Original Research Article

Role of high resolution vessel wall MRI in imaging head and neck vasculitis

Bhoir Bhagyashree[1*], Ingole Shivraj[2]

[1]Resident, [2]Associate Professor, Department of Radio-Diagnosis, Grant Government Medical College, Mumbai, Maharashtra, INDIA.
Email: bhagyashreebhoir20@gmail.com

Abstract

Accurate and timely diagnosis of vasculitis is important due to significant risk of morbidity associated with delayed or incorrect diagnosis and also to guide appropriate therapy. Vessel wall magnetic resonance imaging(VW-MRI) is an upcoming technique that has gained much attention recently. Vascular disorders of head and neck generally share similar findings in traditional imaging modalities like computed tomography angiography(CTA), magnetic resonance imaging angiography(MRA) and digital subtraction angiographic (DSA) studies. An advanced imaging modality like vessel wall MRI helps us to confirm the diagnosis so that appropriate clinical management can be done. Currently vessel wall imaging is being done in a high resolution manner with three dimensional (3D) imaging sequences.
Key Words: Vasculitis, vessel wall imaging, wall thickening, wall enhancement

***Address for Correspondence:**
Dr. Bhagyashree Bhoir, Resident, Department of Radio-Diagnosis, Grant Government Medical College, Mumbai, Maharashtra, INDIA.
Email: bhagyashreebhoir20@gmail.com
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INTRODUCTION

Vasculitis is characterized by inflammation of the walls of blood vessels and may affect vessels of any size. Its pathogenesisis poorly understood.[1,2] Conventional techniques for imaging the arteries of head and neck are CTA, MRA, and DSA. These techniques reveal abnormalities of the vessel lumen, but they can fail to fully characterize disease in the vessel wall where the primary lies in vasculitis. There has been growing interest in direct visualization of the vessel wall with high-resolution vessel wall imaging with MRI. VW-MRI has two major advantages over DSA, CT angiography and MRA: it can delineate non-stenotic lesions and aids in further characterization of stenotic lesions that have already been detected with conventional techniques. With intracranial vessel wall imaging, vessel wall characteristics have tentatively been described for atherosclerosis, vasculitis, dissections, Moyamoya disease, and aneurysms. [1,2] Here we present a case series and review of literature of patients with head and neck vasculitis imaged with vessel wall MRI.

MATERIALS AND METHODS

Patients with suspected vasculitis referred to department of Radiodiagnosis in our tertiary care institute underwent MRI brain using a 32 channel matrix coil on a 3T scanner (Verio, SQ engine; Siemens, Erlangen, Germany). In addition to T1, T2, FLAIR, DWI, SWI and 3D TOF angiography, the specific sequence for vessel wall - T1 fat saturated SPACE pre and post contrast in all three planes were analysed; parameters being as follows:

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Table 1

PARAMETERS	SAGITTAL T1FS SPACE pre and post contrast	3D TOF MRA
Time to echo (ms)	11	3.43
Time to repeat (ms)	700	21
Echo train length	150	-
Slice thickness (mm)	1	0.6
Frequency FOV	250	220
Maximum slices	160 slab	28
Relative SNRs	1	1
NEX	1	4
Bandwidth	630	501
Matrix	256x256	203x320
TSE factor	38	2
Acquisition time (minutes)	6.04	2.20

3D-three dimensional; SNR-signal to noise ratio; FOV-field of view; NEX-number of excitations; TOF-time of flight; MRA-magnetic resonance angiography; FS-fat suppression; SPACE- sampling perfection with application-optimized contrasts by using different flip angle evolutions

CASE 1

A 35 year old female presented with complaints of left sided weakness and deviation of angle of mouth to right since one day.

