

# **AARC Clinical Practice Guideline**

## **Capillary Blood Gas Sampling for Neonatal & Pediatric Patients**

### **CBGS 1.0 PROCEDURE:**

Capillary sampling for blood gas analysis

### **CBGS 2.0 DESCRIPTION:**

Capillary blood gas (CBG) samples may be used in place of samples from arterial punctures or indwelling arterial catheters to estimate acid-base balance (pH) and adequacy of ventilation (PaCO<sub>2</sub>). (1-3) Capillary PO<sub>2</sub> measurements are of little value in estimating arterial oxygenation. (4-6)

A puncture or small incision is made with a lancet or similar device into the cutaneous layer of the skin at a highly vascularized area (heel, finger, toe). (The lancet may be used freehand or as part of a device that limits puncture depth.) To accelerate blood flow and reduce the difference between the arterial and venous gas pressures, the area is warmed prior to the puncture. As the blood flows freely from the puncture site, the sample is collected in a heparinized glass capillary tube. (7-9)

### **CBGS 3.0 SETTING:**

Capillary sampling may be performed by trained health care personnel in

**3.1** Acute care hospitals,

**3.2** Clinics,

**3.3** Physician offices,

**3.4** Extended care facilities,

**3.5** Homes.

#### **CBGS 4.0 INDICATIONS:**

Capillary blood gas sampling is indicated when

**4.1** Arterial blood gas analysis is indicated but arterial access is not available.

**4.2** Noninvasive monitor readings are abnormal: transcutaneous values, end-tidal CO<sub>2</sub>, pulse oximetry.

**4.3** Assessment of initiation, administration, or change in therapeutic modalities (ie, mechanical ventilation) is indicated.

**4.4** A change in patient status is detected by history or physical assessment.

**4.5** Monitoring the severity and progression of a documented disease process is desirable.

#### **CBGS 5.0 CONTRAINDICATIONS:**

**5.1** Capillary punctures should not be performed

**5.1.1** at or through the following sites:(10)

**5.1.1.1** posterior curvature of the heel, as the device may puncture the bone;  
(11)

**5.1.1.2** the heel of a patient who has begun walking and has callus  
development;(12)

**5.1.1.3** the fingers of neonates (to avoid nerve damage);(13)

**5.1.1.4** previous puncture sites;(14,15)

**5.1.1.5** inflamed, swollen, or edematous tissues;(14,15)

**5.1.1.6** cyanotic or poorly perfused tissues;(14,15)

**5.1.1.7** localized areas of infection;(14,15)

**5.1.1.8** peripheral arteries.

**5.1.2** on patients less than 24 hours old, due to poor peripheral perfusion;(1)

**5.1.3** when there is need for direct analysis of oxygenation;(1-3)

**5.1.4** when there is need for direct analysis of arterial blood;

**5.2** Relative contraindications include

**5.2.1** peripheral vasoconstriction;(1)

**5.2.2** polycythemia (due to shorter clotting times);(1)

**5.2.3** hypotension may be a relative contraindication.(1)

## **CBGS 6.0 HAZARDS/COMPLICATIONS:**

**6.1** Infection

**6.1.1** Introduction of contagion at sampling site and consequent infection in patient, including calcaneus osteomyelitis(9,16) and cellulitis

**6.1.2** Inadvertent puncture or incision and consequent infection in sampler

**6.2** Burns

**6.3** Hematoma

**6.4** Bone calcification(14)

**6.5** Nerve damage(9)

**6.6** Bruising

**6.7** Scarring(12)

**6.8** Puncture of posterior medial aspect of heel may result in tibial artery laceration(11)

**6.9** Pain

**6.10** Bleeding

**6.11** Inappropriate patient management may result from reliance on capillary PO<sub>2</sub> values.  
(17,18)

## **CBGS 7.0 LIMITATIONS OF METHOD/ VALIDATION OF RESULTS:**

**7.1** Limitations

**7.1.1** Inadequate warming of the site prior to a puncture may result in capillary values that correlate poorly with arterial pH and PCO<sub>2</sub> values.(19,20)

**7.1.2** Undue squeezing of the puncture site may result in venous and lymphatic contamination of the sample.(14)

**7.1.3** A second puncture may be needed to obtain an adequate amount of blood for analysis.

**7.1.4** Variability in capillary PO<sub>2</sub> values precludes using these samples for assessing oxygenation status.(1,2,3,18,20,21)

## **7.2** Validation of results

**7.2.1** Sample must be anticoagulated and obtained anaerobically with capillary tube filled completely and air bubbles expelled immediately. Sample should be immediately chilled or analyzed within 10-15 minutes if left at room temperature.(22)

**7.2.2** A respiratory assessment of the patient should be documented in the medical record at the time a capillary sample is performed (See 11.0 Monitoring).

