MATERNITY UNIT  
GUIDELINE:

UMBILICAL CORD BLOOD GAS ANALYSIS COLLECTION

SCOPE:
This guideline applies to all midwives, nurses and obstetricians working in the maternity unit and theatre.

AUTHOR:
Midwifery Educator

PURPOSE:
Umbilical cord blood gas analysis, performed for the evaluation of the newborn’s acid-base status immediately after delivery, is an objective way of assessing newborn condition at birth and may help in the management of neonatal care. The information can also be useful from medico legal standpoints since it provides insight into intrapartum fetal physiology and, if normal, excludes perinatal asphyxia or hypoxia secondary to the birth process.

Performing cord blood gas analysis at birth may predict short-term neonatal complications, and may be useful for evaluation of perinatal care, but the predictive value of cord blood pH on long-term childhood development is limited.

DEFINITIONS:

APGAR score:
Apgar scoring has been used as a systematic tool to assess and document the clinical status of the newborn at birth, or more precisely at 1 and 5 minutes of life. The newborn is examined for five signs: breathing, heart rate, muscle tone, reflex irritability and colour. The score may be affected by factors such as drugs given to the mother, anaesthetics, fetal infection, fetal anomalies and prematurity.

<table>
<thead>
<tr>
<th>Sign</th>
<th>Score</th>
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<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Heart rate</td>
<td>Absent</td>
</tr>
<tr>
<td>Respirations</td>
<td>Absent</td>
</tr>
<tr>
<td>Reflex irritability</td>
<td>No response</td>
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<tr>
<td>Muscle tone</td>
<td>Limp/absent</td>
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<tr>
<td>Colour</td>
<td>Blue-gray or pale all over</td>
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- Acidaemia = a low pH in the blood
- Acidosis = a low pH in the fetal blood and tissues
- Respiratory acidaemia = a low pH in the blood which is due to the accumulation of Carbon Dioxide (CO₂)
- Hypoxaemia = low oxygen tension in the blood (a low pO₂)
- Hypoxia = a low oxygen level in the fetal tissues

**GUIDELINE:**

There are a number of measures that can be used to assess newborn condition:

1. History of antenatal and intrapartum events;
2. APGAR scoring (designed to assess which babies need resuscitation, not why);
3. The need for resuscitation;
4. Neonatal behaviour;
5. Cord blood gas and base results

Cord blood gas analysis, if performed with a good technique and analysis, will give the same results even if taken by different people. APGAR scores can be subjective and may differ depending upon who is scoring. Cord blood gas analysis will be valuable if the samples are correctly taken, correctly measured and the results correctly interpreted.

There is no consensus on the indications for umbilical cord blood gas analysis post delivery, but it is reasonable to consider performing cord blood gas analysis after the following births, or at the obstetrician’s discretion:

- an infant with an abnormal fetal heart rate pattern on cardiotocograph (CTG) whether born vaginally or by emergency caesarean section – even if baby is born in good condition with a good APGAR score;
- baby’s condition is poor;
- meconium stained liquor and baby needing resuscitation at birth.
- Instrumental delivery
- Shoulder dystocia
- Vaginal breech delivery
- APGARS <7 at 5 minutes
- Emergency caesarean section
- Small for gestational age baby
- Intrapartum haemorrhage
- Intrapartum fever
- Multiple gestations
- Known fetal anomaly, planned neonatal admission
- Request for paediatrician present at birth

The responsibility for requesting the cord blood sample rests with the obstetrician or midwife conducting the birth. It is recommended that two midwives should be present at all vaginal births at Hauora Tairawhiti, with the second midwife responsible for neonatal resuscitation as required.
In theatre, the responsibility for taking cord blood gases rests with the obstetrician or a delegated midwife, not theatre staff. The primary responsibility of the midwife in theatre is the resuscitation of the baby as required, however if the infant is stable, she may be asked to draw gases.

**Technique:**

1. A 10 to 20cm segment of umbilical cord is doubly clamped *as soon as possible after the birth, first clamp attached nearest placenta. This allows the cord to fill from the baby and provides a better sample*. Any delay in clamping the cord may significantly affect pH and gas values as a result of gaseous diffusion and continuing metabolism.

