Egyptian Journal of Radiology and Nuclear Medicine

CASE REPORT Open Access

FLAIR vascular hyperintensity, an early sign of stroke (case report)

Wael Hamza Kamr[1,4*], Mohannad Saeed Almalki[2], Amr M. Ismaeel Saadawy[3] and Ayman El-Tahan[2]

Abstract

Background: Generally, Diffusion-weighted MR imaging (DWI) is known to be more sensitive in diagnosis of acute stroke than other MR sequences. However, fluid attenuated inversion recovery (FLAIR) MR sequence founded to be sometimes more sensitive compared to DWI for the diagnosis of hyperacute stroke.

Case presentation: An 84 years old female patient brought to ER by ambulance due to loss of speech, dizziness and confusion. Neurological examination showed that the patient can raise her left hand and leg while partially moving her right hand and right leg. The patient had slurred speech. Provisional diagnosis was acute stroke and the patient admitted in the hospital. Non contrast CT scan of the brain was done, was negative for stroke. Then MRI was done showed no areas of restricted diffusion at the DWI sequence or ADC map. Prominent high signal vessels at the left temporal region and on Sylvian fissure were noticed on FLAIR sequence that might have suggested early sign of ischemic vascular insult.

Conclusions: Arterial hyperintensity on FLAIR images can precede diffusion abnormalities and may provide a clue to the early detection of impending infarction.

Keywords: MRI diffusion, FLAIR, Stroke, Vascular hyperintensity

Background

Generally, Diffusion-weighted MR imaging (DWI) is known to be more sensitive in diagnosis of acute stroke than other MR sequences. However, fluid-attenuated inversion recovery (FLAIR) MR sequence founded to be sometimes more sensitive compared to DWI for the diagnosis of hyperacute stroke [1, 2].

Normally, major blood cerebral arteries exhibit signal void or low signal intensity similar to the cerebrospinal fluid on FLAIR sequence. While, in cases of acute vascular insult and ischemic stroke, the vessels might display bright signals [3, 4]. This MRI sign is frequently seen in the anterior circulation of the brain due to significant stenosis or total occlusion, especially in the middle cerebral artery (MCA). It is known as FLAIR vascular hyperintensity (FVH), which indicates low velocity blood flow [5].

Case presentation

An 84 year old female patient brought to ER by ambulance due to loss of speech, dizziness and confusion. Her family noticed the she suddenly can't talk or move. While in the ambulance she suddenly improved (according to the family member she started to talk and move her limbs). According to ER doctor when he saw her after one and half hour from the starting complaint, she was responding to him, talking and obeying commands. The patient gave history of diabetes, hypertension, ischemic heart disease and Alzheimer disease.

Neurological examination showed that the patient can raise her left hand and leg while partially moving her right hand and right leg. The patient had slurred speech. Provisional diagnosis of the patient was acute stroke and the patient admitted in the hospital. Laboratory investigations of the patient were within normal values. Non

*Correspondence: dr.waelkamr@gmail.com
[4] Radiology Department, Security Forces Hospital, Makkah, Kingdom of Saudi Arabia
Full list of author information is available at the end of the article

contrast CT scan of the brain was done while she was in ER, then MRI requested as a stroke workup. On the next day, the symptoms of the patient slightly progressed, so follow up CT scan was done again. The condition of the patient continued to worsen, with no improvement on medication. A trial to repeat the MRI but the condition of the patient was not suitable. A third CT scan done after 2 days from the last one.

Radiological findings

First CT Findings (done about 2 h from complaint onset) showed age related brain involutional changes with arteriosclerotic leukoencephalopathy and bilateral basal ganglionic tiny old lacunar infarcts. No fresh blood density or evidence of acute vascular insult (Fig. 1).

MRI Findings (done about 4 h from complaint onset) showed no areas of restricted diffusion at the DWI sequence or ADC map. Prominent high signal vessels at the left temporal region and on Sylvian fissure were noticed on FLAIR sequence that might have suggested early sign of ischemic vascular insult (Fig. 2).

Second CT Findings (done about 24 hours from complaint onset) showed no significant changes compared to the 1st CT findings with still no evidence of acute vascular insult (Fig. 3).

