SOARING Rx

BY DR. DANIEL L. JOHNSON

The Pregnant Pilot –

Only a woman can be a mom

I paraphrase a recent letter to preserve anonymity:

Dear Dr. Dan,

I'm a glider pilot, and I'm pregnant. I love soaring, and I was hoping to fly until I could either no longer fit in the glider or could no longer comfortably reach the controls, but I don't want to cause harm to my fetus, our baby. My obstetrician suggested that I stop soaring since she does not know what the changes in altitude will do to the fetus. I can't find any reliable information on the risks of flying in pregnancy.

What's safe?

The Simple Answer

1 The main concern is hypoxia of the fetus. Staying below 5000 ft msl (for lowland fliers) is clearly safe. At higher altitudes, using oxygen as required by Federal Aviation Regulations is probably safe.

2 The risks are generally small. Obstetrical emergencies are always a problem when Mom has wandered off, away from civilization. Being at altitude in a glider might feel remote from "civilization," if defined as "that part of the world inhabited by a skilled equipped obstetrician" unless your alternate landing field is the back lot of your local birthing center.

3 During the last trimester there are discomforts and inconveniences with pregnancy that may make getting into a small cockpit seem about as much fun as taking a long trip in the back seat of a subcompact car.

Explanations

Prudent Pregnant Piloting

Obviously, there are two risks in piloting an aircraft while pregnant. One is that your abdominal size might restrict full control movement or create distracting discomfort. The other is that the fetus, which lives in a low-oxygen environment in the uterus, might be harmed at altitude.

The issue of size is your responsibility, and the preflight control check will give you the answer every time. The question of discomfort will be answered, should there be any doubt, by climbing in and clipping on the seat belts.

A woman of normal weight, in the semi-recumbent posture most gliders use, will never find her abdomen actually prevents full back stick. Generally, and I've had much experience taking care of massively obese patients, a big belly begins to spill down the thighs, where it would get in the way of a control stick, somewhere in the neighborhood of 100 pounds over ideal body weight. At this point, the pilot is likely to be over gross in every single-seater on the planet.

Airplanes with control wheels are different. For example, the 300-pound man who owns a Cessna 152; I know of one such, and I did ask him, "Are you able to get full up-elevator?" He changed the subject quickly, and I don't plan to drive to his field to watch his preflight control check.

Nevertheless, pregnancy is a normal human condition. Without obesity, the size of the pregnant stomach makes a woman feel cumbersome, and puts more gravity in the center; yet the chaise lounge position of modern gliders seems designed for best comfort and function. When the gravid womb gets great, your insides get crowded aside and might be very uncomfortable. The size at term depends on how much fluid is in the womb, how many fetuses are roommates, and their position.

There are gliders with side sticks (e.g., HP-18 and Diana 2), and this might become interesting as your baby matures within you, while your innie becomes a vast outie. One that wiggles and giggles and tumbles and tiggles inside your tummy. This is not, of course, a hazard to flight except for distraction. In any case, since your child's arms and hands are for about 40 weeks bound tightly within your skin; you don't have to worry about it grabbing the stick. But of course, to do a loop, or to land safely, you may need full back stick for a moment. So your preflight check should include making sure, as usual, that control movements are full and free right up to that 40th week.

What about oxygen?

After finding no specific research, I wrote to Dr. John B. West, a revered expert on altitude physiology, and asked, "I am wondering if you know of any research specifically assessing fetal respiratory physiology in short-term exposure to altitude such as occurs with flying unpressurized aircraft."

He said, "This is the kind of question where there is really almost no evidence to help us give an accurate reply." So we have to consider indirect evidence, and use our brains.

Obviously, if Mom never steps into a glider, there's no risk. However, that's mindless and uninteresting. We all know that there are two opposite human approaches to ignorance: (1) If you don't now it's safe, don't do it; and (2) What you don't know can't hurt you. Choice (1) is really paralysis, choice (2) is foolish.

