

Neuroimaging in Elderly with New-Onset Unprovoked Seizures - A Pictorial Review

S. Elangovan¹, M. Thangaraj², K. Balamurali³, M. Arun Kumar⁴

ABSTRACT

An unprovoked seizure in elderly is a common occurrence. Various causes of seizures in these patients include cerebrovascular accidents, neurodegenerative disorders like Alzheimer's disease, intracranial tumours and post traumatic epilepsy. The morbidity associated with seizures is likely to be more in elderly patients and they may suffer significant injuries like vertebral and hip fractures or shoulder dislocations. Moreover they usually have a prolonged postictal phase. The imaging is one of the important aspects of management of these patients. CT scan and MRI are the most common imaging modalities for this purpose in these patients. Our study comprised of 52 elderly patients with unprovoked seizures. Neuroimaging of these patients revealed that in most of the patients (50%) CT scan was normal while the common CT findings in these patients were found to be age related cerebral atrophy (21.43%), Gliosis (12.5%) and infarcts (7.14%). MRI was done in 28 patients in whom CT brain was either equivocal or when the lesion needed further evaluation. 28 such patients underwent MRI scans. MRI was normal in 8 (14.29%) patients. The common MRI abnormalities found in these patients included cortical atrophy (10.71%), infarcts (10.71%), small vessel disease (7.14%) and white matter abnormalities (3.57%). MRI was found to be more accurate in the diagnosis of infarct as it was able to demonstrate infarcts in some of the patients in whom CT was reported to be normal. Neuroimaging observations in elderly patients with new-onset unprovoked seizures revealed many underlying abnormalities. In some cases it was reassuring to have normal neuroimaging while in others neuroimaging abnormalities assisted in deciding appropriate therapy.

Keywords: Unprovoked Seizures in Elderly, Epilepsy, Neuroimaging, Computed Tomography, Magnetic Resonance Imaging

INTRODUCTION

With advancement and wide availability of medical care there has been a progressive increase in life expectancy of general population. The population of elderly individuals (more than 60 years) is expected to rapidly increase in near future. With this ageing population the incidence of medical problems associated with increased age like Alzheimer's disease, senile dementia and epilepsy is expected to rise.¹ Elderly patients presenting with first episode of unprovoked seizures is a common occurrence in neurology OPD. Unprovoked seizure is defined as a seizure with no identifiable precipitating cause. It is to be kept in mind that there are many yet unknown causes which might become identifiable in near future due to advances in diagnostic neuroimaging. Making a proper diagnosis in these patients is

a difficult task for the treating physician because of presence of co-existent medical conditions. One of the important tools of the diagnosis in these patients is neuroimaging which in many cases can immensely help in the diagnosis.² Many researchers have reported that an epileptogenic lesion can be found in 10-15% cases of unprovoked seizures and MRI was found to be having a definite advantage over CT scan as an imaging modality since many lesions missed initially on CT could be found on MRI. While neuroimaging may cause increase in cost it is necessary for localization, knowing characteristics and planning management of a specific lesion found on CT or MRI.³ The most common cause of acute symptomatic seizures in elderly patients is acute stroke which is responsible for approximately 50% cases of acute symptomatic seizures in elderly. Though unprovoked seizures by definition are of unknown etiology there are chances of an underlying lesion responsible for these seizures and hence neuroimaging in such patients is an essential part of management.⁴

While CT scan is less sensitive in diagnosing the lesions associated with seizures it is quick, less expensive, widely available and can be done in patients in whom MRI is contraindicated. The common CT findings in these patients include focal cerebral lesions, age related cerebral atrophy, age related white matter changes, intracranial haemorrhage, infarcts, gliosis and granulomas. Less common findings may include intracranial space occupying lesions like glioma, meningioma and metastasis. Though MRI definitely is more sensitive and specific for the diagnosis of intracranial lesions associated with seizures in elderly its utility is limited by its high cost, low availability and time required for scanning. Moreover there are many patients in whom it is contraindicated like patients with claustrophobia, individuals having cochlear implants, cardiac pacemakers or intracranial aneurysmal clips. A practical approach would be doing CT in all patients presenting with unprovoked seizures and doing MRI only in patients in whom the CT findings are ambiguous.⁵

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The studies dealing with neuroimaging in elderly patients with unprovoked seizures are very scarce. This paper is a pictorial essay on the imaging findings in elderly patients presenting with unprovoked seizures. Our emphasis in this pictorial review is on neuroimaging findings in these patients. An early diagnosis will help in prognosticating the condition and deciding further management.