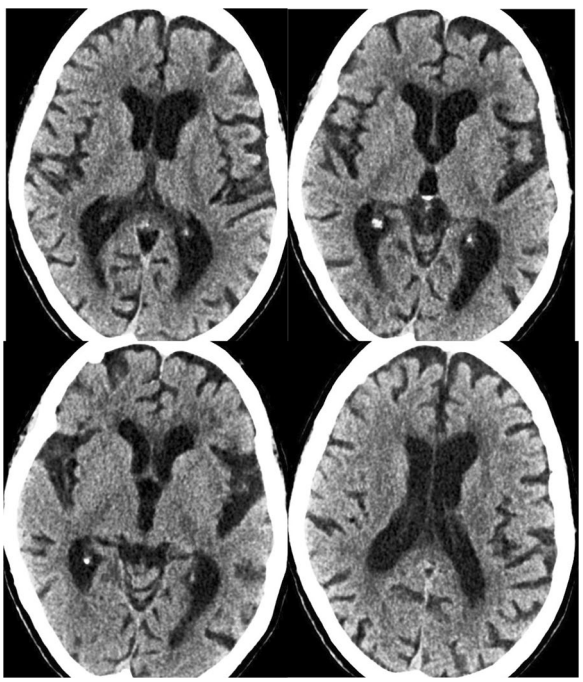

Fig. 1 First CT Findings (done within 2 h from complaint starting): showing age related brain involutional changes with arteriosclerotic leukoencephalopathy and bilateral ganglionic tiny old lacunar infarcts. No fresh blood density or evidence of acute vascular insult

Third CT Findings (done about 72 hours from complaint onset) showed a hypodense area involving the left basal ganglionic region, coping with acute infarction (Fig. 4).

Discussion

According to many studies, in cases of stroke, FLAIR signal intensity changes are variable and mostly detected within 6–12 h after onset of symptoms. In management plan of stroke cases, presence of restricted diffusion and negative FLAIR findings has been adequate to begin therapy [6, 7]. Many recent studies reported that positive diffusion restriction while negative FLAIR sequence study indicates that the stroke is less than 6 h old [3, 8]. Thomalla et al. [9] reported that (in 120 consecutive patients with stroke) positive findings in DWI and negative FLAIR findings were highly suggestive that the stroke was less than 3 h old. Similar results were reported by Aoki et al. [10] (of 333 consecutive patients with stroke). However, it is important to know how much signal intensity can vary at FLAIR imaging as there was reported one patient with no positive FLAIR findings until 24 h after positive changes detected in DWI and ADC map [11].

On the other hand, many patients with acute stroke show false-negative findings at DWI, while showing positive findings in FLAIR [12].

In cases of acute stroke, bright signal intensity of the large and small vessels may be seen on FLAIR sequence as the only positive changes of the brain that indicate early ischemic infarction. This finding known as "FLAIR vascular hyperintensity (FVH)" also, known as hyperintense vessel sign or arterial hyperintensity [13]. The pathophysiologic basis of this sign still unclear, however there are many theories like slowly or stagnant blood flow, intraluminal thrombus or embolus. Arterial hyperintensity may be detected at FLAIR imaging very early in acute stroke, within 0–2 h after onset of symptoms [13, 14].

The sensitivity of this sign is highest during the first 6 h after symptom onset then decreased by time. It is commonly seen at the Sylvain fissure, followed by the cortical sulci, the horizontal segments of the middle cerebral arteries in the affected middle cerebral artery distribution and rarely seen at the posterior cerebral arteries. FVH sign can be easily missed if the radiologist does not aware or actively looking for it [1, 3].

The presence of FVH in association with the positive restricted DWI is an indication of impending infarction and needs rapid management and flow augmentation strategies [6, 7]. Sometimes, FVH can precede diffusion abnormalities as in our case. One of the recent studies reported that the area of the FVH almost equal to that of a perfusion abnormality, particularly in patients examined within 6 h of symptom onset [13].

