Venous stroke: the significance of isolated affections of cortical or small veins without sinus involvement

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Purpose
Intracranial venous occlusive disease, for the greater part, is equated with occlusion of the dural sinuses. Generally we know very little about the occlusion of deep and cortical veins in the absence of sinus occlusion. The imaging characteristic of non-inflammatory thrombosis, limited to cortical or small draining veins and its sequel, is not familiar in practice. We tried to identify the imaging characteristic and its clinical relation in patients with acute stroke as consequence of isolated affections of cortical or small veins in 60 consecutive cases.

Materials & Methods
From 700 patients undergoing stroke selection 60 cases were considered as non-arterial diseases and prospectively studied: They had experienced sensomotor symptoms of different severity. Each case underwent CT, MRI and catheter angiography studies. The angiographic studies were performed with preferences especially for detailed analyses of the venous angiomorphology, including proper oblique views.

Results
Patterns of brain lesions on CT or MR imaging were categorized as hemorrhagic and/or ischemic.

A. Hemorrhagic lesions:
42 patients (mean age 52 +/- 22) had brain hemorrhages:
- in 22 cases one-time lesions were identified;
- 20 patients had some evidence of sequential repeated bleedings.

B. Non-hemorrhagic lesions:
In 18 patients (mean age 45 +/- 25) only ischemic lesions were detected:
- 16 cases demonstrated venous occlusions;
- in 2 cases with venous developmental anomaly an acute decompensation of the drainage veins has been observed;

C. CT & MR imaging:
The observed hemorrhagic lesions were polymorphic, separated into segments and often with different age of occurrence. An extension into subdural space had been detected in 12 cases. The morphological locations of imaging features were not related to any arterial territories.

D. Angiographic imaging:
The catheter angiography detected pathological changes of the cortical veins as isolated thrombosis, venous stasis, venous collateral features, or delay in the local circulation in all cases.

E. Treatment:
In 6 cases with hemorrhages and in 15 cases with ischemic features an anticoagulant treatment was successfully implicated.

Conclusion
The result of the study indicated that an isolated thrombosis of cerebral veins perhaps is more often than commonly recognized. An affection of cortical and small veins should be expected in cases with isolated thrombosis, regional venous stasis, venous collateral features, or delay in the local venous circulation. The affirmative clinical results obtained with anticoagulant therapy in such cases justify the effort to identify an isolated venous thrombosis.

Case reports:

Case 1
35 year-old man with iatrogenic thrombosis of a frontal cortical vein following a ventricular shunt procedure
Sequenced phlebograms of internal carotid artery show the delayed visualization of damaged vein (arrows) in **early** and **middle** venous phases (Fig 1, 2, 3) and the stasis of the same vein in the **late** venous phase (Fig 4). The natural history of an iatrogenic damaged vein is of course not absolutely compatible to the thrombosis of a cortical vein. However it should be useful in further interpretations for detection of affections of cortical and small veins.

**Case 2**

*48 year-old man with 5 week history of very slight recurrent headaches with sinus thrombosis and compensated venous drainage*

**MR image** (Fig 1) shows occlusion of right lateral sinus (arrow) without any parenchymal damage. Oblique lateral view of right internal carotid artery phlebogram (Fig 2) shows a regular and compensated venous drainage in temporo-occipital area with occlusion of right lateral dural sinus (arrow). There is a patent appearance of temporo-occipital vein with retrograde direction of the vein of Labbe (curved arrow) to the sphenoparietal venous sinus. Even though there is occlusion of lateral sinus, non disturbance of local venous drainage had been detected.

**Case 3**

*48 year-old woman with thrombosis of left lateral sinus and thrombotic affection of several temporo-occipital veins*

**CT image** (Fig 1) shows a broadly based hemorrhage located in temporo-occipital and parietal areas separated into segments. It extends into left subdural space. Lateral and oblique views of left internal carotid sequenced phlebograms show in **early** venous phase (Figs 2) delayed venous circulation and absence of temporo-occipital veins. In the **middle** (Fig 3, 4) and **late** (Figs 5, 6) venous phases there are appearances of isolated thrombosis, delayed visualization and venous stasis of temporo-occipital veins. The venous collateral features are absent and the normal venous drainage has been completely disturbed. Consequently a segmented brain hemorrhage has been caused.

**Case 4**

*22 year-old woman with an 1 week history of intermittent headaches and subarachnoid hemorrhage*

**CT image** (Fig 1) shows a discrete subarachnoid hemorrhage in interhemispheric space (arrow). **MR images** (Figs 3, 4) point at an occlusion of superior sagittal sinus (arrows), and **Diffusion** weighted imaging (Fig 2) points at small cortical and frontal area on the left with acute ischemic brain lesion (arrow). Sequenced phlebograms of **right** (Figs 5, 6) and **left** (Figs 7, 8) internal carotid arteries show the delayed venous circulation in the both fronto-parietal areas. The **late** venous phase on the **right** (Fig 6) shows features of collateral drainage (arrow); the venous drainage is damaged, but not totally decompensated. The **late** venous phase and on the **left** (Fig 8) is functionally more damaged; there is persistent absence of collateral drainage with permanent venous stasis (arrow). The poor venous collagen’s on the **left** side correlate to the higher grade of venous drainage disturbance with consequent ischemic parenchymal damage on diffusion weighted imaging (Fig 2).

