



## Part 3 - Clinical Aviation Medicine

### 3.10 Central Nervous System

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## 3.10.1 Traumatic Brain Injuries:

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### 3.10.1.1 Considerations

A Traumatic Brain Injury (TBI) may result in neurological deficit, neurocognitive impairment, psychological/mood changes, and an elevated risk of post traumatic epilepsy. Thus a history of TBI may affect the safe operation of an aircraft.

All injuries need to be carefully evaluated by the ME. A very detailed history must be obtained of the accident event together with a copy of medical records, including those from the ambulance/paramedic service, the emergency department, and inpatient hospital records. This is to more accurately determine the severity of the head injury, duration of any neurological impairments such as LOC, amnesia or confusion, or persistent effects of the head injury. A careful evaluation of alcohol use is important if it was a factor contributing to the accident.

ACC is likely to have provided services in the event of head injury. ACC records, inclusive of fitness for work certificates, concussion services, neurology and neuropsychological reports should also be obtained. CT/ MRI head scan reports and electronic images are very helpful.

A ME who is aware of a recent head injury should attempt to obtain a CT head scan evaluation within the first three days following the injury, while the presence of intracranial bleeding and new cerebral contusions can be detected.

### Definitions

*Traumatic brain injury (TBI)* is defined as an alteration in brain function, or evidence of other brain pathology, caused by external force (Carroll, Cassidy, Holm, Kraus, and Coronado, 2004).

The presence of a skull fracture should be considered to have a TBI associated with it.

Traumatic brain injuries can range from mild concussion (a brief change in mental status or consciousness) to severe (an extended period of unconsciousness and/or memory loss after the injury). The effects can be temporary or permanent.

*Depressed fracture:* is one where the inner table of the skull is depressed more than the thickness of the skull.

*Concussive convulsion:* is a seizure at the instant of the head injury, is not usually epileptic and does not raise the risk of post-traumatic epilepsy. However in the case of a concussive convulsion one must also ensure that an epileptic seizure was not the cause of the head injury.

*Early post traumatic seizure:* occurs within one week of a head injury,

*Post traumatic epilepsy (PTE):* is the occurrence of one or more epileptic seizures one week or later after the head injury.

## Head injury severity

The severity of traumatic brain injuries (TBI) was previously based on clinical observations. Similar injuries by clinical criteria may have different anatomical substrates as demonstrated by modern brain imaging. The risk of PTE has now been showed to depend principally on the presence of intracranial blood.

Blood is readily detectable with early CT brain imaging and may be intracerebral, extracerebral, or both. Subdural bleeding may be acute or chronic. If acute it is generally accompanied by intracerebral bleeding.

*Contusion:* is a form of superficially located intracerebral bleeding and bruising. The terms contusion and intracerebral bleeding may be used interchangeably.

The severity of head injuries can be classified as follows (adapted from Annegers et al, by Bill Wallis):

### Mild TBI

Results in loss of consciousness or post-traumatic amnesia for no more than 30 minutes in the absence of skull fracture or any persistent neurological symptoms or signs. CT scan shows no evidence of intracranial bleeding.

### Moderate TBI

Results in loss of consciousness or post-traumatic amnesia for more than 30 minutes, but less than 24 hours. There may be other symptoms and / or a non-depressed skull fracture. There are no persistent central nervous system symptoms or signs. CT scan shows no evidence of intracranial bleeding.

### Severe TBI

Results in one or more of the following: Loss of consciousness or post-traumatic amnesia of more than 24 hours, structural brain injury (intracerebral or extracerebral haematoma, laceration, or contusion) as demonstrated by CT scan or surgical exploration, any persistent focal neurological deficits or symptoms indicative of cerebral hemisphere damage, an epileptic seizure occurring one week later or more following the TBI, a depressed fracture.

### Likelihood of PTE

Clinical risk factors for PTE include post-traumatic amnesia > 24 hrs, focal neurological signs, loss of consciousness at the time of the injury, early seizures, the need for mechanical ventilation, and a history of alcohol abuse.

Neuroimaging risk factors include focal cerebral injury/cerebral contusion, subdural haemorrhage, intracranial haemorrhage, midline shift and skull fracture.

