Aviation Neurology

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Neurological Disorders: Considerations in decision making

**Deficit**
- Is there a focal deficit? If so, is it functionally significant?
- Is there cognitive impairment?
- Is there risk of an event in flight?

**Episodic**
- What is the recurrence risk in flight?
- Is there predictability?
- Are there measures to reduce recurrence?
- Does risk lower with the passage of time?

**Is there risk of an event in flight?**
The burden of neurological disease in the United States

The economic burden of major neurological diseases in billions (2014 dollars):

- Traumatic Spinal Cord Injury, $19
- Epilepsy, $37
- Migraine Headache, $78
- Traumatic Brain Injury, $86
- Stroke, $110
- Chronic Low Back Pain, $177
- Alzheimer’s + Other Dementias, $243
- Parkinson’s, $15
- Multiple Sclerosis, $25
Annual Incidence of Most Common Adult-Onset Neurologic Disorders

- Stroke: 51.3%
- Alzheimer's disease: 21.4%
- Epilepsy: 11.6%
- Traumatic brain injury: 6.8%
- Parkinson's disease: 4.7%
- Brain tumor: 2.8%
- Multiple sclerosis: 0.9%
- ALS: 0.4%
- HIV (AIDS) dementia: 0.1%
Common neurological conditions in aviators

• Syncope
• Seizure
• Migraine
• Traumatic Brain Injury
• Neoplasm
• Vascular
• Neurodegenerative?
Syncope
Syncope

• LOC and postural tone due to global cerebral hypoperfusion, followed by spontaneous recovery

• Vasovagal, neurocardiogenic, neuroregulatory, neurally mediated syncope are synonymous

• Often benign, but may indicate serious disease such as cardiac syncope
Syncope

- hypotonic, flaccid, limp, “dead weight”
- pallid, colorless, white, sometimes grayish
- shallow to nearly imperceptible respirations
Pallid Syncope: Features

- Nearly always when upright
- Lengthy prodrome of 2-5 minutes in vasovagal syncope
- GI, respiratory, visual autonomic symptoms
- “Syncopal slump”, brief LOC for 10-15”
- Shallow nearly imperceptible respirations
- Little or no confusion
Syncope: Accompaniments

- Urinary incontinence in 10-15%
- Convulsive accompaniments in 10%
- (state of functional decerebration)
- May lead to incorrect diagnosis of seizure disorder, so beware of possible incorrect diagnosis
Mechanisms of Syncope

- Vasovagal (~50%): pain, sight of blood, exertion, micturition, medical procedure

- Orthostatic/dysautonomic: hypovolemia (blood loss, dehydration), medication, alcohol

- Cardiac: Output: Valvular stenosis, IHSS
  Rhythm: Brady, tachy, mixed arrhythmias
Syncope: disposition

- Single vasovagal, explained: may be fit
- Unexplained syncope- Needs further evaluation (cardiac, neurologic)
Seizure(s)
Seizure Disorder

• Definition: A tendency to recurrent (two or more) unprovoked seizures

• Epilepsy and convulsive disorder are synonymous terms

• An abnormal excessive discharge of cerebral cortical neurons
Basic Seizure Classification

- Partial (focal) seizures
  - Simple partial: consciousness preserved
  - Complex partial: consciousness impaired

- Partial with secondary generalization
  (culminating in grand mal seizure)
Generalized tonic-clonic seizure

• Aura, epileptic cry, posturing: “the turns”
• Tonic phase: stiffening, collapse, cyanosis, apnea
• Clonic phase: rough noisy respirations, tongue biting, incontinence, blood tinged saliva
• Post-ictal phase: confusion, combativeness, sleep
• Amnesia for the event
• Headache, nausea/emesis, muscle soreness
• Duration: 1 minute
Etiology of Seizures

- Lesional: scar, stroke, malformation, neoplasm, hereditary
- Acute symptomatic (hyponatremia, other)
- Medication/controlled substances/alcohol
- 66% idiopathic
Seizure evaluation Requires:

- Need Detailed clinical story
- Need EEG (capturing wake and sleep)
- Need MRI
Seizures: Aeromedical Disposition

- Febrile seizures and certain childhood seizures known for permanent remission are OK

- Adult-onset single unprovoked seizure with no risk factors: four years medication-free observation, then OK, assuming supporting studies like EEG and MRI are normal
Seizures: Aeromedical Disposition

- Recurrent seizures: ten years seizure free, four years medication free

- Single seizure with no risk factors (history, EEG, MRI, prior insult, family history), OK exam

- Few have been certified following epilepsy surgery
Migraine

- Common migraine: no aura
- Classic migraine: aura followed by headache
- Migraine equivalent (migraine variant, acephalgic migraine): aura without headache
Migraine: Aeromedical Disposition: consider......

