A case study: Multiple Lacunar Infarct using Magnetic Resonance Imaging

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Abstract

Background: An ischemic stroke takes place when a blood vessel supplying the brain is blocked and blood circulation to a part of the brain is damaged. A lacunar stroke occurs due to one of the arteries that provide blood to the brain's deep structures is blocked. Case Study: A 55-year-old male patient have right cerebrovascular accident (CVA) with left hemiparesis on 16th of August 2019. Normal result was seen by brain Computed Tomography (CT) scanning. Magnetic Resonance Imaging (MRI) brain was done resulted in hyperintense lesion in right pons and foci and Magnetic Resonance Angiography (MRA) was done and resulted in severe basilar artery stenosis.

Keywords: Study case of lacunar infarct, Ischemic stroke

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DOI: https://doi.org/10.37231/ajmb.2021.5.S1.445
Introduction

Definition

A stroke occurs when the blood supply to the brain is either interrupted or reduced [1]. When this happens, the brain does not get enough oxygen or nutrients, and therefore, the brain cells start to die. It is a clinical syndrome of rapid onset of focal deficits of brain function lasting more than 24 hours or leading to death. There are two types of strokes, ischemic stroke and haemorrhagic stroke. Ischemic stroke is an arterial occlusion of an intracranial vessel that leads to hypoperfusion of the brain region it supplies. Lacunar stroke is a type of ischemic stroke. A lacunar stroke occurs due to one of the arteries that provide blood to the brain's deep structures is blocked. According to the National Institutes of Health (NIH), lacunar strokes represent about one-fifth of all strokes and any type of stroke is dangerous because brain cells are deprived of oxygen and begin to die within minutes [1]. Signs and symptoms of lacunar stroke can include slurred speech, inability to raise one arm, drooping on one side of the face, numbness, often on only one side of the body, difficulty walking or moving your arms, confusion, memory problems, difficulty speaking or understanding spoken language, headache and loss of consciousness or coma. As brains cells die, functions controlled by that area of the brain are affected. These symptoms can vary depending on the location of the stroke.

Aetiology

Lacunar stroke is caused by a lack of blood flow in smaller arteries that supply deep brain structures. The reduction of blood flow is due to the occlusion at the small penetrating cerebral vessels supplying the subcortical areas. Hypertension and diabetes mellitus are the most important risk factors for the development of lacunar stroke. These two conditions cause the arteries to narrow, thus, it is easier for cholesterol plaques or blood clots to block blood flow to the deep brain tissues. Other risk factors include smoking, low-densities lipoprotein (LDL) level, carotid artery atherosclerosis, peripheral artery disease, previous TIA, and hyperhomocysteinemia. Certain genetic factors such as APOE e4 alleles and carriers, cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL) are also known to increase the risk of developing small vessel disease [2].

Pathophysiology

In lacunar stroke, the occlusion occurs at a small penetrating artery from the main cerebral branches that supply the cerebrum, cerebellum, and brainstem. The size of arteries is varying from 3 mm to 20 mm in dimension. However, only 17% of lacunar strokes have a size of less than 10 mm. The small arterial occlusion is the fundamental pathogenesis for lacunar strokes. This condition is due to the primary underlying pathophysiological process, including lipohyalinosis and microatheromas [2]. In lipohyalinosis, there is a thickening of the small vessels, fibrinoid deposition, hypertrophy of smooth muscle and other connective tissue elements. These conditions cause a significant reduction in the luminal diameter of small arteries (less than 200 μm in diameter) and cause hypoperfusion to subcortical areas. On the other hand, micro-atheroma cause stenosis of a deep penetrating brain artery. Microatheroma has the subintimal deposition of lipids and proliferation of fibroblasts, smooth muscle cells, and lipid-laden macrophages [2].