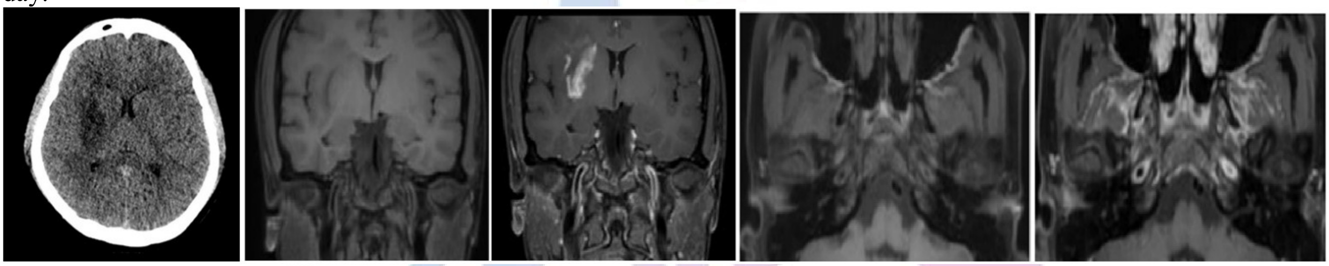

Figure 1-a Figure 1-b Figure 1-c Figure 1-d Figure 1-e

Initial NECT brain showed acute infarct in right corona radiata, internal capsule, lentiform nucleus and external capsule (fig 1-a). Coronal and axial sections of MRI brain with T1 FS SPC showed diffuse concentric wall thickening in cervical (fig.1-b) and petrous (fig1-d) segments of bilateral internal carotid arteries. Post contrast image showed vessel wall enhancement (fig 1-c and 1-e). Patient was worked up further to rule out causes of stroke in young patients. ANA blot was positive for CENP A and B, Patient was diagnosed with CREST syndrome.

CASE 2

A 32 year old female presented with complaints of sudden onset of bilateral upper and lower limb weakness (left >right) since 15 days. She also had history of intermittent holocranial headache since 2 years, associated with autonomic symptoms like redness and watering of eyes, left sided weakness 10 years ago and 2 spontaneous abortions.

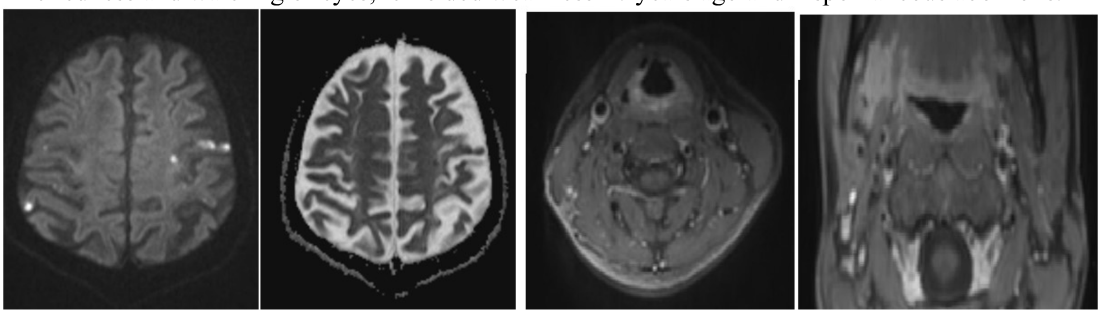

Figure 2-a Figure 2-b Figure 2-c

Axial sections of MRI brain DWI showed subacute infarcts in bilateral cerebral hemispheres (fig 2-a). Axial sections of MRI brain with post contrast T1 FS SPC showed wall enhancement in bilateral common carotid arteries (fig 2-b) and cervical segments of internal carotid arteries (fig.2-c). Her CRP levels were raised and ANA was positive.Patient was diagnosed as recurrent stroke with secondary CNS vasculitis in APLA syndrome.

CASE 3

A 40 year old male presented with left upper and lower limb weakness and imbalance while walking. History of similar episodes in the past associated with single episode of seizure.