PICTORIAL REVIEW

Neuroimaging using computerized tomography and Magnetic resonance Imaging makes an integral part of diagnostic evaluation of elderly patients presenting with unprovoked seizures. CT has a definite advantage over MRI in emergency situations because it is quick and can be done in most of the patients in whom MRI may be contraindicated. The common etiologies responsible for unprovoked seizures in elderly may include ischemic infarcts, intracranial haemorrhage, granuloma or focal lesions involving CNS and white matter abnormalities.

Neurocysticercosis is one of the important causes of focal convulsions in adults and elderly. It is caused by pork tapeworm ie *Tania solium*. India is one of the countries endemic for neurocysticercosis. CT or MRI may be used for the diagnosis of neurocysticercosis. CT characteristically shows calcified cysts and non-enhancing cystic lesions with or without surrounding edema. In some cases mass effect or obstructive hydrocephalus may be seen. MRI may show characteristic cysts within brain parenchyma or ventricular system.

One of the important findings associated with neuroimaging in elderly patients appears to be cerebral atrophy. It is defined as the morphological presentation of brain parenchymal volume loss. It is not the diagnosis in itself rather it's an endpoint of many of the pathological processes of CNS and ageing. It is common neuroimaging finding in the elderly patients. It is difficult to ascertain the degree of disability caused by cerebral atrophy in elderly because in many patients cerebral atrophy is not associated with any cognition defects in which case it is termed as "involutional" or "age related" cerebral atrophy. The cerebral atrophy may be associated with onset of gliosis. On CT or MRI cerebral trophy is generally seen as prominent cerebral sulci, ventriculomegaly without bulging of third ventricular recess. Some of the diseases associated with severe cerebral atrophy are pick disease, Huntington disease, corticobasal degeneration and Parkinson's disease.

Cerebral small vessel disease is a frequent phenomenon encountered in elderly patients admitted for first onset unprovoked seizures. This is one of the important causes of cognitive and motor impairment ultimately progressing to dementia and Parkinsonism in elderly patients. Small vessel disease commonly involves white matter and may manifest as lacunar infarcts. The imaging modality of choice in these patients is MRI though CT scan may also show lacunar infarcts and changes associated with small vessel disease. The common clinical manifestations in these patients include lacunar syndrome, motor and cognitive disturbances

and dementia. All patients with small vessel disease do not present with similar features and there is a wide range of presentation which depends upon various factors and presence of co-existing morbidities. Conventional MRI in some cases may not be able to pick up the early changes of small vessel disease hence diffusion tensor imaging is the imaging modality of choice in patients suspected to be having small vessel disease. MRI may show multiple small hyperintensities involving periventricular areas and along posterior horns of lateral ventricles.

Infarcts are one of the common neuroimaging finding in

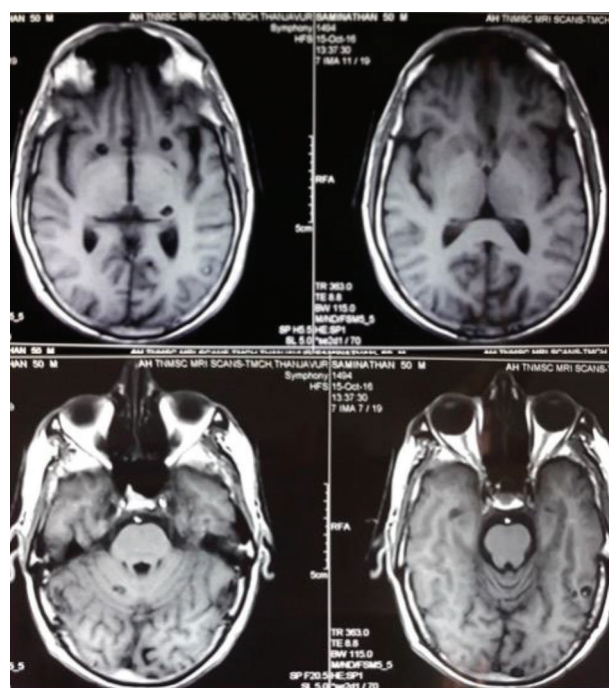


Figure-1: A 60 year old male patient presented to us with h/o 3 episodes of generalised tonic clonic seizures along with uprolling of eyeballs. On neuroimaging multiple characteristic cystic lesions were found in brain parenchyma and brain stem. However there was no mass effect or hydrocephalus seen on neuroimaging. The characteristic finding on MRI include cysts lesions which on T1 appear hypo intense and on T2 weighted images there is a low ring signal surrounded by hyper intense lesion due to edema

