Vascular territories and clinical Syndromes of the Posterior Circulation

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Posterior circulation strokes are suggested by the **acute** onset of …

1. Vestibular symptoms
2. Visual symptoms
3. Bilateral or crossed manifestations
4. Decreased level of consciousness at onset
5. Amnesic syndromes
1. Vestibulo-ocular manifestations of posterior circulation strokes

- Vertigo & nystagmus
- Vertical diplopia
- Ocular tilt reaction
  - Skew deviation
  - Visual tilt
Is the vertigo due to stroke?

Consider stroke or TIA if …

- **Acute** spontaneous onset vertigo/imbalance
- Patient cannot walk anymore, even with help
- Acute associated acute hearing loss (→ AICA)
- New or unusual headache
- Patients with vascular risk factors, elderly, cardiac sources
- Other central symptoms (patient) or signs (witness)
  - Hiccup, dysarthria, new Horner, mild long tract sign, etc.
- On examination:
  - Normal head thrust (Halmagyi) and cold calorics despite persistent vertigo
  - « Central » type nystagmus (see next slide)
Is the nystagmus due to stroke?

**Checklist**

A nystagmus is in general *central* if it is …
- Multidirectional gaze-evoked
- Vertical
- Pendular, convergence-retraction
- Dissociated
- Not accompanied by vertigo/nausea
- Not improved by visual fixation

*Not* useful to differentiate central from peripheral:
- Conjugate horizontal or rotatory nystagmus
- Positional or not (exception: short, stereotyped in BPPV)
- Transitory or persistent
Nystagmus due to stroke

Examination → localisation

- **Midbrain**
  - Convergence-retraction
  - Disconjugate (INO)
  - Rotatory (torsional)
- **Pons**
  - Disconjugate (INO)
  - (Bobbing)
- **Medulla oblongata**
  - May imitate peripheral-type
- **Cerebellum**
  - May imitate peripheral-type
  - Multidirectional gaze-evoked
Vertical diplopia of central origin
Examination and localisation

- Central paresis of elevation/depression of one eye
  - Unilateral midbrain (fascicle of III)
- Acquired vertical strabism = skew deviation
  - May be of central or peripheral origin
  - Precise localisation: see next slide
Vertical diplopia in skew deviation

Where is the lesion?

Elevation one eye  Depression other eye
Vertical diplopia
Example: skew deviation
Ocular tilt reaction (OTR)

- Consists of
  1. Skew deviation
  2. Head lateroflexion
  3. Ocular torsion
     (all to the same side)

- May be associated with visual tilt (of the image)
OTR and subjective visual vertical

Example

Right lateral medullary stroke (Wallenberg)

From right vertebral artery occlusion
2. Visual manifestations
of posterior circulation strokes

- Vertical diplopia and gaze paresis
- Horizontal diplopia
- Conjugate horizontal eye deviation /gaze paresis
  (« Wrong way »)
- Ptosis
- Homonymous visual field deficits
Vertical gaze paresis, vertical diplopia

Central localisations and causes

- Vertical gaze paresis: up- and / or downgaze
  - Uni- or bilateral midbrain (+/- lower thalamus)
- Vertical diplopia (see previous slided)
  - Vertical paresis of one eye (central III)
  - Or vertical strabism = skew deviation
Vertical gaze paresis

Example

- Up- and downgaze paresis

→ bilateral midbrain + lower thalamus stroke
Horizontal diplopia of central origin

Examination and localisation

- ↓ Abduction: fascicular VI
  → pons
- ↓ Abduction: « pseudo-VI » (hyperconvergence)
  → dorsal midbrain
- ↓ Adduction: INO (internuclear ophtalmoplegia)
  → dorsal pons/midbrain
Conjugate horizontal eye deviation

Central lesions: localisation and causes

Ipsilateral
(« Patient looks at his lesion »)

Contralateral
(« Patient looks at his hemi-paresis »)
(« Wrong-way eye deviation »)

Ipsilateral
(« Patient looks at his lesion »)

Hemispheres

Midbrain

Pons

Medulla
Stroke and unilateral ptosis

Examination and localisation

- As part of a central Horner’s syndrome (→ miosis!)
  → ipsilateral dorsally between hypothalamus and Th₁

