Umbilical Cord Clamping

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https://www.placentanetwork.com/your-placenta/delay-cord-clamping/
**DISCLOSURE STATEMENTS**

**Katherine Weiss, MD**
I have no relevant financial relationships to disclose or conflicts of interest to resolve.

I will not discuss any unapproved or off-label, experimental or investigational use of a product, drug or device.
OBJECTIVES

- Be aware of the history and media coverage of umbilical cord clamping
- Understand the physiology of cord clamping
- Be able to discuss the advantages and disadvantages of delayed cord clamping and umbilical cord milking for term and preterm infants
- Be able to define the current recommendations from major professional organizations on delayed cord clamping
- Be able to define the knowledge gaps for delayed cord clamping and umbilical cord milking
HISTORY OF CORD CLAMPING

GREEKS:
In the time of Hippocrates the cord was not cut until the placenta was delivered. At first view the conduct of the ancients appears to be more rational and more physiological than that of the moderns. It seems that the placenta ought immediately to follow the foetus, or at least be separated from the uterus before the cord can be prudently cut; that before it is divided, the circulation ought to be permitted gradually to take on its new type, which soon becomes similar to that of the adult.
Prof. A.A. Velpeau, 1829 (Treatise on Midwifery)

1950s:
Early clamping (within 1 minute of birth), late clamping (greater than 5 minutes)
* Delaying clamping less common as studies came out showing that >90% infant blood volume achieved with first few breaths
* Virginia APGAR & maternal anesthesia crossing the placenta with delayed clamping; DCC = “slow delivery”
* Erythroblastosis fetalis - prevent “excessive amounts of (maternal) antibody containing blood” into infant

General consensus of all: No inconvenience (and perhaps of benefit) to infant to cut cord early and better for the mother
* 1960s – Data showing marked bradycardia in term infants with immediate cord clamping (no changes made)
Hey girl.
You can relax during labour... I've got my eye on that surgical clamp & it's not going anywhere near our baby!

www.cord-clamping.com

https://www.pinterest.com/hmbirth/delayed-cord-clamping
CORD CLAMPING IN THE NEWS!!!

NPR 5/26/15 “Delayed Umbilical Cord Clamping May Benefit Children Years Later”
*Children whose cords were cut more than three minutes after birth had slightly higher social skills and fine motor skills than those whose cords were cut within 10 seconds

CNN 5/30/15 “The great umbilical cord-cutting debate”
*Medical studies show the positive effect of cord clamping (including one noted above)
*WHO recommends delayed cord clamping between 1-3 minutes after birth
*ACOG says most umbilical cords are cut between 15-20 seconds after birth

Physiology of Cord Clamping

Neonatal circulation

http://www.slideshare.net/Rekhankl/fetal-circulation-32816216
PHYSIOLOGY OF CORD CLAMPING

- Transition of blood flow from placenta to infant’s lungs
- Infant *breathes* → decrease pulmonary vascular resistance → increase blood flow to left side heart and increase systemic blood flow
- **Increased preload helps in this process** → more blood from placenta increases and aids in overflow of blood from placenta to lungs to body
- Less preload or cutting umbilical cord too early → Pulmonary vascular resistance (PVR) remains high as less blood flow through lungs while systemic BP rises as lose placental circuit → hypoxia, pulmonary hypertension, decreased cardiac output
LAMB STUDY: PHYSIOLOGY OF DELAYED UMBILICAL CORD CLAMPING (UCC) & VENTILATION

- Preterm lambs
- Delayed cord clamping 2-3 minutes
- Ventilate during UCC and 30 minutes after
- Measure pulmonary, carotid, umbilical artery and venous blood flow with catheters/flow probes

https://s-media-cache-ak0.pinimg.com/736x/30/7c/31/307c31cb43c48b1713f8ad27b1be4c30.jpg
LAMB STUDY: PHYSIOLOGY OF DELAYED UMBILICAL CORD CLAMPING (UCC) & VENTILATION

- **Blood flow** → UCC significantly increased mean, peak systolic and end-diastolic arterial blood pressure (carotid) and heart rate

- **Breathing** → initiation of ventilation has a greater influence on umbilical and cardiovascular blood pressures and flows than changing body position (above or below introitus)
  - Increases pulmonary blood flow, decreases PVR

- **Cerebral blood flow & oxygenation**
  - Clamping *prior* to ventilation: Doubling of cerebral blood flow (CBF) that then returned to baseline with ventilation
  - Clamping *after* ventilation: prevented major increase in CBF and prevented any fall in cerebral oxygenation (less sudden change in cerebral pressure/flow; perhaps why less IVH)
UMBILICAL FLOW PATTERNS, CORD CLAMPING AND BREATHING

- Measured umbilical artery and venous flow patterns in term spontaneous vaginal delivery with Doppler ultrasound during DCC (at least >60 sec), Boere, Arch Dis Child Fetal Neonatal Ed 2015

- Net placental transfusion is complex
  - Breathing (major role)
    - Intermittent flow initially – increased significantly with large breaths, stopped/reversed flow with crying
    - Continuous flow to infant once more regular breathing pattern set
  - Oxytocin
  - Gravity – less of a factor, does not seem to have significant role
Delayed Cord Clamping (DCC)

- Definition: delay in clamping the umbilical cord after birth so as to facilitate placental blood flow to the fetus
- Increases volume of blood transferred to fetus
  - 50-75% of blood available for placenta-to-fetus transfers within first minute after birth (fastest in first 1-2 minutes)*
- Per ACOG: initiate early care of the newborn during this time
  - Dry, stimulate
  - Cover with blanket to maintain temperature, skin-to-skin
  - Only clear secretions if copious/obstructing airway
  - Meconium but vigorous baby – cord clamp away!
Umbilical Cord Milking (UCM)

- Definition: actively push blood from unclamped umbilical cord towards fetus
  - Pinch cord as close to placenta as possible and milk toward infant over a 2 second duration; then release cord and allow to refill with blood for a brief 1-2 seconds (Finer 2015)
  - Milk 20 cm of umbilical cord toward the umbilicus three times (2015 CoSTR) or over 2-3 seconds (Niermeyer 2015)
  - Cut the cord 25 cm from the umbilicus, transfer infant to the resuscitation team, raise the cord and milk the 25 cm toward the infant

- No particular method - difference in length of segment milked, repetitions, speed
Why do DCC/UCM

• Advantages
  • Term
    • Higher iron stores at 6 months
    • Decreases anemia
  • Preterm
    • Stabilize blood pressure and increase urine output acutely
    • Significant reduction of intraventricular hemorrhage [IVH] (by stabilizing blood pressure)
    • Increased iron stores
    • Decreases anemia and need for transfusions
    • Possible decline in necrotizing enterocolitis (NEC)

• Disadvantages
  • Interfere with practice of collecting cord blood for banking
  • Maternal risks – some concern for postpartum hemorrhage (but not proven)
  • Increases polycythemia and hyperbilirubinemia
ACOG COMMITTEE OPINION – Dec 2012

• Ideal timing for clamping has yet to be established

• Several studies suggest a 30-60 second delay in umbilical cord clamping for all preterm deliveries, at or below level of placenta

• Evidence is insufficient to confirm or refute benefits
  • Especially in settings with rich resources
Given the benefits to most newborns and concordant with other professional organizations..... now recommends a delay in umbilical cord clamping in vigorous term and preterm infants for at least 30-60 seconds after birth.

- Does not increase the risk of postpartum hemorrhage or decrease postpartum hemoglobin (Hgb) level
- Term infants
  - Increase Hgb levels and iron stores in first several months of life
  - May have a favorable effect on developmental outcomes
  - Small increase phototherapy need for jaundice – ensure monitoring mechanisms in place
- Preterm infants: significant neonatal benefits
  - Improved transitional circulation
  - Decreased need for blood transfusion
  - Lower incidence of necrotizing enterocolitis and intraventricular hemorrhage

Insufficient evidence to either support or refute umbilical cord milking
American College of Nurse-Midwives Position Statement - May 2014

- Recommend delayed cord clamping for:
  - Term infants 2-5 minutes
  - Preterm infants 30-60 seconds (reduction in IVH, blood transfusions)
- Umbilical milking – if early or immediate cord clamping needed; may benefit term and preterm infants
- No increase in maternal hemorrhage, no need to delay oxytocic drug administration to mothers
WHO Guideline- 2012

