SAFETY FIRST

By Warren V. DeHaan, OD
Human Factors and Safety Education Committee

WAKE UP!

Wow! All of a sudden colors were brighter, my hearing improved, and my thoughts became clearer. I didn't realize how dull my senses had become until I put on the cannula and turned the valve to high. Good stuff, that oxygen. And I didn't even think I was having a problem!

Such is the nature of hypoxia, and its insidious progression. It affects both ability and judgment without our realizing it. Even when we notice a few symptoms such as a dull headache, and slow thinking, there is usually an initial feeling of euphoria that makes us want to believe we are doing very well, at least until we begin using oxygen and realize we were fooling ourselves.

The quantity of oxygen carried in our blood depends, for the most part, on the partial pressure of oxygen in our lungs. If our airplane is not pressurized, then as air pressure drops, we can, to a limited extent, maintain that partial pressure of oxygen by increasing the percentage of the air that is comprised of oxygen. At sea level, oxygen makes up about 20% of air. At 18,000 feet, where atmospheric pressure is approximately half that of sea level, if we want to duplicate that sea level partial pressure, all we have to do is double the percentage of oxygen in the air that we breathe, to 40%. We can do that with a comfortable cannula. Above 18,000 pressure altitude (the altitude you read when you set at 29.92), regulations require the use of a mask instead of a cannula. If we get "way" high (such as in a glider going for an altitude record) then it is necessary to increase the pressure besides using a more specialized mask and device.

You all know the Part 91 regulations requiring the crew to have supplemental oxygen after 30 minutes above 12,500, and all the time above 14,000 feet pressure altitude. Applying the same requirement to everyone appears to incorporate an assumption that all pilots are physiologically identical. That is quite a stretch! I doubt if anyone seriously believes that. Besides considerable differences in our genetics, ages, general health, habits, and physical fitness, our environments also vary widely. When Vici and I took the altitude chamber course at Colorado Springs, we observed that during the 24,000-foot pressure altitude sequence most of the other participants had experienced symptoms and donned their masks by five minutes. Vici and I were still coherent, working the problem sheet and conversing at the ten-minute point. Spending a lot of time in physical activities at 10,000 feet and above has resulted in our having hematocrits at the upper end of the scale, above 50%. Being acclimatized can make a huge difference. However, that was just a laboratory experience. We always use oxygen whenever we fly high in our T210 because we know that doing well at altitude on one day is no guarantee for any other day.

It behooves each pilot to assess his or her own circumstances, both personal and environmental, in making a decision as to when to use oxygen earlier or more generously than the regulations would require. A few factors to consider in decision-making are smoking, fatigue and sleepiness, living at low elevations, poor cardiovascular fitness, poor pulmonary function, being out of shape in general, age, and recent use of alcohol. For night flight, oxygen is recommended above 5000 feet for the purpose of improved night vision, even though there is no regulation to that effect.

How do you learn to recognize the symptoms, and how do you get an idea of your individual response to decreased oxygen saturation? One way is to go up as a passenger with another pilot who is PIC (and who is using supplementary oxygen), while having it available for you to use when you are ready to compare to your preceding hypoxic condition. However, stay below 15,000 feet. You will get the idea well enough without pushing it.

A better way would be to take the FAA hypobaric chamber training course which is given at several locations around the country. In addition to the basic academic contents, this course offers practical demonstrations of rapid decompression (8,000 to 18,000 feet AGL) and hypoxia (25,000 feet AGL) using a hypobaric (altitude) chamber. Here is a link if you are interested:

http://www.faa.gov/pilots/training/airman_education/aerospace_physiology/

If you schedule well ahead, you could take the course at Peterson Air Force Base in Colorado Springs either before or after the FPA Annual Meeting that will be held in Denver in July of 2012.