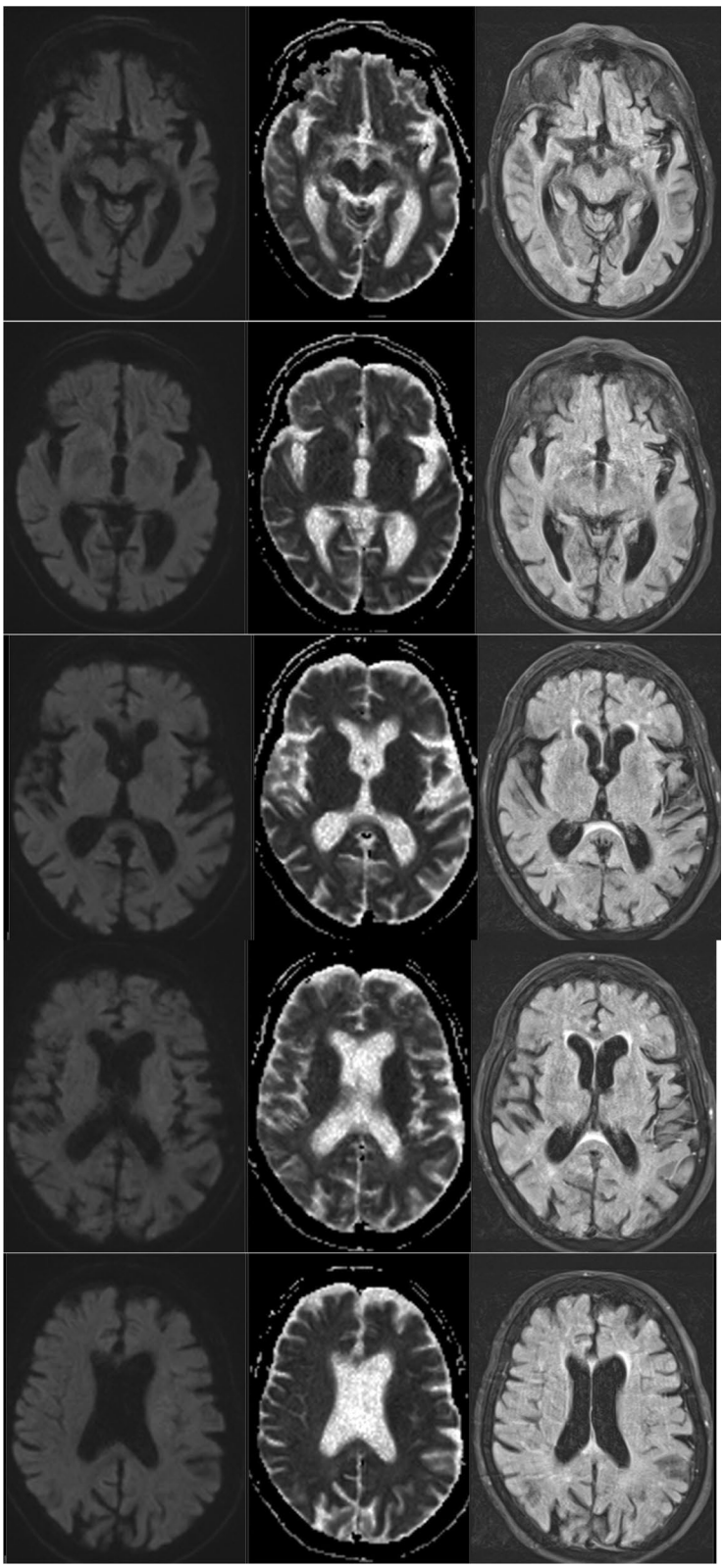

Fig. 2 MRI Findings (done within 4 h from complaint starting); showing No areas of restricted signal could be noted at the DWI or ADC map. Prominent high SI vessels at the left temporal region and Sylvian fissure on FLAIR images may suggest early sign of ischemic vascular insult