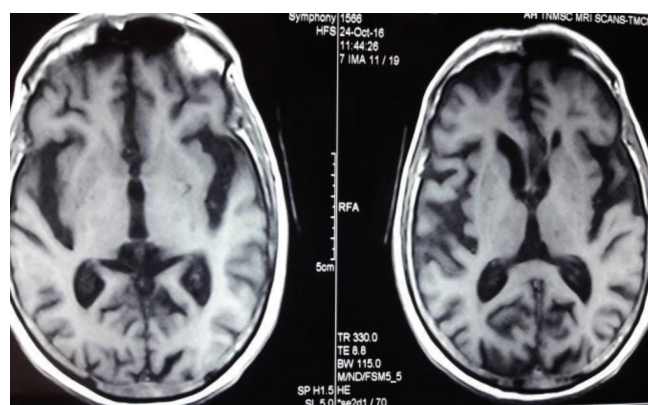


Figure-2: An 84 years old male presented to us 2 episodes of generalised tonic clonic seizures. On MRI there was global cerebral atrophy, ventricular dilatation and chronic bifrontal infarcts. Figure showing T1 Weighted images showing Cerebral Atrophy as denoted by prominent cerebral sulci and ventricular dilatation

elderly patients. It results from sudden cessation of blood supply to the brain. The risk factors include advanced age, male gender, family history of stroke, smoking, diabetes, hypertension, hypercholesterolemia and hypercoagulable states like protein C or protein S deficiency, antithrombin deficiency and lupus antibodies. Non contrast CT may be useful for the diagnosis of infarcts but it has a limited sensitivity in the acute setting. In acute stages it may present as loss of grey-white matter differentiation and hypo attenuation. With time this hypo-attenuation and swelling becomes marked and may produce mass effect. In subacute stages there is hyper-attenuation of the tissue and at this stage the CT may appear normal to inexperienced eyes. In chronic stage the lesion may appear hypodense and gliosis may be become manifest.

Middle cerebral artery infarct is a common cause of acute onset seizures in elderly. It may present with sudden onset of focal deficit resulting due to infarction of the territory supplied by middle cerebral artery. Middle cerebral artery supplies most of the outer cortex, basal ganglia and part of internal capsule. The infarcts occurring in the territory supplied by MCA thus

have diverse neurological complications including infarcts in temporal cortex, basal ganglia and internal capsule. The clinical features depend upon the area involved and may comprise of hemiparesis, hemisensory loss, hemianopia and aphasia. The earliest finding of middle cerebral artery occlusion is called hyperdense middle cerebral artery sign which is seen as unilateral hyperdense MCA. Later the involved area may be seen as hypodense and marked swelling may be present. The mass effect caused by swelling may cause midline shift and may be life threatening. In this situation a decompression craniotomy may be life saving. Intracranial space occupying lesions in elderly patients may present as vomiting, altered sensorium and headache. There are additional clinical features depending upon the part of brain which is primarily involved. In elderly progressive general decline in intellectual functions. Focal deficits and visual disturbances are also common features of neoplastic brain lesions. The secondary consequences of intracranial space occupying lesions may include hydrocephalus secondary to obstruction to flow of CSF, Pressure effect and midline shift due to cytotoxic edema and damage to blood

