Effective implementation of a protocol on initial stabilization of preterm neonates delivered at less than 32 weeks gestation through a simulation programme in a District General Hospital

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Abstract

Background: Effective initial stabilization of preterm neonates in the initial 60 minutes of life (termed neonatal golden hour) helps minimize complications such as intraventricular haemorrhage and chronic lung disease and leads to improved prognosis. Effective resuscitation, respiratory support, maintaining normal temperature and blood sugar, timely parenteral nutrition, timely treatment of sepsis and a completed admission within 60 minutes of delivery are identified as key components of the golden hour. High intensity and multitude of interventions necessary for initial stabilization, performed by a staff that lacks uniform training make golden hour a challenging task. A protocol can provide a care pathway on the essential steps of the golden hour. Simulation-based learning to practise the protocol has been identified as way to create a cohesive team.

Objectives: To evaluate effective implementation of a protocol on initial stabilization of preterm neonates delivered at less than 32 weeks gestation through a simulation programme.

Study design: Prospective study

Method: The extent to which the key components of neonatal golden hour were achieved before and after implementation of the protocol were assessed using a checklist.

Results: In the post-protocol group a significant increase was seen in the number of infants resuscitated with optimal preparation and attended by a senior member of staff ($p<0.05$), the number of infants who received intravenous glucose infusion and antibiotics ($p<0.01$), the number of infants with blood sugar more than 2.6mmol/l in 1 hour ($p<0.05$) and the number of infants with completed admission within 1 hour ($p<0.01$). There was a statistically significant difference in adherence to thermo-protective measures during stabilization ($p<0.01$), and the number of neonates with temperature above 36.5^0C on admission ($p<0.01$) in the post-protocol group.

Conclusions: Implementation of the golden hour protocol through a simulation programme can significantly improve the stabilization of infants delivered at less than 32 weeks gestation.

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(Key words: neonatal golden hour, initial stabilization, preterm neonates, simulation)

Background

Preterm birth is a leading cause of neonatal mortality and morbidity. Poor outcomes result from sepsis, intraventricular haemorrhage (IVH), necrotizing enterocolitis (NEC), chronic lung disease (CLD) and retinopathy of prematurity (ROP). Studies have shown that effective initial stabilization aimed to complete within 60 minutes of birth help in minimizing these complications and lead to improved outcomes. The first 60 minutes after birth is hence named neonatal golden hour[1-5]. The following are identified as the key components of the neonatal golden hour[5]:

1. Resuscitation and respiratory support
2. Maintaining normal temperature and blood sugar
3. Timely parenteral nutrition administration
4. Rapid treatment of sepsis
5. Completed admission within 60 minutes of delivery

To achieve all these goals the team members must act in a coordinated manner and have assigned roles. The high intensity and dynamic situation in stabilizing neonates and the multitude of tasks involved make it a difficult task. Lack of uniformity of skills and knowledge of the staff

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involved make it difficult to offer consistent organized care. A protocol can provide the "road map" on essential steps of the golden hour. Hence each patient is cared for in the same process, allowing for fewer mistakes and better outcomes.

Use of simulation-based learning to practise the protocol in a safe environment has been identified as a way to create a cohesive team[6,7]. Simulation allows the team to utilize the same equipment, practise teamwork and streamline the process in a realistic setting prior to use on a patient. Through facilitated debriefing, team members identify errors as well as communication opportunities and make corrections to their practice.

Objectives

The primary objective was to evaluate effective implementation of a protocol on initial stabilization of preterm neonates delivered at less than 32 weeks gestation through a simulation programme. Specific objectives were to compare the extent to which key components of the neonatal golden hour were achieved before and after introduction of the protocol.

Method

A prospective interventional study was carried out in the neonatal intensive care unit (NICU) of Hambantota District General Hospital from January 2014 to June 2015. It is a 16 bedded unit with 4 ventilated beds. Annual delivery rate in the hospital is 3000. The staff comprised 2 consultant paediatricians who are trainers in neonatal life support (NLS), 5 medical officers trained in NLS, 3 intern house officers with no NLS training and 16 nurses with a diploma in nursing but no training in NLS. Fifty eight neonates were assigned to the pre-protocol group and 64 neonates to the post-protocol group after obtaining parental consent. All pre-protocol neonates were recruited before commencing the post-protocol neonates. The following areas of neonatal stabilization were assessed at each delivery of a preterm neonate less than 32 weeks gestation using a checklist completed by one of the researchers:

