Brain Arteriovenous malformation - initial approach. Value of different imaging modalities.

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Patient: 38 years, male

Clinical History:
A 38 year old male patient presented with headaches and epileptic seizure.

Imaging Findings:
A previously healthy men came to the Emergency Room after suggestive seizure. Inspection detected a tongue bite; but no other anomalies (no urinary or faecal incontinence). Neurological examination was normal.

Discussion:
Arteriovenous malformations (AVMs) of the brain are congenital cerebrovascular anomalies with a mean age of diagnosis between 30-40 years, affecting both genders nearly equally. They can be clinically silent or symptomatic (often intracranial haemorrhage or epilepsy). AVMs typically present as solitary lesions, although multiple AVMs can occur spontaneously or associated with rare vascular anomalies (like Rendu-Osler-Weber Syndrome and Wyburn-Mason Syndrome). In a patient with sudden onset of a neurological deficit, a CT scan is usually the first imaging technique used - a very sensitive modality to haemorrhage diagnosis (parenchymal, subarachnoid and intraventricular bleeding). In unruptured AVMs, CT scan (without contrast) can be normal or even have some abnormal density, mass effect, slightly hyperdense serpiginous structures and intra-parenchymal calcifications. Contrast injection is absolutely mandatory to depict the brain AVM on CT scan, as first modality imaging. The role of CT angiography (CTA) in the diagnosis is not precisely defined. CTA is a useful non-invasive method for detecting brain vascular diseases like AVMs (allowing initial diagnosis and some anatomic information -nidus, draining veins; but not showing small feeders). However, it provides no information on blood-flow dynamics. CTA can be a good initial approach in emergency cases. Therefore, a new technique - dynamic 3D-CTA (d3D-CTA) - is being developed and yields 3D information on the vascular structures and haemodynamics and on the status of the cerebral perfusion. This imaging modality can be useful in the presence of a large haematoma with necessary emergency treatment, allowing a AVM diagnosis preoperatively and helping in surgical strategy. However, small AVMs can be not diagnosed by CTA. High flow aneurysms can also be depicted by CTA. Although today MR-angiography is able to provide three dimensional images of blood vessels, it cannot yet replace angiography in the exact study of the vessels which is required for surgical planning. MR angiography provides useful information when performed using several techniques: TOF with or without contrast injection, PC, 3D gradient echo acquisition after contrast injection and, more recently, MR digital subtraction angiography. Calcification is more easily detected by CT than by MR. MR seems to be superior to both CT and angiography in showing the exact anatomic relationships of the nidus, feeding arteries, and draining veins, as well as in demonstrating the extent of AVM nidus obliteration after embolization. Imaging evaluation of AVMs requires selective visualization of the different compartments of the malformation in order to select the therapeutic management. Different non-invasive techniques are useful and excellent alternative
for assessment of AVMs. However, conventional angiography remains the reference to analyze intracranial vessel conspicuity. Selective and superselective angiography is still need for a comprehensive understanding of the angioarchitecture of AVMs, in the planning of surgical or endovascular treatment, in order to give an accurate assessment of the lesion.

Differential Diagnosis List: Brain Arteriovenous Malformation (brain AVMs)

Final Diagnosis: Brain Arteriovenous Malformation (brain AVMs)

References:

Description: CT scan showed parenchymal heterogeneous mass with mainly lobar topography (right parietal posterior), with some temporal and occipital extension, and with hyperdense round areas. Calcifications and spontaneously hyperdense serpiginous structures and dilated (corresponding to vessels).
No hydrocephalus. Origin:
Figure 2

Description: Different views show AVM location and multiple feeding vessels possible to see but not easy distinctive. Selective angiography remaining the "gold standard" for AVM correct evaluation.

Origin:
**Description:** The Spetzler and Martin classification was established to grade AVMs according to their degree of surgical difficulty and risks of surgical morbidity and mortality, having small value for interventional neuroradiologists. To assign the AVM grade, the size, the venous drainage (deep/cortical) and the eloquence of adjacent brain are determined from imaging exams (CT, MR, Angiography).

Grade is total of assigned points for size and eloquence plus venous drainage (grade 6 is reserved for inoperable lesions). **Origin:**

<table>
<thead>
<tr>
<th>Graded Feature</th>
<th>Points</th>
</tr>
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<tbody>
<tr>
<td><strong>Maximum Diameter of AVM</strong></td>
<td></td>
</tr>
<tr>
<td>(Measured from the angiogram and correcting for magnification)</td>
<td></td>
</tr>
<tr>
<td>Small (&lt; 2 cm)</td>
<td>1</td>
</tr>
<tr>
<td>Medium (2-6 cm)</td>
<td>2</td>
</tr>
<tr>
<td>Large (&gt; 6 cm)</td>
<td>3</td>
</tr>
<tr>
<td><strong>Eloquence of adjacent Brain</strong></td>
<td></td>
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<tr>
<td>(Primary: auditory, visual, motor, hypothalamic, thalamus, internal, brainstem, cerebellum, pons)</td>
<td></td>
</tr>
<tr>
<td>Diffuse</td>
<td>1</td>
</tr>
<tr>
<td>Partial/unequiv.</td>
<td>2</td>
</tr>
<tr>
<td><strong>Pattern of Venous Drainage</strong></td>
<td></td>
</tr>
<tr>
<td>(Deep veins are considered those which drain to the internal cerebral vein, the basal vein of Rosenthal, or the pontine cerebellar vein)</td>
<td></td>
</tr>
<tr>
<td>Superficial</td>
<td>0</td>
</tr>
<tr>
<td>Deep</td>
<td>1</td>
</tr>
</tbody>
</table>
Description: It showed easily the lesion and their different components, extending from the cortical region to deeply white matter, near the ventricular margin. Slightly hyperdense structures (pre-contrast scan) strongly enhanced after contrast injection. The serpiginous structures corresponding to enlarged vessels are better defined. Origin:
Description: In all 3D VR images is possible to identify a compact nidus and enlarged vessels (arteries and veins - as well as dural venous sinuses). Different sections help to have an idea of AVM architecture and help to identify the more important vessels feeding and draining the cerebral AVM.

Origin:
Description: Cerebral AVM is mainly superficial but with a profound component, extending near the right ventricular margin. Enlarged feeding arteries include mainly MCA branches and also PCA and ACA branches. They supply a compact nidus. Enlarged cortical/superficial draining veins are seen in parietal lobe, draining into the superior saggital and right transverse sinuses. No aneurysms are seen (intranidal, pedicle aneurysm) Origin:
**Description:** Coronal planes show better AVM extension from the superficial cortex to near the ventricular margin. **Origin:**
Description: Postprocessing: some anatomical references are important to keep in some images, for example, bone references, for surgeon. Origin:
Description: MPR (multiplanar reformation) is the easiest way to analyze a volumetric data set, in which from a given angle of view a plane is reconstructed in a defined depth of the volume. It’s possible to create coronal, axial, sagittal, as well as any kind of oblique sections. In contrast to 3D methods, the reconstructed planes contain all information that is contained in source images. Therefore, MPR should always be the first choice for the further evaluation of CTA data.
Description: CT angiography is an noninvasive method yielding 2D and 3D information. CTA depicts some features of the solitary supratentorial brain AVM. On CTA we can't appreciate AVMs architecture and hemodynamics. Origin: