MCN for Neonatology West of Scotland Neonatal Guideline	

Cord Clamping Guideline

INTRODUCTION

Placental transfusion is the physiological process during which at birth, umbilical blood flow continues to flow from the placenta to the baby[1]. Deferred cord clamping (DCC) refers to the practice whereby babies remain attached to the umbilical cord to allow placental transfusion, while they transition to ex-utero life.

Various terms and durations are used to describe this process interchangeably, including delayed and optimal cord clamping or management. For the purposes of this guideline, we will use the term deferred cord clamping, whereby the baby remains attached to the cord for at least 60 seconds after birth.

National and international guidance is overwhelmingly supportive of the practice of DCC, which is widely recognised as a **gold standard** of care for both **preterm and term infants**[1-9]. The World Health Organisation, National Institute for Clinical Excellence, Cochrane Library, Royal College of Obstetricians and the British Association of Perinatal Medicine, among others, all recommend waiting at least 60 seconds before clamping the umbilical cord, and do not advocate immediate cord clamping.

This is based on evidence demonstrating both short and long term benefits and crucially, a significant **reduction in mortality** in preterm infants[8,9].

DCC is also a key focus and benchmarking measure in both the National Neonatal Audit Programme (NNAP), and as part of national QI workstreams on perinatal optimisation, including that of the SPSP Perinatal Programme's Preterm Perinatal Wellbeing Package[10-14]. *(https://ihub.scot/improvement-programmes/scottish-patient-safety-programme-spsp/spsp-programmes-of-work/maternity-and-children-quality-improvement-collaborative-mcqic/neonatal-care/preterm-perinatal-wellbeing-package/)*

This guideline summarises the physiology, evidence and practical advice to ensure more babies reap the benefits of deferred cord clamping, and we improve outcomes for our most vulnerable patients.

PHYSIOLOGY

Postnatal transition is a vast and complex physiological process whereby newborns must adapt from an environment of full placental support to complete self-maintenance. Dramatic respiratory and circulatory changes must occur rapidly and are crucial for survival. While these changes are well described, additional focus has now been brought to the critical timing of these events, with a greater understanding of the integral relationship between **lung aeration**, **pulmonary blood flow** and **cardiac output**. Placental transfusion via DCC is vital in supporting these processes to ensure a successful and stable transition to ex utero life[15-19].

Full understanding of the physiology is fundamental in appreciating the processes during transition and the importance of placental transfusion. In utero, a large amount of fetal cardiac output lies within the placenta. Up to 50% of a preterm fetus' circulating volume is within the placenta circulation, compared to up to 30% of a term fetus. As pulmonary blood flow is low, the placental circulation is the source of venous return to the heart. Placental venous return via the umbilical vein is predominantly shunted from the right atrium across the foramen ovale to the left atrium, and therefore provides preload to left ventricle. Placental blood flow is therefore the ultimate source of cardiac output, cerebral and systemic blood flow.

When babies are born, the umbilical arteries constrict to minimise forward flow to the placenta, while flow via the umbilical vein continues for several minutes. Aeration of the lungs at birth is then the key trigger that sets off the series of events, that combined with clamping of the cord, lead to the dramatic changes in the newborn cardiorespiratory system[1,15-21]. Lung aeration results in a rapid fall in pulmonary vascular resistance, and subsequent increase in pulmonary blood flow[15-17]. The baby can draw blood from the low resistance placental circulation, allowing redistribution of blood to the lungs, while maintaining venous return. This process preserves cardiac output which ensures no fall in cerebral or systemic blood flow[15-17]. The additional blood from the placenta during transition provides cardiovascular stability, by boosting circulating blood volume, maintaining organ perfusion, and facilitating a smoother transition from fetal to newborn circulation[15,16].

Physiological based cord clamping (PBCC) is also an emerging practice, which brings additional focus to the timing of cord clamping in relation to lung aeration. PBCC allows generous placental transfusion through DCC, while supporting initiation of respiration and establishment of pulmonary blood flow[20-29]. In both animal and human studies, PBCC has been shown to allow a smoother transition, by supporting an increase in pulmonary blood flow, maintaining systemic blood flow and providing a more stable cerebral haemodynamic transition with less hypoxia and bradycardia[24]. Another study found PBCC stabilised core temperature at delivery when compared to those who had immediate cord clamping[27]. Further observational studies demonstrated increased mortality, increased risk of chronic lung disease and severe IVH if the cord is clamped prior to onset of breathing[23-26].

Through these physiological processes, preterm babies who receive placental transfusion benefit from a significant reduction mortality of one third, as well as less brain haemorrhage, hypotension, anaemia, NEC and sepsis.