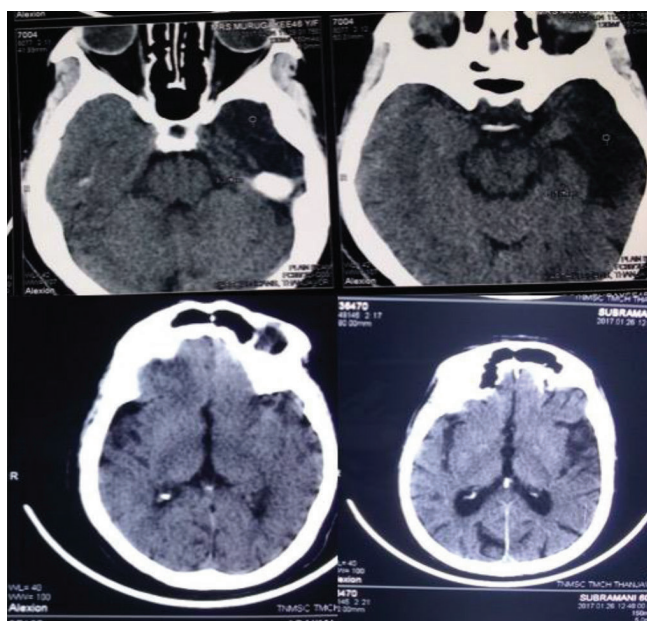


Figure-3: One of the common findings in studied cases was found to be temporal lobe gliosis. Computerized tomography could very well pick up gliosis involving right and left temporal lobes

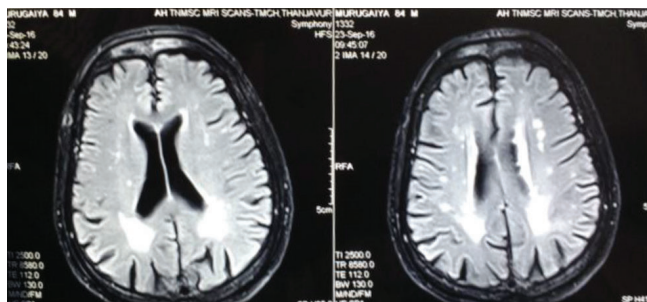


Figure-4: 84 years old male patient presented with complaints of seizures since 4 months. There was also history of frequent falls. MRI showed periventricular hyperintensities s/o small vessel disease

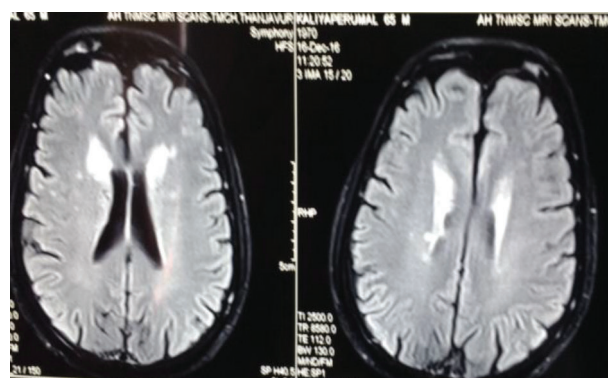


Figure-5: 65 year old male patient presented with history of 1 episode of generalised tonic clonic seizures. There was past history of similar seizure episode 6 months back. MRI again showed periventricular hyperintensities on T1 weighted Images

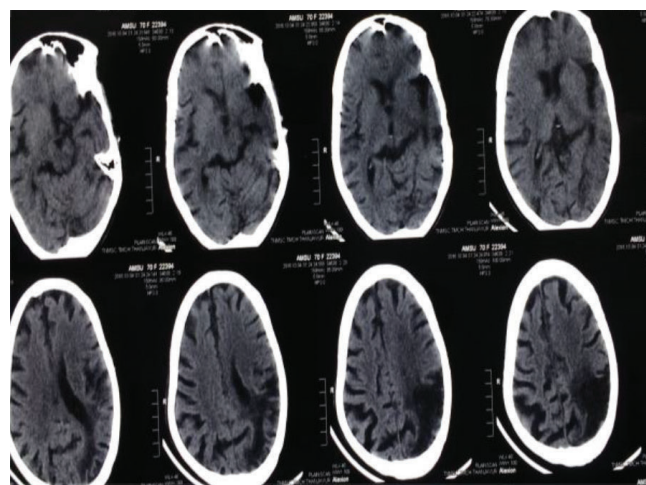


Figure-6: A 70 years old female presented to us with the history of 1 episode of generalised tonic clonic seizures followed by expressive aphasia. An emergency CT scan was done which showed hypodense lesion in left parieto-occipital region suggestive of chronic infarct. In addition to this gliosis was also present

brain barrier. If the lesion involves basal ganglia it may present with cerebellar signs such as dysidiadochokinesis, nystagmus, ataxia, intention tremors and cerebellar speech. Depending upon the location of lesion it may cause wide range of signs and symptoms including visual field defects, temporal lobe epilepsy and dysphasia if temporal lobe is involved. Anosmia, dysphasia and hemiparesis in case of frontal lobe and astereognosis, hemisensory loss and dyscalculia in case of parietal lobe involvement.

