Runners, Head Rushes, Roller Coasters and G-LOC

Have you ever stood up quickly from a sitting or squatting position and suddenly experienced a "head rush" or dizziness? Many runners are familiar with the sensation, but not the name of the condition: **orthostatic hypotension**. Commonly described as lightheadedness when you "stand up too fast," it is something that many people experience, including non-runners. However, some research indicates that highly-fit runners are more susceptible to it, probably because it is caused by a rapid drop in blood pressure and blood supply to the brain. There is no real risk of injury from orthostatic hypotension, other than possible injuries from falling over or passing out.

A similar but much more dramatic condition is **G-LOC**, which stands for "gravity-induced loss of consciousness." G-LOC is highly uncommon outside the world of pilots (military, test, and acrobatic), but is also more likely to affect runners. Unlike orthostatic hypotension, you are probably not likely to experience G-LOC in your lifetime. But if you do, it might comfort you to understand G-LOC and why it affects runners more than non-runners.

Uncommon: Marathoner Blacks Out on Roller Coaster

G-LOC was experienced first-hand by an Austin marathoner at a theme park during the summer of 2009. This marathoner, a slightly-built woman who has a couple of Boston Marathon finishes under her belt, apparently was no match for one of the world's top-rated wooden roller coasters, "Thunderhead" at Dollywood theme park.

Riding with her teenage daughter, the marathoner remembers being on the ride, accelerating into the first drop, and then...blackout. According to the marathoner's daughter, the runner slumped over, hit her head on the side of the car, and finally came to after some concerned yells of "Mom! Are you ok?"

Not at all a neophyte when it comes to roller coasters, the marathoner was a bit concerned when she awoke (while the ride was still going). In addition to the bump on her head and slight disorientation, she was troubled by the thought that perhaps she had some sort of neurological disorder.

To the rescue came her husband, a commercial airline pilot and former aerospace engineer for a defense contractor. He assured her that this was merely "G-LOC," and explained that the increased G-forces of the ride had caused her to temporarily lose consciousness. He told her about his days working on jet fighter performance, and how the engineers used to joke about the "fit and trim" pilots in the program who could not "pull many Gs" in testing, as opposed to the stocky, muscular pilots who for some reason could tolerate higher G forces.

How and why does this occur? And is it true that cardiovascular fitness means lower tolerance for G forces?

G-LOC Explained

We humans are basically all fit for +1G performance, meaning we function normally under the Earth's gravitational pull. Even at that level, while standing, there is proportionally more blood in your legs than in your head. The more Gs you "pull," the more blood – and oxygen – you lose from your brain. At +3G to +4G, many "normal" people tend to notice a "grey out" effect, where one experiences strong light-headed feelings or disorientation. This can be very common on roller coasters, which can present forces of up to +4G or higher.

High-performance jets can take pilots up to +8G or +9G quickly, at which point the pilots can completely lose consciousness. Before that, at +5G and higher, some pilots lose vision completely, but are still conscious. Very high levels of G force ultimately can be deadly for pilots, but not because of the loss of consciousness itself. Instead, the pilot is completely unconscious, leading to a fatal crash if the pilot does not regain consciousness and retake control of the plane.

Other than disorientation and a possible bump on the head, the G-LOC risk to roller coaster riders is not as serious. For highly-fit runners, the risk of losing consciousness at high Gs is slightly higher. Although subject to some debate, there are materials which conclude that "too much" aerobic fitness, such as in marathon runners, sharply reduces G tolerance by a "fairly wide margin" (Dr. D. Newman, "May the G-Force Be With You," Flight Safety Australia, July-August 2002). The reason for lower G tolerance among fit runners is not clear, although logical factors would include lower blood pressure and very efficient circulation.

What does this mean for you, the runner? Not much, other than to be advised the next time you head to an amusement park. If you are planning to ride a roller coaster or two, be on the lookout for the ones touted as having a "high-G rating." Although the risk of complete loss of consciousness is low, you might experience higher than average feelings of dizziness and disorientation. Rest assured, however, that the overall risk of serious injury is incredibly low. A recent "Blue Ribbon Panel" of neurologists and researchers concluded in a report for the Brain Injury Association of America that the maximum G levels of roller coasters are within safe limits, and that the exceedingly rare incidents of brain injury deaths from the rides (six in a 38-year period) were due to pre-existing abnormalities such as aneurisms that were unknown to the riders.

A More Common Experience: The Head Rush

At some point in your life you have probably experienced a "head rush" when you quickly move from a sitting, squatting, kneeling or bending position into a standing position. Maybe that happens to you after every weekend long run. "Whoa...I stood up too fast" is the common response, as well as the incorrect conclusion of "all the blood rushed to my head." Indeed, the sensation is caused by the exact opposite - the blood goes <u>out</u> of your head.

The technical term for this experience is orthostatic hypotension. "Orthostatic" means "standing

upright," and hypotension means "low blood pressure." It is caused primarily by the pooling of blood in the lower extremities (typically induced by gravity) while sitting, squatting or lying down, followed by a sharp drop in blood pressure when moving into an upright position. This in turn causes a rapid loss of blood supply – and oxygen – to the brain, which causes the sensation of dizziness, tingling, blurred vision, and other disconcerting sensations.

There is no serious risk of injury from orthostatic hypotension, other than potential injuries associated with a fall if the person passes out or otherwise loses balance. While it is important to note that orthostatic hypotension can be a sign of more serious medical conditions, the likelihood of underlying medical problems is low.

A number of factors can increase the effects of orthostatic hypotension, including dehydration, low sodium or electrolyte levels, and hypovolemia, which is low blood-plasma volume. A runner who has lost of lot of sweat and electrolytes is going to be dehydrated, have low electrolyte levels, and have blood that is "thicker" than normal due to dehydration – all of the right conditions for a serious head rush if that runner sits for a period of time or maybe bends over to tie a shoelace and then suddenly stands up.

Like with G-LOC, the lesson for runners is to be prepared for the effects of orthostatic hypotension, and understand the conditions that worsen the situation. Basically, take your time moving from a sitting, kneeling, squatting or prone position into a standing position, especially if you are dehydrated or otherwise physically depleted after a workout. Be prepared to grab onto something nearby if you get dizzy after standing, and take deep breaths to help get some oxygen back to your brain.

And watch out for those roller coasters, especially if you just finished a long run.