Umbilical Cord Blood Specimen Collection: Clinical Indications

Site Applicability

St. Paul's Hospital, Maternity Centre (Maternity and NICU) and Operating Rooms

Practice Level

Specialized:

- Perinatal and Neonatal Registered Nurses
- Registered Midwives
- Physicians (Obstetricians, Pediatricians, Family Practice with Maternity Centre privileges)

Need to Know

Universal precautions are to be observed at all times when collecting and/or handling umbilical cord blood samples.

Delayed clamping of the umbilical cord is the recommended standard of care:

- Delayed cord clamping of greater than or equal to 60 seconds, or a minimum of 30 seconds for newborns requiring resuscitation, has proven benefit to newborns of all gestational ages due to increased blood volume and improved iron status.

Cord blood specimens are collected for the following conditions including:

- Umbilical cord blood gas analysis
- Maternal alloimmunization and/or Hemolytic Disease of the Newborn (HDN):
    - Rh Negative or Unknown Rh blood type,
    - Known presence of maternal antibodies (alloimmunization) that may cause hemolytic disease of the newborn (HDN) at the time of delivery
- Any additional blood work required related to maternal or fetal indicators (e.g. history of bleeding disorders, known hemoglobinopathies, etc.)

Collection of a cord blood sample at time of delivery for identified investigations is considered best practice as it has the advantage of being readily accessible, decreases the time and risks associated with obtaining a capillary heel prick or peripheral blood sample, and places less demand on the newborn's small blood volume.

- If a cord blood sample cannot be collected, a capillary heel prick or peripheral blood sample is required (not applicable to the collection of umbilical blood cord gases)

Clinical presentation of the newborn will determine if the collection of umbilical cord blood samples for clinical indications takes priority over the collection of umbilical cord blood for private collection.

Newborn resuscitation takes precedence over the collection of the umbilical cord blood samples.

If multiple cord blood collections are required, **collect the umbilical cord gases first.**

It is necessary that samples are collected as soon as possible and mixed appropriately to prevent clotting of the blood. Clotted samples may result in the investigation(s) not being processed.

Equipment and Supplies

All Umbilical Cord Blood Collections:

- Non-sterile gloves
- Specimen bag(s)
- Specimen labels, and requisitions (if applicable)
- 22 G 1 ½ inch needle x 2

Umbilical Cord Blood Gases:

- Pre-heparinized blood sampling syringe x 2

Umbilical Cord Blood Collection for Rh Alloimmunization (Neonatal Investigation):

- Laboratory (Lab) Tubes:
  - 7 mL EDTA Tube (lavender top)
- Sterile 10 mL Syringe

Other Neonatal Bloodwork from the Umbilical Cord:

- Lab Tubes:
  - 3 mL EDTA Tube (lavender top) for CBC, platelets
  - 3 mL Plasma tube (green top) for bilirubin
  - 3 mL Sodium Citrate (light blue top) for coagulation, factor levels
- Sterile 10 mL Syringe

Procedure

Umbilical Cord Blood Gases:

- **Arterial and venous umbilical cord blood gas analysis is routinely collected for *ALL* deliveries at St. Paul's Hospital, Maternity Centre**
  - Umbilical cord blood samples are obtained from a double clamped segment of cord (see Appendix A)
  - Umbilical cord blood gas analysis assists in planning appropriate newborn care and management (see Appendix B)
  - Timing of cord clamping should be documented to assist with the interpretation of umbilical cord blood gas results
- Measured values of umbilical cord gases are sensitive to delayed sampling procedures. Umbilical cord blood samples must be **collected within 20 minutes of delivery** using heparinized syringes.

Samples are **sent to the Lab for analysis within one hour collection**, and do NOT require ice for storage or transport.