While most term infants can adapt without consequence without full DCC, **immediate cord clamping** (ICC) however, has now been clearly shown to **cause harm** in preterm babies[18-21]. Immediate or early clamping of the cord, particularly when performed prior to lung aeration, forces a baby to transition without the ability to draw from their innate circulation within the placenta. ICC cuts off umbilical venous flow leading to an abrupt drop in venous return by 30-50%[15,17]. The increase in systemic vascular resistance caused by removing the low resistance placental circulation, also leads to increased systemic arterial pressure. Combining a reduction in preload from reduced venous return, together with an increase in afterload due to increased arterial pressure, a **sudden fall in cardiac output** leads to hypotension and bradycardia[13,22], reduced systemic blood flow and impaired organ perfusion.

The impact on cerebral blood flow here is also vital. Following the rapid increase in arterial pressure, cerebral blood flow initially increases, but then rapidly falls due to the reduction in cardiac output. These critical mechanisms contribute to the increased the risk of **intraventricular haemorrhage** and **circulatory collapse** in the preterm infant, as well as a greater need for inotropic support and need for blood transfusion[16,17,20,30,34,38].

These negative effects can be mitigated by delaying the time at which the umbilical cord is clamped, allowing a much more physiological and safe transition. By keeping the baby attached to the cord while lung aeration and pulmonary blood flow is established, umbilical venous flow can maintain venous return, ventricular preload and therefore prevent the harm caused by the drop in cardiac output.

The evidence of benefit from DCC, underpinned by this increased physiological understanding, is now overwhelming and highlights the urgent need to update and improve our clinical practice. PBCC brings further focus to the importance of timing of cord clamping in relation to lung aeration. Perinatal teams should therefore ensure shared goals of clamping the cord after **a minimum of 60 seconds and ideally after lung aeration** has been achieved. Careful attention should be made to the assessment and understanding of an infant's rapidly changing physiology at birth, to ensure they benefit from a stable postnatal transition.

Umbilical Cord Milking

N.B. Only for babies ≥28 weeks

Umbilical cord milking (UCM) is the practice whereby where the cord is grasped and blood is pushed toward the baby prior to clamping of the cord, achieving placental transfusion in approximately 20 seconds. The exact technique varies between studies, a milking around 20cm every 2 seconds, performed 3-5 times, is the most frequently described process in the literature. Cord milking has been proposed as an alternative to DCC in certain situations, whereby placental transfusion can be achieved quickly in compromised or preterm infants who require resuscitation[8].

A meta-analysis comparing UCM to ICC demonstrated that UCM was associated with less IVH of all grades, less chronic lung and higher haemoglobin levels[32].

A RCT comprising 197 infants <33 weeks comparing UCM to DCC have demonstrated that UCM is beneficial in infants born by caesarean section. These infants had higher SVC and right ventricular outflow (RVO) blood flow, a higher haemoglobin, better delivery room temperature, higher blood pressure and higher urine output in the first 24 hours[31]. This is potentially as more blood remains in the placenta at birth due to anaesthetic and surgical interventions interfering with active uterine contractions.

However, a recent study comparing UCM to DCC has demonstrated a significantly increased incidence of **severe IVH in the babies under 27 weeks gestation**[33]. No comparison was made between UCM and ICC however. This raises sufficient concerns regarding UCM in the very preterm, and **we do not currently recommend this option in this group of babies.**

The recommendation from the BAPM Optimal Cord Management Toolkit[8] is to reserve UCM for the rare situation of maternal collapse requiring resuscitation in babies ≥28 weeks, where cord clamping needs to be expedited due to maternal health issues.

SUMMARY OF EVIDENCE

Benefits in Preterm Infants:

The benefits of DCC are vast, and critical to improving outcomes in the preterm population. Several high quality studies have clearly demonstrated both short and long term positive impacts of DCC and the stark evidence requiring a change to our practice. This includes:

- **Reduction in mortality of up to 32%**[8,9,30,31,38]
    - For every 33 babies born ≤32 weeks who receive at least 60 seconds of DCC, there is one additional survivor
    - In infants ≤28 weeks the NNB reduces to 20
- **Reduction in intraventricular haemorrhage**[32,40]
- Reduction in late onset sepsis[38]
- Reduction in necrotising enterocolitis[32]
- Improvement in blood pressure with reduced need for inotropic support[30,31]
- Reduction in need for blood transfusion by 10%[34]
- Lower risk of death or severe neurodevelopmental impairment at 22-26 months[41,42]

Benefits in Term Babies:

- Higher haemoglobin concentration[34]
- Higher iron stores with lower incidence of iron deficiency[34]
- Improved fine-motor and social domains at 4 years of age[41]

Risks:

In both preterm and term infants the only noted negative impact of DCC is a higher incidence of jaundice, with higher peak bilirubin levels and the need for phototherapy[8,34]. Importantly there is no evidence of an increased need for exchange transfusion or harm.

Access to frequent assessment and treatment for jaundice is recommended.

