

Beaumont Laboratory

Clinical Pathology

Grosse Pointe, MI 48230

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Related Documents:

GC.CH.ABL.SOP.001, ABL 825 SOP

**BLOOD GASES: Arterial and Venous Blood Gas, Arterial and Venous
Cord Blood Gas, Mixed Venous Blood Gas, Capillary Blood Gas,
Critical Care Panel 1,2 & 3**

RADIOMETER ABL 825

GC.CH.ABL.PR.002.r06

Purpose

The purpose of the procedure is to provide staff with instruction and information for analyzing, performing and resulting various arterial and venous blood gas tests.

Introduction

The Radiometer ABL 825 is used for the determination of Arterial Blood gases, Arterial and Venous Cord blood gases, Capillary blood gases and Critical Care Panels 1, 2 and 3. Methodologies of the tests include Potentiometric, Amperometric, and Absorbance spectrophotometry.

The ABL 825 calculates HCO_3^- , Total CO_2 , Base Excess (BE), and O_2ct using measured parameters.

A. Arterial or Mixed Venous Blood gases

The measurement of **Arterial or Mixed Venous Blood gases** includes pH, PCO_2 , PO_2 , Base Excess, Bicarbonate, Total CO_2 , Total Hemoglobin, Oxyhemoglobin, Methemoglobin, Carboxyhemoglobin, Sulfhemoglobin (if present) and O_2 content.

B. Arterial and Venous Cord Gases

The measurement of **Arterial and Venous Cord Gases** includes pH, PCO_2 , PO_2 , Base Excess, Bicarbonate, Total CO_2 , Oxyhemoglobin and Total hemoglobin.

C. Capillary Blood Gas

The measurement of a **Capillary Blood gases** includes pH, PCO_2 , PO_2 , Base Excess, Bicarbonate, Total CO_2 , Total hemoglobin, Methemoglobin, Carboxyhemoglobin and Sulfhemoglobin (if present). **Sulfhemoglobin** results do not display on the ABL 825, unless Sulfhemoglobin is present. These tests are resulted on the **LAB RESULTS** screen of the Instrument Menu. Use the "Keypad" and select, None Detected, <1% detected or > 1% Detected

D. Critical Care Panels 1, 2 and 3 (Arterial Specimen Only)

The measurement of **Arterial Critical Care Panel 1** includes the same as a blood gas plus Sodium, Potassium, Chloride and Ionized Calcium

The measurement of **Arterial Critical Care Panel 2** includes the same plus Glucose, Sodium, Potassium, Chloride and Ionized Calcium

The measurement of **Arterial Critical Care Panel 3** includes the same as a blood gas plus Glucose.

Clinical Significance

Clinical management of respiratory and metabolic disorders and of patients undergoing surgical correction of cardiopulmonary disorders has been greatly improved by the development of instrumentation for rapid, accurate measurements of oxygen and carbon dioxide in blood and expired air. The determination of blood gases and pH also plays an important part in the detection of acid-base imbalance and in following the effects of therapy.

Specimen Collection

Whole blood, anticoagulated with dry heparin is the specimen of choice.

Specimens submitted for blood gas analysis, (arterial and venous) must be received in a 1 mL to 3 mL plastic syringe containing dry heparin. The specimen must be transported to the laboratory within 30 minutes at room temperature or on ice within 60 minutes from the time of collection.

Capillary specimens must be collected in a plastic capillary tube containing dry heparin. These specimens must be transported to the laboratory in crushed ice within 60 minutes from their time of collection.

Specimen must **not** contain a needle at any time. If a needle is present, take precautions to remove needle carefully. An external PSQI variance report **must** be written for any sample with needle.

All specimens must be analyzed immediately upon receipt.

Rejection Criteria:

Samples should be rejected and cancelled if they fall within one of these categories:

- Unlabeled syringe
- Sample with large air bubbles
- Clotted samples
- Samples received greater than 60 minutes if not on ice.
- Samples received greater than 30 minutes if at room temperature.

