The First Hour
Early Care of the Preterm Infant - Paediatric Full Clinical Guideline - Burton Only

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Aim
Early care of the preterm infant is important

Introduction

The CESDI 27-28 week project [1] highlighted deficiencies in resuscitation and early care in many babies born at 27 or 28 weeks gestation as well as communication within teams and with families. These were increased significantly in those babies who did not survive beyond the first 28 days of life. This policy aims to address many of the recommendations of this report, ensuring evidence based stabilisation and early care for the preterm infant.

Sick newborn infants tolerate both handling and hypothermia poorly. Minimal handling and maintenance of normal temperature are paramount. Monitors should be used to provide observation of the infant rather than by repeated examination and an arterial line inserted if more than occasional blood gas measurements required. Painful procedures should be kept to a minimum. In EMNODN we aim to stabilise, admit and put lines into the most vulnerable babies within an hour of admission and then leave them as undisturbed as possible.

Evidence

Thermoregulation

It has long been recognised that neonatal mortality increased with falling admission temperature [2]. In the Epicure study, 40% of infants (21-25 weeks gestation) had an admission temperature <35^{o}C [3], which was independently associated with risk of death [3]. Vohra et al showed a median increase in temperature of 1.9^{o}C when infants <28 weeks gestation were placed in a polythene bag, without drying, immediately post delivery compared to controls [4]. Similar results have been shown by others as part of ongoing audit[5].

Early Respiratory Management

Clinical studies suggest that those infants who receive “aggressive” early care compared to “gentle” early care have an increased risk of chronic lung disease in the neonatal period [6,7]. More detailed information comes from the preterm animal model. Both high and low volume lung injury occurs rapidly in the preterm surfactant deficient lung. In a number of elegant studies Bjorkland et al have shown that lung compliance is reduced and histology worsened by initial inflation breaths at birth whether or not surfactant is administered and that the damage increases with the size of inflation breaths [8,9,10]. Preterm animals ventilated without PEEP have reduced compliance, increased alveolar protein leak and more histological lung injury than those ventilated with PEEP [11,12]. These changes are seen within 10 minutes of birth [11].

Preterm animals, who by definition are surfactant deficient stimulated to breath spontaneously have histological evidence of lung injury by 15 minutes of life [13]. Prevention of this lung injury, the ultimate aim, required true surfactant prophylaxis.

Although 100% oxygen has been historically used during initial stabilisation of newborn infants there is no evidence base for this practice. Both excess and inadequate oxygen may be harmful. Healthy term infants breathing air at birth only reach saturations in the low 80s by 7 minutes of age [14,15]. Hypoxic infants resuscitated in 75% oxygen have PaO2 levels of up to 43.3Pa within 1 minute [16]. Term infants resuscitated in air have higher Apgar scores, short time for first cry and lower $PaCO_2$ at 30 minutes of age [17,18].

A single study has randomised preterm infants to air or oxygen during resuscitation [14]. In this study the air group were allowed oxygen if it were felt clinically necessary. 74% of this group received no oxygen and no baby required >50%. Infants resuscitated in oxygen had persistent cerebral vasoconstriction at 2 hours of age. There is no human data on the long-term effects of resuscitating in oxygen as compared to air.

Early Cardiovascular Management

A number of retrospective studies have demonstrated extremely poor intact survival in infants of low birth weight or gestation who need CPR and/or resuscitation drugs at birth [19,20,21]. A more recent study from the Vermount Oxford Network has suggested improved survival rates in these groups compared to historically [22]. Finer et al in a retrospective study from California suggest that intact survival is possible for infants weighing <750g at birth after delivery room CPR. Of 10 survivors 7 were followed up to beyond 10 months of age and 6 had normal neurodevelopmental outcomes [21]. It was not possible in ether of these retrospective studies to ascertain whether indications for commencing CPR were appropriate and in the second study a number of babies received adrenaline without cardiac massage.

Communication

We make every effort to communicate with families before preterm delivery. This is particularly true for infants where significant morbidity or mortality risk is to be expected e.g. <30 weeks.

At very low gestation reviews of results of neonatal intensive care suggest that survival is particularly at risk and many survivors have significant disabilities. EMNODN take the view that it is inappropriate to resuscitate infants of <23 weeks gestation, though obstetricians can involve neonatologists for discussion with parents in some cases. Under certain circumstances it is also acceptable to agree antenatally with parents not to resuscitate infants at slightly higher gestations. A consultant needs to be involved in this decision making. At 24 weeks or beyond a postnatal assessment is usually necessary. Calculation of exact gestation, by a neonatologist, is obviously vital.