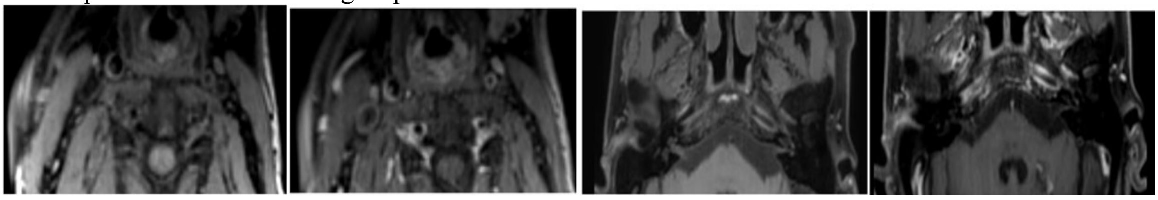

Figure 3-a Figure 3-b Figure 3-c Figure 3-d

Axial sections of MRI brain with T1 FS SPC showed diffuse concentric wall thickening of cervical segment (fig.3-a) and petrous segment (fig 3-c) of left internal carotid artery and p. Post contrast image showed wall enhancement of respective vessels (fig 3-b and 3-d).

CASE 4

A 45 year old male presented with left sided weakness since one day.

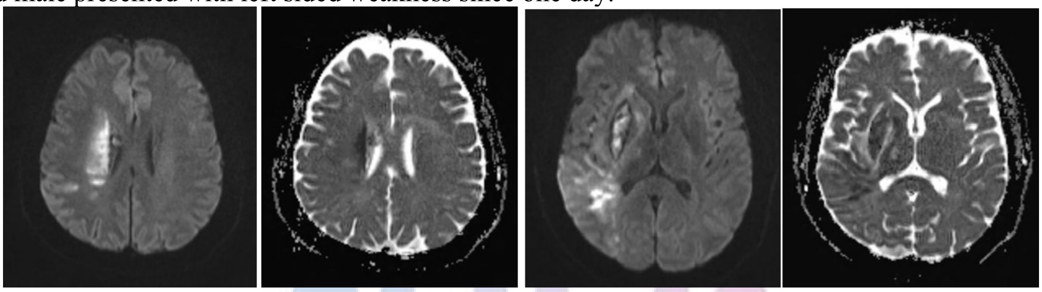

Figure 4-a Figure 4-b

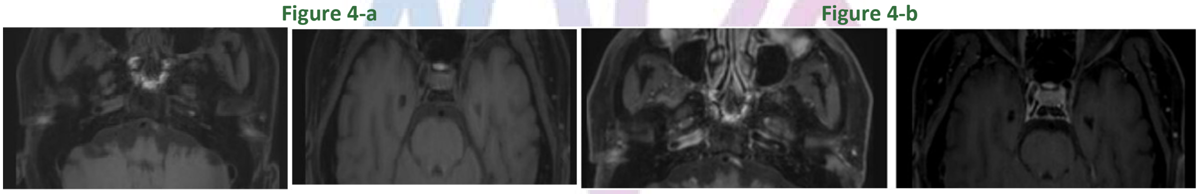

Figure 4-c Figure 4-d Figure 4-e Figure 4-f

Axial sections of MRI brain DWI showed subacute infarcts in right corona radiata and gangliocapsular region (figures 4-a and 4-b) Axial sections of MRI brain with T1 FS SPC showed diffuse concentric wall thickening in the petrous (figure 4-c)and supraclinoid (figure 4-d) segments of right ICA. Post contrast image of the same sequence showed vessel wall enhancement (figures 4-e and 4-f).

CASE 5

A 30 year old female, known case of Takayasu's arteritis, presented with right sided weakness since one day. She had History of similar episodes in the past.