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Exception: Irretrievable sample: Refer to Criteria for specimen rejection procedure (G. PY.OP.007)

NOTE: Irretrievable samples include:

- Cord blood gases
 - Blood gas drawn by arterial puncture
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Calculations

The ABL 825 calculates HCO_3^- , Total CO_2 , Base Excess (BE), and O_2ct using measured parameters.

Sample volume

The optimum sample volume when performing an arterial or venous blood gas is 195 μL . The minimum volume required is 85 μL . The optimum sample volume when performing a capillary blood gas is 85 μL . The minimum volume required is 55 μL .

Limitations/Interfering Substances

1. Halothane use in anesthesia causes unreliable PO_2 results due to reduction of halothane by the PO_2 electrode.
2. Lipid therapy and protamine sulphate used in treatments may interfere with oximetry measurements.
3. Methylene Blue used as medication may interfere with oximetry measurements.

Other Limitations

1. Analyzing specimens in EDTA will interfere with Ionized Calcium results. Always initiate a Cleaning followed by a Rinse procedure after analyzing a specimen with EDTA.
 2. An error occurring in the "Note" section of the result print-out, may cause an analyte the inability to be calculated. If not calculated, the result will not appear on the result printout. Ex: O_2ct . Result as "Unable to perform".
 3. Any test with a (?) next to the result must be resulted as "Unable to Perform, possible interference".
 4. Any specimen greater than one hour old, as well as: clotted, large air bubbles or quantity not sufficient will not be analyzed and must be cancelled.
 5. Any syringe containing a needle will be analyzed, and a variance will be written after analysis.
 6. Any syringe with cap off of specimen during transportation will not be analyzed and must be cancelled.
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Precautions

Universal Standard Precautions should be observed when handling patient samples.

Reagents Calibrators

All reagent solutions and gases are supplied by Radiometer America, Inc.

Reagent/Cal	Use	Contains	Unopened Stability	Opened Stability
S1820 Calibration Solution 1	Calibrate pH and metabolite electrodes	Contains K^+ = 4 mmol/L, Na^+ = 145 mmol/L, Ca^{2+} = 1.25 mol/L, Cl^- = 102 mmol/L, glucose = 10 mmol/L, lactate = 4 mmol/L, a buffer which maintains a pH of 7.4, preservatives and surfactants.	Manufacturer Exp stated on the bottle if stored between 2 - 25°C.	4 weeks when stored between 2 - 25°C.
S1830 Calibration Solution 2	Calibrate pH and metabolite electrodes	K^+ = 40 mmol/L, Na^+ = 20 mmol/L, Ca^{2+} = 5 mmol/L, Cl^- = 50 mmol/L, a buffer which maintains a pH of 6.8, preservatives and surfactants	Manufacturer Exp stated on the bottle if stored between 2 - 25°C.	8 weeks if stored between 2 - 25°C
S4980 Rinse Solution	Rinse the analyzer	Salts, a buffer, preservatives and surfactants	Manufacturer Exp stated on the bottle if stored between 2 - 25°C.	Stable for 6 months
S7385 Cleaning Solution	Used during the cleaning procedure	Salts, a buffer, preservatives and surfactants	Exp. date on the bottle	2 months when stored between 2 - 32°C.
Gas 1	Used to calibrate PCO_2 and PO_2	33L of gas at 500 psi. 19.76% O_2 , 5.6% CO_2 & 74.64% N_2	Exp date on the tank	Exp date on the tank
Gas 2	Used to calibrate PCO_2 and PO_2	10L of gas at 140 psi. <0.04% O_2 , 11.22% CO_2 , & 88.78% N_2	Exp date on the tank	Exp date on the tank
S7770 tHb Cal Solution	Calibration of tHB	Salts, Buffer, Preservative and color agent	Manufacturer exp date on bottle, if stored at 2 - 32°C	2 months onboard instrument

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See Maintenance Procedure for loading of any of these solutions on to the ABL 825.

Calibration

The ABL 825 automatically calibrates all parameters, except hemoglobin, using calibration solutions 1 and 2, and calibration gases 1 and 2; supplied by Radiometer America, Inc.