1. Availability of all necessary resuscitative equipment at site of delivery which were pre-checked (as per Sri Lanka NLS course manual).
2. Attendance of a senior staff member for delivery (senior house officer/consultant trained in NLS).
3. Adherence to NLS algorithm during resuscitation.
4. Use of surfactant prophylactically in gestation less than 26 weeks, and as rescue treatment within 1 hour if oxygen demand is more than 30%
5. Oxygen saturation at 10 minutes of birth. Eighty five percent was considered the lowest normal value.
6. Use of thermos-protective measures (hat, dry warm towels, plastic bag, radiant warmer, pre-warmed humidified incubator) throughout resuscitation, transport and stabilization
7. Axillary temperature on admission; 36.5^0C was considered the lowest normal value.
8. Time taken from birth to administer IV fluids infusion and antibiotics
9. Random blood sugar within 1 hour of birth; 2.6mmol/l was considered the lowest normal value
10. Time taken to complete admission

A protocol on early stabilization of very preterm neonates was developed, based on the position statement published by the British Association of Perinatal Medicine, 2005[8], American Neonatal Resuscitation Programme[9], European Consensus Guidelines on the Management of Neonatal Respiratory Distress Syndrome[10] and some guidelines used by British Neonatal Networks (Table 1).

The protocol was introduced to medical, nursing and minor staff of neonatal unit (NNU), General Hospital Hambantota in the form of a lecture. The lecture comprised the special requirements of preterm neonates, key areas of neonatal golden hour stabilization, behavioural skills such as assigning roles, effective communication, delegation and call for help. A questionnaire with multiple choice questions at the end of the lecture was used to ensure that key areas of stabilization were understood by participants. This was followed by practical training sessions comprising a scenario teaching (using mannequins) of an extreme preterm extreme low birth weight neonate. Each staff member was given the opportunity to resuscitate and stabilize the preterm neonate followed by a debriefing session. The above areas of neonatal stabilization were assessed in the neonates born in post-protocol time period using a checklist completed by one of the researchers.

Statistical analysis was conducted using SPSS version 16. Statistical significance between pre- and post-protocol observations was assessed using Chi-Square test for discrete categorical variables and ANOVA for continuous variables. A p value less than 0.05 was considered significant. Ethical approval was obtained from the ethical review committee of the Sri Lanka College of Paediatricians

Table 1: ***Protocol on early stabilization of preterm neonates 32 weeks or less***

	Preparation/ duties of doctors	**Preparation/ duties of nurses**
Before birth	*Communicate with labour room regarding impending preterm deliveries*	
	Warm resuscitaire	Decide who is responsible for the admission
	Small endotracheal tubes (ETTs), laryngoscope, adhesive tapes	Prepare warm incubator
	Check Ambu bag and oxygen	Prepare ventilator /Ambu/ Suction
	Check suction apparatus	Prepare monitors (saturation, heart rate (HR), temperature, blood pressure)
	Warm towels	Prepare infusions (10% Dextrose)
	Surfactant (<27+6 weeks)	Scales
	Polythene bags	Prepare equipment to transfer baby
At delivery	Place baby in plastic bag	Assist with resuscitation Help with ETT fixation
	Open airway with inflation breaths – see HR rise Continue ventilation breaths	Keep baby warm
	Intubate – where appropriate Check ETT position	Set up Transfer equipment
	Continue gentle ventilation	Assist with transfer to transport incubator
	Consider cardiac massage, drugs if needed	Apply oxygen saturation monitor
On arrival in neonatal unit	Check / Adjust ventilation	Weigh the baby
	Prepare surfactant if not given already	Transfer to incubator in plastic bag
	Prescribe drugs & fluids	Connect to ventilator – reassess A B C
	Write blood test forms	Measure temperature
		Attach saturation and temperature probes
		Baseline observations
5-30 minutes after arrival	Insert intravenous (IV) cannula	Vitamin K
	Early capillary gas and glucose	Ensure IV and intra-arterial (IA) fluids ready
	Take blood culture, full blood count, clotting, Group, direct Coombs test, glucose	IV access, Start infusions
	Give surfactant	Monitor oxygen saturation, HR and temperature
		Assist with positioning for X-Rays
30-60 minutes after arrival	Review ventilation with gases and oxygen saturations	Umbilical venous catheter (UVC)/ Umbilical arterial catheter (UAC) if possible
	Treat hypoglycaemia - if present	Monitor saturations, HR, temperature
	Treat hypotension - if present	Set up opiate infusion - if required
	Request chest x-ray and abdominal x-ray - do not wait for 4 hours	Do not remove plastic bag until temperature stable
	Sedation	
	Ensure antibiotics and Vitamin K given	
	UAC/UVC if necessary	
	The first hour is up *Once the baby is set up, Hands Off – Eyes on!*	

