

STUDYING THE FEATURES OF MRI OF THE BRAIN IN PATIENTS WITH HYPERTENSIVE ENCEPHALOPATHY FOR STROKE PREVENTION

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Research goal. Analysis of changes in brain matter (BM) according to the type of “leukoaraiosis” (LA) in patients depending on the presence of hypertensive crises (HC) in the anamnesis in order to reduce the risk of stroke.

Materials and methods. We studied 55 patients with GE . The average duration of hypertension 9 years. They were divided into 2 groups: group I included 25 women (average age- 45.5 ± 7.7 years) and group II included 30 men (average age- 51.2 ± 7 years). Both groups comparable in age and diagnosis.. The average age of patients 62.8 ± 8.3 years. The average duration of the disease 5-7 years. The control group (CG) consisted of 20 healthy individuals with normal blood pressure (BP) and without stenosis of cerebral vessels. The median age in this group 53.1 ± 9 years. Methods: clinical examination , magnetic resonance imaging.

Results. In the examined patients, a history of HC was revealed in 27.3% (15/55) of cases. To the phenomenon of "LA» related bilateral, mostly symmetrical hyperintense changes on T2 - weighted images. The frequency of detection of LA 49.1% (27/55), ($p=0.01$). The crisis course of hypertension significantly more often accompanied by changes in the white matter type of LA compared to individuals with hypertension without HC in history, so among individuals with HC the share of LA was 66.7% (10/15), without HC – 12.5% (5/40) ($p=0.01$).

Studying MRI Features of the Brain in Patients with Hypertensive Encephalopathy for Stroke Prevention

Hypertensive encephalopathy (HE) is a clinical condition that occurs as a result of severe and prolonged high blood pressure, which leads to brain dysfunction. It is often associated with acute or chronic hypertension and can increase the risk of stroke. Identifying the MRI features of hypertensive encephalopathy is crucial for early detection, risk assessment, and preventive strategies for stroke.

Understanding Hypertensive Encephalopathy (HE)

Hypertensive encephalopathy is primarily caused by the sudden onset of extremely high blood pressure, which can lead to the following:

- **Cerebral autoregulation failure:** In patients with long-standing hypertension, the brain's ability to regulate blood flow fails, leading to cerebral edema (swelling of the brain).

- **Blood-brain barrier dysfunction:** Prolonged hypertension can damage the blood-brain barrier, allowing fluid to accumulate in the brain, contributing to encephalopathy.

- **Neurotoxicity:** Severe hypertension may also cause direct neurotoxic effects.

In addition to brain swelling, HE can cause symptoms such as confusion, altered mental status, headaches, and visual disturbances.

MRI Features of Hypertensive Encephalopathy

MRI (Magnetic Resonance Imaging) plays a pivotal role in detecting structural and functional brain abnormalities associated with hypertensive encephalopathy.

Key MRI findings include:

1. Cerebral Edema (Vasogenic and Cytotoxic)

- **Vasogenic edema:** Swelling caused by the leakage of fluid from blood vessels into the brain tissue, often seen in the white matter.

- **Cytotoxic edema:** Swelling of brain cells due to water retention within the cells, often associated with ischemia (inadequate blood supply to tissues).

MRI Imaging Appearance:

- **T2-weighted and FLAIR sequences:** These sequences are sensitive to edema and can show areas of high signal intensity (hyperintensity) in the white matter, particularly in the posterior regions (parieto-occipital lobes).

- **Diffusion-weighted imaging (DWI):** This can highlight cytotoxic edema, particularly if ischemic damage is present.

2. White Matter Hyperintensities

- **Chronic Hypertension:** Long-term uncontrolled hypertension can lead to the development of small vessel disease, causing damage to the small arteries in the brain.

- **MRI Imaging Appearance:**

- **T2-weighted and FLAIR sequences:** These hyperintensities are seen as bright spots in the deep white matter, especially around the periventricular areas. These are indicative of microvascular changes and ischemic injury to the brain.