- If only one sample can be obtained, the arterial sample is preferred
    - Umbilical artery samples indicate the state of fetal oxygenation
- Delay in cord clamping may slightly decrease the pH with cord sampling but there is no reported clinical significance for up to 20 minutes of delay

Steps

1. Identify the umbilical vessels (two smaller arteries and one larger vein) while carefully wiping away any excess blood and/or amniotic fluid from the cord segment
    - Obtain the arterial sample first
    - Some newborns have a two (2) vessel cord wherein there is only one (1) umbilical artery and an umbilical vein
2. Insert the needle at one end of the identified vessel with the bevel down in order to reduce the risk of puncturing the posterior wall of the vessel
3. Aspirate a minimum of 0.5 mL of umbilical cord blood from the specified vessel (1 mL preferred) prior to applying the foam cap to the heparinized blood sampling syringe in order to ensure that there is an adequate sample volume for analysis once the foam cap is filled. The minimum sample volume for analysis is 0.085 mL.
4. Once the sample is obtained, expel any air from the syringe, “Safety Lock” the needle and dispose needle in the Sharps container. Apply the foam cap, and fill with the blood sample until the foam area has changed from white to red
5. Thoroughly mix the syringe for 20 to 30 seconds in order to activate the heparin
6. Confirm patient identifiers, and affix correct patient label; place in specimen bag with completed requisition (see ‘Documentation’ below)
7. Repeat steps 3 through 7 for the umbilical venous sample
8. Ensure sample is transported to the Laboratory (Lab) as soon as possible (within one hour of collection)
    - If using the pneumatic tube system, specimens must be securely wrapped in bubble wrap and sent to the Lab (Station #07) – ensure specimens have left the sending station
    - If taking to the Lab in-person, proceed to Accessioning Desk and give directly to an attendant – do not leave the specimens unattended on the desk

Umbilical Cord Blood Collection for Rh Alloimmunization (Neonatal Investigation):

- Rh incompatibility is the most common cause of alloimmune hemolytic disease of the newborn (HDN).

- HDN occurs when some of the mother's antibodies are transported across the placenta and enter the fetal circulation causing hemolysis; this can result in hyperbilirubinemia (jaundice) +/- associated anemia of the newborn.
- Clinical manifestations of Rh HDN range from mild, self-limited hemolytic disease to hydrops fetalis.
- Antenatal care, including intrauterine transfusion, has decreased the rates of neonatal morbidity and mortality due to Rh alloimmune HDN.

Steps

1. RN will place the 10 mL sterile syringe and one sterile 22 G 1 ½ inch needle on the delivery cart
    - In the event that the delivery is to take place in the OR, the RN will ensure that the items are added to the sterile field
2. The delivering practitioner will:
    - Identify the umbilical vein and collect the sample prior to the delivery of the placenta
    - Insert the needle at one end of the umbilical vein with the bevel down in order to reduce the risk of puncturing the posterior wall of the vessel
    - Aspirate 7 mL of blood (minimum is 3 mL)
    - Once the sample is obtained, expel any air from the syringe, and "Safety Lock" the needle
    - Hand over to attending RN for dispense into the appropriate lab tube
3. RN will attach the second 22G 1 ½ inch needle and expel any air from the syringe (if not already done). The needle will be inserted into the appropriate lab tube and allow the blood sample to fill by vacuum (do NOT push blood into tube).
    - Invert the lab tube 4 to 5 times gently

NOTE: If the delivering practitioner is unable to collect the sample prior to delivery of the placenta, the sample can be obtained from the umbilical vein after the delivery of the placenta

4. Confirm patient identifiers, and affix correct patient label; place in specimen bag (see 'Documentation' below)
5. Ensure sample is transported to Transfusion Medicine as soon as possible
    - If using the pneumatic tube system, specimens must be securely wrapped in bubble wrap and sent to Transfusion Medicine (Station #04) – ensure specimens have left the sending station
    - If taking the sample in-person, proceed to Transfusion Medicine (Blood Bank) and give directly to an attendant – do not leave the specimens unattended on the desk

NOTE: If the birthing parent is determined to be a candidate for Rh immunoglobulin based on the result of the Neonatal Investigation, the appropriate bloodwork will automatically be ordered in the birthing parent's chart