The analyzer performs a:

- One point gas calibration every 30 minutes
 - One point calibration every 4 hours and a
 - Two point calibration every 8 hours
 - The operator may also initiate a calibration manually
 - The spectrophotometer is manually calibrated every three months using the Hgb calibration solution supplied by Radiometer America, Inc.
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Quality Control

Three levels of AutoCheck5+, Level 1, Level 2 and Level 3, quality control, supplied by Radiometer America, one level per shift, and three levels in a 24 hour period. Quality Control is also required post analyzer maintenance and as warranted for troubleshooting.

AutoCheck5+ is an assayed quality control system for evaluating the accuracy and precision of all parameters listed in the introduction of this procedure.

Procedure and Resulting/QC

The following procedure should be followed when processing samples on the Radiometer ABL 825. Measurements can be made manually or with the FlexQ.

Manual Measurements of a blood sample

1. Instrument Menu restarts every night at midnight.
2. The ABL 825 must be in the “ready” mode before the instrument will accept a sample.
3. Mix sample appropriately before analyzing. Roll between palms until mixed well or place on automatic mixer.
4. Once mixed, lift the inlet flap and place syringe tip or capillary into the inlet, or hold vacuum tube up to the inlet.
5. There are two inlet flaps on the front of the instrument. The inlet flap for a syringe, a vacuum tube or Quality control material is on the left and the inlet flap for a capillary specimen is on the right.
6. Select desired mode, by pressing the appropriate touch key on the screen. Modes include specific tests:
 - Critical Care Panel 1
 - Critical Care Panel 2
 - Critical Care Panel 3
 - Cord Blood

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- ICA Only
 - Sample size to be analyzed.
 - Use 195 µL for a full syringe
 - 95 µL for a small sample size.
 - 195µL and 95µL are used for Arterial and Venous specimens.
7. There is a Mode for QC “Ampule QC”. Choose this mode for analyzing any level of QC. The instrument recognizes each level of QC.
 8. Press Start.
 9. The analyzer will automatically aspirate the sample and the patient ID screen will appear.
 10. Instrument will prompt operator when specimen has completed aspiration. Remove specimen and close inlet flap.
 11. Enter patient collection/accession number using the touch screen or bar code reader. Always scan the barcode that is on the specimen if at all possible.
 12. Results will cross over into LIS.
 13. Review results with printout and post/verify.
 14. If results are critical, they must be repeated and/or verified with previous results.
 15. All critical results must be called to the appropriate unit or may be verbally communicated to the respiratory therapist who has delivered the specimen to the lab.
 16. All arterial blood gas orders, excluding Cord blood gases, must include an FIO2 result. An FIO2 can be a % or LPM or both. This information should be available from the collector during order entry or collection.
 17. An error occurring in the “Note” section of the result printout, may cause an analyte the inability to be calculated. If an analyte is not calculated, the result will not appear on the result printout. Ex: O2ct.
Result as “Unable to perform, possible interference”.
 18. Any test with a (?) next to the result must be reviewed for accuracy. (?) next to a result may be due to QC failure or possible interference. If due to “QC failure”, repeat analyte on another instrument. If due to possible interference, enter as “unable to perform”.

Analytical Measuring Range

Parameter	Measuring Range
pH	6.787-7.837
pCO ₂	5.4-114 mmHg
pO ₂	30.3-647 mmHg
THb	0.0-24.0 g/dL
Na	77-178 mmol/L
Cl	36-127 mmol/L
FO ₂ Hb	1.1-99.8%
COHb	0.0-52.2%
MetHb	0.0-31%
Ion Ca	1.04-16.56 mg/dl
K	0.7-14.3 mmol/L
Glucose	0-1171 mg/dl