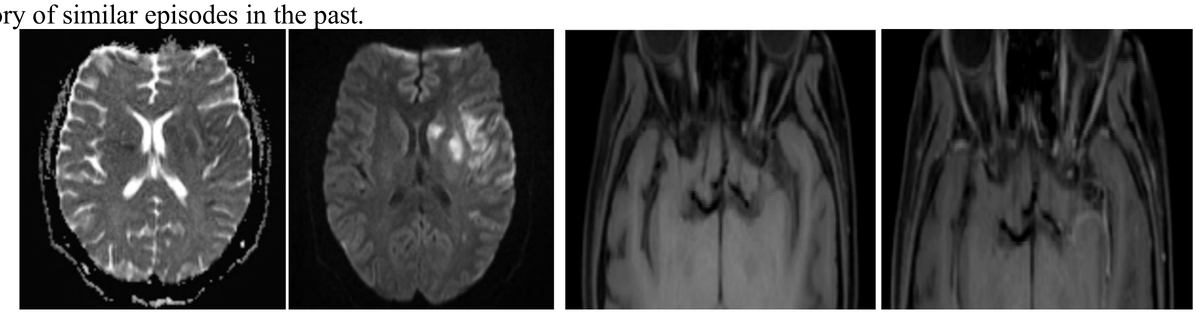

Figure 5-a Figure 5-b Figure 5-c

Axial sections of MRI brain DWI showed acute infarcts in left gangliocapsular region and insular cortex. (figures 5-a) Axial sections of MRI brain with T1 FS SPC showed mild wall thickening in the M1 segment of left middle cerebral artery (figure 5-b). Post contrast images showed vessel wall enhancement (figures 5-c). Rest of the distal left middle cerebral artery was not visualized.

DISCUSSION

Vasculitis is a heterogeneous group of disorders with varied clinical and imaging manifestations. It may affect large vessels (Takayasu arteritis, giant cell arteritis), medium-sized vessels (Kawasaki disease, polyarteritis nodosa), small vessels (microscopic polyangiitis, granulomatosis with polyangiitis), or variable-sized vessels (Behçet disease).[1] Primary angiitis of the central nervous system (CNS) is an idiopathic disorder. Vasculitis may be secondary to systemic disease, infection, malignancy, drug use, or radiation therapy. Imaging findings vary from small ischemic changes to frank infarction, hemorrhage, and white matter edema and may show contrast enhancement. Correlation of imaging findings with clinical presentation and laboratory test results helps establish the diagnosis of vasculitis.[4]

Conventional imaging of vasculitis includes CTA, MRA and DSA. CTA can be used to evaluate both the vessel walls and the lumen. However, it cannot depict relatively small vessels. It also carries a small risk owing to iodinated contrast material administration and exposure to radiation. It is useful for imaging large-vessel involvement in Takayasu arteritis and can help make an early diagnosis of this disease, since it allows evaluation of wall thickness as well as luminal narrowing. CTA demonstrates stenosis, occlusion, aneurysm, and concentric arterial wall thickening. [1]

Routine time of flight MRA and DSA can tell us about the occlusion in the lumen and show multifocal or diffuse narrowing, however definitive comment on the vessel wall cannot be made.

The principal technical requirements for intracranial vessel wall MR imaging are the following: 1) high spatial resolution, 2) multiplanar 2D acquisitions or 3D acquisitions, 3) multiple tissue weightings, and 4) suppression of signal in luminal blood and CSF.[5]

Because of the need for very high resolution and thus higher signal, higher field strengths, 3T scanners should be preferred over 1.5T. with reports demonstrating improved results with 7T. [12,13] Most of the studies in literature have used two-dimensional (2D) black blood imaging techniques, there has been recent application of three-dimensional (3D) techniques. 3D acquisitions allow for improved through plane resolution, with increased brain coverage, and can allow for isotropic resolution which can be reformatted in multiple planes. [14,15,16] The most commonly used 3D sequences for vessel wall MR imaging are the variable flip angle refocusing pulse, fast spin-echo sequences with brand names such as VISTA (volume isotropic turbo spin-echo acquisition; Philips Healthcare, Best, the Netherlands), SPACE (sampling perfection with application-optimized contrasts by using different flip angle evolutions; Siemens, Erlangen, Germany), and Cube (GE Healthcare, Milwaukee, Wisconsin). [17]

CNS vasculitis, including primary CNS angitis shows wall thickening which is smooth, concentric (can be rarely eccentric), diffuse or multifocal. Post contrast enhancement is noted in the thickened segments. Contrast enhancement may extend into the surrounding brain tissue. Vessel wall T2 hyperintensity which is seen in atherosclerotic disease is typically absent. Ancillary Imaging findings which may further point towards vasculitis include small vessel ischemic changes to frank infarction, hemorrhage, and white matter edema which may show contrast enhancement.[3]