Literature Review

Neuroimaging is required to differentiate ischemic stroke from an intracerebral haemorrhage, as well as to diagnose other abnormalities apart from a stroke. The choice of neuroimaging depends on its availability, eligibility for acute stroke interventions, and the presence of patient contraindications. Subarachnoid haemorrhage presents most commonly with severe headache and may require analysis of cerebrospinal fluid when neuroimaging is not definitive [3]. There are two types of strokes, 1) ischemic strokes; 85% of stroke cases and 2) haemorrhagic stroke; 15% of stroke cases. Haemorrhagic strokes are divided equally into intra-cerebral haemorrhage and atraumatic subarachnoid haemorrhage. The severity of ischemic stroke ranges from clinically mild or transient to very severe, but the underlying causes are identical [1]. The diagnosis of stroke is confirmed with the help of brain imaging. MRI is the brain imaging method of choice in stroke because it is more sensitive in detecting early ischaemia and it allows for differentiation between old and new ischaemia. MRI is preferred for the investigation of transient ischemic attack (TIA) [3]. To solve stroke disease, antiplatelet medication, clopidogrel was introduced, combined with antiplatelet therapies in ischemic stroke populations [4]. Others, like aspirin, also has been the antiplatelet drug of choice for the treatment of Acute Ischemic Stroke (AIS), with administration required within 24 to 48 hours after onset of stroke symptoms [7]. For lacunar stroke, CT scan, MRI and angiogram are the choices of diagnosis. Due to small size of lacunar stroke, CT scan rarely identifies lacunar ischemic insult within the first 24 hours. Normally, CT scan could be done along with CT angiogram of the head and neck [5]. MRI is a superior imaging modality in acute and subacute settings in the detection of lacunar infarction [5]. The MRI diffusion-weighted image (DWI) has the most diagnostic accuracy in most acute stage cases. MRI-DWI helps to differentiate between acute and chronic infarction [2].

Case study

Patient history

The patient was a 55-year-old male patient. He was investigated to have a right cerebrovascular accident (CVA) with left hemiparesis on the 16th of August 2019. The normal result was seen by brain CT scanning. On 17 October 2019, an MRI brain was done resulted in right cerebellum/pons infarction. The Magnetic Resonance Angiography (MRA) was done on the same day and resulted in severe basilar artery stenosis.

Sign and symptoms

He was having sudden giddiness, headache, and limb weakness. His appetite was reducing after vomiting on day one. He was admitted due to spinning sensation and having ear blockage bilaterally. The general symptoms include sudden numbness or weakness of the face, arm, or leg.
Sudden confusion, trouble speaking, or understanding speech. Sudden trouble seeing in one or both eyes. Sudden difficulty walking, dizziness, loss of balance or coordination. Also, sudden severe headache with no known cause.

**MRI examination**

The MRI examination performed on the patient was brain MRI. The projection reconstruction is done using multiplanar reconstruction. Before the MRI examination, patient is ensured to change into hospital gown and remove all the accessories or magnetic item that might interfere the scanning process. Prior to the scanning, patient was injected with contrast solution; gadolinium, through an IV to allow the MRI machine to see certain parts of the brain more easily, particularly blood vessels. The MRI protocol used for the brain scanning as listed below:

