Altitude and Brain Mush

Self-administered carbon monoxide poisoning

We're at a beautiful 3km-high mountain gliderport out west for a week of winch-launching fun. We're a little intimidated when we discover that with us are some European pilots who have thousands of winch launches among them. Performance-anxiety looms.

However, during the week our self-esteem begins to heal, for every so often one of these high-time guys flies awkwardly. There's a launch failure: the glider's going fast – but only about 2 meters AGL and level when the winch fails. The pilot could coast to a safe stop straight down the 2-kilometer runway. However, he inexplicably climbs steeply *after* losing the cable; stalls at about 20 meters AGL. Wait! He has the nose down; he's going to handle it after all! The glider *(whew!)* rounds off in ground effect ... and then *climbs* again, has a secondary stall, and pancakes onto the tarmac. No harm, so no NTSB scrutiny, just the LEP (Local Embarrassment Panel).

In addition, sometimes these smart, highly seasoned pilots just don't look as sharp flying landing patterns as we expected. Speed sometimes looks scary-slow to the locals, the turn to final is often overshot, and accuracy is off. Between launches, they huddle together talking, having a smoke, and debriefing. They seem ebullient. Happiness is a week in the mountains; happiness is hypoxia.

The launch master suggests they try oxygen. After his next flight, one steps out of the glider and exclaims, "When I put on the oxygen, the colors got a lot better!" This surprises the rest. They are willing to try the oxygen to experience the color, but they are clear that otherwise they don't need it: "I feel *fine*." "Oxygen isn't required below 14,000!" "I've got a pulse-ox!"

Why are these experienced guys having trouble? Why aren't they worried? Well, why should they be? – They've got a pulse-ox!

The reasons are several. First, there are the standard procedural differences: unfamiliar site, novel aircraft, and different procedural nuances. Therefore, training is an issue. Second, there's the altitude effect on airspeed. The airspeeds are all the usual ones, but TAS is invisibly higher, so when down low, the ground goes by a faster, and highly trained reflexes automatically make things *look* and *feel* right. (Wrongly.)

Yet the most important reason is the "I feel fine" problem. Our brilliant minds and superb motor skills depend, for excellence, on the neurochemistry working just right. However, our bodies' impairment-detector is pretty much a near-death detector, and ignores and compensates for mild annoyances (to do otherwise would create continual unhelpful distractions). At least three things have sabotaged our elite pilots: jet lag, altitude effects, and carbon monoxide (it's not engine exhaust that's the problem).

Circadian asynchrony (Jet Lag): Our hormonal biorhythms are synchronized by sunset. To go forward on the clock over 3 hours each day or back by 1 hour causes next-day fatigue and measurable performance loss. Recovery from greater change takes at least 3 days. Melatonin, the synchronicity hormone, may speed this up but doesn't prevent it. Our friends have recently backed up 7 hours, and surely are out of sync neurochemically.

Altitude: This decreases performance in two ways: hypoxia and altitude sickness (which amplifies effect of hypoxia). The problem with oxygen is that, even though it's our most important need, our bodies have no oxygen detector. Shortness of breath is *not* caused by low

oxygen – but by whatever increases the *work* of breathing (resistance to airflow, lung stiffness from asthma, fibrotic tissue, infection, or venous congestion), alters the blood acid-base balance, or alters the carbon dioxide content.

Altitude sickness does not respect age or fitness. Just about any time a person feels "ill" after an ascent of 4-6 thousand feet, altitude sickness is the first thing to think of. Details in the future, perhaps.

We are far more sensitive to hypoxia than the FARs recognize. The FARs are concerned with *incapacitation*, and flying is usually such a simple, straightforward task that pilots have often returned to brag again from flights without oxygen above 20,000 ft MSL. However, none of them could have worked a calculus problem up there, or subtracted a compass heading (that it wouldn't have seemed important, anyway, is itself a symptom of hypoxia).

Anyone who's donned oxygen while flying at night at 5-7k ft MSL will tell you how quickly the lights on the ground went to 'bright.' (They don't mention that the brain also went to 'bright.') It's known that smokers function as if they are 3-5k ft higher than the altitude on the altimeter.

Therefore, these guys had jet lag, possibly mild altitude sickness, mild hypoxia, and mild carbon monoxide toxicity going against them. Each of these things can cause subtle impairment of neurological function (wisdom, coordination, creativity). Combinations are more than additive. Moreover, there's evidence that smokers are less aware of their hypoxic symptoms than non-smokers.

CO: Carbon monoxide in tobacco smoke does more than smokers realize – five things: It ties up, generally, 3-10% of hemoglobin and permanently prevents it from transporting oxygen to the brain (etc.). Second, it decreases the ability of hemoglobin to release oxygen into the tissues ("shifts the Hgb-O2 dissociation curve to the right"). Third, it interferes in all tissues with metabolism even at low concentrations (5-9%) by interfering with the heme-containing proteins that are centrally important in energy transport.

Fourth, it makes the oximeter read falsely high. *"Carboxyhemoglobin levels in nonsmokers are less than 2%, while they may be as high as 10-20% in heavy smokers. COHb ... resemble[s] ... oxyhemoglobin in the red range, and [thus] looks like oxyhemoglobin, causing the pulse oximeter to over read. For every 1% of circulating carboxyhemoglobin, the pulse oximeter over reads by 1%. Fifty percent of cigarette smokers have a carboxyhemoglobin concentration of 6%. ... The most important limitation of pulse oximeters is that they are inaccurate in patients who need them the most."*

I'm not going to tell you to quit smoking! Your conscience, your kids, your spouse, and your doctor have already failed. However, I will say this: if the gliderport is more than 4000 ft MSL above the altitude you inhabit, or you plan to climb more than about 6000 ft above your home elevation, please wear oxygen from the ground up. You'll look much more skillful to the spectators, and the colors will be prettier, too.

We will write this column on the role that our own thinking and physiology plan in accidents as long as our interest and yours persists. If you know of any soaring incident in which something awkward or harmful happened, in which the pilot failed to perceive the situation accurately, we'd be willing to consider using it for a column. If so, send information to johnsondanl@yahoo.com.