nature of the data. A *P* value less than .05 was considered significant, and the statistical analyses were conducted using IBM SPSS Statistics, 19.0 for Windows (SPSS, Inc, Chicago, Illinois).

RESULTS

Data for a total of 225 preterm infants were reviewed, 106 (47.1%) in the preprotocol group and

TABLE 1. Comparison of Patient Demographics and Outcomes Between Pre- and Postprotocol Infants

	Preprotocol Patients (n = 106) Median (IQR)	Postprotocol Patients (n = 119) Median (IQR)	*P*-Value
Gestational age (wks)	26.0 (3.0)	26.0 (2.0)	0.338
Birth weight (kg)	0.778 (0.300)	0.830 (0.299)	0.187
Admit temperature (C°)	36.4 (1.0)	36.6 (0.7)	0.053
Admit glucose (mg/dL)	57.0 (38.0)	62.0 (32.0)	0.027
Time difference (hr:min)	1:46 (0:40)	0:55 (0:26)	<0.001

Abbreviation: IQR, interquartile range.

119 (52.9%) in the postprotocol group. As shown in Table 1, birth weight ($P = 0.187$) and gestational age between infants in the pre- and postprotocol groups did not differ significantly.

Admission Temperature

There was a trend for the median admission temperature to be higher in the postprotocol patients (Table 1). In looking at whether or not the admission temperature was in-range, there was a statistically significant difference in the number of infants admitted with an axillary temperature in-range between the pre- and postprotocol groups (Table 2). The difference in the number of infants with an admission temperature in-range (36.5°C–37.4°C) between the preprotocol and postprotocol group was statistically significant (odds ratio [OR]: 2.5; 95% CI: 1.4–4.3).

Admission Glucose

Infants in the preprotocol group had a significantly lower median admission glucose than infants in the postprotocol group (Table 1), and there was a statistically significant difference in the incidence of having an admission glucose greater than 50 mg/dL between the pre- and postprotocol groups (Table 2). Infants in the postprotocol group were 2 times more likely to have an admission glucose greater than 50 mg/dL than infants delivered before the protocol was implemented (OR: 2.1; 95% CI: 1.2-3.6).

Infusion of Intravenous Solution

One of the goals of the Golden Hour Protocol was to ensure that an intravenous administration containing glucose and amino acids was started through umbilical catheters or a peripheral intravenous catheter (IV) within 1 hour of birth. Infants in the postprotocol group were significantly more likely to have an infusion running sooner than infants in the preprotocol group (Table 1). In addition, there was a highly significant difference in the number of postprotocol infants who had an IV administration started within 1 hour compared with the preprotocol group (Table 2). Infants in the postprotocol group were nearly 19.5 times more likely to receive an IV administration within 1 hour from birth compared with infants in the preprotocol group (OR: 19.4, 95% CI: 8.7-43.7).

DISCUSSION

Our institution became aware of the need for improvement in our delivery room management of preterm infants when a pharmacy resident project reported a significant delay in the average time that transpired from birth until umbilical catheters were placed. A Golden Hour Protocol was developed from information gained through participation in the Vermont Oxford Network's 2007 Potentially Better Practices and from referencing the toolkit from the California Perinatal Quality Care Improvement Collaborative for the management of the admission of infants delivered at less than 28 weeks gestation. A multidisciplinary committee comprising NICU registered nurses, respiratory therapists, a pharmacist, neonatal nurse practitioners, and neonatologists was formed to develop the protocolized script (Table 3). Special attention was dedicated to thermoregulation; the script included measures such as maintaining the delivery room temperature at 77°F, placing a hat and enclosing the infant in a food grade polyethylene bag, and application of the servo temperature probe from a prewarmed radiant warmer by 10 minutes of age.[10] The goal of an admission axillary temperature range between 36.5°C and 37.4°C was selected in compliance with the Association of Women's Health, Obstetric and Neonatal Nurses recommendations.[11] Because of the concern for hyperthermia, sometimes reported with the use of polyethylene bags, it was determined that monitoring a temperature range would be more prudent than just screening for hypothermia.