So let's be reasonable and lay out what we know, then let this expand our safe options.

The Fetus is Well Engineered

Fundamentally, we run on oxygen and fuel. Oxygen is carried throughout our body, through the blood, by red cells, packages of hemoglobin. Hemoglobin is a tangle of protein surrounding a molecule of iron. Hemoglobin comes in different flavors, each of which adsorbs and releases oxygen at slightly different levels.

Different animal species have different hemoglobins, each suited to the range of oxygen levels in which it lives. Hemoglobin vacuums up oxygen at the higher

levels (higher partial pressures) of its environment and releases it at the lower levels (partial pressures) of its tissues.

Mom's hemoglobin absorbs oxygen well in her lungs and releases it well in her tissues. Her fetus, functionally, is a tissue – so its hemoglobin must vacuum up oxygen at the same level (partial pressure) at which Mom's hemoglobin is releasing it.

Conveniently, fetal hemoglobin has different affinity for oxygen than adult hemoglobin, such that it does exactly this. After birth, fetal hemoglobin gradually disappears over the first few months and is replaced by adult hemoglobin.

Interestingly, there's a third type of human hemoglobin, embryonic hemoglobin, that operates at an even lower oxygen level than fetal hemoglobin. This is present from the beginning of gestation, before the blood circulation through the placenta has developed. This disappears during the first trimester.

There are really three stages of low-oxygen risk for the fetus. The first occurs early, before a woman might even know she's pregnant, before the placenta has developed. Maternal hypoxia during this time would cause miscarriage, and I know of no research into the effects of acute hypoxia on fetal loss.

The second stage is most of the pregnancy, after the placenta and its circulation are well developed. Various abnormalities and diseases can injure the fetus or cause its loss. There is research on both animals and humans on long visits to or moving to high altitude, but little on short ascents that might cause acute hypoxia. Studies in sheep have shown that blood supply to the uterus increases during ascent at 1000 ft/min, and up to 15,000 ft msl the drop in fetal oxygen partial pressure is only about 20% with no evidence of distress or injury. Pregnant women have been monitored while riding airliners, and cabin pressures of 8500 to 11,500 ft msl have not caused any evidence of fetal distress.

The third stage is when the pregnancy is "at term," when the oxygen-transport capacity of the placenta is near its maximum. Many physiologic things can go subtly and undetectably awry at this point, and at this point we tend to be anxious and skittish about taking any risks. For example, if there's a twin pregnancy, there's increased demand on the placenta and energy supply, and all risks are greater.

Adjustment versus Adaptation

Adaptation is a long-term response; adjustment is a short-term response. For example, in Peru and in Tibet, native populations have evolved adaptations to living at high altitude – 5,000 meters / 15,000 feet, and both mothers and babies do well. Mothers who have moved to high altitude and lived there for months or years have adapted physiologically, but even after years of adaptation their infants' birth weights are lower and their complications more frequent than native moms.

Visitors to high-altitude regions have more trouble. Birth weights of infants decrease by about 100 grams per 1000 meters of altitude. Researchers report

that lowland women visiting Colorado have more premature births and more obstetrical bleeding than those who live there. Colorado is not Tibet, only about 3000 meters (5000-7000 ft).

Adjustment comprises all the things we might provide a woman to decrease the risk of altitude. In flying, "adjustment" means "use oxygen."

What Altitude for Oxygen?

To be reasonable about oxygen use by pregnant pilots, we can look at other evidence. One clue is the common experience of pilots wherein putting on oxygen above about 5000 ft msl at night makes the lights brighter and more colorful.

This occurs because the retina is one of the most oxygen-hungry tissues in the body. The information is available because we're always conscious of our vision. A scientific study is well and good, and can yield very specific knowledge, but there's nothing so convincing as personal experience.

So I'd recommend that pregnant pilots turn on the oxygen at 5000 ft. after setting yourself up on the ground to avoid fussing around with switches and valves while flying.

