

# Air Travel with Neurological Conditions

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Each year, approximately 1 billion people travel by air on domestic and international airlines, with further annual increase expected. Ageing populations in many countries, suggest many will be older air passengers with existing illness, including early or established dementia. If they become ill in the air, the passenger cabin of a commercial airliner, designed to carry the maximum complement in comfort and safety, cannot provide the facilities of an ambulance, emergency room or intensive care unit.

The UK Civil Aviation Authority's Aviation Health Unit (AHU) has a statutory function in safeguarding the health of all persons on board aircraft. Travel health professionals need to be aware of the environmental and physiological effects of air transportation on passengers and the stresses of flight, to properly advise patients proposing to travel by air. This transport mode may exacerbate existing medical conditions.<sup>1</sup>

The cabin of a commercial airliner in flight presents a number of physiological challenges. Commercial flights cruise between 28,000 and 43,000 ft.<sup>2</sup> and atmospheric pressure inside the cabin is reduced 15-18% as compared to sea-level.<sup>3,4</sup> At such altitudes the rate at which oxygen can diffuse into the blood is decreased.<sup>5,6</sup> The humidity in an air cabin is kept low (8-12%)<sup>7</sup> and exposure to cosmic radiation is about 100% greater than at sea level.<sup>8</sup> In addition, passengers' postural mobility in cabin settings is greatly restricted. Air travellers are exposed to cramped, dry, hypobaric and hypoxic environments, with high levels of cosmic radiation.<sup>9,10</sup> Passengers who cross several time zones are also subject to jet lag.<sup>11</sup>

The vast majority of passengers tolerate in-flight physiological challenges. In general, anyone who can walk 50 metres, or climb one flight of stairs and whose disease is stable can tolerate normal passenger jet cabin conditions, without additional oxygen.

However, air travel contributes to the development of a number of serious health problems particularly for specific at-risk populations.<sup>12</sup>

### General contraindications to air travel include:

- severe respiratory disease where the patient is breathless at rest
- unstable angina
- uncontrolled arrhythmia
- poorly controlled heart failure
- had myocardial infarction within 21 days
- deep vein thrombosis - until adequately anti-coagulated and in absence of pulmonary complications
- suspected pneumothorax, pneumo-mediastinum
- untreated communicable disease
- acute gastrointestinal bleeding
- severe anaemia - Hb less than 7.5 g/dL,
- had post-hollow viscous surgery, within ten days,
- had uncomplicated chest surgery - air travel must not be undertaken for 3 - 4 weeks.<sup>7,11,12</sup>

### Neurological contraindications to flying

After *stroke or cerebrovascular accident*, passengers can usually travel 4 days following the event, if stable or recovering. Formal medical clearance should be sought if travel is required within 10 days. Flying is contraindicated for 7 to 10 days following an ischaemic stroke. For those with cerebral artery insufficiency, hypoxia may lead to problems and supplementary oxygen may be advisable. Patients who have had a recent cerebral infarction, or other acute neurological event, should be observed until sufficient time has passed to assure stability of the neurological condition. The risk of post-event complications, physical and mental disability and decreased capacity to withstand flight stressors, are reasons to avoid flight. Once the acute phase of recovery is over and the patient is stable, travel may be reconsidered.

Persons with *disturbed or unpredictable behaviour* which could endanger passengers and / or crew and those with psychiatric disorders, where behaviour is aggressive, disorganized, disruptive or unsafe, should not travel by air.

Patients with *psychotic disorders* who are stabilized on medication and are accompanied by a knowledge-able companion may be able to fly with airline per-mission, but any condition which may be exacerbated by the flight environment, or any unstable condition with a risk of deterioration prejudicial to the passenger or the flight is contraindicated. Because of safety implications, psychiatric disorders need to be stable and controlled. Acutely disturbed or psychotic patients should not travel.