The differentiation of intracranial vasculopathies using conventional imaging techniques can be difficult, and this is an area of promise for vessel wall imaging. Vessel wall imaging can be particularly helpful when luminal imaging and clinical markers are inconclusive. This is useful in differentiating reversible cerebral vasoconstriction syndrome (RCVS), intracranial atherosclerotic disease (ICAD) and vasculitis. There might be overlapping imaging features in terms of pattern of wall involvement and presence of enhancement, but other characteristics including outer wall remodelling and T2-weighted vessel wall signal characteristics can provide additional differentiating data. Multiple vessel wall characteristics have been utilised for disease differentiation, including presence of contrast enhancement, pattern of wall involvement (eccentric vs circumferential), pattern of enhancement, presence of remodelling and T2 signal characteristics. Table 1 provides a summary of vessel wall imaging characteristics of the various intracranial vasculopathies which are differentials for vasculitis. [7,8] A majority of atherosclerosis cases showed eccentric vessel wall involvement, varying degrees and patterns of enhancement and mixed T2-weighted lesion signal intensity. Vasculitis on the other hand typically showed a circumferential lesion with diffuse enhancement and isointense T2 lesion signal. RCVS lesions typically showed circumferential vessel wall involvement with no to mild enhancement and mild isointense wall thickening on T2-weighted IVW.

Table 1: vesssel wall imaging characteristics of various intracranial vasculopathies

Characteristics Wall thickening	Vasculitis Circumferential, rarely eccentric	RCVS Circumferential, rarely eccentric	Atherosclerosis Eccentric, rarely circumferential	Moya Moya disease Eccentric, rarely circumferential
Contrast enhancement	++	+/-	++	+/-
T1 hyperintensity (due to intra plaque or intra luminal haemorrhage)	-	-	+/-	-
T2 signal characteristics	Isointense, homogeneous	Isointense, homogeneous	Heterogenous, juxtaluminal hyperintensity	N/A
Outer wall remodelling	-	-	++	-
Potential overlap in findings	RCVS, atherosclerosis	Vasculitis	Vasculitis	Vasculitis

- no abnormality; +mild abnormality; ++ more pronounced abnormality; N/A not applicable

High resolution MR vessel wall imaging has an important role in differentiating varied intracranial vasculopathies like atherosclerosis, vasculitis and Moyamoya disease. [3] The correct diagnosis is critical in patient management and this can be done more specifically by using high resolution vessel wall imaging [4] Moreover, 3D sequences allow us to visualise the vessel wall in all planes thereby increasing accuracy. The activity of the disease can be assessed by vessel wall contrast enhancement and the duration of treatment can also be planned. Follow up imaging after completing course of treatment tells us about regression/progression of disease and guides in further management of the patient. Correlation of imaging findings with clinical manifestations and laboratory test results helps establish the diagnosis of CNS vasculitis. [5,6]

CONCLUSION

High resolution MR vessel wall imaging acts as a useful, non invasive, adjunctive tool in the diagnosis and follow up of cases of head and neck vasculitis. although biopsy remains the gold standard in diagnosis of vasculitis, vessel wall imaging may obviate its need in certain cases in an appropriate clinical setting. Further prospective studies are needed for expanding the diagnostic utility of this novel imaging tool, which could aid in the management of intracranial vasculopathic disorders.