- As part of a IIIrd nucleus or fascicle lesion
  → dorsal midbrain
Stroke and **bilateral** ptosis

**Examination and localisation**

- Uni- or bilateral lesion of the III\(^{rd}\) nucleus
  - \(\rightarrow\) dorsal midbrain

- Supratentorial « eye opening apraxia »
  - \(\rightarrow\) large **right** hemispheric lesions
3. Bilateral manifestations in posterior circulation strokes

- « Syndrome alterne »
  - Cranial nerve deficit ipsilateral
  - Long tract signs contralateral

- Bilateral corticospinal signs and ataxia
  - Basilar artery supplies both sides
  - Paramedian lesions are often bilateral
  - Anterior pons: crossings of cerebellar fibers
Basilar artery occlusion

- Causes, syndromes and arterial pathology are heterogeneous:
  - **Proximal**: Wallenberg +/- cerebellar +/- medial medullary sdr.  
    - (bilateral) vertebral artery disease
  - **Mid-basilar**: locked-in syndrome  
    - local atherosclerosis or embolic
  - **Distal**: top of basilar syndrome  
    - embolic from proximal source or cardiac
- About 50% of patients have precursory symptoms or a progressive onset
- Overall prognosis is poor

BASICS-investigators, Lancet Neurology 2009
4. Decreased level of consciousness in posterior circulation strokes

- Lesion localisation
  - Mesencephalon +/- thalamus
  - Usually bilateral, dorsal (tegmentum, RAS)
- Beware: « pseudo – stupor » in posterior stroke
  - Locked-in syndrome (anterior pons): consciousness preserved
  - Bilateral ptosis may occur without decrease of consciousness
5. Amnesia
in posterior circulation stroke

- Anterior cerebral artery
- Anterior choroidal artery
- Anterior communicating artery

- Posterior cerebral artery
- Posterior choroidal artery
- Posterior communicating artery

Thalamus:
- NA – anterior nuclei
- NDM – dorsomedial nuclei

Basal forebrain

Fornix
Mamillothalamic tract
Mammillary body

HIPPO - CAMPUS
PARA HIPPOCAMPAL GYRUS

Slide: courtesy J. Ferro, Lisbon
5. Amnesia in posterior circulation stroke

- The limbic mnestic system (Papez’ circuit) is mainly supplied by the posterior circulation.
- Main lesion localisations:
  - Anterior thalamus (posterior comm. art.)
  - Medio-temporal lobe (PCA)
- Unilateral lesion: transient confusional/amnestic state
- Bilateral lesions: persistent amnestic state

Anterior thalamic Radiology CHUV
Typical posterior circulation syndromes

- Medulla oblongata
- Pons
- Mesencephalon
- Cerebellum
- Thalamus / PCA
Brainstem and cerebellum: arterial supply

Paramedian arteries

Short circumferential art.

Long circumferential art.

Cerebellar arteries
  - Cerebellum
  - Posterier brainstem
  - (Lateral trunc)

Tatu 1996, Foix 1925

Drawing: Caplan, Goodwin 1982
Lateral medullary syndrome

→ **Wallenberg’s syndrome**
  - Vertigo, conjugate contralateral horizontal and/or rotatory nystagmus, contralateral eye deviation
  - Ocular tilt reaction (OTR), Horner’s
  - Ipsilateral hemiataxia
  - IX, X: dysphagia, hoarseness, hiccup
  - V (ipsi- and/or contra-lateral)
  - Sensory hemisindrome (mostly spinothalamic contralateral)

**Arteries responsible:**
1. Circumferential arteries (perforators)
2. PICA-branches
   (Beware: cerebellar involvement cannot be evaluated clinically)
Lateral medullary syndrome

Medial vestibular nucleus  NTS

Trigeminal nucleus and fascicle

Cerebellar peduncle

Spinothalamic tract

PICA

Circumferential perforators

Vertebral artery

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Medial medullary syndrome

- Typically
  - Contralateral hemiparesis (arm, leg)
  - Contralateral posterior-column sensations loss (arm, leg)
  - Ipsilateral XII

- Other manifestations
  - Hemiparesis may be ipsilateral, or bilateral (depending on lesion site within pyramid)
  - Combination with symptoms of Wallenberg’s

Arteries responsible:
1. Perforator occlusions (coming from the vertebral artery)
2. Vertebral artery occlusion
Pontine syndromes

