MRI AND EPILEPSY

Humera Ahsan

Department of Radiology
Aga Khan University Hospital

An Eplileptic seizure is a clinical manifestation of abnormal excessive neuronal activity arising in the gray matter of cerebral cortex.

Its prevalence in Pakistan is 9.99 per 1000 population.

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ETIOLOGY OF MEDICALLY INTRACTABLE EPILEPSY

- Mesial Temporal Sclerosis	50-70%
- Nonvascular developmental causes, Perinatal Hypoxia & Injury	13-35%
- Tumors	15%
- Vascular Malformations	3%
- Traumatic scarring	2%
- Hamartomas	2%

Epilepsia 35 (suppla 6)S2 – S13 - 1994

The development of MR imaging with its outstanding sensitivity and specificity in identifying structural abnormalities has made the neuro-radiological contribution in the pre- surgical work-up of patients with drug resistant epilepsy of paramount importance.

In a study involving 113 patients at Yale, the epileptic abnormality was localized by CT in 28% of patients compared to 86% of patients by MRI

Robert R Edelman, Michael B Zlatkin, John R Hesselink
Epilepsy – Clinical Magnetic Resonance Imaging

Algorithm for medically uncontrolled seizures

- Most centers use a combination of EEG and neuro-imaging as the primary means. If these studies localize an epileptogenic focus and all studies are concordant, invasive EEG testing may not be necessary.

- Depends upon institutional policy and availability of resources.

The MRI techniques involved in the evaluation of patients with epilepsy include

MRI

- T1 & T2 weighted fast spin echo & gradient echo in two orthogonal planes.
- Fluid Attenuated Inversion Recovery (Flair).
- Contrast Enhancement where needed.

Functional Imaging

- MR perfusion scans.
- MR spectroscopy.

Isotope Studies

- SPECT
- PET

Hippocampal Sclerosis

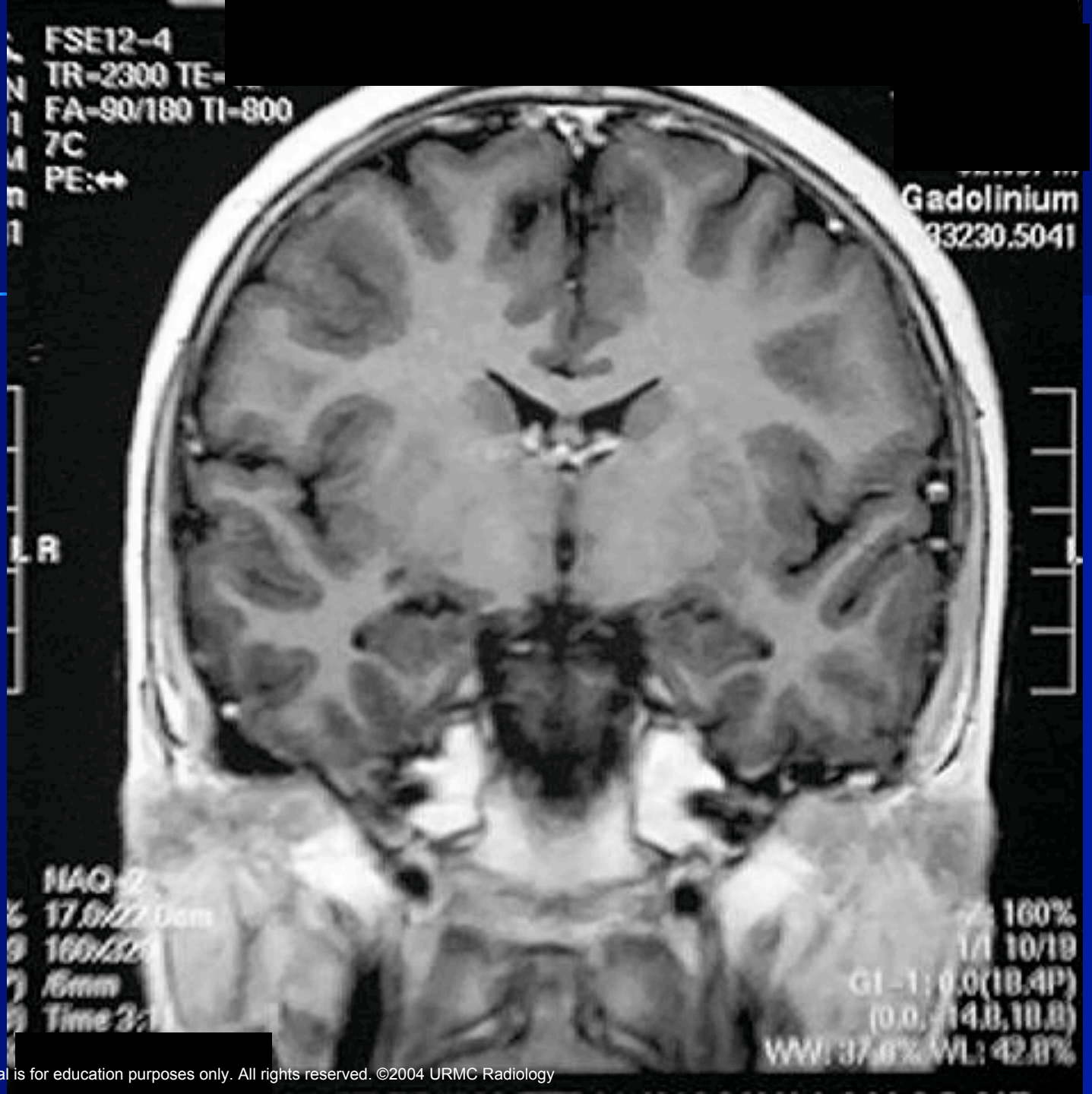
This is characterized by hippocampal neuronal loss and gliosis associated with medial temporal lobe epilepsy. It is also known as mesial temporal sclerosis.