   **Note:** If delayed cord clamping is practised as well as cord blood gas sampling, times should be carefully noted because the blood gas results will change with the time. In theatre, the obstetrician will call out the time and the midwife or theatre staff will make note.

2. Blood is drawn from *an umbilical artery (one of the two small vessels carrying de-oxygenated blood to the placenta) AND the umbilical vein (the large single vessel carrying oxygenated blood from the placenta to the fetus)* in separate, specifically designed, blood gas syringes.

3. Draw the blood with the heparinized syringe nearly parallel to the vessel to prevent puncturing the back wall of the vessel and taking an incorrect sample. Fill the syringe if possible.

4. Arterial blood will be darker than venous blood (oxygenated), and there should be a mean difference in pH results of at least 0.03 units.

5. Be careful not to collect air bubbles in the syringe – any collecting should be expelled if possible as they could alter the results.

6. Once the samples have been taken, the needles are removed (and the sharps disposed of appropriately) and the syringes capped. The syringe should be rolled briskly to mix the blood with the heparin. Wipe the outside of the tube if there is any blood present.

7. The clamped section of cord may be left for *up to half an hour at room temperature and the acid-base balance will not alter significantly. The blood is also unlikely to clot. If a longer delay is anticipated, place the section of cord in a refrigerator or on ice.*

8. The obstetrician/midwife needs to identify which sample is arterial and which is venous.

9. The specimens can be labelled prior to obtaining baby registration as follows:
   a. Use 2 blank labels
   b. Record ‘Baby of …’ (mothers forename and surname but NOT NHI number), & date of baby’s birth and attach one to each tube and the laboratory request form with the required information if sending to TLab.
   c. Type of sample i.e. arterial or venous cord blood to be written on laboratory form along with usual details e.g. time sample taken, signatures etc. The request should be for pH and base excess.

10. An orderly should be paged by an appropriate person, to take the ‘urgent blood gas samples’ to the laboratory (within 10 minutes) in normal working hours (0800hrs - 1630hrs Monday to Friday), or to Emergency Department or ICU using the i-STAT analysers out of hours. During normal working hours, the theatre orderly may be asked to take the sample to the laboratory.

11. If the sample cannot be transported within 30 minutes, then it should be kept ‘on ice’ and transported to the laboratory/ED/ICU as soon as possible.

12. The specimens should be handed to a relevant member of staff requesting urgent processing and testing.

13. If the samples are taken to ED or ICU, the print out from the iSTAT should be stapled to the request form for the laboratory and labelled as stated in point 9.
14. If difficulty is encountered in obtaining umbilical blood samples, the vessels on the fetal surface of the placenta may be utilised (arteries cross over veins) and will provide similar, but not necessarily equivalent, results.

15. As soon as the baby is registered and has an NHI number, this should be phoned through to the laboratory.

16. The samples will be processed and results may be given if requested over the telephone, but they will not be placed onto Hauora Tairawhiti Clinical Views until the baby’s NHI number is phoned through to the laboratory.

17. If the samples are tested in ED or ICU, the print-out of results must be stapled to the baby’s clinical record along with a written entry in the notes or electronic record as the print-out may fade over time.

**Results Range:**

Arterial blood will best represent the condition of the fetus as it has just left the fetus but having venous blood too may give additional information. If only a single specimen is available, you cannot be sure if this is an arterial sample.

The difference in arterial and venous pH may give some information as to the timing and/or cause of the acidaemia:

- The mean difference is 0.08 units.
- If a previously healthy fetus has become acidaemic because of a second stage problem (acute problem, cord compression), the A-V difference is often large.
- If the acidaemia occurs due to a more longstanding problem, both arterial and venous pH tends to be low and the A-V difference is small.

A very small difference of <0.3 units suggests that there is NOT a paired sample.

The range (mean + 2.5 and 97.5th centiles) of **Umbilical Artery** Blood pH and gas values in newborns is:

<table>
<thead>
<tr>
<th>pH</th>
<th>7.26 (7.05 – 7.38)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCO2 (mmHg)</td>
<td>7.3 (4.9 – 10.7)</td>
</tr>
<tr>
<td>Base excess (mEq/L)</td>
<td>-2.5 to -9.7</td>
</tr>
</tbody>
</table>

The range (mean + 2.5 and 97.5th centiles) of **Umbilical Vein** Blood pH and gas values in newborns is:

<table>
<thead>
<tr>
<th>pH</th>
<th>7.35 (7.17 – 7.48)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCO2 (mmHg)</td>
<td>5.3 (3.5 – 7.9)</td>
</tr>
<tr>
<td>Base excess (mEq/L)</td>
<td>-1.0 to -8.9</td>
</tr>
</tbody>
</table>

Metabolic acidaemia at birth is defined as pH<7.00 and a base deficit of >16 mmol/L.