For the purpose of aeromedical certification the following estimates of likelihood of PTE can be obtained from the literature (adapted by Bill Wallis):

<b>TBI severity</b>	<b>Estimated initial risk of PTE</b>	<b>Estimated time to near the risk of the general population</b>
<b>Severe</b> Combined extra and intracerebral bleeding	Up to 40 %	Well over 10 years
<b>Severe</b> Intracerebral bleeding only	25 %	10 years and over
<b>Severe</b> No intracerebral bleeding; but may have extracerebral haematoma, early epilepsy, depressed skull fracture or more than 24 hours of post-traumatic amnesia	3 – 4 %	2 years if only one risk factor, 3 years if the risk factors occur in combination
<b>Moderate</b> Post-traumatic amnesia or loss of consciousness for greater than 30 minutes but less than 24 hours, may have a linear fracture with or without other signs or symptoms, no persistent signs or symptoms, CT scan shows no intracranial bleeding	Close to that of the normal population	N/A
<b>Mild</b> Post-traumatic amnesia or loss of consciousness for less than 30 minutes, no skull fracture, no persistent signs or symptoms, CT scan shows no intracranial bleeding	Same as normal population	N/A

### 3.10.1.2 Information to be provided

- Ambulance, ED, hospital notes and any existing concussion services/neurology/neuropsychological reports;
- Copy of the original reports relating to any brain imaging as well as the actual images (usually on a CD);
- A recent neurologist report, except that in the case of a well-documented mild TBI, this may not be necessary.

### 3.10.1.3 Disposition

**Mild TBI:** An applicant with a history of mild head injury (simple concussion) may be considered as having a condition that is not of aeromedical significance if:

- A detailed history by the ME supports a diagnosis of mild head injury;
- A review of all medical records pertaining to the head injury by the ME supports a diagnosis of mild head injury. This is to include duration of PTA and LOC;
- A review of any CT scan original report indicates absence of any abnormality;
- The applicant is asymptomatic and there are no cognitive or mood sequelae;
- A full neurological examination by the ME is normal;
- 3 months or more has lapsed since the mild head injury;
- In doubt the ME should readily consult with CAA.

### **Moderate TBI**

An applicant with a history of moderate head injury should be considered as having a condition that is of aeromedical significance if unless:

- A detailed history by the ME supports a diagnosis of moderate head injury; and
- A review of any medical records pertaining to the head injury by the ME supports a diagnosis of moderate head injury; and
- A CT scan was performed at the time of the injury and the original report indicates absence of any abnormality; and
- There is a good clinical recovery and there are no cognitive or mood sequelae; and
- A full neurological examination by the ME is normal; and
- A neurologist report concludes to the absence of sequelae or elevated risk of seizure;
- 2 years or more have lapsed since the moderate head injury; or
- A previous AMC has considered the case in details and concluded favourably;
- In doubt the ME should readily consult with CAA.

For clarification a moderate head injury occurring within the past two years should generally be considered as being of aeromedical significance and handled via the flexibility process. This is to ensure correct classification of the head injury and resulting risk.

### **Severe TBI**

An applicant with a history of severe head injury should be considered as having a condition that is of aeromedical significance unless:

- A previous AMC has considered the case in detail and concluded favourably, allowing a return to flying, perhaps with restrictions; and
- More than 10 years have lapsed since the injury;
- There has been no change in the medical condition since the AMC.

Applicants with documented structural brain injury, or evidence of intracerebral bleeding will generally not be considered for a return to flying until 5 to 10 years, or possibly more time has elapsed.

## 3.10.2 Migraines and Headaches

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### 3.10.2.1 Considerations

Migraines are relatively common. It is estimated that 18 % of women and 6 % of men have had at least one migraine attack in the previous year.

Nearly everyone would have experienced headaches. A rare episode of mild headache without any impairing symptoms can generally be regarded as being of no aeromedical significance. The same applies to rare episodes of more severe headaches that are clearly related to temporary benign illnesses.

The diagnosis of migraine is based on history. Often the history taken by the first doctor after the initial episode(s) is useful. Hence GP, ED or after hours care clinic medical notes are useful in confirming the diagnosis and identifying the severity and triggers for migrainous episodes.

Headaches and migraines are of aeromedical significance if capable of distraction or interfering with the visual, sensory and motor functions, affecting the ability to concentrate because of pain, nausea, vomiting, photophobia, and impaired motor function. Rapid speed of onset, unexpected onset, long episode duration of few hours or longer, need for strong analgesia, and disruption/cessation of activities due to migraine are also features of aeromedical significance.