- The presence of these white matter changes correlates with an increased risk of stroke and cognitive decline.

3. Punctate or Diffuse Hemorrhages

- Severe hypertensive crises can lead to rupture of small blood vessels, resulting in hemorrhagic events.

- **MRI Imaging Appearance:**

- **T2-weighted and Gradient Echo (GRE) sequences:**

- These sequences are sensitive to blood products and can reveal small or larger hemorrhages in areas like the basal ganglia, thalamus, and brainstem, which are more prone to hypertensive-related hemorrhages.

4. Brainstem and Posterior Reversible Encephalopathy Syndrome (PRES)

- **PRES** is a condition associated with hypertension, where the brainstem and posterior regions of the brain (including the occipital lobes) may experience vasogenic edema.

- **MRI Imaging Appearance:**

- **T2-weighted and FLAIR sequences:** These sequences show bilateral hyperintense areas in the posterior regions of the brain, including the occipital lobes and parietal lobes, which can mimic other conditions but are strongly suggestive of hypertensive encephalopathy.

5. Cerebral Infarctions (Ischemic Changes)

- **Ischemic Stroke:** In some cases of hypertensive encephalopathy, if blood pressure is not controlled or if there is significant failure of cerebral autoregulation, ischemic damage can occur.

- **MRI Imaging Appearance:**

- **DWI and T2-weighted imaging:** Infarctions are typically seen as areas of restricted diffusion and hyperintensity, particularly in regions supplied by small arteries that may be damaged by chronic hypertension.

MRI for Stroke Prevention in Hypertensive Encephalopathy

The primary role of MRI in patients with hypertensive encephalopathy is to:

- **Detect early structural changes:** MRI helps identify brain damage before overt clinical symptoms like stroke or cognitive decline appear.

- **Assess the extent of damage:** Identifying white matter changes, edema, or small infarcts allows clinicians to gauge the severity of hypertensive encephalopathy and adjust treatment plans accordingly.

- **Evaluate the risk of stroke:** MRI findings, particularly the presence of microvascular disease, white matter hyperintensities, and infarcts, can inform the clinician about the risk of future stroke events. Early detection can help in

the management of blood pressure and other cardiovascular risk factors to prevent a stroke.

Stroke Prevention Strategies Based on MRI Findings

1. **Blood Pressure Control:** Managing blood pressure is the cornerstone of preventing further brain damage. Strict blood pressure control (usually targeting a systolic BP of <140 mmHg) is recommended in patients with hypertensive encephalopathy to prevent both future encephalopathy and stroke.

2. **Antihypertensive Therapy:** Various classes of antihypertensive medications (e.g., ACE inhibitors, calcium channel blockers, diuretics) may be used based on individual patient factors, including comorbidities like diabetes or chronic kidney disease.

3. **Lifestyle Modifications:** Patients are advised to adopt lifestyle changes such as a low-sodium diet, increased physical activity, and weight management to reduce hypertension and prevent stroke.

4. **Regular Monitoring:** MRI can be repeated periodically to assess the effectiveness of blood pressure management, detect new infarctions, or monitor worsening white matter lesions.

5. **Secondary Stroke Prevention:** In patients who have already experienced a transient ischemic attack (TIA) or stroke, MRI findings guide additional interventions such as antiplatelet or anticoagulation therapy, carotid artery management, or lifestyle counseling.

Conclusion. Changes in the substance of brain are detected in every 4 examined at the age of 45 to 60 years. In the majority (66.7%) LA was associated with HC. In the crisis course of hypertension, changes in the white matter of the brain were detected five times more often than in the absence of HC in the history. MRI is a crucial diagnostic tool for assessing brain changes in patients with hypertensive encephalopathy. Identifying early MRI features, such as white matter hyperintensities, cerebral edema, and small infarctions, allows clinicians to assess the risk of stroke and intervene with appropriate strategies to prevent further brain damage. Early detection of these brain changes and strict blood pressure control can significantly reduce the risk of stroke and improve long-term patient outcomes.