Other Neonatal Bloodwork from the Umbilical Cord:

- Umbilical cord blood may be collected in order to provide specimens for additional laboratory investigations for the newborn

- Umbilical artery cord blood samples are preferred, however, if unable to obtain adequate sample volume then umbilical venous cord blood sampling is acceptable
- Do NOT mix umbilical cord blood from different sources in a single collection tube
- Ensure samples are labelled appropriately with the correct source (see Documentation)

- Indications for additional blood work include:
  - Family/birthing parent history of bleeding disorders (e.g. hemophilia, thrombocytopenia, etc.)
  - Family/birthing parent history of hemoglobinopathies (e.g. sickle cell disease)
  - Birthing parent has Identified antibodies
  - Known or suspected fetal anemia
  - Known or suspected congenital or metabolic disorder of the fetus

Steps

Follow the same steps as for "Umbilical Cord Blood Collection for Rh Alloimmunization (Neonatal Investigation)" (as above), with these added specifications:

- The required amount of umbilical cord blood is a minimum 2 to 3 mL for each tube being collected (see Appendix C)
- Samples are sent to the Lab as soon as possible
  - If using the pneumatic tube system, specimens must be securely wrapped in bubble wrap and sent to the Lab (Station #07) – ensure specimens have left the sending station
  - If taking to the Lab in-person, proceed to Accessioning Desk and give directly to an attendant – do not leave the specimens unattended on the desk

Documentation

Specimen Labelling

- **Umbilical Cord Blood Gases** –
  - Pre-printed Lab labels (for blood only) from maternal chart – mark with source of collection (i.e. arterial vs venous), time of collection, initials of individual who performed the collection, and birth order (if applicable)
  - Pre-printed requisitions (vessel specific) – mark time of birth, time of collection, initials of individual who performed the collection, and birth order (if applicable)
- **Neonatal Investigations/Other Bloodwork** –
  - Pre-printed Lab labels (for blood only) from newborn's chart – mark with source of collection (i.e. cord blood arterial/venous), required investigation (e.g. NI, CBCD, etc.), time of collection, initials of individual performing collection, and birth order (if applicable)

CERNER PowerChart

- Review and mark as complete in Orders, Single Patient Task List, and CareCompass

- Interactive View and I&O →
    - Labour and Delivery Band → Delivery Information Nursing → Delivery Summary Information Nursing → Baby 'X' → Cord Blood Sent to Lab & Cord Blood pH Drawn
    - Labour and Delivery → Delivery Information Provider → Delivery Summary Information Provider → Baby 'X' → Cord Clamped

Other Forms

- British Columbia Resuscitation Record (if applicable)
- Fetal Scalp Lactate Audit Form (if applicable)

Patient and Family Education

- Review with patient and support person/family:
    - Explain the rational for the collection of the sample for umbilical cord blood gas analysis, neonatal investigation, and any other additional blood work.

- For Patients and families collecting umbilical cord blood for private use (Life Bank, etc.):
    - Explain the potential need to collect umbilical cord blood for gas analysis, neonatal investigation, and other additional blood work as a priority over the collection of umbilical cord blood for private collection

Related Documents

- B-00-12-10073 – Umbilical Cord Blood Collection: Private Collection
- B-00-13-10218 – Group and Screen Sample Collection: Patient Identification, Specimen Collection and Labelling

References

Armstrong & Stenson. (2006). Effect of delayed sampling on umbilical cord arterial and venous lactate and blood gases in clamped and unclamped vessels. Arch Dis Child Fetal Neonatal Ed, 91, F342-F345.

Backett, T. F. (2019). From tragedy to triumph: Canadian connections in the management of Rhesus hemolytic disease of the newborn. JOGC, 41 (2): S207-214.

BCRCP. (2005). Obstetric Guideline 6B Electronic Fetal Monitoring in Labour, Scalp Sampling, and Cord Blood Gases. Vancouver, BC: Author.

BCWH. (2019). Cord blood specimen: Collection. Vancouver, BC: Author.