**Case 5**

*30 year-old woman with history of single complex partial seizure and mild left hemiparesis due to venous ischemia*

**MR images** (T 2 – weighted ) on admission (Fig 1) detect a circumscribed right frontal area of parenchymal edema with leptomeningeal enhancement after Gd application (arrows). Sequenced phlebograms of right internal carotid artery (Fig 2) reveal in The **early** venous phase (left) delayed local venous circulation with absence of a cortical frontal vein (arrow); the **late** venous phase (right) shows delayed appearance of the cortical vein with venous stasis (arrow). 1 month **follow-up** imaging (Fig 3) shows nearly complete reversal of venous parenchymal damage. The venous ischemic lesions may be located cortical or subcortical and du not present any territorial similarity to the arterial ischemia. They appear to recover morphologically much more complete as the arterial ischemic lesions.

**Case 6**

*25 year-old man with history of slight headaches for few days and stroke on admission with ataxia, dysarthria and left-hemiparesis*

**CT image** (Fig 1), MR T 2 – weighted image (Fig 2) and **Diffusion** weighted imaging (Fig 3) reveal a circumscribed and not typical acute ischemic damage of upper right cerebellum. The angiography of vertebrobasilar system (Fig 4, 5, 6, 7) and the **selective injection** of right superior cerebellar artery (Fig 8, 9, 10, 11) show an area in right upper cerebellum with blush related enhancement detected in early arterial phase and increasing progressively during the parenchymal phase (arrows).
The venous phase presents many atypical cortical venous structures, like a “caput medusae”, with large sample vein compatible with appearance of a developmental venous malformation. Especially the early lateral venous phase of selective right superior cerebellar angiogram (Fig 10) shows dichotomically divided venous channels while the late venous phase of same projection show normal venous structures only (Fig 11).

MR imaging 1 week follow-up (Fig 12,13) demonstrates regress of edematous lesion, and MR imaging 5 months follow-up (Fig 14) shows almost complete reversal of parenchymal damage. The ischemic lesion was generated within the framework of an existing developmental venous malformation, probably because of thrombotic affection of drainage vein. Therefore, the follow up MR imaging show nearly complete reversal of venous parenchymal damage.

Case 7
71 year-old man with history of slight headaches for few days presented with stroke and right-side weakness
CT images show a cortical intraparenchymal hemorrhage on the left tempo-parietal area associated with more extensive hemorrhage of subdural space (Fig 1).

Sequence of oblique phlebograms of left internal carotid artery shows the absence of temporo-occipital vein (arrow) in the early venous phase (Fig 2), the delayed visualization in the middle venous phase (Fig 3), and the stasis of the same vein in the late venous phase (Fig 4). The vein of Labbe is absent, probably as an anatomic variant, and the temporo-occipital vein represents its substitution.

Case 8
60 year-old women with progressive right hemiplegia
CT imaging detected a parietal hemorrhage (Fig 1); CT follow-up images 2 days later (Fig 2) and 5 days later (Fig 3) revealed progressive increasing of the irregular and segmented hemorrhage.

Sequence of internal carotid phlebograms shows occlusion of a parietal cortical vein (arrows) with delayed visualization and stasis in late venous phase.

Case 9
71 year-old woman presented with stroke and left-side weakness
MR T 1 weighted images show a subacute segmented hemorrhage in the right parietal area.

Sequence of internal carotid artery phlebograms detect absence of parieto - occipital cortical veins (arrows) in early venous phase (Fig 2) with delayed and irregular appearance of the same in late venous phase (Fig 3).

Case 10
77 year-old woman presented with stroke 3 days before admission and right-side weakness
CT images (Fig 1) demonstrate a cortical and subcortical polymorphic hemorrhagic lesion partially with subarachnoidal compartment, separated into segments and probably with different age of occurrence.

Oblique sequence of internal carotid artery phlebogram detects in early (Fig 2) and middle (Fig 3) venous phase delayed local venous circulation with absence of vein of Labbe and of temporo-occipital veins. The late venous phase (Fig 4) shows delayed appearance of the cortical temporo-occipital veins with venous stasis (arrow). The vein of Labbe (curved arrow) is only insinuated. The venous drainage of temporo-occipital area seems to be insufficient and pattern of collateral drainage has been not detected.

Case 11
81 year-old man presented with stroke and right-side weakness
CT image (Fig 1) shows irregular hemorrhagic lesion separated into segments located temporo-occipital and probably with different age of occurrence.

MR images (Fig 2) after Gd-administration shows pial enhancement in left tempo-occipital area and several prominent vascular structures consequently to confused venous drainage in temporo – occipital area.

A sequence of internal carotid artery phlebograms demonstrates in early venous phase delayed local venous circulation with absence of temporo-occipital vein (Fig 3). The late venous phase (Fig 4) shows delayed appearance of the cortical vein with venous stasis (arrow).

References

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