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Reference Range

A. Arterial Blood Gas Adult, Capillary Blood Gas, Critical Panels 1, 2 and 3

pH	7.35 - 7.45
pCO ₂ (mmHg)	35 - 45
pO ₂ (mmHg)	80 - 100
BE (mmol/L)	-2 - +2
HCO ₃ ⁻ (mmol/L)	23 - 29
TCO ₂ (mmol/L)	22 - 32
O ₂ Hb %	95 - 98
Ca ²⁺ (mg/dL)	4.48 - 5.28
O ₂ Con (Vol%)	18 - 21
Hgb (g/dL) male	13.5 - 17.0
Hgb (g/dL) female	12.1 - 15.0
COHb (%)	Non-smoker <1.5% Heavy smoker <9%
MetHb (%)	0 - 2
Sodium (mmol/L)	135 - 145
Chloride (mmol/L)	98 - 110

B. Mixed Venous Blood Gas

pH	7.32 - 7.42
pCO ₂ (mmHg)	41 - 51
pO ₂ (mmHg)	25 - 40
BE (mmol/L)	(-5) - (+5)
HCO ₃ ⁻ (mmol/L)	24 - 28
TCO ₂ (mmol/L)	22 - 32
O ₂ Hb %	40 - 70
O ₂ Con (Vol%)	18 - 21
Hgb (g/dL) male	13.5 - 17.0
Hgb (g/dL) female	12.1 - 15.0
COHb (%)	Non-smoker < 1.5% Heavy smoker <9%
MetHb (%)	0 - 2

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C. Arterial Cord Blood Gas

pH	7.18 - 7.38
pCO ₂ (mmHg)	32 - 66
pO ₂ (mmHg)	6 - 30
BE (mmol/L)	(-10) - (-2)
HCO ₃ ⁻ (mmol/L)	17 - 27

D. Venous Cord Blood Gas

pH	7.25 - 7.45
pCO ₂ (mmHg)	27 - 49
pO ₂ (mmHg)	17 - 41
BE (mmol/L)	(-10) - (-2)
HCO ₃ ⁻ (mmol/L)	12 - 28

Critical Ranges

A. Arterial Blood Gas

Critical Care Panels 1, 2 and 3

Parameter	Less Than	Greater Than
pH	7.2	7.6
pCO ₂	None	70
pO ₂	50	None
tHb	6.5	20.0
O ₂ Hb	85	
Na	120	160
FO ₂ Hb	None	None
COHb	None	20.0
TCO ₂	15	40
MetHb	None	9.9
Glucose	50	500
K	2.7	6.1

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B. Mixed Venous Blood Gas

Parameter	Less Than	Greater Than
pH	7.2	7.6
pCO ₂	None	None
pO ₂	None	None
tHb	6.5	20.0
FO ₂ Hb	None	None
COHb	None	20.0
TCO ₂	10	40
MetHb	None	9.9

C. Arterial and Venous Cord Blood Gas

None

References

1. Radiometer Medical A/S, ABL 800 Series Operator's Manual, 2008.
 2. Radiometer Medical A/S, ABL 800 Series Reference Manual, 2008.
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Authorized Reviewers

Laboratory Medical Director, Chemistry Medical Director, and Chemistry Supervisor

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Document Control

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 Master printed document stored in the section Supervisor's office.

Number of Controlled Copies posted for educational purposes: 1

Number of circulating Controlled Copies: 1

Location of circulating Controlled Copies: Radiometer Procedure Manual

Document History

Signature	Date	Revision #		Related Documents Reviewed/ Updated
Prepared by: K. Cousineau MT(ASCP)	2/13/2012			
Approved by: V. Pansare MD B. Muglia MD	3/22/2012 3/22/2012			
Reviewed by: (Signature)	Date	Revision #	Modification	Related Documents Reviewed/ Updated
B. Muglia MD	7/13/13	01	Addition of critical O2Hb	
B. Muglia MD	12/26/2013	02	Addition of critical Methemoglobin and Critical Care Panels 1, 2 and 3	
K. Cousineau MT(ASCP)	1/30/2014	03	Added modes to use for specific tests	
B. Muglia MD	8/13/2014	04	Glucose critical change to <50 for EC & IP: Age 2 - Adult. Reportable range change from <1 to <10	
Beatrice Muglia	6/30/2015	05	Reference Range change for CI and TCO2	
Beatrice Muglia	7/15/2015	06	Critical Range for Hgb change to <6.5	

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