The potential adverse consequences of a given migrainous episode during flight are likely to be different depending on the type of operation. For instance, a single pilot operating by night under IFR may be unable to cope with a relatively mild migrainous episode. However, the same pilot suffering from a similar episode might be able to land safely if flying under VFR by day. Thus, operational restrictions may at times provide adequate mitigating circumstances.

### 3.10.2.2 Information to be provided

- **A Headache Investigation Report:** This questionnaire should be completed in all cases presenting with a history of migraines, or recurrent headaches, and in cases presenting with any episode of moderate or severe headache in recent years;
- Copy of the GP notes for the past 2 – 5 years (depending on the case), unless the ME is confident about the reported history;
- A neurologist report if there is uncertainty regarding the diagnosis or the headache characteristics.

### 3.10.2.3 Disposition

A history of headaches / migraines should be assessed as being of aeromedical significance unless:

- There is absence of nausea, vomiting, photophobia, phonophobia, aura, sensorial or motor features; and
- There is an avoidable triggering cause;
- There is no need to take medication other than Paracetamol or a NSAID;
- There is no need to attend for acute medical treatment; and
- There is no inability to carry on with a task when suffering from an episode of headache / migraine; and
- The headaches / migraines are infrequent, occurring less than twice per year; or
- The headaches / migraines have not occurred in the past 5 years; or
- The headache / migraine was a single event related to a temporary benign illness.

Through the flexibility process many cases of migraines / headaches have a favourable outcome. For instance:

A **Class 2** applicant with migraines that are predictable and infrequent, have auras of slow onset, do not interfere with function, and are not accompanied by severe headaches, vomiting or neurological impairment, is likely to obtain a medical certificate following the flexibility process, perhaps with operational restrictions.

A **Class 1** applicant is less likely to be issued a certificate. However a young applicant, with a similar history of mild migraines / headaches, who has been free of symptoms for over two years, is more likely to obtain a medical certificate following the flexibility process. Operational restrictions may apply.

### 3.10.3 Loss of consciousness (non-traumatic):

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#### 3.10.3.1 Considerations

Any history of loss of consciousness (LOC) needs to be thoroughly investigated. It is useful and often essential to question witnesses to the episode. Review of any clinical notes and investigations are similarly important. Careful history taking about any previous episodes is important.

Unless the cause is clear it is usually necessary to investigate potential cardiac and neurological causes for loss of consciousness, including epilepsy. Most cases seen by the CAA are vasovagal in aetiology and are discussed in more depth in the cardiology chapter.

An ME should not accept at face value a reported history of normal investigations. These must be obtained for perusal.

#### 3.10.3.2 Information to be provided

- Copy of all medical records pertaining to the LOC;
- Copy of GP notes;
- Copy of the original reports of any investigations;
- Copy of all specialists' reports.

#### 3.10.3.3 Disposition

An applicant with a history of LOC should be considered as having a condition that is of aeromedical significance unless:

- The LOC was a single episode of clearly provoked vasovagal syncope, occurring at least five years prior; or
- A previous AMC has considered the case in detail and concluded favourably, allowing a return to flying, perhaps with restrictions; and
- There has been no new episode.

**Note:** the word “provoked” refers to typical conditions such as medical procedures etc. A LOC provoked by conditions that may be met in flight is of concern.

## 3.10.4 Seizure disorders:

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### 3.10.4.1 Considerations

A history of seizure is of great concern to aviation safety. Seizures generally occur without warning and are unpredictable. They are likely to result in total and sudden incapacitation. A pilot suffering a seizure may input the controls with erratic forces susceptible to stress the aircraft structure beyond its certificated operational limits. Rapid loss of control or in-flight destruction of the aircraft may result. Convulsive incapacitation is thus considered a higher risk than other forms of incapacitation. Some have coined the term 'excapitation' for this type of event.

Very careful evaluation is necessary when dealing with any history of convulsion whether generalised or not, inclusive of febrile convulsions. It is equally important when dealing with any history of loss of consciousness to ensure that the cause was not a seizure. A careful history, preferably confirmed by witnesses, must be obtained. Copies of clinical notes from GPs, Emergency Department and specialist should also be obtained to corroborate the history. A neurologist opinion is often necessary if a clear cardio-vascular cause for an episode of altered consciousness has not been confirmed.