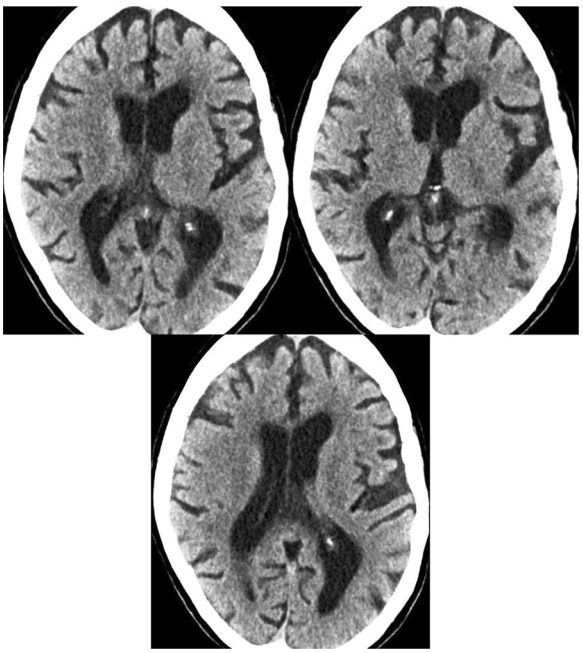

Fig. 3 Second CT Findings (done within 24 h from complaint starting): showing no significant changes compared to the 1st CT with still no evidence of acute vascular insult

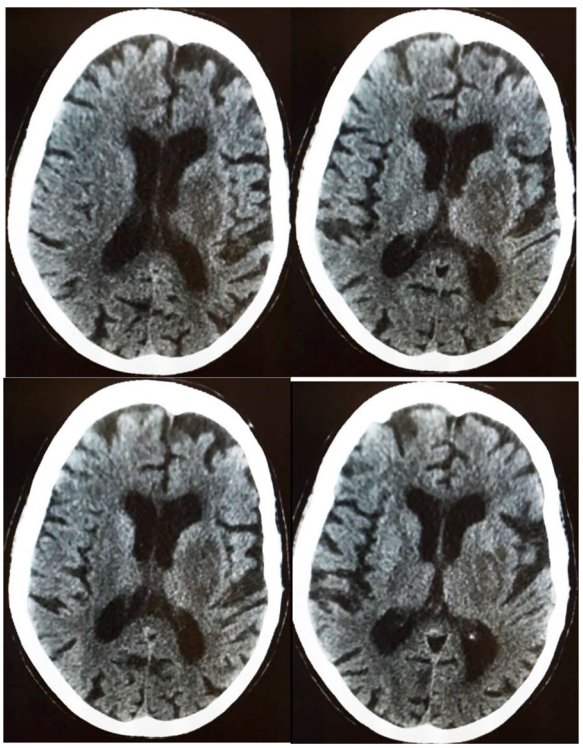

Fig. 4 Third CT Findings (done within 72 h from complaint starting): showing a hypodense area involving the left ganglionic region coping with acute infarction

Other recent studies reported that the presence of FVHs beyond the boundaries of a restricted DWI area (FVH-DWI mismatch) is suggestive of a large penumbra in PWI and cope with (PWI-DWI mismatch) that indicate large infarct growth [15].

Another quantitative analyses study done by Nomura et al. [1] based in comparison of the hypoperfusion between the FVH low and FVH high groups. They reported that the large hypoperfusion area was detected in patients with FVH high group more than patients with FVH low group.

Conclusions

It is known that DWI is highly sensitive in diagnosis of acute stroke; however DWI alone may give false negative results in hyperacute infarction. Arterial hyperintensity on FLAIR images can precede diffusion abnormalities and may provide a clue to the early detection of impending infarction. Radiologist should be aware of this sign.

Abbreviations

DWI: diffusion-weighted MR imaging; FLAIR: fluid-attenuated inversion recovery; MCA: middle cerebral artery; FVH: FLAIR vascular hyperintensity.

Acknowledgements

Not applicable.

Authors' contributions

Guarantor of integrity of the entire study: W.H.K., M.S.A., A.E. Study concepts and design: W.H.K, A.S., A.E. Literature research: W.H.K, A.S., A.E. Clinical studies: W.H.K, M.S.A., A.S., A.E. Imaging and data analysis: W.H.K, A.S., M.S.A., A.E. Manuscript preparation: W.H.K, A.S. Manuscript editing: W.H.K, A.S., A.E. All authors read and approved the final manuscript.