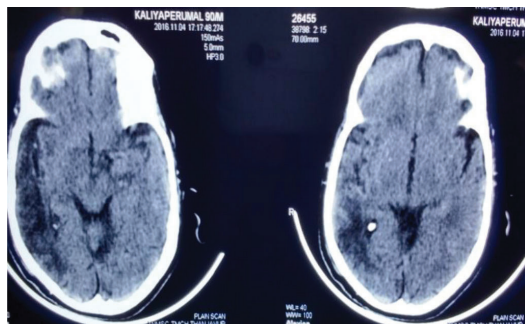


Figure-7: A 65 year old male presented with 3 episodes of generalised tonic clonic seizures in last 1 month. The seizures occurred during night time. During episodes of seizures patient had frothing of mouth and there was one episode of tongue bite. After the seizures he remained in altered sensorium for 10-15 minutes. For these complaints he was brought to us. A CT scan was done which showed infarct in right MCA territory. He was given phenytoin sodium to which he responded and later there were no further episodes of seizures

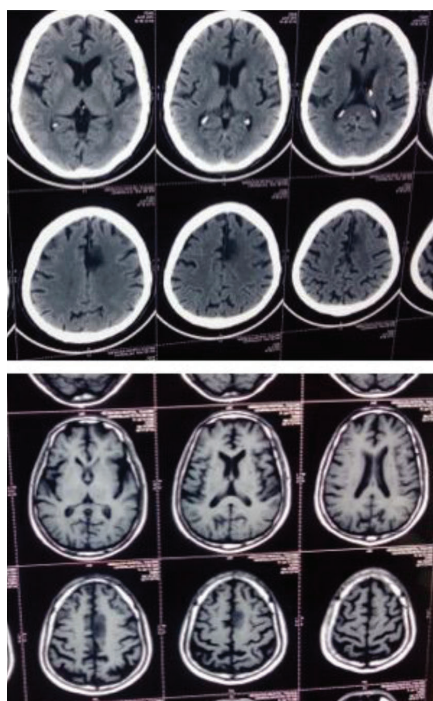


Figure-8: A 74 year old male was admitted with history of right sided focal seizures involving right side of face and right arm. There was no h/o secondary generalisation. Neuroimaging showed intracranial space occupying lesion most likely to be neoplastic in etiology. Patient was started on phenytoin to which he responded well. For further management the patient was referred to neuro-oncologist

DISCUSSION

With the increase in life expectancy of general population the incidence of unprovoked seizures in elderly is increasing. First unprovoked seizure in elderly is defined as occurrence of first episode of seizures without an obvious precipitating cause. With advancement in diagnostic and imaging techniques many of these “unprovoked seizures” are expected to have some underlying pathology. While EEG is an important investigation to find out presence of epileptogenic focus it is well known fact that in many of the cases interictal EEG is often normal.⁶ Modern structural and functional imaging techniques can be utilized in these cases for diagnosis and localization of the lesion. The use of appropriate imaging technique can diagnose subtle lesions in central nervous system and provide with the insights into the pathophysiology of seizures in elderly. The importance of neuroimaging can be understood from the fact that many elderly patients who have been found to have seizures without any identifiable precipitating factors later were found to be having lesions like neurocysticercosis, infarcts or even intracranial space occupying lesions. All these pathologies demand a specific treatment which couldn't have been possible without appropriate neuroimaging.⁷

Computerized tomography is the first investigation used in neuroimaging of the elderly patients presenting with first onset unprovoked seizures. Though it involves ionizing radiation its advantages include quick scans, wider availability, lesser cost and it can be done in patients in whom MRI is contraindicated like in patients with cochlear implants, cardiac pacemakers, claustrophobic patients and patients with intracranial aneurysmal clips. Moreover quick scanning means reduced motions which decreases the incidence of motion artifacts which are commonly seen during MRI. Moreover CT scan can very well pickup abnormalities like intracranial bleeds, infarcts, calcified granulomas and intracranial space occupying lesions the problems with the use of CT in unprovoked seizures include its low sensitivity, poor resolution of temporal fossa and ionizing radiation. These abnormalities included age related cerebral atrophy, gliosis, Infarcts, focal lesions or granuloma. The authors like Sanjib Sinha et al found a similar incidence of the neuroimaging abnormalities detected on CT scan in a cohort of elderly manifesting with new onset seizures. The other common neuroimaging abnormalities found in their study were intracranial haemorrhage, infarcts, space occupying lesions, granulomas, metastasis and white matter changes. The authors reiterated the importance of neuroimaging in elderly patients with new onset seizures.⁸