After *skull fracture or brain surgery*, flying should be avoided for 10 to 14 days to allow absorption of any air that may be inside the skull due to trauma or surgery.<sup>13</sup>

The passenger with stable *epilepsy* may be more prone to seizures during a long flight. Mild hypoxia and hyperventilation are known precipitating factors, in addition to the aggravation of fatigue, anxiety and irregular medication. Air travel is associated with an increase in seizures for individuals with epilepsy.<sup>13</sup> Participants monitored their seizure frequency for one week prior to flying and for one week after flying. Seizures were significantly more common after flying ( $p = .02$ ). No seizures were reported occurring during flight. Participants who experienced an increase in seizures after flying compared to those who did not (a), had a higher baseline of seizure frequency ( $p = .004$ ), (b), were more likely to have previously experienced an increase in seizures after flying ( $p = .001$ ), (c), were more worried about having a seizure while flying ( $p = .001$ ) and (d), were more likely to avoid air travel ( $p = .02$ ). Participants with complete seizure control prior to flying did not experience seizures after flying. Distance travelled, time zones crossed, duration of flight and direction of flight were not significantly different for those with seizure increase than for those without such an increase.<sup>14</sup>

This study suggests that air travel promotes an increase in seizures for those with a prior history of flight related seizures and a relatively high baseline seizure frequency. Several flight-related physiological challenges for example, sleep deprivation, oxygen desaturation may lower seizure threshold. The relative risk of passengers with epilepsy having a seizure either during or after flying has not been established. While there are no published estimates of how many people with epilepsy travel by air, the number of individuals affected is likely to be considerable. In one year 646 million passengers enplaned in the US.<sup>15</sup> An estimation based on a crude prevalence rate for epilepsy of 6.42 per 1000 suggests that individuals with epilepsy therefore flew over 4 million times. This is perhaps an overestimation, as individuals with epilepsy are less likely to fly due to concerns about air travel.<sup>16,19</sup> Nevertheless, this travel mode has the potential of affecting many individuals with epilepsy.

If air travel does lower seizure threshold it may do so through causing sleep disruption and sleep loss.<sup>20-21</sup> For many individuals with epilepsy, seizures appear more likely around fluctuations of consciousness associated with sleep, such as the brief period of falling asleep,<sup>21</sup> momentary awakenings,<sup>22</sup> and awakening in the morning while still drowsy.<sup>22</sup> Telemonitored observations indicate that seizures tend to be concentrated around fluctuations of consciousness.<sup>23,24</sup>

Prolonged air travel in a fixed environment with restricted movement and a limited range of activities, may promote drowsiness and periods of reduced cortical activation. Sleep rhythms may be disrupted for several days after flying, particularly with extended flights. Eastward air travel is particularly disruptive to sleep schedules.<sup>25</sup> The number of days required for a traveller to return to pre-flight sleep patterns is about one day for each 90 min travel west-ward compared to one day per 60 min travel east-ward.<sup>26</sup>

Another means by which air travel may lower seizure threshold is through the effect of air cabin oxygen desaturation. At high altitudes the rate at which oxygen can diffuse into the blood is diminished. While most travellers tolerate prolonged exposure to decreased ambient oxygen during flight, individuals with epilepsy may be at risk. Lower inspired oxygen during flight may trigger compensatory hyperventilation.<sup>27</sup> Seizures may result from metabolic instability created by hyperventilation.<sup>28</sup> The resultant decreased carbon dioxide intake results in reduced cerebral blood flow and oxygen supply to the brain. In addition, hyperventilation increases blood pH (alkalosis), which makes oxygen less likely to be released to tissues.<sup>28</sup> Hyperventilation induces seizures for those with idiopathic epilepsy<sup>29,30</sup> and controlled breathing can result in reduced seizure frequency.<sup>31,32</sup> The likelihood that a person with epilepsy will have a seizure while flying is difficult to determine. Airline studies report the frequency of neurological events but seldom report the incidence of seizures per se. Neurological events range from 4 to 12% of all in-flight medical emergencies<sup>33</sup> with some of these events, seizures. One study,<sup>34</sup> found that in-flight medical emergencies occurred for

about one of every 39,000 passengers and about 6% of these were seizures. The inability to adequately manage a seizure inflight has serious health and financial consequences. While most seizures resolve without the need for medical intervention, an episode of generalized convulsive status epilepticus may result in irreversible damage.

### **Management of potential air travellers**

***Fitness-to-fly*** - in people in the above categories, is best considered on an individual basis with expert advice if there is uncertainty. The freedom of the affected individual to travel must be balanced against those of other passengers and safety considerations.