- **p.ex.: Foville syndrome** (paramedian antero-posterior)
  - Ipsilateral nuclear VII
  - Ipsilateral gaze paresis (PPRF and/or nucleus VI)
  - Contralateral hemiparesis

- **Other manifestations of pontine strokes**
  - INO, ipsilateral V or VI
  - Hemiataxia (ipsi- and/or contralateral)
  - Horner’s, OTR
  - Contralateral hemisensory loss (any modality)

**Arteries responsible:**
1. Paramedian and circumferential arteries (perforators)
2. AICA-branches
Pontine syndromes

Example: paramedian perforators (Foville)

Facial nucleus and fascicle

Abducens nucleus

Corticospinal fibers

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Midbrain syndromes

- p.ex. : Weber’s syndrome (paramedian midbrain)
  - Ipsilateral III
  - Contralateral hemiparesis

- Other manifestations of midbrain strokes
  - Vertical gaze palsy, OTR, IV, Horner’s
  - Convergence-retraction nystagmus
  - Temor, myoclonus, chorea
  - Contralateral hemiataxia, dysarthria (cerebellar SCA territory)
  - Contralateral hemiparesis (pedoncule)
  - Contralateral spinothalamic sensory los

Arteries responsible:
1. Paramedian and circumferential arteries (perforators)
2. SCA-branches
3. PCA-branches
Midbrain syndromes

Example: paramedian perforators (Weber’s)

- Oculomotor nucleus and fascicle
- Corticospinal fibers (Cerebral peduncle)
Thalamic stroke syndromes

4 classical territoires

Illustration: Barth et al, In: Bogousslavky & Caplan, Stroke Syndromes 1999
## Thalamus: the great imitator

<table>
<thead>
<tr>
<th>Artery</th>
<th>Thalamic territory</th>
<th>Signs</th>
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<tbody>
<tr>
<td>Thalamo-geniculate artery  → Lateral</td>
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<td>Sensory hemisindrome</td>
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<td>Hemiataxia, pain</td>
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<td>Hemidystonia</td>
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<td>Polar artery  → Anterior</td>
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<td>Abulia, confusion</td>
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<td></td>
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<td>L: aphasia, verbal amnesia</td>
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<td></td>
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<td>R: visual amnesia</td>
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<tr>
<td>Thalamic-subthalamic art.  → paramedian art.</td>
<td>→ Paramedian</td>
<td>‡Vigilance, amnesia, vertical gaze paresis</td>
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<td>Dystonia, asterixis</td>
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<td>Posterior choroidal artery  → Pulvinar, lateral corpus geniculatum</td>
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<td>Visual field defects</td>
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<tr>
<td></td>
<td></td>
<td>(Amnesia, aphasia, dystonia, hemisindrome)</td>
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Cerebellar strokes
Cerebellar arterial supply
Cerebellar strokes
They may all have hemi-ataxia and gait ataxia

<table>
<thead>
<tr>
<th>Cerebellar artery</th>
<th>Purely cerebellar territory</th>
<th>Plus adjacent brainstem territory</th>
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<tbody>
<tr>
<td>Superior (SCA)</td>
<td>Dysarthria</td>
<td>IV, contralateral spinothalamic signs</td>
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<td>Chorea, ipsilateral Horner</td>
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<td>Antero-inferior (AICA)</td>
<td>Rotatory vertigo</td>
<td>Hypoaccousie/tinnitus</td>
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<tr>
<td></td>
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<td>VII, V, ipsilateral Horner</td>
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<td></td>
<td></td>
<td>Contralateral spinothalamic signs</td>
</tr>
<tr>
<td>Postero-inferior (PICA)</td>
<td>Rotatory vertigo</td>
<td>Wallenberg’s syndrome</td>
</tr>
</tbody>
</table>
Posterior cerebral artery stroke

3 territories

- **Mesencephalo-thalamic territory**
  - See previous slides

- **Occipital territory**
  - Homonymous visual field deficits

- **Medio-temporal territory**
  - **Left**: (transient) verbal amnesia, alexia, visual agnosia, color anomia
  - **Right**: (transient) visual amnesia, color agnosia
  - **Bilateral** (or right acute): prosopagnosia
Ce... ce vertige!... C'est atroce...