1. **Patient positioning:** Patient supine with the head positioned in the head coil and immobilized with cushions. The laser beam localizer was centre over the glabella.
2. **Protocol selection:** MR sites have developed an extensive list of imaging protocols for various diseases and clinical scenarios. Each protocol contains sequences oriented in different planes and with different parameter weightings. The sequences used in this exam are Axial T1, T2, FLAIR, GRE, DWI, Coronal T1, Sagittal T1, post contrast T1, MRA with contrast for both carotid arteries and circle of Willis/ cerebrovascular arteries.
   - Axial T1: Passing through the lateral ventricles and basal ganglia.
   - T2: Diminishes sensitivity to susceptibility.
   - FLAIR: Stands for Fluid-Attenuated Inversion Recovery. This use to denote an inversion recovery sequence with dark CSF.
   - GRE: Gradient recalled echo. It can detect the smallest changes in uniformity in the magnetic field.
   - DWI: Neuroimaging has used diffusion weighted imaging (DWI) in the detection and characterization of brain lesions. Atypical and malignant subtypes may show greater than expected restricted diffusion.
   - Coronal T2: Abnormalities remain bright but normal CSF fluid is attenuated and made dark.
   - Sagittal T1: Provides an image of the corpus callosum and the prefrontal cortex.
   - Post Contrast T1: Intense and homogeneous enhancement.
   - MRA: Evaluate blood vessels and help identify abnormalities.
3. **Localizer scans:** A three plane localizer was taken in the beginning to localize and plan the sequences. Localizers are usually less than 25 seconds.
4. **Calibration scans:** If parallel imaging is to be performed, a coil sensitivity calibration scan may also be required. This blurry image is not used for diagnosis but is often displayed as a separate series.
5. **Slice positioning:** The exact positions and angulation of slices will be graphically specified. Protocol parameters such as field-of-view, directions of phase and frequency-encoding, slice thickness can be modified at this point, so they are optimized for the particular patient’s anatomy.
6. **Automatic prescan:** The scanner first goes through a brief (10-20 seconds) calibration procedure known as prescan.
7. **Image acquisition:** Desired pulse sequence is run, and images are produced.
8. **Post-processing:** MRI angiography and functional MRI are the examples of post-processing.
9. **Data archiving:** Using PACS system, the images are sent to the radiologist so they can immediately evaluate and diagnose.

**Findings/Report**

There is hyperintense in the right occipital region seen on T2, FLAIR and DWI images. Post gadolinium, no obvious enhancement seen. There is hyperintense lesion in right pons and foci hyperintense seen in right cerebellum on T2W suggestive of previous infarct as in MRI image in Figure 1 and Figure 2. There are foci high signal intensities in right centrum semiovale, both corona radiata, both basal ganglia and right thalamus suggestive of lacunar infarct. No other focal parenchymal or mass lesion is seen. No mass effect or midline shift. The ventricles and basal cisterns appear normal. There is hyperintense mucosal thickening in right maxillary sinus suggestive of sinusitis changes. The rest of visualized paranasal sinuses appear clear. On the MRA study, normal calibre and appearance of both carotid arteries and branches as in Figure 3. No significant narrowing or stenosis seen. The circle of Willis, anterior/middle/posterior cerebral arteries appear intact. No obvious stenosis. The vertebral and basilar appears intact. No obvious stenosis. On the MRA study, the visualized dural and deep venous sinuses show normal flow characteristics. No obvious venous thrombosis is evident on this scan. Figure 4 shows a 3D multi-slab image shows the multiple lacunar infarct.

**Figure 1.** T2 Axial image shows hyperintense in the right occipital region. The arrow shows the hyperintense area.
Discussion

From this case study, it can be concluded that MRI examination has a big role in aiding the diagnosis of multiple lacunar infarct. MRI itself is safe, no radiation and readily available in most hospitals. The use of contrast, specifically, is considered to result in a more precise imaging of infarct. Lacunae were defined as penetrating artery occlusions 3 to 15 mm in diameter in horizontal sections with high intensity on both T2-weighted and proton density images. Lacunae were located within the basal ganglia, thalamus, internal capsule, corona radiata, and pons. DWML were defined as diffuse hyperintensities that were located in the subcortical and periventricular white matter with T2-weighted images and proton density images [8].

Prevention is better than cure. If someone has already had a stroke or are at risk of having a stroke, they can make some heart-healthy lifestyle changes to try to prevent a stroke. As examples, eating a healthy diet, aiming for a healthy weight, managing stress, getting regular physical activity, quitting smoking, managing blood pressure and cholesterol levels. Treatments for stroke include medicines, surgery, and rehabilitation. Which treatments the patient get depend on the type of stroke and the stage of treatment [9].
References