• Delayed umbilical cord clamping (at least 60 seconds after birth) recommended for term and preterm infants
  • Exceptions: if PPV* required, asphyxiated newborn

• If possible, late cord clamping (1-3 minutes) recommended while initiating normal newborn resuscitation
NRP GUIDELINES 2017

- Current evidence suggests that cord clamping should be delayed for at least 30 to 60 seconds for most vigorous term and preterm infants.
- If placental circulation is not intact (i.e. placental abruption, bleeding placenta previa, bleeding vasa previa or cord avulsion), the cord should be clamped immediately after birth.
- There is insufficient evidence to recommend an approach to cord clamping for newborns who require resuscitation at birth.
**GOOD**

*Delayed cord clamping* (>30 seconds) is associated with:
- Less IVH of any grade
- Higher BP and blood volume
- Less need for transfusion after birth
- Less NEC
- BUT, NO evidence of decreased severe IVH or mortality
2015 ILCOR Review

BAD
- Studies low quality -- downgraded for imprecision and very high risk of bias; small groups
- Mild increase hyperbilirubinemia with phototherapy need
- Unknown benefits in infants needing immediate resuscitation (may benefit the most)
2015 ILCOR Review

Umbilical milking → insufficient evidence; few studies
   - Concern that rapid change in blood volume may affect ELBW infants (i.e. increase IVH risk)
   - Suggests AGAINST this for ELBW infants on a routine basis

*OR could it be that…. blood is directed to lungs as pulmonary vascular resistance falls and IVH not affected; this rapid change may be no different than infant cry or uterine contraction pushing blood through at a rapid speed**
Overall Recommendations:
- Suggest DCC for premature infants not requiring immediate resuscitation after birth
  - Not enough studies on those who were “sicker” and may have benefitted most from DCC
Cochrane Reviews

Effect of timing of umbilical cord clamping and other strategies to influence placental transfusion at preterm birth on maternal and infant outcome (2012):

*15 randomized controlled trials (RCT), 738 infants ranging from 24 to 36 weeks gestation, born via C-section or vaginal delivery

*Delayed cord clamping ranging from 30 to 180 seconds or umbilical cord milking

*Less need transfusion, better circulatory stability, less IVH (all grades), lower risk for NEC

*Insufficient data for comparable effects on all primary outcomes
Cochrane Reviews

Effect of timing of umbilical cord clamping of term infants on maternal and neonatal outcomes (2013):
* 15 RCTs, 3911 women/infant pairs
* No significant difference in postpartum hemorrhage rates between early and late umbilical cord clamping
* Increases early hemoglobin concentrations and iron stores
* Beneficial as long as have access to treat hyperbilirubinemia (i.e. phototherapy)
* More liberal approach or consideration to umbilical cord clamping given growing evidence of benefits

KNOWLEDGE GAPS

- Contraindications
- Positioning
- C-section vs. vaginal delivery (VD)
- Optimal timing of uterotonic agents
- Delayed cord clamping vs. cord milking
- Delayed vs. immediate cord clamping in premature infants who need immediate resuscitation
- Benefits of enhanced placental stem cell transfusion
- Effect on neurodevelopmental outcome (2+ years down the road..)
- Developed vs. developing countries
CONTRAINDICATIONS AND CONCERNS FOR DCC/UCM

* Maternal hemorrhagic complications (previa, abruption)
* Cord abnormalities/accidents; tight nuchal cord
* Neonatal hemolytic disease (increase in antibodies causing hemolysis)
* IUGR/IDM/Pre-eclampsia/High altitude - infant already polycythemic or at risk
POSITIONING

- ACOG 2017
  - States skin-to-skin care is appropriate with VD
  - C/S: place on maternal abdomen/legs or held close to level of placenta

- Boere, ADC-FNN, 2015
  - Infants placed on maternal chest
  - Direct skin-to-skin contact is standard of care in Netherlands

**Positioning**

- Yao and Lind, Lancet, 1969
  - Measured residual placenta blood volume; “gravity hastens placental transfusion”
  - Placement 40-60 cm above introitus: decrease placental transfusion similar to ICC (hydrostatic pressure overrode pressures of contractions)
  - **No change when placed 10 cm above or below introitus during uterine contractions (minimal change in hydrostatic pressure)**