Results

Data for a total of 122 preterm infants were reviewed, 58 (47.5%) in the pre-protocol group and 64 (52.4%) in the post-protocol group. Three neonates in the pre-protocol group and 2 neonates in the post-protocol group were not included as parental consent was not obtained. There was no significant difference in demographic data between the two groups as shown in Table 1. Data for resuscitation and respiratory support are shown in Table 2. Data for maintaining normal temperature and blood sugar are shown in Table 3. Data for administration of dextrose, antibiotics and vitamin K are shown in Table 4.

Table 1: ***Demographic data***

Demographic data	Pre-protocol	Post-protocol	P value
Birth weight	Mean 1168.8 SD 251.5	Mean 1190.2 SD 232.3	0.627
Gestation	Mean 29.90 SD	Mean 30.0 SD 1.85	0.708
Male: female ratio	28:30	31/30	0.239
Vaginal delivery	No. 42 (72.4%)	No. 40 (62.5%)	0.244
Cesarean section	No. 16 (27.6%)	No. 24 (37.5)	0.244
Antenatal steroid received	No. 27 (46.6%)	No. 33 (51.6%)	0.58

Table 2: ***Resuscitation and respiratory support***

	Pre protocol No. (%)	Post protocol No. (%)	P value
Availability of pre-checked resuscitation equipment on site	82.8%	96.9%	0.013
Attendance of senior medical staff (SHO/consultant)	74.1%	90.6%	0.018
Adherence to NLS guideline	94.8%	96.9%	0.569
Intubation / surfactant as indicated	68.4%	92.9%	0.090
Saturation>85% at 10 minutes	79.3%	92.2%	0.065

Table 3: ***Maintaining normal temperature and blood sugar***

	Pre protocol No. (%)	Post protocol No. (%)	P value
Use of warming methods of newborn at all times	65.5%	92.2%	0.001
Axillary temperature on admission >36.5^{0}C	60.3%	84.4%	0.004
CBS>2.6mmol/l within 1 hour of birth	65.5%	84.4%	0.021

Table 4: ***Administration of dextrose, antibiotics and Vitamin K***

	Pre protocol No. (%)	Post protocol No. (%)	P value
Administration of intravenous fluids within 1 hour	65.5%	93.8%	0.000
Administration of antibiotics within 1 hour	65.5%	90.6%	0.001
Vitamin K within 1 hour	93.1%	100.0%	0.048
Completed admission within 60 minutes	60.3%	82.8%	0.008

Discussion

Our study demonstrated significant improvement in preparation for resuscitation, higher rates of early surfactant administration and better oxygen saturation at 10 minutes following implementation of the protocol. It showed better adherence to thermo-protection resulting in better axillary temperature on admission. Further, it showed improved rates of IV fluid and antibiotic administration, better random blood sugar within 1 hour of birth and higher rates of completing admission within 1 hour.

Several studies have been done on implementation of the protocol on golden hour as part of quality improvement projects. Ashmede et al. demonstrated improved surfactant administration, dextrose and aminoacid infusion, body temperature at admission, odds of developing chronic lung disease, and odds of developing ROP following implementation of the project[11]. Wallingford B et al concentrated extensively on strategies to prevent CLD, thermoregulation and team work[3]. This study showed increasing compliance with the golden-hour practices and decreased incidence of CLD. Finer et al reported improved resuscitation of preterm neonates following use of video recordings to look at the use of oxygen, effectiveness of bag and mask ventilation, intubation in the delivery area and communication among team members[12]. These studies have used lectures, posters, emails and training sessions to introduce the protocol. None mention the educational background of the staff involved. None have studied the sustainability of improvement achieved. Our study concentrated on achievement of all key components of neonatal golden hour described by Doyle and Vermont Oxford Network. The principal method of training was a simulation programme where every staff member had the opportunity to be trained and evaluated. Effective resuscitation needs optimal preparation, availability of appropriate senior help and adhering to standard resuscitation guidelines.

Limitations of the study include non-assessment of secondary outcomes such as CLD, ROP and IVH and non-evaluation of the sustainability of results obtained.

Conclusion

Implementation of the Golden Hour Protocol through a simulation programme can significantly

improve the stabilization of infants delivered at less than 32 weeks gestation.

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