

How to Interpret an ABG or VBG—and Why It Matters After Lung Transplant

Blood gases answer three urgent questions:

- 1. Is the patient acidemic or alkalemic?
- 2. Is the primary problem respiratory or metabolic?
- 3. Is ventilation and oxygenation adequate?

ACA Pearl: A VBG can help evaluate pH, bicarbonate, and the direction of CO₂ change—but a venous PO₂ does not tell you whether the lungs are oxygenating adequately.

ABG versus VBG

Measurement	ABG	VBG
pH	Most accurate	Usually slightly lower
PaCO ₂ /PCO ₂	Best for precise ventilation assessment	Useful for screening and trending
PaO ₂ /PO ₂	Measures arterial oxygenation	Do not use to assess oxygenation
HCO ₃ ⁻	Useful	Usually clinically comparable
Lactate	Useful	Often acceptable if collected and processed correctly
Best use	Hypoxemia, respiratory failure, ventilator changes, PGD grading	Acid-base screening, metabolic problems, routine trending

Obtain an ABG when accurate PaO₂ or PaCO₂ will change management, including worsening hypoxemia, suspected ventilatory failure, major respiratory distress, ventilator adjustment, severe acidemia, shock, or calculation of the PaO₂/FiO₂ ratio. Blood-gas analysis assesses oxygenation, ventilation, and acid-base status. AARC blood-gas guideline

Normal ABG reference ranges

Value	Typical range	What it represents
pH	7.35–7.45	Overall acid-base state
PaCO ₂	35–45 mmHg	Ventilation; respiratory component
HCO ₃ ⁻	22–26 mEq/L	Metabolic component
PaO ₂	Approximately 80–100 mmHg	Arterial oxygenation; interpret with age, FiO ₂ and clinical setting
Base excess	-2 to +2 mEq/L	Metabolic acid-base contribution

Reference ranges can vary slightly by laboratory.

The five-step interpretation

1. Check the pH

- pH <7.35: acidemia
- pH >7.45: alkalemia
- A normal pH does not exclude a mixed or compensated disorder.

2. Check the CO₂

- Think respiratory:
- High CO₂ pushes the pH down → respiratory acidosis.
- Low CO₂ pushes the pH up → respiratory alkalosis.

3. Check the bicarbonate

- Think metabolic:
- Low HCO₃⁻ pushes the pH down → metabolic acidosis.
- High HCO₃⁻ pushes the pH up → metabolic alkalosis.

4. Decide whether compensation is appropriate

- If the compensatory response is much greater or smaller than expected, suspect a second acid-base disorder.
- For metabolic acidosis: Expected PaCO₂ = (1.5 × HCO₃⁻) + 8 ± 2
- This is Winter's formula.
- Measured PaCO₂ above expected → additional respiratory acidosis.
- Measured PaCO₂ below expected → additional respiratory alkalosis.

5. Assess oxygenation—but only from an ABG

- Interpret PaO₂ with: FiO₂; oxygen-delivery device; PEEP or ventilator settings; SpO₂ waveform and reliability; hemoglobin; hemodynamics and perfusion; chest imaging and clinical trajectory.
- For an intubated or critically ill patient: P/F ratio = PaO₂ ÷ FiO₂
- Example: PaO₂ 80 on FiO₂ 0.40: 80 ÷ 0.40 = 200

ACA Pearl: Always document the oxygen device, flow or FiO₂, and ventilator support present when the gas was obtained. A PaO₂ without its FiO₂ has limited meaning.

Rapid pattern recognition

pH	CO ₂	HCO ₃ ⁻	Primary pattern
↓	↑	Normal or ↓	Respiratory acidosis
↑	↓	Normal or ↓	Respiratory alkalosis
↓	Normal or ↓	↓	Metabolic acidosis
↑	Normal or ↓	↑	Metabolic alkalosis

Why it matters after lung transplant

Respiratory acidosis

Pattern: Low pH with elevated CO₂.

- Hypoventilation from opioids or sedation
- Respiratory-muscle fatigue
- Mucus plugging or airway obstruction
- Severe atelectasis
- Weak cough or neuromuscular weakness
- Excessive ventilator dead space or inadequate minute ventilation

A normal SpO₂ does not exclude significant CO₂ retention.

Respiratory alkalosis

Pattern: High pH with low CO₂.

- Pain or anxiety
- Hypoxemia
- Sepsis
- Pulmonary embolism
- Excessive ventilator support
- Early respiratory distress

ACA Pearl: Tachypnea plus a falling CO₂ can represent compensation or early distress—not improvement.

Metabolic acidosis

Pattern: Low pH with low HCO₃⁻.

- Lactic acidosis from shock or impaired perfusion
- Acute kidney injury
- Sepsis
- Diarrhea
- Ketoacidosis
- Hyperchloremia after large-volume chloride-rich fluids

Metabolic alkalosis

Pattern: High pH with elevated HCO₃⁻.

- Aggressive diuresis
- Vomiting or gastric losses
- Hypokalemia
- Chloride depletion
- Chronic CO₂ retention with renal compensation

Metabolic alkalosis can suppress respiratory drive and make CO₂ clearance more difficult.

Call now

Escalate promptly for:

- Rapidly worsening acidemia
- Rising CO₂ with somnolence, fatigue, or increased work of breathing
- PaO₂ or P/F ratio worsening despite increased support
- New metabolic acidosis with rising lactate or hemodynamic instability
- Abrupt gas change inconsistent with the patient's prior trend
- A result that does not match the clinical picture—verify the sample and repeat if necessary

Final ACA Pearl: Treat the patient and the trend—not one isolated blood gas. Compare the result with respiratory effort, mental status, oxygen support, hemodynamics, imaging, renal function, and the preceding gas.

Educational reference only. Use center-specific oxygenation targets, PGD definitions, ventilator protocols, and escalation pathways. A structured approach to ABG interpretation is also outlined by the American Thoracic Society.