How high should you go? I don't know. However, if you want to go reasonably high, do purchase a pulse oximeter, learn how to use it, and use it. (Oximeters were covered in this column in June 2012. If you don't have the magazine handy, go to http://www.danlj.org/~danlj/Soaring/SoaringRx/ to find it. May and December 2011 and January 2012 also cover aspects of oxygen need and use.)

The safest thing, I think, is simply to check your saturation on the ground, and keep it within about 3% of this value while flying, by adjusting the flow rate.

Flight Levels

Of course, it's possible to go into the flight levels, and maintain normal oxygen saturation. In pregnancy, this increases the risk to the fetus in case the oxygen supply fails. Somewhere above 20,000 ft msl, you will pass out quickly when this happens. The fetus in an unconscious hypoxic mom in this situation would seem to be in a terrible spot of trouble.

The idea behind risk-taking is to avoid harm that's irremediable, which is a real possibility in Class A airspace, and hardly likely below that, because it's possible to descend quickly if the oxygen fails. Having said that, you will want an indicator of failure. For this reason, I prefer the Mountain High system, with which you get a reassuring little puff in your nostrils with each breath.

Tobacco-induced hypoxia

I've never met a woman pilot who smoked, so perhaps this isn't necessary. Fundamentally, smoking causes hypoxia in several ways. It decreases blood flow to the uterus and placenta, its carbon monoxide decreases the blood's oxygen-carrying capacity for both mother and fetus, and it causes degradation of the quality of the placenta.

Risks Near Term

On one hand, pregnancy is a normal condition, not a disease. On the other hand, there are many risks, especially near its end, where the physiologic mechanisms are near their natural limits. At this point, it's not necessarily altitude exposure or cockpit posture that affect the decision to fly. You should take into account all the activities involved, on the ground as well as in the air.

It may indeed be OK for you to fly until you go into labor. However, that's not a question we can answer in an informal essay like this one.

Inconveniences and Annoyances of Pregnantly Piloting sailplanes

Risks aside there are some annoyances involved in taking your own fetus for a ride in the glider.

Awkwardness

One of God's great gifts to gravid girls is that their gravity remains central while their girth becomes greater. So the plane's CG won't shift, and pregnancy isn't going to take it meaningfully over gross. But you will feel clumsier on the ground. Hoisting yourself in and out of the cockpit might create more audience interest than you want.

Fluid management

Pregnancy-associated urinary frequency is always annoying and will be much worse when you cool off during the climb, due to the phenomenon of "cold diuresis" that I have written about. This is not a danger to the fetus unless you hold it until your bladder pops, which is very painful and might distract you from safe flying. The anesthesia and surgery to repair it is definitely a small but real risk for the fetus.

Solving the bladder problem, when gravid, is probably best done with a diaper. Use a high-capacity one, and let the urine go frequently, in small voids, because diapers are not designed to handle a flood; they are designed to soak up lots and lots of little leaks. I confess that I have trouble with this one, because I don't like to be wet, and I frankly, have trouble relaxing my well-trained sphincter while thermaling. So I have to really concentrate to let any urine out. Your mileage may be different. You have a shorter spigot, but the same social inhibitions.

You should not use self-catheterization while pregnant because there is an increased risk of urinary tract infection with catheters, which pose a small but definite risk to the pregnancy. Most people aren't willing to do this anyway, but I mention this to be complete.

An Air Force study done by Col. Tracy Smart, MD, showed that if the zipper of the flight suit goes all the way down under one's bottom, and the urine bag and tubing were hooked up to a neonatal resuscitation face mask (the "nose" is held at the back of the perineum), that this works just fine in a fighter jet. But this involves use of the autopilot, which your glider most likely does not have.

I personally have found that fussing around with portable urine-collection aids while thermalling does not improve coordinated flight, which would be a hazard for the fetus and its mother, and to fellow pilots, in a gaggle.