The Golden Hour Protocol was written considering the physical layout of the workspace and the proximity of the NICU to labor and delivery. Three operating room suites are connected to the NICU by a resuscitation "island" where high-risk infants are stabilized before being transferred to their NICU bed space. It had been the practice that after a stable airway was established, the infant would be transferred to a bed space on 1 of 2 floors where the umbilical catheters or peripheral IVs would then be placed. The Golden Hour Protocol mandated that an IV administration be started before the infant was transferred to the NICU and delineated roles for admission personnel to help accomplish that task. Because the practice of oxygen saturation targeting, the use of bubble continuous

TABLE 2. Comparison of Admission Temperatures, Glucose, and Intravenous Access Between Pre- and Postprotocol Patients

	Preprotocol Patients (n = 106)	Postprotocol Patients (n = 119)	
	N (%)	*N (%)*	*P*-Value
Admit temperature in-range	30 (28.3)	53 (49.6)	0.002
Admit glucose >50 mg/dL	59 (55.7)	86 (72.3)	0.012
Intravenous access within 1 hour	8 (7.5)	73 (61.3)	<0.001

TABLE 3. Golden Hour Script

Time	MD/NNP/PA	RT1	RT2	RN1	RN2 (Charge/TL)
Predelivery preparation 2nd floor unit representative admits infant	• Obtain info from OB/prenatal visit • Notify charge nurse • Check equipment • Define roles • Discuss special considerations • Set up tray for UVL/UAL placement	• Prepare intubation supplies (tape, ETT holder, CO_2 detector) • Set up NeoPuff including CO_2 detector (PiP 20 cmH_2O, PEEP 5 cmH_2O) • Dial O_2 blender to FiO_2 0.4 • Check suction • Turn on SpO_2 monitor without attaching SpO_2 probe	• Set up ventilator/humidifier (PiP 20 cmH_2O, PEEP 5 cmH_2O, PS 6 cmH20, IT 0.35 sec, SIMV 40 breaths/min) • Have bubble CPAP system including hat and size (…) nasal prongs available • Obtain surfactant and administration supplies	• Turn giraffe on • Prepare bed including hat and polyethylene bag	• Call for Na acetate • Locate admission cart • Warm starterTPN • Obtain supplies for PIV/UVL/UAL placement in island • Take D10W to island • Obtain 2 syringe pumps • Obtain 2 horizon pumps
Birth 1 min	• Direct/assist team • Assist with polyethylene bag • Place hat • Clear air way as indicated • Place NeoPuff face mask and deliver CPAP/PPV • Maintain PEEP	• Place SpO_2 probe on right wrist, then connect to SpO_2 monitor • Check chest movement and breath sounds • Monitor CO_2 detector		• Receive infant • Place infant into polyethylene bag • Assess heart rate • Place EKG leads and skin temp probe	• Record resuscitation
1–5 min	• Monitor response to stabilization • Follow CPAP guidelines	• Monitor response to stabilization • Follow CPAP guidelines • Monitor SpO_2 • Adjust FiO_2 to maintain SpO_2 in target range (chart on island wall)	• Monitor response to stabilization • Follow CPAP guidelines • Monitor SpO_2 • Adjust FiO_2 to maintain SpO_2 in target range (chart on island wall)	• Monitor response to stabilization • Follow CPAP guidelines • Assess HR at 5 minutes	

(*continues*)

Table 3. Golden Hour Script (*Continued*)

Time	MD/NNP/PA	RT1	RT2	RN1	RN2 (Charge/TL)
	Continue to follow CPAP guidelines and consider intubation and surfactant at any time if indicated				
	• Intubation if indicated • Write admission orders	• Assist with intubation if indicated • Confirm correct placement of ETT • Adjust and secure ETT (kg + 6 cm = position at lip) • Administer surfactant • Connect to ventilator • Adjust PiP, PEEP and FiO_2 to patient needs (SpO_2 89-94%, V_T 4-6ml/kg)	• Monitor SpO_2 and HR • Adjust FiO_2 to maintain SpO_2 between 89–94% • Assist RT1 • Prepare surfactant • Assist RT1	• Monitor SpO_2 and HR • Auscultate • Obtain weight/length/OFC	• Record vital signs and chart events • String D10W • String starter TPN • String UAL fluids • Scan admission orders to pharmacy
20–30 min	• Line placement • Obtain blood from UVL or UAL • Connect D10W but maintain sterile field	• Run ABG/VBG/dex		• Assist with UVL and UAL • Collect labs (CBC/ABG/VBG/NBS/blood cx) • Maintain temperature at 36.5–37.4°C	• Send labs
30–60 min	• Review ABG/VBG • Evaluate CXR/KUB • Adjust umbilical catheters • Complete physical exam • Debrief team • Update parents	• ABG/VBG target: $PaCO_2$ 45–60 mmHg, pH 7.20-7.40 • Adjust PiP, PEEP, and FiO_2 to patient needs (SpO_2 89-94%, V_T 4-6ml/kg) • Evaluate CXR • Adjust ETT • During transfer to NICU bedside, protect airway, maintain PEEP, monitor SpO_2 and HR		• Call for CXR/KUB • Assist with CXR/KUB • Connect UAL fluids • Connect starter TPN • Secure umbilical catheters • Place ID band • Start antibiotics • Move to NICU bed spot • Place BP cuff • Connect to monitor • Obtain vital signs/OFC	