MRI is more sensitive and specific neuroimaging modality and is a preferred modality over CT scan for neuroimaging of elderly in presenting with first unprovoked seizures. It has an advantage over CT scan in the diagnosis of more subtle lesions, acute infarcts and imaging of temporal fossa. Moreover it can better delineate the nature of lesion than the CT scan. The utility of MRI in neuroimaging of the elderly patient is limited by its unavailability at many centers,

high cost, and increased scanning time (causing motion artifacts during scanning). Moreover it is contraindicated in claustrophobic individuals and patients with aneurysmal clips, cochlear implants and cardiac pacemakers. The increase yield of MRI in patients with unprovoked seizures depends upon the underlying pathology, MRI technique (epilepsy protocol) and experience of radiologist interpreting the results. The important role of MRI in patients presenting with unprovoked seizures is identification of underlying pathologies like mesial temporal sclerosis, intracranial space occupying lesions, infarcts and malformations of cortical development. Given the advantages of MRI over CT scan commission on neuroimaging of the international league against epilepsy has recommended that MRI should be considered imaging modality of choice for investigating patients with epilepsy and is superior to CT scan both in terms of sensitivity and specificity for identification of small lesions and abnormalities of cerebral cortex.⁹

The other more advanced modalities for neuroimaging like Single photon emission computerized tomography, positron emission tomography and magnetic resonance spectroscopy are preferable in certain conditions to find out metabolic changes in epileptic zones. The main advantage of functional brain imaging is their ability to detect metabolic abnormalities even in structurally normal brain. Again their use is restricted due to the high cost, low availability and scarcity of experts interpreting their results.¹⁰

CONCLUSION

Neuroimaging plays a critical role in evaluation of elderly patients with unprovoked seizures. Because of high sensitivity and specificity MRI is preferable to CT scan in evaluation of elderly patients with unprovoked seizures. The role of neuroimaging for diagnosis and localization of lesion is crucial. Other modalities like positron emission tomography, single photon emission computed tomography and magnetic source imaging are complex modalities used in presurgical evaluation of patients with refractory seizures.

REFERENCES

1. Brodie MJ, Kwan P. Epilepsy in elderly people. *BMJ : British Medical Journal*. 2005;331:1317-1322.
2. Wieshmann UC Clinical application of neuroimaging in epilepsy *Journal of Neurology, Neurosurgery and Psychiatry* 2003;74:466-470.
3. Calik M, Karakas E, Cullu N. Clinical importance of neuroimaging in epilepsy. *Journal of Neurosciences in Rural Practice*. 2013;4:S11-S12.
4. Molla Mohammadi M, Tonekaboni Sh, Khatami A, et al. Neuroimaging Findings in First Unprovoked Seizures: A Multicentric Study in Tehran. *Iranian Journal of Child Neurology*. 2013;7:24-31.
5. Rajshekhar V, Chandy MJ. Comparative study of CT and MRI in patients with seizures and a solitary cerebral cysticercus granuloma. *Neuroradiology*. 1996;38:542-6.
6. Van Cott AC. Epilepsy and EEG in the elderly. *Epilepsia*. 2002;43 Suppl 3:94-102.
7. Acharya JN, Acharya VJ. Epilepsy in the elderly: Special considerations and challenges. *Annals of Indian*

Academy of Neurology. 2014;17:S18-S26.

8. Sinha S, Satishchandra P, Kalband BR, Bharath RD, Thennarasu K. Neuroimaging observations in a cohort of elderly manifesting with new onset seizures: Experience from a university hospital. *Annals of Indian Academy of Neurology*. 2012;15:273-280.
9. Verma R, Lalla R. Why MRI of brain is superior to CT in multiple neurocysticercosis? *BMJ Case Reports*. 2012;2012:bcr0320126046.
10. Laufs H. Functional imaging of seizures and epilepsy: evolution from zones to networks. *Curr Opin Neurol*. 2012;25:194-200.

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