ETIOLOGY

It is postulated that an insult to the developing brain during childhood such as a complicated febrile seizure damages hippocampal inhibitory inter-neurons.

This initial damage leads to creation of an aberrant hyperexitable synaptic system, which is clinically manifested as recurrent seizures.

Eur Radiol 9, 493 – 507 (1999)



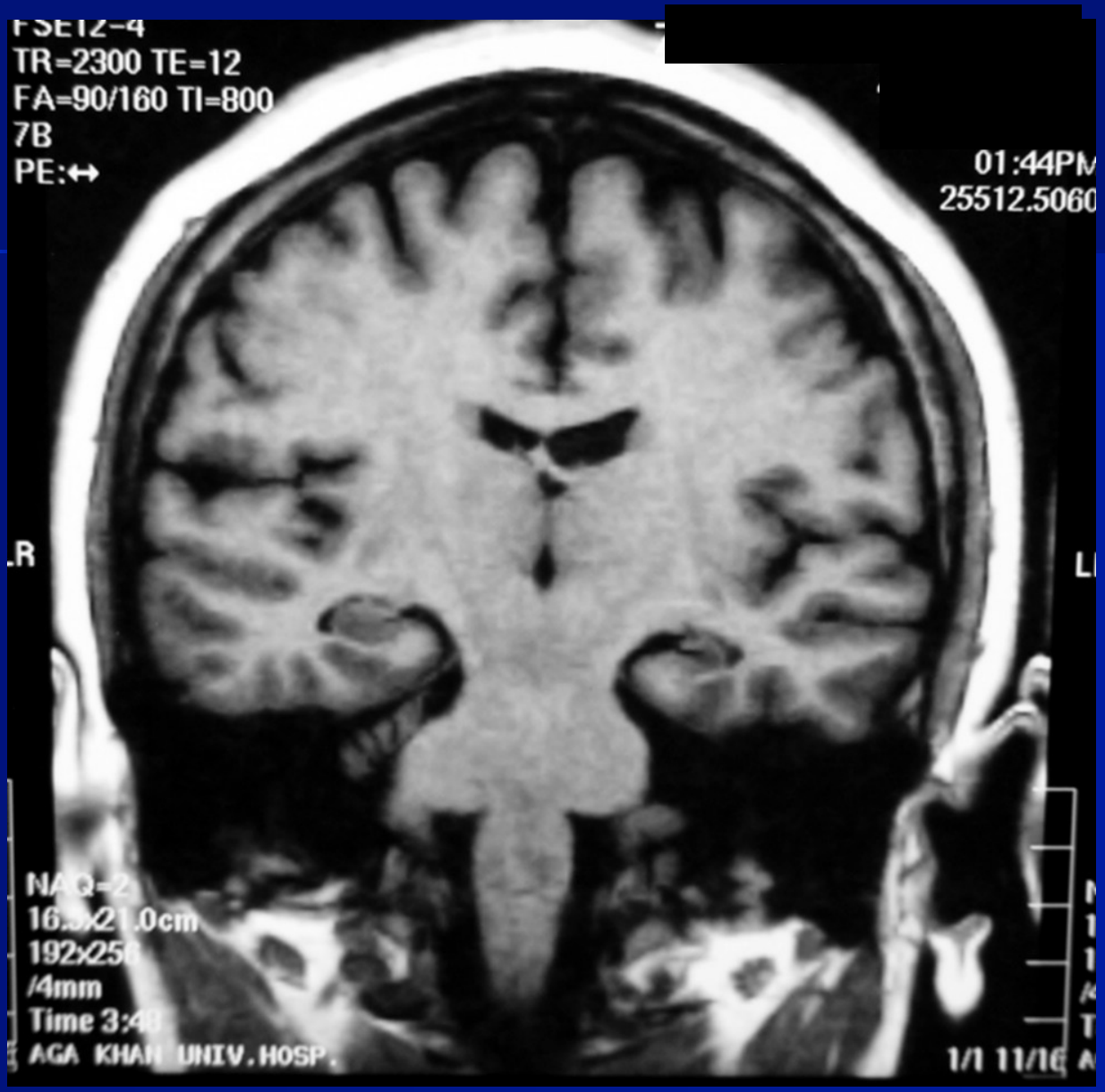
Surgical resection of the hippocampus and anterior temporal lobe can cure epilepsy in 85% of patients with hippocampal sclerosis. Thus pre-operative identification of this disorder is imperative.