BCWH. (2019). Delayed cord clamping. Vancouver, BC: Author.

BCWH. (2019). Umbilical cord blood gas analysis. Vancouver, BC. Author.

Calhoun, D. A. (2020). Postnatal diagnosis and management of hemolytic disease of the fetus and newborn. UpToDate (Accessed 07/22/2021).

Clarke, G. Hannon, J. (2018). Hemolytic disease of the fetus and newborn and perinatal immune

thrombocytopenia. Canadian Blood Services. (Accessed online 07/22/2021).

Desilets, V. et al. (2018). No 363 – Investigation and management of non-immune fetal hydrops. JOGC, 40 (8): 1077-1090.

Dore, S. & Ehman, W. (2020). No. 396 – Fetal health surveillance: Intrapartum consensus guideline. JOGC, 42(3): 316-348.

Fung, K. F. K., Eason, E. (2018). No. 133 – Prevention of Rh alloimmunization. JOGC, 40 (1) E1-E10.

Jefferies, A. L. (2017). Management of term infants at increased risk for early onset bacterial sepsis. Paediatr Child Health, 22 (4): 223-228.

Lemyre, B. et al. (2015, reaffirmed 2021). Minimizing blood loss and the need for transfusion in very premature infants. Paediatr Child Health, 20(8): 451-456.

Lowdermilk, D. L. et al. (2016). Maternity and women's health care (11th ed). Elsevier

Lynn & Beeby. (2007). Cord and placenta arterial gas analysis: the accuracy of delayed sampling. Arch Dis Child Fetal Neonatal Ed, 92, F281-F285.

Nudelman, M.J.R., et al. (2020). Effect of delayed cord clamping on umbilical blood gas values in term newborns: A systematic review. Obstet Gynecol 2020; 135:576.

PHSA Laboratory Services. (2014). Providence Sites, Transfusion Medicine Laboratory Manual. Author.

PSBC. (2011). Core competencies and decision support tools: Management of labour in an institutional setting if the primary maternal care provider is absent. Vancouver, BC: Author.

Simhan, H. (2021). Umbilical cord blood acid-base analysis at delivery. UpToDate.(Accessed 07/16/2021).

SOGC Policy Statement. (2000). Attendance at labour and delivery guidelines for obstetrical care. JOGC, 22 (5): 389-391.

Valero, Desantes, Perales-Puchalt, Rubio, Diago Almela & Perales. (2012) Effect of delayed umbilical cord clamping on blood gas analysis. EJOG, 162:1, 21-23.

VCH Professional Practice. (2013). Maternal – Infant Investigations: RhIg Eligibility, Hemolytic Disease of the Newborn (HDN) [D-00-12-30094]. Author.

Wiberg, Kallen & Olofsson. (2008) Delayed umbilical cord clamping at birth has effects on arterial and venous Blood gases and lactate concentrations. BJOG, 115, 697-703

Wilson, R. D. (2017). 'New or enhanced' third stage delivery protocol for neonatal benefits. JOGC, 39 (6): 471-473.

Zwingerman, R. et al. (2015). Alloimune red blood cell antibodies: Prevalence and pathogenicity in a Canadian prenatal population. JOGC, 37 (9): 784-790.

Appendices

- Appendix A – Obtaining a Double Clamped Cord Section for Umbilical Cord Blood Gas Analysis
- Appendix B – Cord Blood Acid-Base Values
- Appendix C – Laboratory Investigation Collection Tubes for Common Neonatal Indications

Appendix A – Obtaining a Double Clamped Cord Section for Umbilical Cord Blood Gas Analysis

Double clamp the umbilical cord at least 10 cm and again at 3–4 cm from the baby's abdominal wall. Cut the cord between the double clamps with sterile scissors. Collect cord blood gases from the isolated section immediately or set aside for later sampling.