**7.2.3** An arterial sample may be analyzed to compare with the capillary pH and PCO<sub>2</sub> values.

## **CBGS 8.0 ASSESSMENT OF NEED:**

Capillary blood gas sampling is an intermittent procedure and should be performed when a documented need exists. Routine or standing orders for capillary puncture are not recommended. The following may assist the clinician in assessing the need for capillary blood gas sampling:

**8.1** History and physical assessment;(23)

**8.2** Noninvasive respiratory monitoring values

**8.2.1** Pulse oximetry;(23)

**8.2.2** Transcutaneous values;

**8.2.3** End-tidal CO<sub>2</sub> values;

**8.3** Patient response to initiation, administration, or change in therapeutic modalities;(23-25)

**8.4** Lack of arterial access for blood gas sampling.(1-3)

## **CBGS 9.0 ASSESSMENT OF TEST QUALITY:**

Sampling of capillary blood is useful for patient management only if the procedure is carried out according to an established quality assurance program. The validity of the test may be jeopardized if any of the following occur:(10,26,27)

**9.1** The sample is contaminated by air;

**9.2** Clots prevent accurate analysis;

**9.3** Quantity of sample is insufficient for analysis;

**9.4** Analysis of sample is delayed (> 15 minutes for samples at room temperature, or > 60 minutes for samples held at 4°C).(22)

## **CBGS 10.0 RESOURCES:**

**10.1 Equipment:** Single puncture-preheparinized glass capillary (eg, Natelson) tubes, metal fleas, magnet, clay/wax sealant or caps, lancet to make incision < 2.5 mm in depth, gauze/cotton balls, ice, gloves, skin antiseptic, warm and moist cloth/diaper or commercially prepared warming pads (42°C), sharps container, labeling materials(10)

**10.2 Personnel:** Capillary sampling must be performed under direction of a physician. Individuals who perform capillary sampling should have a background in mathematics and science and specific training in capillary blood sampling and related procedures. They must competently demonstrate capillary blood gas sampling and undergo periodic skills assessment of technique: implementation of Universal Precautions; success at obtaining a quality sample; preparation, storage and transport of specimens; documentation; and post sampling site care and/or complication rate.(10,28,29)

## **CBGS 11.0 MONITORING:**

The following should be monitored and documented in the medical record as part of the capillary sampling procedure:

**11.1** FIO<sub>2</sub> or prescribed oxygen flow;(10,23,28,29)

**11.2** Oxygen administration device or ventilator settings;(10,23,27,28)

**11.3** Free flow of blood without the necessity for 'milking' the foot or finger to obtain a sample;(10,14)

**11.4** Presence/absence of air or clot in sample;(10,26,27)

**11.5** Patient temperature, respiratory rate, position or level of activity, and clinical appearance;(10,27)

**11.6** Ease or difficulty of obtaining sample;(10,27,28)

**11.7** Appearance of puncture site;(14,15)

**11.8** Complications or adverse reactions to the procedure;

**11.9** Date, time, and sampling site;(10)

**11.10** Noninvasive monitoring values: transcutaneous O<sub>2</sub> & CO<sub>2</sub>, end-tidal CO<sub>2</sub>, and/or pulse oximetry;(23)

**11.11** Results of the blood gas analysis.

## **CBGS 12.0 FREQUENCY:**

The frequency of capillary sampling should depend upon the clinical status of the patient and the indications for performing the procedure, not upon a prescribed frequency.

**12.1** Those patients requiring frequent CBGs should be considered candidates for placement of an indwelling arterial access for blood gas sampling or noninvasive monitoring techniques, to limit trauma associated with repeated punctures.

**12.2** Repeated puncture of the foot/finger increases the risk of scarring or serious laceration. Care should be exercised to alternate the sampling site for patients requiring multiple punctures.(14,15)

## **CBGS 13.0 INFECTION CONTROL:**

**13.1** Universal Precautions as published by the Centers for Disease Control and directives issued by the Department of Labor concerning occupational exposure to blood-borne pathogens must be followed during capillary sampling.(29,30)

**13.2** Aseptic techniques should be employed due to the invasive nature of this procedure. Punc-ture site should be cleaned with antiseptic solution.(10)

**13.3** Blood specimens, contaminated materials, and lancets must be disposed of in appropriate containers.(29)

**13.4** Gloves should be worn by caregivers to protect against blood splashes on sores or skin breaks.(29)

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