Anticonvulsant medications are generally not acceptable.

#### **Traumatic brain injury**

In the case of a traumatic brain injury a single seizure occurring within 24 hours of the injury maybe acceptable but requires careful evaluation. Early seizures after 24 hours are a risk factor for post-traumatic epilepsy. Consideration should involve the flexibility process.

Further discussion about TBI and seizure risk is outlined in 3.10.1. If in any doubt the ME should consult with CAA.

#### **Alcohol and other drugs**

A history of alcohol or other drug withdrawal seizures is complex and a clear risk to aviation safety. Careful evaluation that AOD withdrawal was the cause of seizure(s) is important. In addition is the need for strong evidence that the applicant has a safe relationship with alcohol or other drugs. Evaluation is likely to include neurology and addiction medicine specialist reports. Some cases maybe acceptable for certification following an Accredited Medical Conclusion.

If in any doubt the ME should consult with CAA.

#### **Epilepsy**

By definition a diagnosis of epilepsy requires two or more unprovoked seizures. A new definition has been proposed requiring the occurrence of one unprovoked seizure and a high probability of further seizures.

In general, a diagnosis of epilepsy makes someone ineligible for a medical certificate, with very few exceptions.

### **Benign Rolandic epilepsy**

This is also called “benign partial epilepsy of childhood with centrotemporal spikes”. This condition is discussed because it may in some cases be acceptable for certification following an Accredited Medical Conclusion.

This disorder represents ~ 15 % of childhood epilepsy. Typically, seizures start at age 4 to 10, beginning during sleep and are simple partial, involving the face and tongue, but secondary generalised seizures are not uncommon. Daytime seizures occur in about one third of cases but are almost exclusively simple partial involving the face and tongue.

Rolandic epilepsy has the best prognosis of all epilepsies. The prevalence of epilepsy in adults who have suffered from Rolandic epilepsy is said to be quite similar to that of the general population. The disorder appears to have a genetic origin, with an age-related penetrance. By mid-teenage years the disorder is said to vanish in most cases. The only indicator of late resolution is an early onset of the condition. Cases of persistent epilepsy in adult appear to relate to a different epileptic syndrome. However, a frequently quoted study by Loiseau, has found that 3 out of 168 (2 %) of patients with Rolandic epilepsy ultimately developed a later seizure, this is in fact higher than the general population and represents an incidence of perhaps 0.2% per annum.

The diagnosis is based on a typical history, a normal neurological examination and typical EEG with broad centrotemporal spikes. An accurate diagnosis is critical and occasionally difficult. It should involve a neurologist opinion and a detailed review of relevant information.

Someone with a history of benign Rolandic epilepsy does not meet the medical standards but flexibility may be considered.

### **Febrile convulsions**

The National Institute of Health (NHI–UK) consensus statement defines a febrile seizure as “an event in infancy or childhood usually occurring between 3 months and 5 years of age, associated with fever but without evidence of intracranial infection or defined cause for the seizure”.

About 2 – 5 % of all children between the ages of 3 months and 5 years will have at least one febrile seizure (Europe, USA). The peak age is 18 – 22 months.

Febrile seizures are classified as “simple”, being generalized tonic-clonic convulsions of less than 15 minutes duration and without recurrence within 24 hours.

Febrile seizures are classified as “complex” (or “complicated”) if focal, lasting more than 15 minutes or occur in a cluster of 2 or more convulsions within 24 hours.

Risk factors for later epilepsy include:

- Three or more febrile seizures;
- An abnormal neurological and developmental status prior to the first febrile seizure;
- A family history of afebrile seizures;
- A complex febrile seizure.

In one large prospective controlled study (Dreier et al 2019), comprising 2,103,232 children, the 30-year cumulative risk for epilepsy was 2.2%. For the 75,593 children with a history of febrile seizures the cumulative risks were 6.4%, 10.8% and 15.8% after the first, second and third febrile seizure respectively. One might assume that the risk of epilepsy declines the longer someone remains free of seizure. This was not the case in this study and others. The cumulative risk after even after one seizure remained above the risk for the reference/control population up to 25-30 years later.

The probability of developing epilepsy is about 5 – 10 % following a complex febrile episode.

Therefore, the ME should ensure that fever was present, look critically at the age of occurrence and consider other risk factors and the type, simple or complex, of the event. For instance, a history of first “febrile” convulsion at the age of 4 - 5 should be looked at with caution, particularly if the temperature elevation was only moderate.