- Vain, Lancet, 2014
  - Term VD, vigorous - held infants at introitus or abdomen (skin-to-skin) for 2 minutes
  - Measured weight at birth and at 2 minutes after DCC
  - **No change in weight; position did not seem to affect placental transfusion**
  - Skin-to-skin enhances maternal-infant bonding & may increase OB compliance with DCC

- Hooper, ADC-FNN, 2016:
  - Preterm lambs held 10 cm above or 10 cm below introitus
  - Below introitus: umbilical flows reduced & carotid BF increased (signifying more blood in infant, less in placenta) but no physiological change (no change in PBF, arterial pressure or HR)
  - No change in blood volume in infant whether held above or below
  - **Thus, likely small flow difference with gravity and not clinically significant**
A GAP SHORTENED…
KATHERIA, PEDIATRICS, 2015

*Umbilical cord **milking** works **better in C-section** than delayed cord clamping to improve overall blood volume in premature infants
*2 center trial, <32 weeks (mean GA 28 2/7 wks)
*Umbilical cord milking (4 strippings, ~20 seconds), delayed cord clamping (45-60 seconds)
*Primary outcome: increased SVC flow (P< 0.05)
*UCM in C-section: higher hemoglobin, delivery room temperature, blood pressure, urine output in first 12-24 hours (not primary outcome, not all statistically significant)
  *No statistically significant difference in IVH (trend of less IVH in UCM)
*UCM vs DCC in vaginal deliveries: no differences noted
*May be preferable in ELBW infants in whom **more immediate resuscitation** is preferred
PREMATURE INFANTS & DCC

Backes, J. of Perinatology, Jan 2016

- Study evaluating timing of cord clamping in more premature infants -- big concern is resuscitation and delay
- RCT 08/2009-12/2013; Ohio State Wexner Medical Center
- 2 groups - Immediate cord clamping (ICC-n 22) or delayed cord clamping of 30-45 seconds (DCC-n 18)
  - Delayed method: held infant in sterile towel 10-15 inches below mother’s introitus for vaginal deliveries or level of incision of C-section
- Average gestational age ~24 4-6/7 weeks
Premature Infants & DCC

- No increased incidence **postpartum hemorrhage** in mothers
- No difference in **delivery room** or NICU admission markers of infant safety, i.e. supplementary oxygen need, intubation, surfactant need
  - Trend of higher temperatures at NICU admission in DCC group (wrapped in warm sterile towels during delayed cord clamping; perhaps more attention overall to maintaining temperature)
- No infant in either group developed **polycythemia**
- Increased number of **blood transfusion** in first 28 days for those in ICC but when evaluating overall hospitalization, no change between 2 groups*
Premature Infants & DCC

- Higher overall hematocrit in first 72 hours in those in DCC group
- Higher mean arterial pressure in those in DCC group in first 24 hours; 4X increased need of treatment for hypotension in first 24 hours in those in ICC group
- Twofold lower risk of severe IVH in DCC group than ICC group (not statistically significant)

• OVERALL MESSAGE: DCC in premature infants is SAFE, FEASIBLE and may provide hematologic/circulatory benefits (especially in first 24-72 hours)
Umbilical Cord Milking

- Systematic review and meta-analysis of UCM (Al-Wassia, JAMA, 2015)
  - 7 studies, 501 preterm infants
  - Most compared UCM to ICC
  - Method of UCM varied
  - UCM group: higher Hgb levels, decreased incidence IVH, lower risk of chronic lung disease

- RCT of DCC (30 sec) to UCM (4 times); (Rabe H, Obstet Gynecol, 2011)
  - Mean gestational age: 29 weeks
  - Mean Hgb values at 1 hour after birth were the same
  - No significant difference in transfusions needed later in course
UMBILICAL CORD MILKING CONCERNS

- Concern over cerebral flow dynamics
  - UCM vs DCC: Similar resistive index, pulsatility index and cerebral blood flow velocities of MCA between 24 & 48 hours by cranial US (Jaiswal, Indian J Pediatr, 2015)
  - No long-term adverse effect on neurodevelopmental outcome at 2 and 3.5 years in preterm infants whether they had UCM or DCC (Rabe, Neonatology, 2016)