Metabolic acidosis results in excess production of acid and decreased buffer base, which is referred to as the base deficit or negative base excess. Base deficit does not significantly change during respiratory acidosis.

A pH of 7.00 is seen as a reasonable threshold for significant or ‘pathologic fetal acidaemia’. A base deficit >12mmol/L suggests metabolic acidosis and is associated with an increased risk of neonatal morbidity.
The risk of neonatal morbidity is inversely related to the pH, with the highest risk at the lowest pHs, especially less than 6.9.

Fetal blood gas analysis has some limitations that should be considered when interpreting results. A cord blood pH value alone does not distinguish between a primary fetal or placental disorder and the indirect effect of a maternal acid-base disorder.

**Delayed Cord Clamping:**
Delayed cord clamping is now a commonplace practice. It allows for 21% of the neonate’s final blood volume to transfuse to the baby. This is unaffected by use of oxytocics or the position of the baby relative to the placenta. Three quarters of the transfusion occurs in the first minute. A delay in cord clamping does affect both the arterial and venous blood gases, as well as lactate levels. Despite a rise in pO2 when an infant starts to breathe, a trend towards a mixed respiratory and metabolic acidemia is seen. The hypoxic stress of labour causes a redistribution of foetal blood flow away from the periphery and viscera to vital organs. After birth, vascular beds in hypoperfused non-priority organs are perfused and accumulated anaerobic metabolites flood into the central circulation. Once ventilation is established, PaCO2 drops rapidly but the fixed acids accumulate and lead to further decrease in bicarbonate and base excess. Timing of delivery and timing of cord blood sampling should also be noted, as the longer the interval, the greater the potential changes in gases.

**Neonatal Care:**
A baby may be born in excellent condition but have abnormal cord blood gas results – **these babies will need to be observed for 24 hours in hospital as they may be at risk of hypoglycaemia.** A paediatric referral should be made in these cases.

Approximately 2% of all births may be complicated by metabolic acidemia, but the vast majority of such infants will not develop cerebral palsy. If the cord blood pH is low, consideration should be given to repeating blood gas analysis from the infant within 2 hours of birth.

Conversely, a baby may be born in poor condition but with normal cord blood gas results – in this case it is important to consider causes other than hypoxia, e.g. congenital abnormalities.

**ASSOCIATED DOCUMENTS:**
- Hauora Tairawhiti Organisational Guideline - Laboratory Specimen Transport
- Maternity Unit Guideline - Management of Babies Born with Meconium Stained Liquor
- Maternity Unit Guideline - Referral of Neonates to the Paediatric Service
- Maternity Unit Guideline - Neonatal Resuscitation
- Appendix 1 - Procedure for Collection of Umbilical Cord Blood Bas Analysis in Theatre

**REFERENCES:**

Authorised By:

__________________________
HOD Obstetrics

__________________________
Clinical Care Manager, Woman, Child and Youth

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Next Review Date: November 2018
APPENDIX 1:

PROCEDURE FOR COLLECTION OF UMBILICAL CORD BLOOD GAS ANALYSIS IN THEATRE

Specific syringe/s supplied by Maternity and kept in C/S cot

Syringe/s given to circulating nurse and opened on sterile tray

Blood sample/s taken by Obstetrician, needle is removed and syringe capped
O & G to identify whether arterial and/or venous sample/s

Syringe with sample handed back to circulating nurse

Handed to hospital midwife if able to receive

If midwife unable to receive circulating nurse will put sample on ice until it can be processed

Samples labelled using recommended cord gas labels by midwife
Baby of + DOB and time of birth and time of specimen collection – NO maternal NHI – form completed

Orderly rung to take specimen to lab/or after hours alternative by midwife when possible

Baby’s NHI number is phoned through to lab when available – ASAP
Enter in MCIS that cord blood gases were taken.
Follow up results once processed.

See full guideline for further information