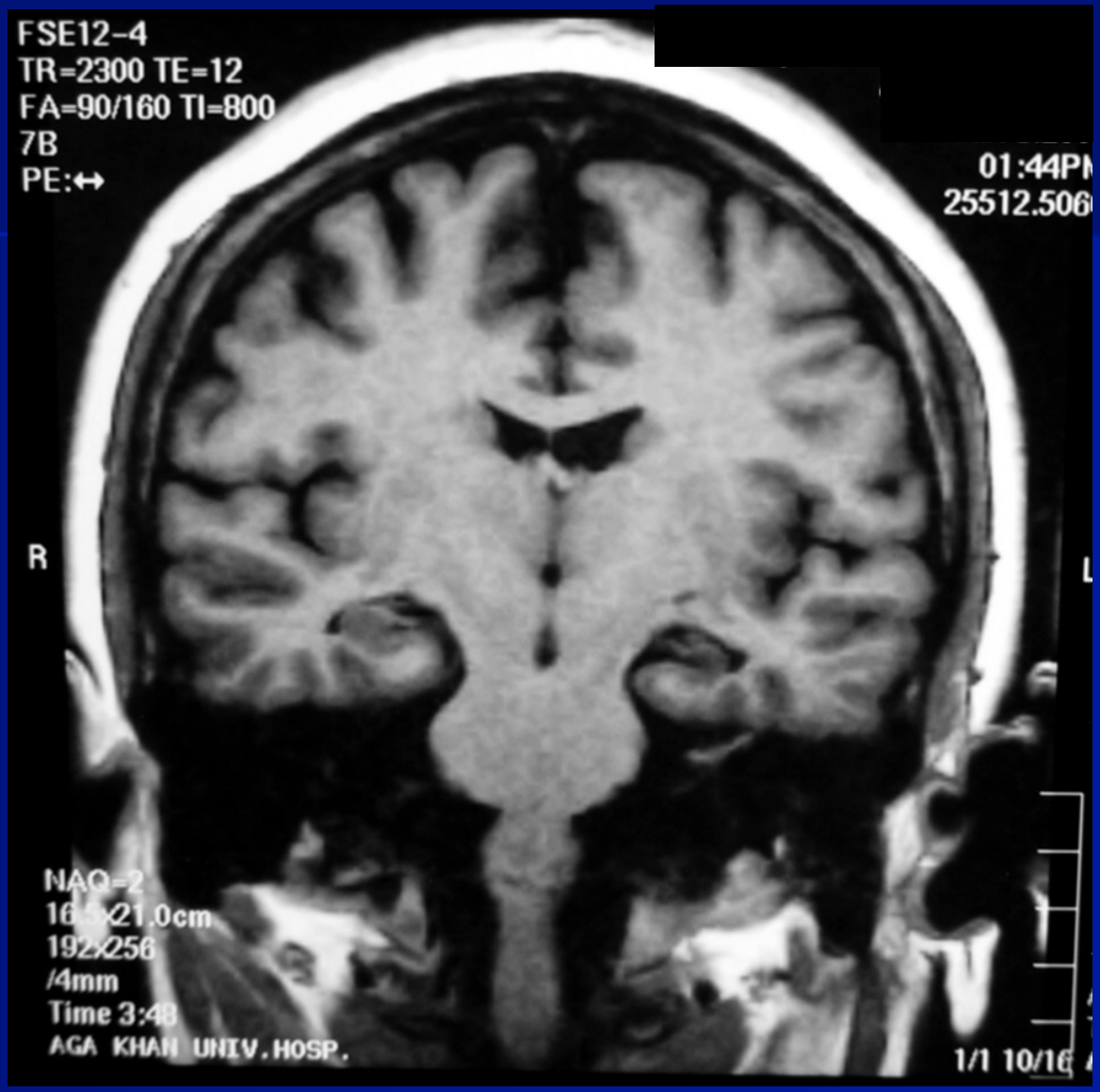
Engel J Jr(ed) Surgical treatment of Epilepsies
Raven Press New York PP 609 - 622

