Effects of Air Travel on Lymphedema

The aircraft environment, as well as other airline travel related elements might represent risk factors for the lymphedema patient, or individuals at risk to develop lymphedema, which may either exacerbate symptoms in existing lymphedema or cause the onset of lymphedema in those patients at risk (latent lymphedema). Elements in question include the air pressure (and density) and cabin pressure, as well as the cabin environment (air quality, seating).

Air pressure and the effects of altitude: the air's pressure is caused by the weight of the air pressing down on the earth, the body, and the ocean, as well as on the air below. The pressure value depends on the amount of air above the point where the pressure is measured. Consequently, the air pressure grows less with height, e.g. air pressure decreases as altitude increases. The exact pressure at a particular altitude is also dependent on weather conditions. To understand the general idea of how pressure decreases with altitude, the following approximation can be used:
As a rule of thumb, the air pressure drops about 1 inch of mercury for each 1,000-foot increase in altitude or about 0.49 pounds per square inch (psi). At sea level the atmosphere weighs in at about 14.7 psi, the pressure of the atmosphere at 8,000 feet is around 10.9 psi.

Cabin Pressure: commercial aircraft are capable of flying at altitudes that are incompatible with human life, and yet the passengers and pilots are healthy because of the onboard environmental and pressurization systems. Although aircraft cabins are pressurized, while traveling at altitude, that pressure is less than that on the ground. Regulations require that commercial aircraft be capable of maintaining a cabin altitude no higher than 8,000 feet at the maximum authorized flight altitude. For most flights, the cabin pressure is the same as that at 5,000 – 8,000 feet above sea level. In other words, when flying at – let's say 18,000 feet, the atmosphere within the aircraft is like that on a 5,000 – 8,000 foot mountain peak. Referring to the information above, it is apparent that air pressure at 5,000 – 8,000 feet is lower than on sea level.

Effects of altitude on air density: in simple terms, density is the mass of anything divided by the volume it occupies. The density of air is directly proportional to the pressure. With increasing altitude, the pressure decreases and so does the density of air. Since air is a gas, it can be compressed or expanded. When air is compressed (resulting in increased pressure), a greater amount of air occupies a given volume, thus the density of air is increased. When pressure is decreased on a given volume of air, the air expands and occupies a greater space; thus the density of air is decreased. Oxygen accounts for about 21% of the gasses in the air (on sea level as well as in altitude), but since air density decreases with altitude, the amount of oxygen inhaled will decrease with every breath taken. Hence less oxygen is absorbed into the blood and circulated throughout the body during flight.

Cabin pressure and the effects on lymphedema: the lower air density with the resulting decrease in oxygen absorbed into the blood does not cause serious problems as long as the traveler, apart from the lymphedema, is in reasonably good health. The decrease in air pressure (the force exerted on the body by the weight of the air) on the other hand may trigger the onset of lymphedema, or it may exacerbate the symptoms in existing lymphedema. This problem is most obvious, but not limited to, flights of eight hours or more. Many patients report that their extremities had started to swell during air travel. In a 1993 Australian study 27 of 490 patients reported the onset of lymphedema during aircraft flight (15 legs and 12 arms). Worsening of existing lymphedema was reported by 67 patients (44 legs and 23 arms).

The most reasonable explanation for the onset or worsening of lymphedema (especially on the lower extremity) may be inactivity. Most aircraft are crowded, and passengers, specifically in coach class, are often uncomfortable and unable to stretch, or easily leave their seats. It is a well-known fact that even people with an intact lymphatic system develop swollen feet and ankles during long flights. It is apparent that inactivity in combination with a compromised lymphatic drainage may have even more serious consequences. Inactivity, with the legs in a dependent position, coupled with the subsequent pooling of venous blood, will lead to an increase in tissue fluid in the lower extremities. This may be enough to trigger the onset of swelling in those patients with latent lymphedema, or worsen already existing lymphedema.

In addition to inactivity, other factors may play a crucial role in those patients traveling with lymphedema. The reduced cabin pressure (10.9 psi versus 14.7 psi on sea level) does have certain effects on those tissues that are, or may be affected by lymphedema (suprafascial tissues). These effects may allow more fluid to leave the blood capillaries into the tissues, some of which must be removed by the lymphatic system. The increase in the interstitial fluid content may be just enough to trigger the onset of lymphedema in patients with compromised lymphatic drainage, or increase the swelling in patients with upper and/or lower extremity lymphedema. It can also be assumed that the lower pressure in cabins allows fibrotic capsules in the tissue to become rounded, causing compression and/or distortion of adjacent structures, such as lymphatic collectors and inlet valves of lymph capillaries. This may also result in increased swelling and/or reduced uptake of lymphatic fluid. In many cases, the elastic fibers in the skin are damaged in lymphedema due to the constant stretch caused by the swelling, which may present an additional factor in the worsening of lymphedema in a low cabin pressure environment.

Compression therapy seems to be the most effective measure to counter possible negative effects on lymphedema during air travel. Compression, either applied by short stretch bandages or compression garments (or the combination of both), increases the tissue pressure. The elevated tissue pressure effectively reduces the accumulation of fluid in the tissues and promotes lymphatic and venous return.