***Epilepsy*** - Contraindications to flying include frequent or uncontrolled fits, or within 24 hours of a grand mal fit. Passengers with a history of a loss of consciousness, or infrequent fits should be accompanied by a responsible companion. Travel should be delayed for 24 hours after a grand mal seizure. It may not be appropriate to change medication immediately prior to a trip. Consideration should be given however to providing extra anticonvulsant medication. The passenger with epilepsy must ensure that they have sufficient medication in hand luggage. Patients with controlled epilepsy can generally fly safely. However, they should be made aware of the potential seizure threshold-lowering effects of fatigue, delayed meals, hypoxia and disturbed circadian rhythm. Care should be taken that medication should not be omitted inadvertently when travelling through different time zones.<sup>35</sup>

### **Patient Advice**

The patient should be advised:

- air travel may precipitate fits due to a variety of reasons
- potential seizure threshold-lowering effects, are delayed meals, hypoxia, and disturbed circadian rhythm if passing through multiple time zones.
- to be cautious about consuming alcohol before or during the flight.
- of importance of complying with their treatment regimen.
- anticonvulsant medication should be readily available in carry-on bags.
- to carry evidence of health status and medications.
- advise cabin staff of the risk of a seizure.
- to try to get usual amount of sleep.
- set a reminder to take epilepsy medicines at usual time.

***Mental disorders*** - person may be fit to fly, if stable on medication and accompanied by responsible companion. A patient who has disruptive, unpredictable, aggressive or unsafe behaviour should not be allowed to fly.

***Brain Tumour*** - patients who have a brain tumour are advised not to fly due to a risk of increased swelling in the brain, or cerebral oedema. During flight, air pressure and oxygen levels change when the plane reaches high altitudes. Swelling of the brain increases pressure inside the skull with symptoms of increased intracranial pressure which include headache, decreased consciousness and vomiting. Air travel with a brain tumour carries the risk of having a seizure. A common symptom of a brain tumour, noted that the risk for brain tumour patients is two-fold. First, the decreased oxygen in the airplane cabin lowers the seizure threshold. The second risk for patients is the difficulty of handling a seizure in the limited space.

### **Regulations and Guidelines**

Each airline has its own regulations and medical standards and requires medical certificates confirming that a patient is currently stable and fit to fly. Most have medical advisors who provide advice and 'clear' passengers as "fit to fly".<sup>36</sup> They may ask for a medical information form (MEDiF). The British Medical Association advises doctors 'to word statements on a person's fitness to fly carefully, indicating the information on which the advice is based, rather than positively certifying a person's fitness'. For example:

- 'I know of no obvious reason why this person should not fly'; OR:
- 'There is nothing in the medical record to indicate that flying is risky for this patient'.

This ensures that the doctor is not guaranteeing in any way that this patient can travel without any problem but rather saying that, on the available evidence, there is nothing to indicate a greater risk for this person than for others. However, the doctor is partly dependent on what the patient chooses to disclose to them about past health problems.

The main factors to take into account are whether air travel could adversely affect a pre-existing medical condition and whether or not a patient's condition could adversely affect the comfort and safety of the other passengers, or the operation of the flight. Regardless of a doctor's opinion on this latter question, the ultimate sanction to refuse travel lies with the airline and captain of the flight. If they consider there is a risk to the aircraft or its passengers, they may refuse to carry a particular passenger.

British Airways *air travel guide* for physicians advises: Medical clearance must be sought well in advance of intended travel. For passengers with other disorders, such as anxiety or depressive neurosis, the impact of the airport environment and the flight itself has to be considered.

The objectives of medical clearance are to provide safe, healthy travel, and prevent delays and diversions to the flight as a result of a deterioration in the passenger's well-being. It depends, upon self-declaration by the passenger and upon the attending physician having an awareness of the flight environment and how this might affect the patient's condition.

*Information Form (MEDIF)* is available from airlines.

Medical clearance is required when fitness to travel is in doubt as a result of recent illness, hospitalisation, injury, surgery or instability of an acute or chronic medical condition. Part 1 of the MEDiF is completed by the agent and/or passenger and Part 2 by the passenger's doctor and passed to the airline at booking, to ensure timely medical clearance.

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