The neonatal team (usually a consultant) must discuss the situation with the family prior to the delivery and agree a planned approach. A “comfort care only” plan will typically involve baby being wrapped and handed to parents without efforts being made to resuscitate the baby, and may include neonatal staff not attending the delivery. Families and professionals need to anticipate that babies may gasp or even breathe at very low gestations.

Preparation (applies to all <32/40)	
Checklist	**Comments**

• **Incubator** set up and pre warmed
• **Humidity** – according to unit policy
• **Ventilator and controlled pressure resuscitation system** plugged in and working (set both at 20/4, air)
• **Suction and catheters** present and working
• **Monitors** – all with **appropriate attachments** e.g. cables and probes
  ○ Pulse oximeter
  ○ Heart-rate
  ○ Non-invasive blood pressure
  ○ Invasive blood presser with transducer
  ○ Temperature thermistor
• **UAC and UVC trolley** set up on NNU
• Ensure **resuscitaire** is set up on delivery suite
  ○ Pressures 20/4, set to deliver air
  ○ Plastic bag ready
  ○ On “Manual” heat output, set to maximum
  ○ Both gas cylinders with adequate capacity
  ○ Appropriate staff aware of impending delivery
• **Nurse** who will care for admission is identified and work distributed accordingly
• **Consultant/SpR/SHO** aware of delivery
• Ensure **surfactant** available
• **Discuss management plan for birth and outcomes with parents**
• **Emergency trolley** checked and available
	• Midwives responsible for routine checking of resuscitaire prior to delivery
	• Neonatal nurse/ANNP/middle grade should attend all deliveries <32/40
	• Make consultant aware of anticipated deliveries <28/40
	• The amount of information given at this stage should be tailored to the individual family and timescale for delivery.
	• **Mortality data** – remember mortality rates will vary depending on time point e.g. pre-birth, birth, admission to NNU, 1st week
	• **Morbidity** – at least mention risk of later developmental problems

When the Baby is Born (<28/40)	
Actions	**Rationale and Comments**

• Place baby in plastic bag	• To ensure adequate maintenance of temperature
	  ○ Place directly in a plastic bag, without drying, at birth
	  ○ Ensure plastic bag covers as much of baby of possible. If access required for UVC do not remove bag; cut small hole instead
	  ○ Place a hat of baby's head, after drying it
	  ○ Do not cover baby with towels until heater switched off immediately before transfer

• Use air for lung inflation • Increase to O_2 if cyanosis, persistent bradycardia	• Air has been shown to be as effective as 100% oxygen in research evaluations and RCT in term infants. Avoids oxygen induced lung injury, respiratory centre depression and cerebral blood low restriction associated with hyperoxia
• Intubation as clinically appropriate – record time • Surfactant administered once ETT in correct position • Record condition of baby and time of administration of surfactant	• Allows airway control and surfactant prophylaxis • ETT should be seen to go through cords • Demonstrate good, equal bilateral chest movement and equal air entry • Cut NGT for administering surfactant (same length as ET tube)
• Deliver ventilation • Apply PEEP at 4cm H20	• In animal work PEEP is as important as early surfactant in the establishment of FRC
• Gentle inflation breaths. Max initial pressures 20cm H_20 (most babies will not require >16mmHg to move chest). Rate 30-60 bpm. Monitor effect by assessing heart rate and chest movement. May need to increase pressure if no chest movement	
• Gentle mask inflation, starting pressures 20cm H20. Monitor effect by assessing heart rate and chest movement • Call SpR/consultant if not already present	• Controlled pressure systems are preferred

When the Baby is Born 28-31^{+6}/40	
Actions	**Rationale and Comments**
• Place baby in plastic bag before commencing resuscitation	• To ensure adequate maintenance of temperature
• Gentle mask ventilation breaths. Max initial pressures 20cm H_20. Monitor effect by assessing heart rate and chest movement • Low threshold for intubation and ventilation in delivery suite but not mandatory • Give surfactant on delivery suite if intubated	• Air has been shown to be as effective as 100% oxygen in research evaluations and RCT in term infants. Avoids oxygen induced lung injury, respiratory centre depression and cerebral blood low restriction associated with hyperoxia