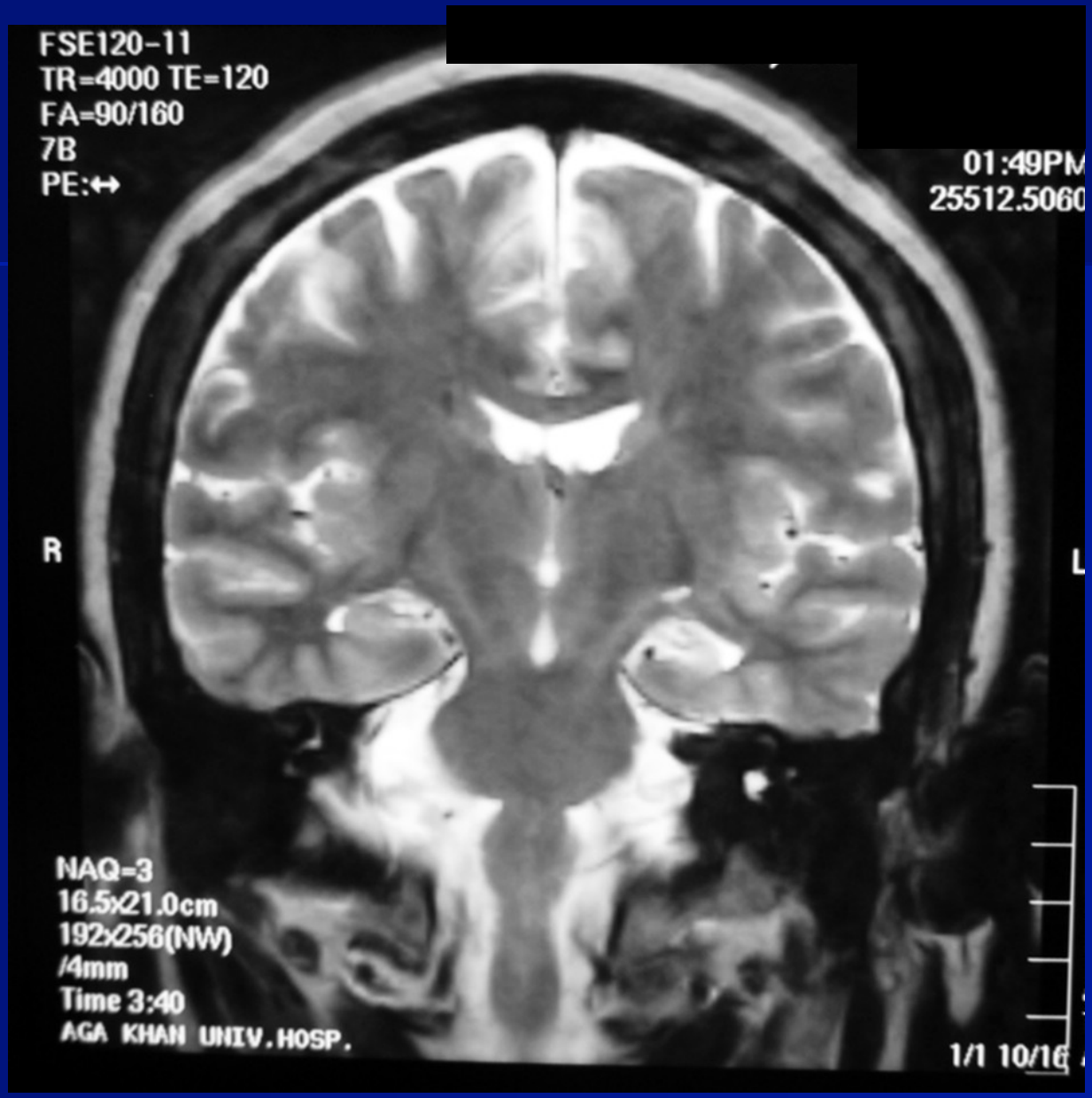
MRI Features

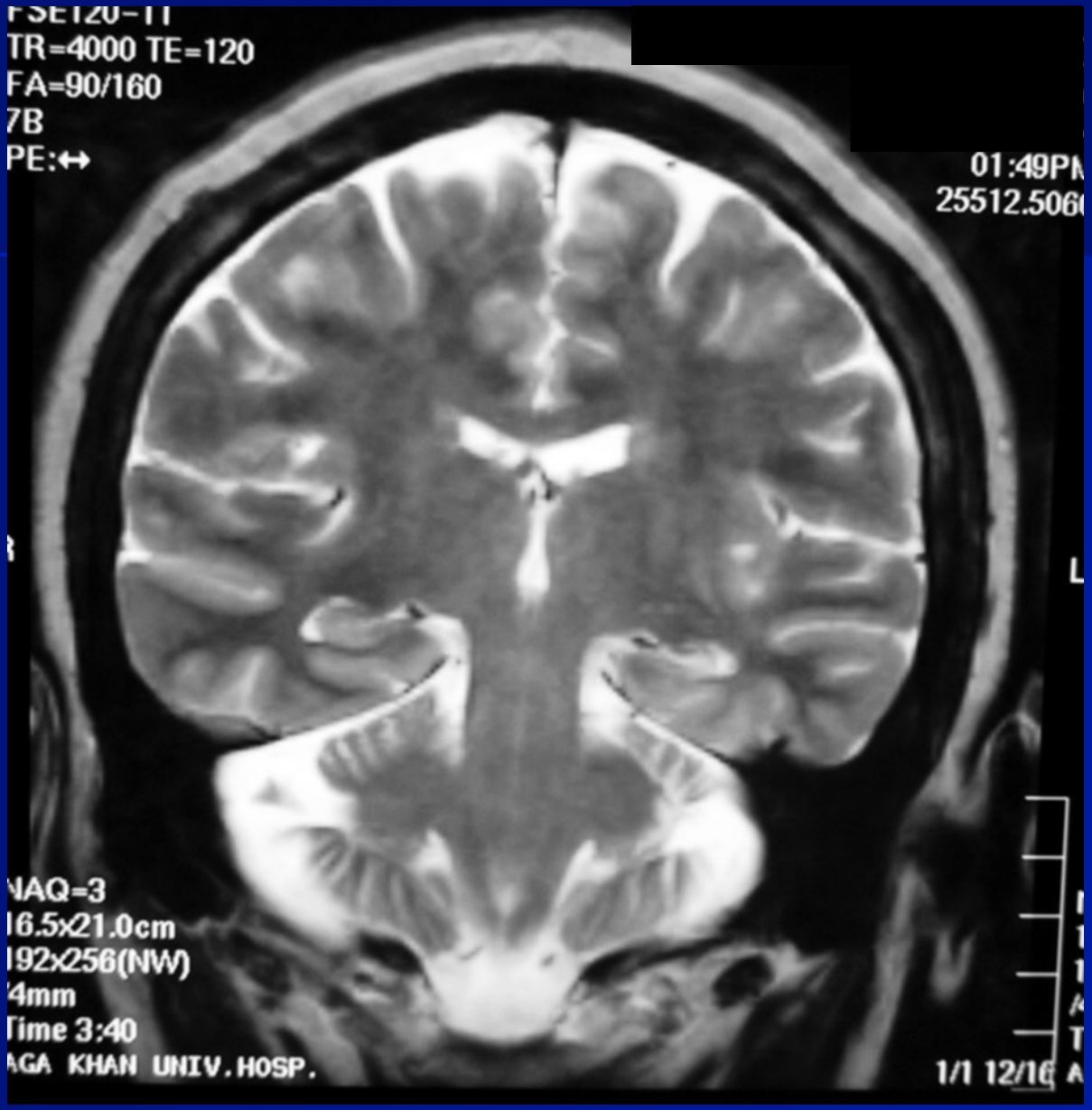
The most consistent MRI feature for diagnosing hippocampal sclerosis are volume loss and signal changes in the ipsilateral hippocampus.