One has to be careful in accepting a history of febrile convulsion. There are a number of convulsive disorders affecting childhood starting as early as aged 2. This can lead to a mistaken diagnosis of febrile convulsions. One such disorder is Generalised Epilepsy with Febrile Seizures. This disorder is autosomal dominant with high penetrance and is caused by a defect in the neuronal voltage-gated sodium channel. In its simplest form, the children have ordinary febrile seizures that continue to an older age than usual. This is only mentioned to bring to the ME’s attention that not all febrile convulsions are equal and benign.

In summary the ME should consider recurrent, complex or late occurring febrile convulsions with suspicion. A thorough history is essential and copies of clinical notes are necessary to assess such cases.

#### 3.10.4.2 Information to be provided

- Copy of the GP notes for the past five years and the period when seizures occurred;
- Copy of all medical records relating to any episode of seizure;
- Copy of original reports of all investigations;
- Copy of all specialists’ reports;
- A recent neurologist report unless there is a well-documented history of one simple febrile convulsion and the applicant is over 20 years of age.

#### 3.10.4.3 Disposition

- An applicant with an established history of adult epilepsy or post traumatic epilepsy should be considered as having a condition that is of aeromedical significance. The applicant should generally not be considered for the application of flexibility and the application should be declined;
- An applicant with an established history of adult epilepsy or post traumatic epilepsy who has been free of seizures for a prolonged period, i.e. over 10 years while off anticonvulsant medication, should be considered as having a condition that is of

aeromedical significance. The applicant may possibly be considered under the flexibility process;

- An applicant with a history of childhood epilepsy or atypical or complex febrile seizures should be considered as having a condition that is of aeromedical significance. The applicant may be considered under the flexibility process;
- An applicant with a well-documented history of a single episode of non-complex febrile convulsion before the age of 5, who is aged 20 years or over may be considered as having a condition that is not of aeromedical significance. If in any doubt the ME should consult with CAA.
- An applicant with a history of alcohol or other drug withdrawal seizures should be considered as having a condition that is of aeromedical significance. The applicant may be considered under the flexibility process.

## 3.10.5 Meningitis / Encephalitis:

### 3.10.5.1 Considerations

There are two Aeromedical concerns following meningitis or encephalitis:

*Neurological sequelae:* The ME should in all cases complete a thorough neurological examination, inclusive of an audiogram. Anyone who has suffered from an episode of meningitis or encephalitis should also undergo a neurologist evaluation unless the infection was documented to be uncomplicated viral (other than herpetic) or bacterial meningitis, occurring more than 12 months previously, in the absence of any sequelae or seizure episode.

*Risk of unprovoked seizures:* This risk is significant and was found in one study to be 6.8 % over 20 years in one study. The ratio of observed to expected case of unprovoked seizures was 6.9. The risk was highest during the first 5 years but remained elevated for the next 15 years of follow up. It was dependent on the type of infection. This is summarised in the table below – adapted from Annegers (1988):

Condition	Risk of unprovoked seizure	Comments
Viral encephalitis (non-Herpes) with early seizures	22 % over 20 years	
Viral encephalitis (non-Herpes) without early seizures	10 % over 20 years	
Viral meningitis (non-Herpes)	2.1 % over 20 years	No significant increase over general population
Bacterial meningitis with early seizures	13 % over 20 years	
Bacterial meningitis without early seizures	2.4 % over 20 years	No significant increase over general population

Thus the ME must remain cautious in assessing any applicant with a history of meningitis or encephalitis.

### 3.10.5.2 Information to be provided

- Copy of the GP notes for the past 5 years or since the acute illness if more recent;
- Copy of any discharge summary and any neurologist report;
- A recent neurologist report unless the illness was an uncomplicated viral (non-Herpes) or bacterial meningitis occurring more than 5 years prior.

### 3.10.5.3 Disposition

- An applicant with a history of encephalitis should be considered as having a condition that is of aeromedical significance;
- An applicant with a history of Herpes Virus meningitis or encephalitis should be considered as having a condition that is of aeromedical significance.

An applicant with a history of uncomplicated, viral (non-Herpes), or uncomplicated bacterial meningitis should be considered as having a condition that is aeromedical significance unless:

- There has been no seizure activity;
- Full recovery has occurred and there are no sequelae of any sort;
- More than five years has lapsed since the acute illness.

