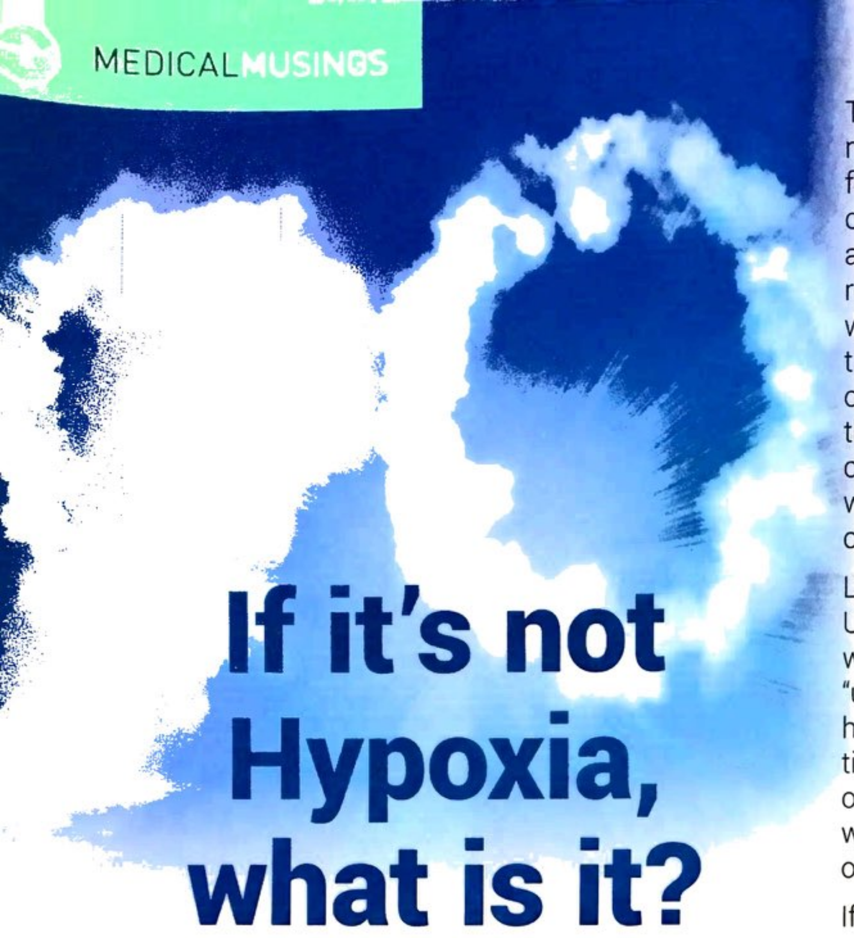

If it's not Hypoxia, what is it?

by DR. JERROLD SECKLER

You're flying along at 8,000 feet; it's a cold day outside, but you're snug and comfortable in the warm cabin of your Cirrus. Gradually you notice that you're just not feeling right. You have a headache, and some nausea and dizziness as well. You wonder if you're hypoxic, so you check your pulse oximeter and find that your oxygen saturation reads 98 percent. Gradually, the symptoms worsen and you decide you're coming down with the flu ... but you're not ... you have carbon monoxide poisoning and unless you do something quickly, you will become unconscious and probably die.

Carbon monoxide, or CO, is a colorless, odorless gas that is one of the products of the combustion of carbon-based fuels. In our Cirrus engines, gasoline – a hydrocarbon – is mixed with oxygen and ignited by a spark, thereby generating energy as well as water and carbon dioxide. For combustion to be complete, there must be sufficient oxygen present to allow all the fuel to burn. If there is not sufficient oxygen to burn all the fuel, then combustion will be incomplete and will generate carbon monoxide as well as carbon dioxide. The carbon monoxide leaves via the exhaust and if there is any leak in the exhaust system, it can enter the cabin.

Because it is incomplete combustion that results in the production of carbon monoxide, it's important to understand that when you are running rich of peak (more fuel than the amount of oxygen can fully burn), you will produce carbon monoxide in the process. A major advantage of lean of peak operation is that there is an excess of oxygen for the amount of fuel present so the fuel is completely burned thereby eliminating the production of CO.

To understand why carbon monoxide is dangerous, one needs to understand how oxygen, which is necessary for all our cellular activities, is distributed throughout our bodies. The distribution system relies on a specific and complex protein, hemoglobin, that is present in our red blood cells. Each molecule of hemoglobin can bind with four molecules of oxygen. As blood moves through the capillaries of the lung, oxygen is picked up, and this oxygen-rich blood is carried throughout the body, releasing the oxygen molecules into the tissues and allowing for cellular metabolism. The blood then returns to the heart where it is pumped to the lungs for a fresh supply of oxygen in a cycle that never ends.

Like oxygen, carbon monoxide can bind to hemoglobin. Unlike the bond between oxygen and hemoglobin, which is fairly weak and easily allows oxygen to become "unattached," the bond between carbon monoxide and hemoglobin is hard to break. In fact, it is more than 200 times as strong as the bond between hemoglobin and oxygen. Therefore, once a hemoglobin molecule binds with CO, it is no longer available to pick up and transport oxygen and you effectively become hypoxic.

If you are hypoxic due to carbon monoxide poisoning, why doesn't it show on the pulse oximeter? It's because the pulse oximeter measures the percentage of oxygen binding sites on hemoglobin molecules that are filled. So, for example, if you had 1,000 molecules of hemoglobin, you could bind 4,000 molecules of oxygen. If 3,900 of the available binding sites are full, your saturation would be 97.5 percent. Unfortunately, the pulse oximeter can't differentiate between hemoglobin saturated with oxygen or hemoglobin saturated with carbon monoxide and therefore is entirely unreliable as an aid in diagnosing carbon monoxide poisoning.

How much CO in the cockpit is dangerous? The only really safe amount is zero. Certainly, a CO concentration of 10 PPM (Parts Per Million) is cause for significant concern and a concentration of 20 PPM should prompt an emergency landing at the nearest suitable airport.

Because of the danger of CO poisoning, it is worthwhile for pilots to equip their aircraft with carbon monoxide detectors. These come in a variety of types, both portable and installed, with varying sensitivities and alarm functions. Pilots should choose a unit with low level CO detection capability (10 PPM of CO is best), as well as the ability to annunciate an alarm when CO is detected. A good selection of detectors suitable for aircraft may be found at *www.aeromedix.com*.

If you suspect CO poisoning, or if you have an alarm that is telling you there is greater than 10 PPM of CO in your cockpit, you should open any fresh air sources you have available, breathe oxygen if you have it on board, go to LOP operation, and land at the nearest suitable airport. Immediately after landing seek medical attention and have an A&P check your exhaust system for cracks or leaks. Because it takes about five hours for the volume of CO in the blood to decrease by half, do not plan to fly until you are back to normal as determined by an accurate laboratory assessment of your blood CO level. Depending on how much CO you were exposed to and how much bonded with your hemoglobin, it may take several days for your CO level to return to an unmeasurable level. Also, be sure the source of the carbon monoxide has been identified and corrected before flying your aircraft again. ⊕

Dr. Jerrold Seckler has recently retired after practicing medicine (urology) for over 40 years and as an active AME for 25 years. He has over 6,000 total hours, 2,200 of those in his 2001 Cirrus SR22. He is an ATP, CFII, former COPA Board Member and a ground instructor at CPPPs.

The items discussed in this column are related to experiences by Dr. Seckler in his many years as an AME, and made hypothetical for the article. Any information given is general in nature and does not constitute medical advice.

If you have a medical question, it can be asked with anonymity on the COPA website (www.cirruspilots.org) under the medical forum.