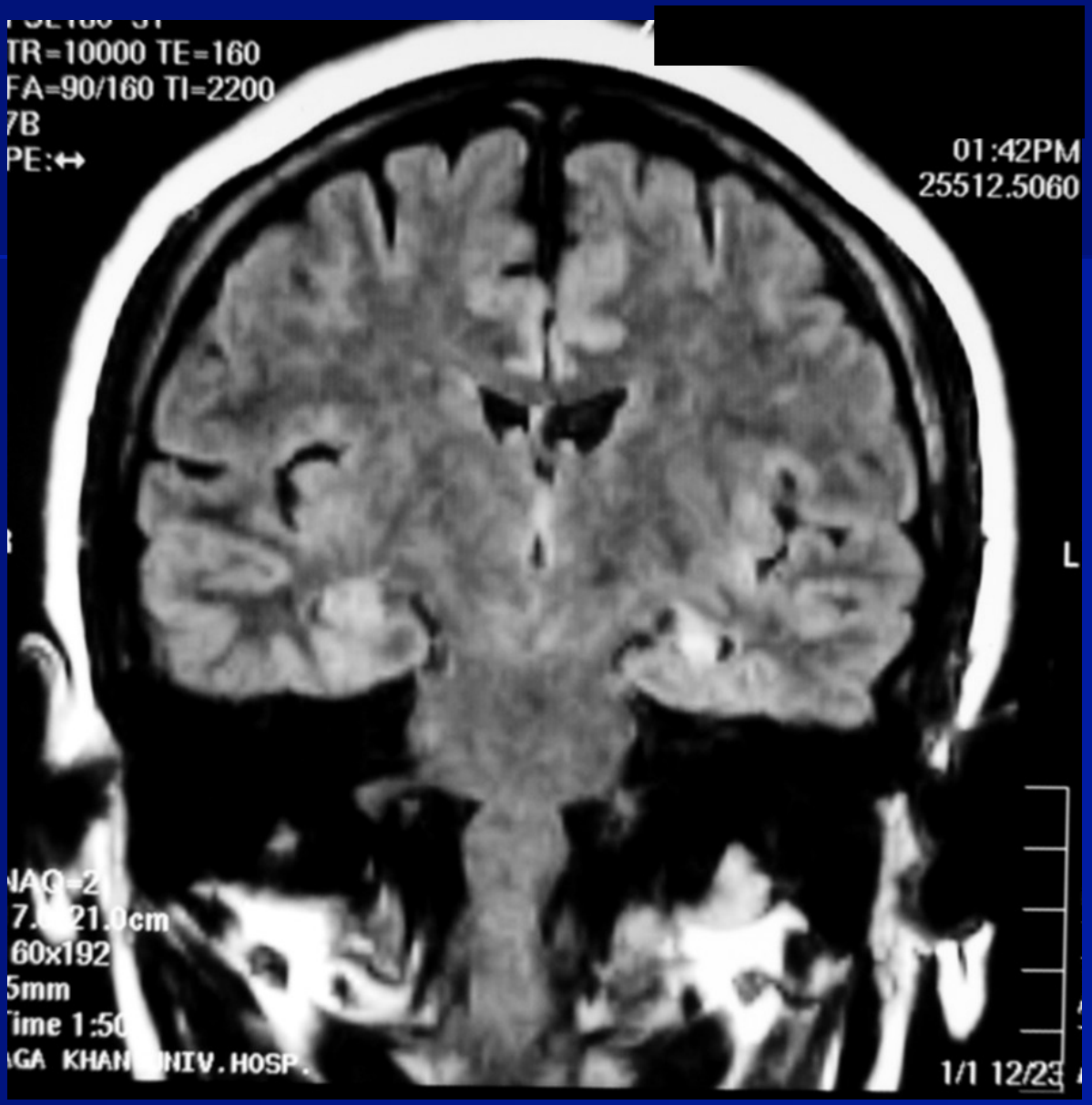
This is seen in 70-100% of the cases.