## 3.10.6 Transient Global Amnesia

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### 3.10.6.1 Considerations

This condition is a transient loss of memory. It is commoner in middle aged and older people. Typically, the disorder occurs following a physically demanding task (28 %), coitus (6.5%), emotional stress (6.5 %), hot or cold bath / shower (5 %), driving or a medical procedure. In about 50 % (33 – 84%) of cases there is no precipitating factor identified.

The mean amnesia duration is ~ 6 hours although complete recovery of subtle functions may take months. Most episodes do not exceed 10 hours although up to 24 hours has been reported. There is no peripheral neurological deficit. A history of amnesia lasting less than one hour is suspicious of an epileptic disorder.

The memory defect is recognised by the individual. There is complete or partial anterograde amnesia. The patient may not recognise acquaintances but does remember close relatives. There is preservation of ideas and motor skills. Some complex tasks are preserved, such as the ability to drive, but there is cognitive impairment with impaired ability to copy complex figures or to name objects.

The following witnessed criteria support the diagnosis (Caplan 1985 and Hodges and Warlow 1990):

- The episode must be witnessed by an observer who is present for most of the attack.
- There must be clear-cut presence of anterograde amnesia during attack.
- There must be no alteration of consciousness.
- There must be no loss of personal identity.
- Cognitive impairment is limited to amnesia (no aphasia, apraxia, etc.).
- There should be no presence of focal neurological symptoms or deficits during or after attack.
- Epileptic features must be absent.
- Memory impairment must resolve within 24 hours.
- No other causes for amnesia must exist—patients with recent head injury or active epilepsy (medication or seizure in the previous two years) are excluded.

Associated symptoms (headache, nausea, dizziness) and some grade of retrograde amnesia may occur, although these are not required for diagnosis. As previously mentioned, the episode may or may not be associated with some triggering event.

The major differential diagnoses for TGA includes other transient amnesic conditions such as TIA, transient epileptic amnesia (TEA) and psychogenic amnesia. Other conditions that should also be considered include alcohol and other drug intoxication (including prescription and OTC medications), hypoglycaemia, head injury, limbic encephalitis, or a severe exacerbation of depression.

In one study 7 % of patients developed epilepsy, all within 12 months. In another study 4.5 % had recurrences of seizures which disappeared with antiepileptic medication. It is thought that in some people epilepsy may be the cause of the transient amnesia. Thus an accurate diagnosis is necessary. It is useful to obtain an EEG early together with cerebral imaging. This should involve a neurologist and investigations. Exclusion of epilepsy and TIA is paramount if the pilot is to ever fly again.

The majority of TGA studies report a significant association with migraine headaches especially in younger individuals. Family and personal history of psychiatric diseases, anxiety, depression, alcohol use, and certain phobic personality traits also have been associated with TGA.

TGA has a significant recurrence rate but there are no predictors for this. The table below is from a 2018 FAA review of TGA. The aggregated data suggest an annual rate of recurrence in the vicinity of 2.5 – 6 % per annum.

**Table 1.** Recurrence in TGA

Study	Patients in study (n)	Recurrence	Annual recurrence rate	Mean Follow-up
Hinge et al., 1986 <sup>93</sup>	74	22%	4.7%	66.6 months
Miller et al., 1987 <sup>20</sup>	277	14.4%*		80 months
Hodges and Warlow, 1990 <sup>17</sup>	114	7.9%	3%	-
Melo et al., 1992 <sup>51</sup>	48	6.25%		17.4 months
Gandolfo et al., 1992 <sup>92</sup>	102	18.63%		82.2 months
Zorzon et al., 1995 <sup>49</sup>	64	9.4%	2.5%	45.6 months
Lauria et al., 1997 <sup>22</sup>	77	8.2%		-
Chen et al., 1999 <sup>32</sup>	28	18%		42 months
Pantoni et al., 2005 <sup>12</sup>	51	8%		6.8 years
Quinette et al., 2006 <sup>26</sup>	142	3.5%	5.8%	-
Quientte et al., 2006 <sup>26</sup> **	1259**	10.19%		-
Agosti et al., 2006 <sup>13</sup>	85	14.11%		3 years***
Arena et al., 2017 <sup>30</sup>	221	5.4%		4.21 years

\* Included “probable episodes of TGA” recurrence of 23.8%

\*\*Report based on author's literature review.