Speaking of which, there is no reason not to be in a glider wiggling your wrist and toes right up to term. After all, it's hardly more strenuous than sitting in a chaise longue. If your blood pressure goes up during pregnancy, your doctor might prescribe bed rest. And what better way of getting bedrest than in the recumbency of the glider cockpit, relaxing happily – and reducing your blood pressure – by drifting in peaceful circles near cloudbase? Who knows, this may become standard treatment for pre-eclampsia after your own success becomes known.

In-flight Labor

If you go cross-country after the 35th week or so, you might include in your landout alternatives' airstrips conveniently near obstetrical units. It would be inconvenient for piloting excellence to be delivering a child vaginally during approach to landing, and would likely present some risk for unsafe flying if this happens. (I assume you are flying a single-seater in giving this advice.)

I would suggest that if contractions begin, you should plan to land if the contractions are closer than 5 minutes apart if this is your first child or 10 minutes apart if this is your second or subsequent pregnancy. This all depends, of course, on how fast your previous deliveries went, and whether your husband is waiting with the car idling on the ramp, and whether there is someone to put away the glider for you after you land.

Contractions can be pretty distracting, so if they begin while in flight, you should probably just come straight home. I don't want to be harsh about this, and you know that Braxton-Hicks contractions probably won't lead to anything, so if they're mild and sporadic, you can probably finish the contest task.

Having said this, if you can find an OB that is a soaring pilot, in a side-by-side motorglider with an autopilot, this might be a chance to make medical and soaring history. We would have to make a whole new FAI category (feminine): "Free distance while in labor." The problem might be how to record the onset of labor and time of delivery on the .igc file.

References

From the University of Colorado School of Medicine, Children's Hospital, Denver – Susan Niermeyer. The pregnant altitude visitor. Adv. Exp. Med. Biol. 1999; 474:65-77.

"The human fetus develops normally under low-oxygen conditions. Exposure of a pregnant woman to the hypoxia of high altitude results in acclimatization responses which act to preserve the fetal oxygen supply. The fetus also utilizes several compensatory mechanisms to survive brief periods of hypoxia. While fetal heart rate monitoring data during air travel suggest no compromise of fetal oxygenation, exercise at high altitude may place further stress on oxygen delivery to the fetus. The limited data on maternal exercise at high altitude suggest good tolerance in most pregnancies; however, short-term abnormalities in fetal heart rate and subsequent pregnancy complications have been observed, as well. A survey of Colorado obstetrical care providers yielded a consensus that preterm labor and bleeding complications of pregnancy are the most commonly encountered pregnancy complications among high-altitude pregnant visitors. Dehydration, engaging in strenuous exercise before acclimatization, and participation in activities with high risk of trauma are behaviors that may increase the risk of pregnancy complications. Medical and obstetrical conditions which impair oxygen transfer at any step between the environment and fetal tissue may compromise fetal oxygenation."

Jay F. Storz1 and Hideaki Moriyama. Mechanisms of Hemoglobin Adaptation to High Altitude Hypoxia. High Alt Med Biol. 2012 Jun; 13(2):73-81. doi: 10.1089/ham.2012.1021

"The effects of altitude on pregnancy have been extensively studied in high-altitude residents, but there is a lack of knowledge concerning the pregnant altitude visitor. Exposure to hypoxia results in physiologic responses which act to preserve maternal and fetal oxygenation. However, these reactions are limited and maternal/fetal complications may be observed, especially in association with exercise. Certain preexisting conditions or risk factors of hypertension/pre-eclampsia and/or fetal growth restriction are contraindications for traveling to high altitude, especially after 20 weeks. The acclimatization process has to be respected to avoid acute mountain sickness without taking drugs, and at least a few days of acclimatization are required before exercising."

John B. West. Human responses to extreme altitudes. Integrative and Comparative Biology, volume 46, number 1, pp. 25–34 doi:10.1093/icb/icj005

"It is a strange coincidence that the highest point on Earth is very close to the limit of human tolerance to hypoxia. The physiological changes that allow humans to reach these extreme altitudes involve enormous alterations of their normal state."