Transfer to NNU – All Babies <32/40	
Actions	**Rationale and Comments**
• Fix ETT prior to transfer • Transfer on resuscitaire/or transport incubator	• Minimising risk of tube displacement
• Do not disconnect from power until ready to go • Cover in warm towels immediately prior to transfer • Show baby to parents	• Power off stops alarms
• Ensure sufficient gases before leaving delivery suite • Ask for cord samples for pathology • Request cord pH samples taken (all <32/40)	• Air and oxygen must be full enough for transfer. Remember to check with cylinder turned on but wall gas not applied

Admission – All Babies <32/40	
Actions	**Rationale and Comments**
• Nurse caring for baby may need assistance from others, but remains with baby for the first hour	• Identified nurse provides continuity and gets help from others with drugs etc.
• Initial actions ○ Weigh baby in plastic bag ○ Transfer to incubator still in bag ○ Attach baby to ventilator/CPAP as appropriate ○ Reassess ABC ○ Give surfactant if intubated and not already given, assess response	• Ti 0.3 – 0.5s, PEEP 4, PIP and Fi02 as at resuscitation • Is baby on appropriate ventilatory support? Review chest movement, consider adjusting PIP **without** waiting for first gas
• Nursing admission procedure ○ Take axilla temperature ○ Commence monitoring (skin temp, ECG, Sp02) ○ Record baseline observations ○ Give Vitamin K ○ Photograph baby for parents	• Medical staff/ANNP prepare to insert umbilical lines giving nursing staff time to complete initial admission procedures • Target admission temp 36.8^{o}C. Avoid temp > 38^{o}C • ECG leads <26/40 may cause skin damage, consider using heart rate from $Sp0_2$
• Do not remove bag until humidity and incubator temp optimised	• In animal work PEEP is as important as early surfactant in the establishment of FRC

Admission – All Babies <32/40 (continued)	
Actions	**Rationale and Comments**

Intubated babies
• Site and secure umbilical arterial and venous lines
  ○ UAC for IBP and arterial oxygen monitoring
  ○ Double lumen UVC
 	
• **Take blood for**
  ○ ABG
  ○ CRP (if sepsis considered)
  ○ Blood glucose (bedside)
  ○ FBC
  ○ Blood Group and Coombs
  ○ Blood Culture
  ○ Clotting studies
  ○ Start maintenance fluid 10% glucose
 	
Target time for both IV and IA fluids up is 60 minutes after birth
	Arterial access is easiest in first hour – do not delay
	
	UAC
	• Commence 0.9% saline with heparin (1iu/ml) at 1m/hr
	• Monitor heart rate via UAC. Ensure alarms on monitors set correctly
	
	UVC
	• Use a double lumen UVC (with tip placed just outside right atrium). If difficult to obtain use a single lumen UVC
	• A sterile procedure should be used to access line
	• The UVC tip must lie at or immediately above the diaphragm on x-ray. If it lies linked within the liver then the catheter should be removed
	• All drugs including TPN can be given through it if the UVC tip lies in the IVC or right atrium
	• Give maintenance fluid 10% glucose through UVC whilst awaiting x-ray
	
	In an emergency do not delay the administration of drugs before the x-ray is available

Summary of Early Care Guidelines			
Parameter	**<25 weeks**	**<28 weeks**	**28-31 weeks**
Antenatal Counselling	Ideally consultant Trained SpR	Consultant, Trained SpR/ANNP	Trained SpR/ ANNP
Attends delivery	Leader with defined competencies Nurse to care for baby, SpR SHO	Leader with defined competencies Nurse to care for baby, SpR, SHO	SpR/ANNP Nurse to care for baby, SHO
Surfactant	Aim for delivery suite prophylaxis. Repeat early if significant oxygen requirement and/or CXR of HMD	Aim for delivery suite prophylaxis. Repeat early if significant oxygen requirement and/or CXR of HMD	Give as soon as possible if intubated
Ventilation at resus	Resuscitaire start at 20/4 in air	Resuscitaire start at 20/4 in air	Resuscitaire start at 20/4 in air
Manage Temperature with	Plastic bag	Plastic bag	Plastic bag
Resuscitate with	Air, increasing Fi02 if cyanosis	Air, increasing Fi02 if cyanosis	Air, increasing Fi02 if cyanosis
Transfer	Resuscitaire/Incubator	Resuscitaire/Incubator	Resuscitaire/Incubator
Ventilate with	Lowest PIP achieving adequate chest movement	Lowest PIP achieving adequate chest movement	Lowest PIP achieving adequate chest movement
Monitoring	Sp02, HR, IABP	ECG, RR, Sp02, HR, IABP	ECG, RR, Sp02, HR, IABP
Access	Early UAC, UVC	Early UAC, UVC	UAC, UVC

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