Abbreviations: ABG, arterial blood gas; BP, blood pressure; CBC, complete blood count; CPAP, continuous positive airway pressure; cx, culture; CXR, chest x-ray; D10W, 10% dextrose water; dex, dextrostix; EET, endotracheal tube; EKG, electrocardiogram; HR, heart rate; IT, inspiratory time; KUB, kidney ureter bladder radiograph; MD, medical doctor; NBS, newborn screen; NICU, neonatal intensive care unit; NNP, neonatal nurse practitioner; OB, obstetrician; OFC, occipital frontal circumference; PA, physician assistant; PEEP, positive end expiratory pressure; PiP, positive inspiratory pressure; PIV, peripheral intravenous; PPV, positive pressure ventilation; RN, registered nurse; RT, respiratory therapist; SIMV, synchronized intermittent mandatory ventilation; TL, team leader; TPN, total parenteral nutrition; UAL, umbilical arterial catheter; UVL, umbilical venous catheter; VBG, venous blood gas.

positive airway pressure, and the T-piece resuscitator was already a standard of care in the unit, the quality improvement protocol was focused on admission temperature, glucose, and time to IV administration.

Information about the Golden Hour Protocol and goals and expectations were provided during mandatory unit meetings, neonatology medical meetings, and through the monthly unit newsletter. A dedicated supply cart was stocked with equipment necessary for resuscitation and a "bundle" for admission medications, sodium acetate, and starter total parenteral nutrition was assembled by the pharmacy. Laminated copies of the Golden Hour script were posted as a reference in the resuscitation island. NICU registered nurse committee members served as resources for the staff as the protocol was implemented. Audits were performed on Golden Hour admissions and reviewed by committee members.

DISEASE SPECIFIC CERTIFICATION

Because of the success of the Golden Hour Protocol, which was made a standard of care for all deliveries of infants less than 28 weeks gestation, application was made to The Joint Commission for Disease Specific Certification for Prematurity. This certification program "evaluates clinical programs across a continuum of care."[12p6] Certification requirements address compliance with national standards, use of evidence-based clinical practice guidelines, and an organized approach to quality improvement measures. The program requires submission of data on a regular basis for review by The Joint Commission and mandates recertification every 2 years.[12] Using the Golden Hour Protocol as the template, 3 clinical measures were identified: admission temperature, admission glucose, and time to IV administration. Three months of data for these clinical measures were provided with the application. After the application was accepted, a reviewer from The Joint Commission made an on-site visit during which time charts were reviewed, interviews were conducted with nursing staff, respiratory therapists, and parents and a program overview was presented by NICU personnel. Benefits of Disease Specific Certification through The Joint Commission include the reduction of variation in clinical practice and thereby decreasing the risk of error, establishment of a framework for ongoing performance improvement, and validation of the quality of care provided by the clinical team.

QUALITY IMPROVEMENT

Opportunity for improvement in delivery room teamwork and communication as identified by the Vermont Oxford Network's 2007 Potentially Better Practices include establishing the routine of debriefing after a Golden Hour delivery and providing more consistent communication with families. Amendments to the protocolized script will be made to include prompts for debriefing and parent interaction. A delivery room checklist is in the process of being formulated, and when the final revision of this checklist is completed, there will be ongoing staff education. Scenarios that address Golden Hour deliveries are being added to simulation-based training and a videotape of an actual Golden Hour delivery will be edited to be used as a mandatory Web-based training.

CONCLUSION

Preterm birth is the leading cause of neonatal mortality and a substantial portion of all birth-related short- and long-term morbidities.[13] Strategies to optimize the performance of interprofessional teams during the resuscitation of these high-risk infants through the use of protocols such as the Golden Hour may help improve outcomes.[14] Data suggest that the implementation of the protocol positively impacted the clinical measures of temperature, glucose, and IV administration.

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