Other imaging features that may be beneficial in subtle cases are:

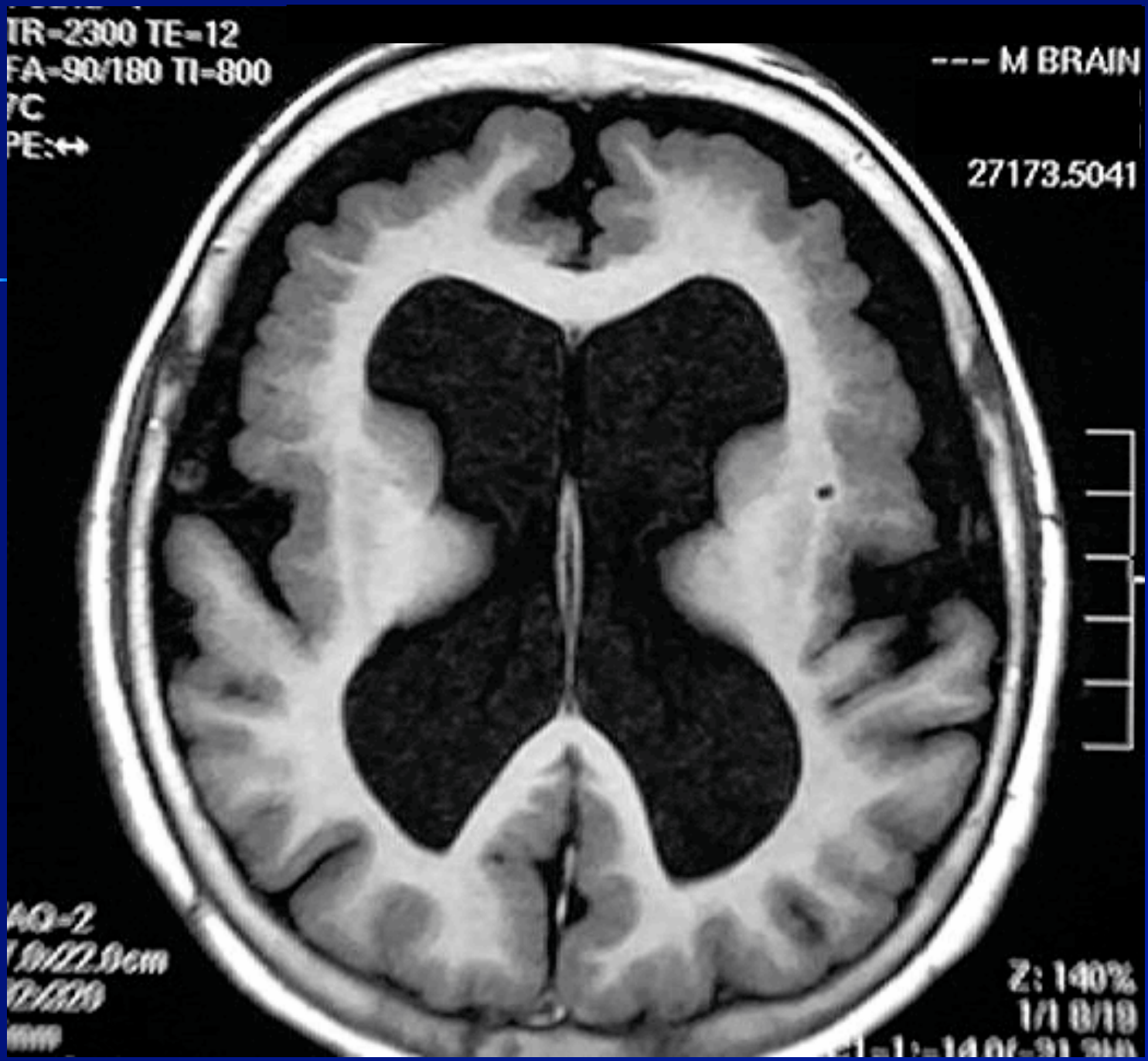
- Abnormal hypo intense signal on T1 weighted images.
- Volume loss of the temporal lobe.
- Dilatation of ipsilateral temporal horn.
- Loss of collateral white matter.
- Thinning of ipsilateral fornix.
- Mamillary body atrophy.