\*\*\*Retrospective study where patients were recruited over a 3-year period.

-No data available.

CAA UK and FAA report a low risk of recurrence is pilots who have been returned to flying following a first TGA episode.

If an applicant with TGA presents with a recurrent episode there should be a careful review to ensure that the initial diagnosis was correct.

**Aeromedical considerations:**

A pilot suffering from TGA during flight may possibly be able to continue piloting the aircraft and land, if flying day VFR in a known area, with well-known features available for orientation.

But on the other hand, TGA may result in disastrous consequences. When flying on instrument or by night, the complex cognitive functions required, and the lack of available orientation features make it unlikely that a pilot affected by TGA will be able to navigate the aircraft back to safety.

**3.10.6.2 Information to be provided**

On the first occasions that an applicant presents with a history of Transient Global Amnesia:

- Copy of all medical records relating to the episode of Transient Global Amnesia;
- A recent neurologist report.

**3.10.6.3 Disposition:**

An applicant who first presents with a history of TGA should be considered as having a condition that is of aeromedical significance.

A favourable AMC may allow a return to flying, usually with operational restrictions if:

- Criteria and investigations support the diagnosis of TGA;
- The diagnosis has been confirmed by a neurologist;
- Epilepsy and other causes for the index event have been excluded;
- A 12 month recurrence free period has lapsed since the index event;

An applicant who subsequently presents with a history of TGA may be considered as having a condition that is not of aeromedical significance if:

- There has been no recurrence of TGA;
- A previous AMC has allowed issue of a medical certificate and no change is made to the previously imposed restrictions.

## 3.10.7 Parkinson's disease:

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### 3.10.7.1 Considerations

Parkinson's disease (PD, also known as idiopathic or primary parkinsonism, hypokinetic rigid syndrome/HRS, or paralysis agitans) is a degenerative disorder of the central nervous system. The motor symptoms of Parkinson's disease result from the death of dopamine-generating cells in the substantia nigra, a region of the midbrain; the cause of this cell death is unknown. Research is ongoing.

Early in the course of the disease, the most obvious symptoms are movement-related. These include shaking, rigidity, slowness of movement and difficulty with walking and gait. These are not always obvious however. Later, thinking and behavioral problems may arise, with dementia commonly occurring in the advanced stages of the disease, whereas depression is the most common psychiatric symptom. Other symptoms include sensory, sleep and emotional problems.

The condition is progressive and requires due consideration not only in regard to its impact on flight safety at the time of certification but also its likely future evolution during the period of certification.

The impairment caused by the disease fluctuates so that the status at the time of examination may not reflect the more serious intermittent impairment that may occur.

Medication does reduce symptoms but does not alter the course of the disease. Many of the preparations given for Parkinson's disease have side effects that are not acceptable for certification.

### 3.10.7.2 Information to be provided

- Copy of the GP notes for at least the past two years
- Copy of all specialists' reports relating to the Parkinson's disease;
- A recent neurologist report;
- A neuropsychological assessment may also be requested
- A medical flight test will often be required as part of an AMC process.

### 3.10.7.3 Disposition

- An applicant with suspected or confirmed Parkinson's disease should be considered as having a condition that is of aeromedical significance.
- Following the flexibility process, a medical certificate may be issued in rare circumstances.

## 3.10.8 Cerebrovascular diseases / accidents

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### 3.10.8.1 Considerations

Cerebrovascular events can be classified as ischaemic or haemorrhagic events, depending on the primary cause.

#### Ischaemic events

These can be divided in transient ischaemic attacks (TIAs), and strokes or cerebral infarction. Reversible ischaemic neurological deficits (RINDs) is a term sometimes used to describe an ischaemic event with neurological deficit lasting more than 24 h but less than 48 h.

There is an increased cardiovascular risk associated with ischaemic strokes and TIAs. Certification will depend on the presence or absence of sequelae, the likelihood of seizure, the underlying pathology and the risk of recurrence conferred by this pathology. Some possible causes are:

- Vascular stenosis / plaque;
- Small vessels disease
- Thrombo-embolism;
- Blood hyperviscosity;
- Migraines.

In many instances the cause remains unclear, all investigations being negative. In such cases the final diagnosis will often be that of probable occult vascular or cardiac disease, such as Paroxysmal Atrial Fibrillation, or Patent Foramen Ovale (PFO) which should be looked for.