If your airplane has built-in oxygen, keep it topped off. Even when flying over lower elevations, you never know when going up above 12,500 will give

you that super tailwind. There are so many portable systems available that an internet research project is in order before you buy in order to tailor the system to your needs and to the capability of your aircraft. If your aircraft's service ceiling is 14,000 feet, you are not going to need as robust a system as you would if you plan to fly long, high legs in a non-pressurized aircraft that is certified to 27,000 feet.

Even though our Cessna T210 has a huge built-in oxygen supply for the two of us (since it is designed for six occupants), I also carry an emergency oxygen bottle that is always on and ready just by pressing a lever. Mine uses "single-use" small bottles and has a mouthpiece, although by the time I would realize my built-in oxygen system has failed, I would probably just put my mouth over the tube and take several breaths of 100% oxygen initially. Besides the pre-filled single-use types, there are also handy emergency oxygen bottles that can be refilled, and that have larger capacity.

Oxygen systems do fail. A friend who regularly takes a T210 up to 35,000 feet for air sampling research told me about his experience with a total oxygen system failure. By the time he realized it, he was seriously fading to the extent that he barely remained semi-conscious until his rapid descent brought him down low enough to regain useful consciousness. He did not comment on the subject of the detrimental effects of shock-cooling on the cylinders since he was just glad to be alive, but if he had carried a small emergency oxygen bottle he would not have risked his life or damaged his engine.

A pilot who experiences a system failure at 15,000 feet will likely notice danger signs like slurred speech, slow responsiveness, poor control, or euphoria. However, a pilot who experiences oxygen system failure above 20,000 feet may lose consciousness before realizing there is anything wrong. Here in Colorado we have a saying that with a four-wheel-drive vehicle you can get farther off-road before you get stuck in deeper snow than with a standard car. Similarly, it seems that the increased capability of turbocharging and a large-capacity oxygen system enables us to fly higher where a system failure is more likely to be catastrophic. You are likely to become disabled sooner and you have a lot more altitude to lose before you can descend to where you can get enough oxygen. If you Google "Time of Useful Consciousness," you can get an idea of how long you might have with a system failure at various altitudes.

A quickly accessible emergency oxygen bottle may come in handy if one of your passengers gets blue fingernails at any altitude. It can take awhile to hook up the usual cannula or mask if it is tucked away in its bag, but the emergency bottle that is ready to supply 100% oxygen quickly can help bring more than peace of mind to a passenger (or pilot?) that suddenly experiences an unanticipated cardiovascular event. You can no doubt think of multiple uses and one company probably should get the prize for that when they stated that in the event of an underwater escape situation, the supply tube could be disconnected from the mask and placed in the mouth to provide an underwater oxygen supply.

Some pilots carry an oximeter and try to meter their oxygen according to readings on it. Oxygen is cheap. My shop charges me $45 whether I need a little or a lot. Use plenty. It feels better.

I invite you to attend the Flying Physician's Association Annual Meeting here in Denver, Colorado in July of 2012. At over 5000 feet, your kidneys will produce extra EPO and you'll have a new batch of red blood cells seven days later. If you extend your trip up into our beautiful mountains at 10,000 feet and above, you can develop a whole bunch of new red blood cells, and have fun at the same time. See you in July!

The FPA Quarterly Bulletin

"an on line quarterly news publication"

Published for the Promotion of Aviation Medicine and Safety.

Publisher:
Flying Physicians Association, Inc.
11626 Twain Drive,
Montgomery, Texas 77356

Co-Editors:
Owen Brodie, MD
Darrell D. Burgess, MD

Editor Emeritus:
George Gumbert, Jr., MD

Managing Editor:
Alice A. Henderson, M.S.Ed.
Executive Vice-president

Officers:
David R. Mauritson, MD, JD
President

Felix R. Tormes, MD
Immediate Past President

Gareth A. Eberle, MD
President-elect

Gardner T. Kenny, MD
Secretary

John R. Hunt, MD
Treasurer

Advertising and Subscriptions
Contact the FPA Headquarters

11626 Twain Drive
Montgomery, Texas 77356
936-588-6505
FAX 832-415-0287
ahenderson@fpadrs.org
www.FPADRS.org