Acute Wallerian degeneration secondary to diffuse axonal injury: 

MR imaging

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Authors: Cristina Serrano García, Inés Solís Muñiz, Amparo Gilabert & Úbeda, Francisco Valero García, Carolina Torres Alés, Lourdes Martínez Encarnación.
Patient: 10 years, male

Clinical History:

10-year-old male patient who suffered a severe cranioencephalic trauma after bicycle accident.

Imaging Findings:

The patient is a 10-year-old male with severe cranioencephalic traumatism. Physical exploration demonstrated GCS (Glasgow coma scale) 8, hyperextension with intern rotation of both arms and hyperreflexia. A cranial CT was made in the emergency room, which showed small haemorrhagic contusions in perisylvian region. The patient was admitted to the intensive care unit and was intubated during 48 hours. After he awoke the exploration showed left hemiparesis predominantly in arm and hand. It was decided to perform cranial MR (GE Medical Systems, Milwaukee, Wis., USA) with T1-T2 sequences, gradient echo, FLAIR and diffusion-weighted (DW) imaging. MR showed multiple hemorrhagic lesions localized in vermis, basal ganglia, and fronto-temporal lobes predominately in right hemisphere (cortical and subcortical localization). The diagnosis was diffuse axonal injury grade 1. DW imaging also demonstrated restricted diffusion along right corticospinal tract (affecting posterior limb of internal capsule (PLIC), right cerebral peduncle and protuberance) compatible with acute Wallerian degeneration as a consequence of right hemisphere cortical contusions.

Discussion:

Diffuse axonal injury (DAI) is one of the two most common types of traumatic parenchymal lesions in patients with severe head injury. They constitute 48% of all primary intra-axial lesions in patients with moderately-severe head injuries. It is characterized by multiple, small, and focal traumatic lesions localized throughout white matter. Most lesions spare the cortex, frequently located at the gray-white matter interface. They usually range in size from 5 to 15 mm while those of larger white matter tracts, such as the corpus callosum, tend to be much larger. It occurs in three fundamental anatomical areas: 1. Cerebral lobar white matter (Grade 1), 2. lobar white matter and posterior half of the corpus callosum (Grade 2), and 3. in the dorsolateral aspect of the midbrain and upper pons (Grade 3). Wallerian degeneration is the term used to describe secondary degeneration of axons and their myelin sheaths from numerous causes, including infarction, hemorrhage, neoplasm, demyelinating disease and cortical posttraumatic lesions. The presence of Wallerian degeneration in the descending white matter tracts, particularly the corticospinal tracts, is associated with persistent hemiparesis and poor neurologic outcome. MR findings can be divided into four stages: - Stage 1: T2-weighted images show no changes within the first 4 weeks. - Stage 2: From 4 to 14 weeks. Decreased signal intensity on T2-weighted images can be seen. - Stage 3: From 14 weeks there is increased T2-
weighted signal intensity. - Stage 4: After months to years, volume loss occurs due to atrophy. Diffusion-weighted imaging is sensitive to early changes of cytotoxic edema, so it may have utility in the identification of acute white matter injury corresponding to stage 1 of Wallerian degeneration, which is not detectable by conventional MR imaging. So, DW results could serve as a valuable prognostic indicator in infants with intracranial injury, and they could aid in the selection of patients for early therapeutic intervention or rehabilitation.

**Differential Diagnosis List:** Acute Wallerian degeneration secondary to diffuse axonal injury

**Final Diagnosis:** Acute Wallerian degeneration secondary to diffuse axonal injury

**References:**


Description: Multiple hyperintense lesions (subacute hemorrhagic contusions) in vermis (a), subcortical (b and c) and cortical (d) in frontal and temporal lobes. Origin:
Figure 2

Description: Multiple hyperintense contusions in vermis (a,b), basal ganglia (c). Cortical and subcortical lesions in frontal and temporal lobes (b,c,d). Origin:
Figure 3

**Description:** DW sequences show restricted diffusion in right corticospinal tract due to acute Wallerian degeneration, secondary to cortical contusions. It affects protuberance (a), cerebral peduncle (b,c) and PLIC (d). **Origin:**
Figure 4

Description: Multiple hypointense lesions (haemorrhagic contusions) in vermis (a), cortico-subcortical (b,c,d) and basal ganglia (d) (white arrows). Origin:
Description: Restricted diffusion in right corticospinal tract (acute Wallerian degeneration) in protuberance (a,b), cerebral peduncle (c) and PLIC (d). Origin: