

Breath-holding times distinguish gases diffusing from lungs, arteries, veins and the average of all tissues

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ABSTRACT A novel breath collection method (US patent 10,386,357) is presented that distinguishes levels of free gases diffusing from the lungs, arteries, veins and the average of all tissues. It quadruples the amount of meaningful data that can be obtained from traditional breath collection methods, revealing where gases arise and how most are not in equilibrium among lungs, blood and tissues.

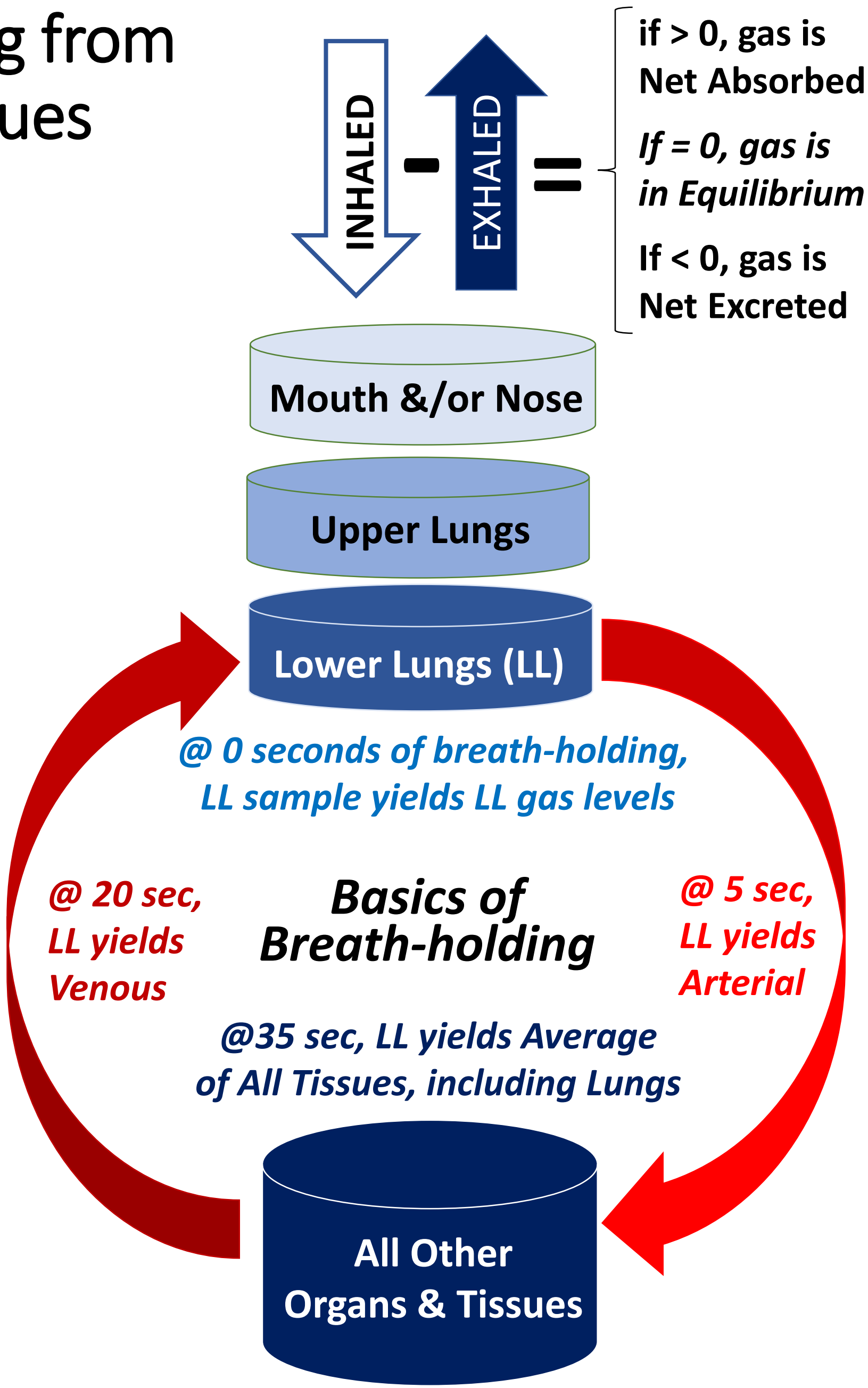
By repeating these measures over time, more information can be obtained about gas absorption, distribution, metabolism and excretion. In contrast, most breath collection methods used with multi-gas and single-gas analyzers specify analyzing all or one or more fractions of breath but from just one compartment. They typically involve collecting either full breaths over time with no breath-holding, such as Owlstone recommends, or collecting a single exhalation after a fixed breath-holding time.

Breath alcohol testers, for example, specify a breath-hold time of zero to get an alveolar measure, while carbon monoxide testers specify 20 seconds to most closely correlate with venous carboxyhemoglobin.

Comparing CO exhaled by smokers and non-smokers, we identified the optimal breath-holding time for arterial gas levels at 5 seconds and the average of all tissues at 35s. Results from these 4 compartments show that levels of alcohol diffusing from the lungs and arteries are several fold higher than from veins and tissues 30 minutes after consumption but in equilibrium after 60. Levels of CO in contrast, never reach equilibrium, even in non-smokers, with arterial normally greater than venous except after exposures when the level diffusing from tissues is highest.

Comparison of Continuous Breath Samples collected without Breath-Holding versus Single Breath Samples collected with Breath-Holding

| | CBS-BH | SBS+BH |
|---|---|--|
| # of distinct compartments in humans from which free gases can be sampled | 4 = mouth &/or nose, upper lung, and end-tidal lower lung | 7 = same as CBS-BH <u>plus</u> arterial, venous, and average of all organs & tissues |
| Sample collection time per compartment | collected together in 5 to 20 minutes | < 1 minute, longer if repeated to collect larger sample volume |
| Works with any inhaled gas mixture or ambient air | ✓ | ✓ |
| When inhaling ambient air, can distinguish net absorbed gases from net excreted | ✓ | ✓ |
| Can distinguish primary sources and sinks of both net inhaled and net exhaled gases from among lungs, arteries, veins, and other organs & tissues | ○ | ✓ |
| Works with sleeping or unconscious people and others who cannot hold their breath | ✓ | ○ |
| Works with any gas analyzers, inline or offline | ✓ | ✓ |
| Works with any gas collection mask, bag, cannister, or sorbent tubes, including Owlstone's ReCIVA™ | ✓ | ✓ |



Medical Breath Gas Tests that specify a breath-holding time

Note all specify only 1 time and so measure only 1 compartment

1. Alcohol after 0 seconds used to calculate % BAC
2. Carbon Monoxide after 10 seconds used to calculate Transfer Factor, aka DLCO, after first inhaling 0.3% CO
3. Carbon Monoxide after 20 seconds used to calculate venous % COHb
4. Hydrogen, Methane & Carbon Dioxide after 0 seconds used to assess digestive disorders
5. Nitric Oxide after 0 seconds used to assess lung inflammation

EXAMPLES