REFERENCES

1. Abdel Razek AA, Alvarez H, Bagg S, Refaat S, Castillo M. Imaging spectrum of CNS vasculitis. Radiographics. 2014 Jul 14;34(4):873-94.
2. Adhithyan R, Kesav P, Thomas B, Sylaja PN, Kesavadas C. High-resolution magnetic resonance vessel wall imaging in cerebrovascular diseases. Neurology India. 2018 Jul 1;66(4):1124.
3. Alexander MD, Yuan C, Rutman A, Tirschwell DL, Palagallo G, Gandhi D, Sekhar LN, Mossa-Basha M. High-resolution intracranial vessel wall imaging: imaging beyond the lumen. J NeurolNeurosurg Psychiatry. 2016 Jun 1;87(6):589-97.
4. Kesav P, Krishnavadana B, Kesavadas C, Sreedharan SE, Rajendran A, Sukumaran S, Sylaja PN. Utility of intracranial high-resolution vessel wall magnetic resonance imaging in differentiating intracranial vasculopathic diseases causing ischemic stroke. Neuroradiology. 2019 Jan 14:1-8.
5. Mandell DM, Mossa-Basha M, Qiao Y, Hess CP, Hui F, Matouk C, Johnson MH, Daemen MJ, Vossough A, Edjlali M, Saloner D. Intracranial vessel wall MRI: principles and expert consensus recommendations of the American Society of Neuroradiology. American Journal of Neuroradiology. 2017 Feb 1;38(2):218-29.
6. Lindenholz A, van der Kolk AG, Zwanenburg JJ, Hendrikse J. The use and pitfalls of intracranial vessel wall imaging: how we do it. Radiology. 2017 Dec 20;286(1):12-28.
7. Mossa-Basha M, Hwang WD, De Havenon A, *et al*. Multicontrast high-resolution vessel wall magnetic resonance imaging and its value in differentiating intracranial vasculopathic processes. Stroke. 2015;46:1567–73
8. Dieleman N, van der Kolk AG, van Veluw SJ, *et al*. Patterns of intracranial vessel wall changes in relation to ischemic infarcts. Neurology. 2014;83:1316–20.
9. Salvarani C, Brown RD, Jr, Huston J, III, *et al*. Prominent perivascular enhancement in primary central nervous system vasculitis. Clin Exp Rheumatol. 2008;26(3 Suppl 49):S111.
10. Obusez EC, Hui F, Hajj-Ali RA, *et al*. High-Resolution MRI Vessel Wall Imaging: Spatial and Temporal Patterns of Reversible Cerebral Vasoconstriction Syndrome and Central Nervous System Vasculitis. AJNR Am J Neuroradiol. 2014;35:1527–32.
11. Campi A, Benndorf G, Filippi M, *et al*. Primary angiitis of the central nervous system: serial MRI of brain and spinal cord. Neuroradiology.
12. Vergouwen MD, Hendrikse J, van der Kolk AG, Wermer MJ, Versluis MJ, Biessels GJ, Rinkel GJ, Velthuis BK. 7 T esla vessel wall imaging of the basilar artery in

perimesencephalic hemorrhage. International Journal of Stroke. 2015 Apr;10(3):E31-.

13. van der Kolk AG, Zwanenburg JJ, Brundel M, Biessels GJ, Visser F, Luijten PR, Hendrikse J. Intracranial vessel wall imaging at 7.0-T MRI. Stroke. 2011 Sep;42(9):2478-84.
14. Crowe LA, Gatehouse P, Yang GZ, Mohiaddin RH, Varghese A, Charrier C, Keegan J, Firmin DN. Volume-selective 3D turbo spin echo imaging for vascular wall imaging and distensibility measurement. Journal of Magnetic Resonance Imaging: An Official Journal of the International Society for Magnetic Resonance in Medicine. 2003 May;17(5):572-80.
15. Xie Y, Yang Q, Xie G, Pang J, Fan Z, Li D. Improved black-blood imaging using DANTE-SPACE for simultaneous carotid and intracranial vessel wall evaluation. Magnetic resonance in medicine. 2016 Jun;75(6):2286-94.
16. Zhang L, Zhang N, Wu J, Zhang L, Huang Y, Liu X, Chung YC. High resolution three dimensional intracranial arterial wall imaging at 3 T using T1 weighted SPACE. Magnetic resonance imaging. 2015 Nov 1;33(9):1026-34.
17. Busse RF, Hariharan H, Vu A, Brittain JH. Fast spin echo sequences with very long echo trains: design of variable refocusing flip angle schedules and generation of clinical T2 contrast. Magnetic Resonance in Medicine: An Official Journal of the International Society for Magnetic Resonance in Medicine. 2006 May;55(5):1030-7.

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