- Breathing
  - Often occurs before first breaths, establishment of respirations & pulmonary blood flow—thus, diminished benefits??
  - Enhances earlier onset of breathing
    - Katheria, Pediatrics, 2015: more infants were breathing by the time the cord was clamped with UCM vs a 45 second DCC
Resuscitation During DCC; Neurodevelopmental Outcome

UK CORD Trial - pilot trial at eight sites in UK investigating use of active resuscitation during DCC among very preterm infants (<32 weeks); 03/2013-02/2015 recruitment

- Concern that cord clamping delays resuscitation
- Cord clamping within 20 seconds vs > 2 minutes
  - Initial neonatal care at bedside if > 2 minutes
- Primary outcome: death and neurosensory disability at 2 years
- Some recent evidence that establishing ventilation before cord clamping improves outcomes
  - If respirations set may increase overall blood flow to infant from umbilicus --> pulmonary system opens and retain more blood volume in infant
- 261 women/infant pairs; Follow-up women at 1 year, infants at 2 years: results pending
PLATFORM FOR BEDSIDE RESUSCITATION PRIOR TO CLAMPING UMBILICAL CORD (LIVERPOOL WOMEN’S HOSPITAL)
RESUSCITATION PLATFORMS – LIFESTART ON STEROIDS, SAN DIEGO

- T-piece resuscitator, air-oxygen blender, oxygen flowmeter, 50 psi air and oxygen hoses (connect any gas supply; no need to carry O2 tank), pulse oximeter, disposable supply bag (water proof cover for stand, ventilation circuit, resuscitation mask, oximeter probe, bulb suction, extension tubing)
- Premature (<28 weeks): Chemical mattress, warm sterile towels, sterile polyethylene wrap; if cord too short, place these items on mother
- Concerns – umbilical cord cut too short (this decreased with more regular use of LifeStart)

RESUSCITATION PLATFORM: LIFESTART

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5263890/figure/F2/
Resuscitation Platform

- VentFirst (diagrams, picture) - 29 infants, median GA 30 weeks, C/S 72%, 2014-2015
  - Protocol: receive assisted ventilation during 90 seconds of DCC
  - Two neonatal provider approach (nurse, doc; RT behind)
  - OB ceded space to neonatal team for 90 seconds
  - VentFirst pole (C/S)/table (SVD) on wheels: T-piece resuscitator, oxygen and air tanks, blender, flowmeter
  - C/S: placed on mother’s pelvis/thighs; SVD – placed near introitus after delivery
  - Temperature control: chemical gel warming pad, sterile polyethylene sheet (placed on mother’s pelvis during C/S)
  - Sterility in C/S: sterile plastic sleeves/bags cover VentFirst; disposable items previously sterile
  - Feasible and safety but workable items → one neonatal provider at table?, have team work on set-up prior to doing so quicker
  - Doing large multicenter RCT infants < 29 weeks with DCC 120 seconds with assisted ventilation (control with DCC up to 60 seconds without assisted ventilation)
RESUSCITATION PLATFORM- VENTFIRST

A DIFFERENT TYPE OF TRANSFUSION

- DCC = enhanced placental stem cell transfer; “Mankind’s first natural stem cell transplant”
- Umbilical blood contains pluripotent stem cells
  - Not only “transfused” to infants but also adults
  - Pediatric, genetic, blood, immune, metabolic and oncological disorders
- Could stem cells have an effect on neonatal conditions/diseases??
  - Immediate & long-term immunity, host defense and repair
- Downfall: May decrease umbilical cord blood donation yield
RESOURCE-LIMITED SETTINGS

*Large, population-based observational study in Tanzania
*12,730 term and preterm infants (presumed to be healthy; no particular complications)
*Association between timing of umbilical cord clamping relative to onset spontaneous respirations and outcomes of death or admission to a special care area
*Risk of outcome higher if cord clamped prior to spontaneous respirations; decreased by 20% for every 10-second delay in cord clamping after spontaneous respirations up to 2 minutes
*Less risk of iron deficiency anemia; would need phototherapy treatment
IN CONCLUSION: OBJECTIVES

- Be aware of the history and media coverage of umbilical cord clamping
- Understand the physiology of cord clamping
- Be able to discuss the advantages and disadvantages of delayed cord clamping and umbilical cord milking for term and preterm infants
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