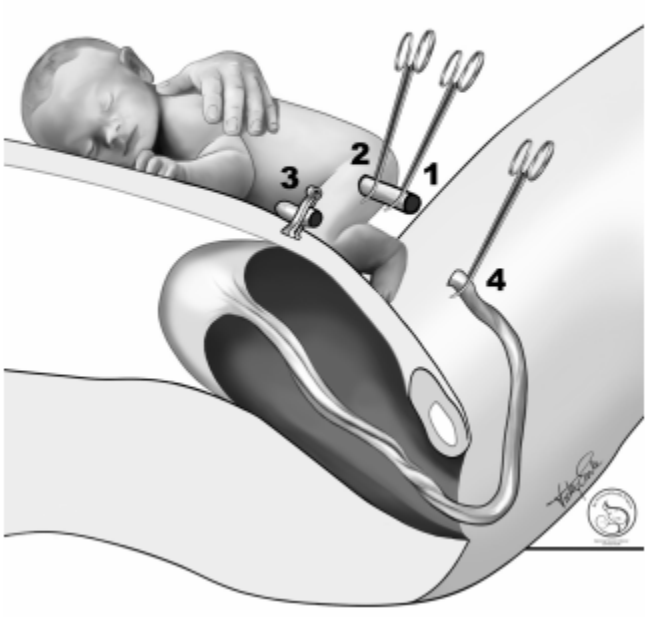

Image from PSBC (2011) Managing Labour Decision Support Tool No. 6: Birth in the Absence of a Primary Care Provider

Appendix B - Cord Blood Acid-Base Values

Reported Tests	Arterial Cord Reference range in Cerner:	Venous Cord Reference range in Cerner:
pH	7.20 – 7.34	7.28 – 7.40
P_{CO_2} (mmHg)	39 - 61	33 - 49
P_{O_2} (mmHg)	None	None
HCO_3 (mmol/L)	18 - 26	19 - 24
Base Deficit (mEq/L)	0.0 – 5.5	0.0 – 4.4
Total Hemoglobin	None	None

Type of Acidosis	pH	P_{O_2}	P_{CO_2}	HCO_3	Base Deficit
Respiratory	Decreased	Variable	Increased	Normal	Normal
Metabolic	Decreased	Decreased	Normal	Decreased	Increased
Mixed	Decreased	Decreased	Increased	Decreased	Increased

P_{CO_2} = partial pressure of carbon dioxide

P_{O_2} = partial pressure of oxygen

HCO_3 = bicarbonate

Tables adapted from SOGC Consensus Guideline No. 396

Appendix C – Laboratory Investigation Collection Tubes for Common Neonatal Indications

Fill parameters for 3 mL lab tubes

Investigation	Tube	Instructions
Coagulation Investigations/ Factor Levels	Light Blue Top (Sodium Citrate)	Must be exactly 2.7 mL - allow tube to fill completely to frosted circle at top of tube
Bilirubin	Light Green Top (Plasma tube)	Minimum 2 mL
CBCD/Platelets	Lavender Top (EDTA Tube)	Minimum 1 mL – less will result in OVER Anticoagulation of the sample
Other investigations	Contact the Lab for specifications, or consult the PHC Laboratory Test Directory	

NOTE: Ensure that tubes are adequately mixed IMMEDIATELY by gently inverting back and forth 5 to 7 times for each tube in order to avoid clotting.

Persons/Groups Consulted:

Laboratory Technical Coordinators – Hematology, Chemistry

Hematopathologist

Medical Biochemist

Technical Lead Transfusion Medicine

Pediatrician

Department Head Obstetrics and Gynecology

Project Manager, Patient and Family Centered Care

Patient Care Manager, Maternity Centre

Developed By

Maternity Quality and Safety Committee

Nurse Educator, Maternity Centre

First Released Date:	Revised from B-00-07-10033, B-00-07-10047, B-00-12-10036 31-AUG-2021
Posted Date:	31-AUG-2021
Last Revised:	
Last Reviewed:	
Approved By:	PHC
	Professional Practice Standards Committee Maternity Quality Safety Committee
Owners:	PHC
	Maternity