Contraindications to DCC

All babies will be eligible for delayed cord clamping unless there is an absolute contraindication. In reality, there are very few situations whereby deferred cord clamping is not safe or achievable[8]. The only true contra-indications whereby DCC is not recommended are in cases of:

- Massive maternal haemorrhage, with the need for acute resuscitation
- Cord issues - such as ruptured vasa praevia, a snapped cord or lack of cord integrity, all of which could lead to significant bleeding from the baby

Compromised Infants

When babies are compromised at birth, the team must use their clinical judgement as to when is appropriate to clamp the cord. It is important to remember that in the absence of major haemorrhage or issues with cord integrity[8], compromised babies are likely to benefit from DCC, and their ability to transition may be hampered further by clamping early. In babies where there is a delay in establishing breathing, they are likely to receive substantial benefit from DCC[15].

Preterm babies are a particularly vulnerable group to highlight. As they may not be vigorous at birth, this often leads to anxiety and early clamping of the cord. However these infants are expected to have the greatest benefit from placental transfusion, and can potentially be harmed by ICC. We therefore must reframe any misconceptions around DCC, understand the physiology, and do our utmost to achieve a minimum of 60 seconds DCC.

Where there are signs of life, but concerns regarding the condition of the baby, we can initiate resuscitation by stimulating the baby, drying or placing them in a plastic bag if premature, and opening the airway to help with lung aeration.

If there are no signs of life, resuscitation should not be delayed. However it is worth considering that in settings where resources are available, e.g. LifeStart™ trolley or similar, **resuscitation can be commenced with an intact cord**, which can allow the baby to achieve the benefits of placental transfusion and aid in their resuscitation.

Short Cord

A short cord is **NOT** a contraindication to DCC[8]. The team should be prepared for this in all scenarios, and adapt to deliver DCC as best as possible. This can still be achieved by placing the baby at the perineum, and in preterm infants, using a plastic bag and heat source where available.

Complete Placental Separation/En Caul Birth

Where the placenta separates completely and delivers with the baby, it can be held above the baby and gentle pressure applied to facilitate forward flow of blood. The cord can then be clamped at 60 seconds before the placenta is lowered. Umbilical cord milking can be also considered in this situation in the more mature babies[8].

Preterm Births

Effective perinatal teamwork, including preparation, communication and clarification of shared goals, is vital for preterm births in order to achieve full perinatal optimisation and increase the chance of the best possible outcome for mothers and babies.

The use of a delivery room prompt or checklist is useful to ensure allocation of roles, checking of equipment and optimisation of the environment. A MDT perinatal "**preterm pause**" pause should also be performed prior to all preterm births, and formalised into theatre safety briefs. This provides an opportunity for clear communication of the birth plan including the need for a plastic bag, heat source or LifeStart™ trolley, cord bloods and any plans for delivery room cuddles. The 3 most vital shared perinatal goals should be agreed:

1. Deferred cord clamping of a *minimum* of 60 seconds
2. Lung aeration & gentle transition
3. Normothermia

Neonatal and obstetric teams should **stand side by side** to support the process of DCC. During caesarean births, an experienced member of the neonatal team can scrub up and join the theatre team to help stabilise the baby and instil confidence. This will help minimise anxiety and unnecessary early clamping of the cord. Clamping of the cord should be a **joint perinatal decision**, and should *not* be performed prior to 60 seconds without discussion between teams. In the absence of maternal concerns, timing of cord clamping should be led by the neonatal team.

Multiple Gestations

Several studies have demonstrated that DCC can be safely achieved in multiple gestation pregnancies. Monochorionic (MCMA/MCDA) multiples present a unique challenge at delivery if there is concern around Twin-To-Twin Transfusion Syndrome. Many studies therefore excluded this group of babies. However, recent small studies have shown DCC is feasible in both monochorionic and dichorionic/trichorionic multiples, with comparable neonatal outcomes in preterm singletons and multiples, first and second order multiples and monochorionic and dichorionic/trichorionic multiples.

DCC can be **considered in all multiples**, and delivery plans should be made on an individual case bases with by an experienced perinatal team[8].

Maternal considerations

There has been no maternal harm demonstrated by DCC. Evidence confirms DCC does not increase the duration of third stage of labour, post-partum haemorrhage, postpartum transfusion, and importantly has no impact on maternal mortality[34]. Mothers may receive benefit from DCC and administration of oxytocinin after delivery of the placenta[15]. Administration of prophylactic uterotonic drugs i.e. syntocinon, should *not* be delayed as they have no proven impact on the efficacy of DCC.

If there are maternal health concerns during DCC, this should be communicated between the teams and a *joint decision* made on cord clamping.

Cord Bloods

DCC may impact the ability to achieve adequate volumes for cord gases and bloods[37,38]. However this is not a contraindication to performing DCC, and the benefits far outweigh the desire for cord bloods.

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