- Prodrome
- Precipitating factors & predictability
- Aura
- Rapidity of onset
- Severity
- Frequency
- Treatment (acute, prophylactic, life style change)
Migraine Treatment

- Beta Blockers OK
- Calcium channel blockers OK
- Triptans OK (12 hour no fly)
- NSAIDs
- OTC non sedating
- No anticonvulsants (topirimate, valproic acid)
- CGRP antibodies?
AME Guide: Migraine

• Requires FAA decision if significant complications

• Submit all pertinent medical records, neurologic report to include characteristics, frequency, severity neurologic phenomena, medication, side effects.

• Defer initially if in doubt
Traumatic Brain Injury

Figure 2: July 1917, von Richthofen with his nurse Sister Käte at field hospital No 76 in Kortrijk, Belgium, after having received a head wound during aerial combat
Nature of TBI

- Concussion
- Closed
- Penetrating
- Diffuse axonal injury
- Contusion
- Laceration
- Intracranial hematoma
Epidural Hematoma
Epidural Hematoma
Subdural Hematoma
Parenchymal Blood

- Petechial hemorrhage
- Contusion
- Organized hematoma
- Diffuse axonal injury (DAI)
Post Traumatic Epilepsy (PTE)

- Incidence as high as 40% in penetrating head injury (meningo-cerebral cicatrix of Penfield)

- In closed head injury incidence is closer to 5%
Immediate (impact) seizure may be a non-specific reaction to trauma

Early seizure (first week) carries 25% risk of further seizures

Late seizures (beyond first week) suggest cicatrix and portend recurrent seizures
Pathogenesis of PTE

- extravasated RBC into neural tissue
- iron liberated from hemoglobin
- highly reactive free radical oxidants are produced in the metabolism of iron
- Lipid peroxidation leads to cell membrane and organelle injury
First Seizure in PTE

- 50% within 6 months
- 75% within one year
- 83% within two years
- 95% within three years
Clinical criteria considered: Glasgow Coma Score, Posttraumatic Amnesia

Imaging criteria: Intracranial blood: Epidural, subdural, subarachnoid, ventricular, parenchymal

Two year observation common related to PTE risk

With severe TBI, five years observation
Douglas DC3
Intracranial Neoplasm
Meningioma

Characteristically a benign extraparenchymal neoplasm
Gliomas

An intraparenchymal neoplasm without definitive borders, infiltrating projections, and a tendency to recur
Glioblastoma multiforme
For benign extraparenchymal neoplasms, generally one year with freedom from complications and recurrence.

For parenchymal infiltrating gliomas, recurrence is the rule, ordinarily precluding certification.
Cerebrovascular Disorders

- Plugs: thrombosis
- Leaks: hemorrhage
Large Vessel Stroke: Middle Cerebral Artery

- Primary thrombosis
- Embolic source
  - Artery to artery
    - intracranial
    - siphon
    - cervical carotid
    - aorta
  - Cardioembolic
Small Vessel Stroke: Lacunar Infarct

- Commonly related to hypertension
- May be multiple
- May be silent
Cerebral Aneurysm
Arteriovenous Malformation

- Often present with seizures rather than hemorrhage
- Surgery may be curative for hemorrhage, but not seizures
Cavernoma
(cavernous angioma)
Ischemic Stroke
Aeromedical Disposition

- For TIA and ischemic stroke (primary or embolic)
  usual observation period is two years with
  documentation of risk factor attention

- Aneurysm: one year without isolation from the
  circulation and lack of complications

- Malformations, cavernomas: individual
  assessment
Other Major Conditions

- Neurodegenerative
  - Dementias
  - Parkinson’s disease
  - ALS

- Inflammatory
  - Multiple Sclerosis