#### Haemorrhagic events

Haemorrhagic stroke may be caused by the rupture or leak of an arterial aneurysm, resulting in a subarachnoid haemorrhage. Aneurysms with a diameter of less than 7 mm have a low probability of rupturing. Occasionally, with angiography, no pathological vessel is found causing subarachnoid haemorrhage. This situation has a more favourable prognosis.

Other causes of intracranial bleeding include anticoagulants, arteriovenous malformations, amyloid angiopathy and hypertensive cerebral haemorrhages.

### 3.10.8.2 Information to be provided

- Copy of the GP notes for the past 2 years or since the acute illness if more recent;
- Copy of any discharge summary and any neurologist report;
- Copy of any investigation report.

### 3.10.8.3 Disposition

- An applicant with a history of cerebrovascular accident or stroke should be assessed as having a condition that is of aeromedical significance.

**Class 1 and 3** certification is unlikely in most cases of ischaemic strokes or TIAs.

**Class 2** certification may be possible in some cases of ischaemic strokes or TIAs, in the absence of sequelae, or elevated risk of seizure, following a two to three years waiting period. Exclusion of identifiable vascular disease or cardiac ischaemia is required. Restrictions usually apply.

**Class 1, 2 and 3** certification may be possible in some cases where an adequately treated cause has been identified for the cerebro-vascular event and there is absence of safety relevant sequelae or elevated risk of seizure. For example, in the case where a large patent Foramen Ovale (PFO) is the probable cause for an ischaemic event and closure has been successfully undertaken.

## 3.10.9 Demyelinating Disease

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### 3.10.9.1 Considerations

A demyelinating disease occurs when the myelin sheath of neurons is damaged, affecting the conduction of signals in the affected nerves. The impaired conduction function causes deficiency in sensation, movement, cognition, or other functions.

The possible causes include genetic characteristics, infectious agents, autoimmune processes, toxic and unknown factors.

### 3.10.9.2 Information to be provided

- Copy of the GP notes for the past 2 years or since the acute illness if more recent;
- Copy of any discharge summary and any neurologist report;
- Copy of any investigation report.

### 3.10.9.3 Disposition

- An applicant with a history of demyelinating disease should be considered as having a condition that is of aeromedical significance.

## 3.10.10 Neurocognitive Impairment

### 3.10.10.1 Considerations

The effects of aging on cognitive performance are important in safety critical activities such as aviation especially when dealing with novel or inflight emergency events. The ability to perform safely on cognitively demanding tasks requires good executive functioning and spatial working memory. Older experienced pilots tend to show preserved spatial working memory. But even mild cognitive impairment may adversely affect the ability to cope with the complex and high task level demands characteristic of aviation, including in experienced pilots. Cognitive impairment may not be recognised by the applicant.

Dementia (cognitive and behavioural problems severe enough to impair normal function) is incompatible with certification.

It is important to have an index of suspicion in older pilots. Mild cognitive impairment may not interfere with normal daily activities but is a potential significant risk to flight safety.

A ME should ask about the applicant's flying since their last application, how well they manage different situations, difficulties flying a different aircraft type, flight planning, or with procedural activities such as cockpit or ATC communications. Information about any recent flying related incidents or near misses should be reviewed. Other collateral information that may be covered by the ME include changes in daily or work activities, recent motor vehicle accidents, or problems managing personal affairs such as financial matters.

MEs may use office based tests such as Montreal Cognitive Assessment (MOCA) as an initial screen or using the CAA aging pilot form. Unfortunately, many of the simple tests of cognition available to MEs are unlikely to pick up mild but aeromedically significant cognitive impairment.

Formal neurocognitive testing may be needed in some situations, but it is recommended that MEs contact CAA to discuss this before proceeding with such evaluations.

A ME should consider requesting a copy of the most recent BFR / competency flight check report. A CAA flight examiner assessment may be required, specifically to test decision-making and flight planning skills, as well as procedural tasks.

### 3.10.10.2 Information to be provided

- CAA Aging Pilot report;
- Copy of the GP notes for the past 2 years;
- Copy of any specialist reports e.g. neurologist, geriatrician;
- Copy of any investigation reports.

### 3.10.10.3 Disposition

- An applicant with a history suggestive of cognitive impairment should be considered as having a condition that is of aeromedical significance.