Funding

Not applicable.

Availability of data and materials

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate

This work had approval from the Institutional Review Board of SFHM, KSA. Ethical committee's reference number is not available. Informed consent was obtained from the patient.

Consent to publication

The patient gave informed consent to publish the data contained within this study.

Competing interests

All authors declare that they have no competing interests.

Author details

[1]Radiology Department, Mansoura University, Mansoura, Egypt. [2]Radiology Department, Security Forces Hospital Makkah, Mecca, Kingdom of Saudi Arabia. [3]Radiology Department, Ain-Shams University, Cairo, Egypt. [4]Radiology Department, Security Forces Hospital, Makkah, Kingdom of Saudi Arabia.

Received: 8 June 2021 Accepted: 26 September 2021
Published online: 04 October 2021

References

1. Nomura T, Okamoto K, Igarashi H et al (2020) Vascular hyperintensity on fluid-attenuated inversion recovery indicates the severity of hypoperfusion in acute stroke. J Stroke Cerebrovasc Dis 29(2):104467
2. Maeda M, Yamamoto T, Daimon S et al (2001) Arterial hyperintensity on fast fluid-attenuated inversion recovery images: a subtle finding for hyperacute stroke undetected by diffusion-weighted MR imaging. AJNR Am J Neuroradiol 22:632–636
3. Allen L, Hasso A, Handwerker J et al (2012) Sequence-specific MR imaging findings that are useful in dating ischemic stroke. Radiographics 32:1285–1297
4. Adam G, Ferrier M, Patsoura S et al (2018) Magnetic resonance imaging of arterial stroke mimics: a pictorial review. Insights Imaging 9:815–831
5. Makkat S, Vandevenne JE, Verswijvel G et al (2002) Signs of acute stroke seen on fluid-attenuated inversion recovery MR imaging. AJR 179:237–243
6. Legrand L, Tisserand M, Turc G et al (2015) Do FLAIR vascular hyperintensities beyond the DWI lesion represent the ischemic penumbra? AJNR Am J Neuroradiol 36:269–274
7. Legrand L, Tisserand M, Turc G et al (2016) Fluid-attenuated inversion recovery vascular hyperintensities-diffusion weighted imaging mismatch identifies acute stroke patients most likely to benefit from recanalization. Stroke 47:424–427
8. Liu D, Scalzo F, Rao NM et al (2016) Fluid-attenuated inversion recovery vascular hyperintensity topography, novel imaging marker for revascularization in middle cerebral artery occlusion. Stroke 47:2763–2769
9. Thomalla G, Rossbach P, Rosenkranz M et al (2009) Negative fluid-attenuated inversion recovery imaging identifies acute ischemic stroke at 3 hours or less. Ann Neurol 65(6):724–732
10. Aoki J, Kimura K, Iguchi Y et al (2010) FLAIR can estimate the onset time in acute ischemic stroke patients. J Neurol Sci 293(1–2):39–44
11. Kufner A, Galinovic I, Ambrosi V et al (2015) Hyperintense vessels on FLAIR: hemodynamic correlates and response to thrombolysis. J Neuroradiol 36:1426–1430
12. Cheng B, Ebinger M, Kufner A et al (2012) Hyperintense vessels on acute stroke fluid-attenuated inversion recovery imaging: associations with clinical and other MRI findings. Stroke 43:2957–2961
13. Ahn SJ, Lee KY, Ahn SS et al (2016) Can FLAIR hyperintense vessel (FHV) signs be influenced by varying MR parameters and flow velocities? A flow phantom analysis. Acta Radiol 57:580–586
14. Lee KY, Latour LL, Luby M et al (2009) Distal hyperintense vessels on FLAIR: an MRI marker for collateral circulation in acute stroke? Neurology 72(13):1134–1139
15. Emeriau S, Serre I, Toubas O et al (2013) Can diffusion-weighted imaging-fluid-attenuated inversion recovery mismatch (positive diffusion-weighted imaging/negative fluid-attenuated inversion recovery) at 3 Tesla identify patients with stroke at < 4.5 hours? Stroke 44(6):1647–1651

Publisher's Note