Focal Migrational Disorders

- These are often associated with seizure disorder but were frequently unrecognized before MRI era.
- Following subtypes are distinguished schizencephaly, lissencephaly ,polymicrogyria, focal dysplasia and ectopic grey matter.

Polymicrgyria

- Cortex may be slightly thickened.
- MRI may demonstrate paradoxical smoothing of the brain surface.
- Long TR images may show increased signal in the adjacent subcortical white matter.

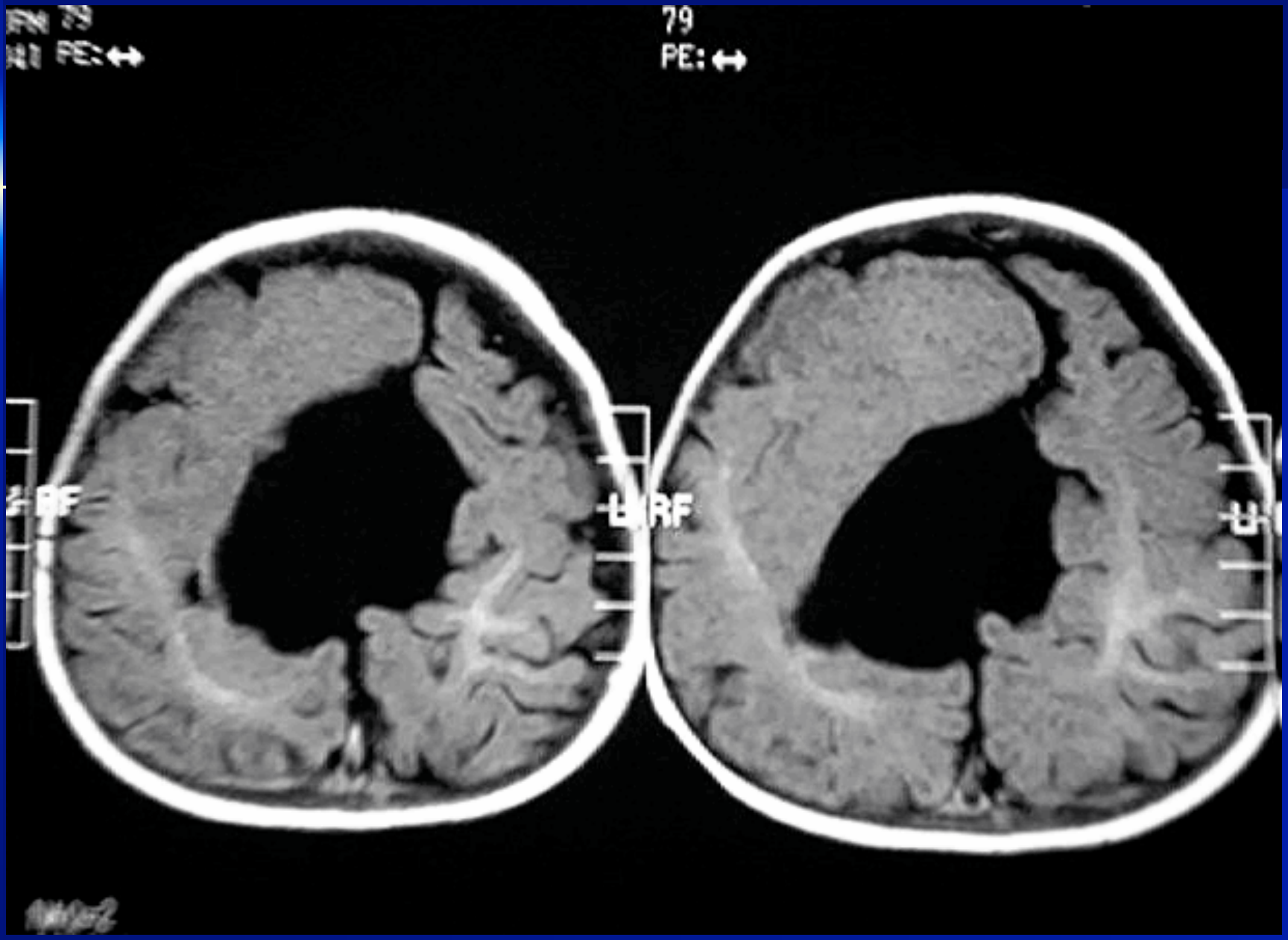


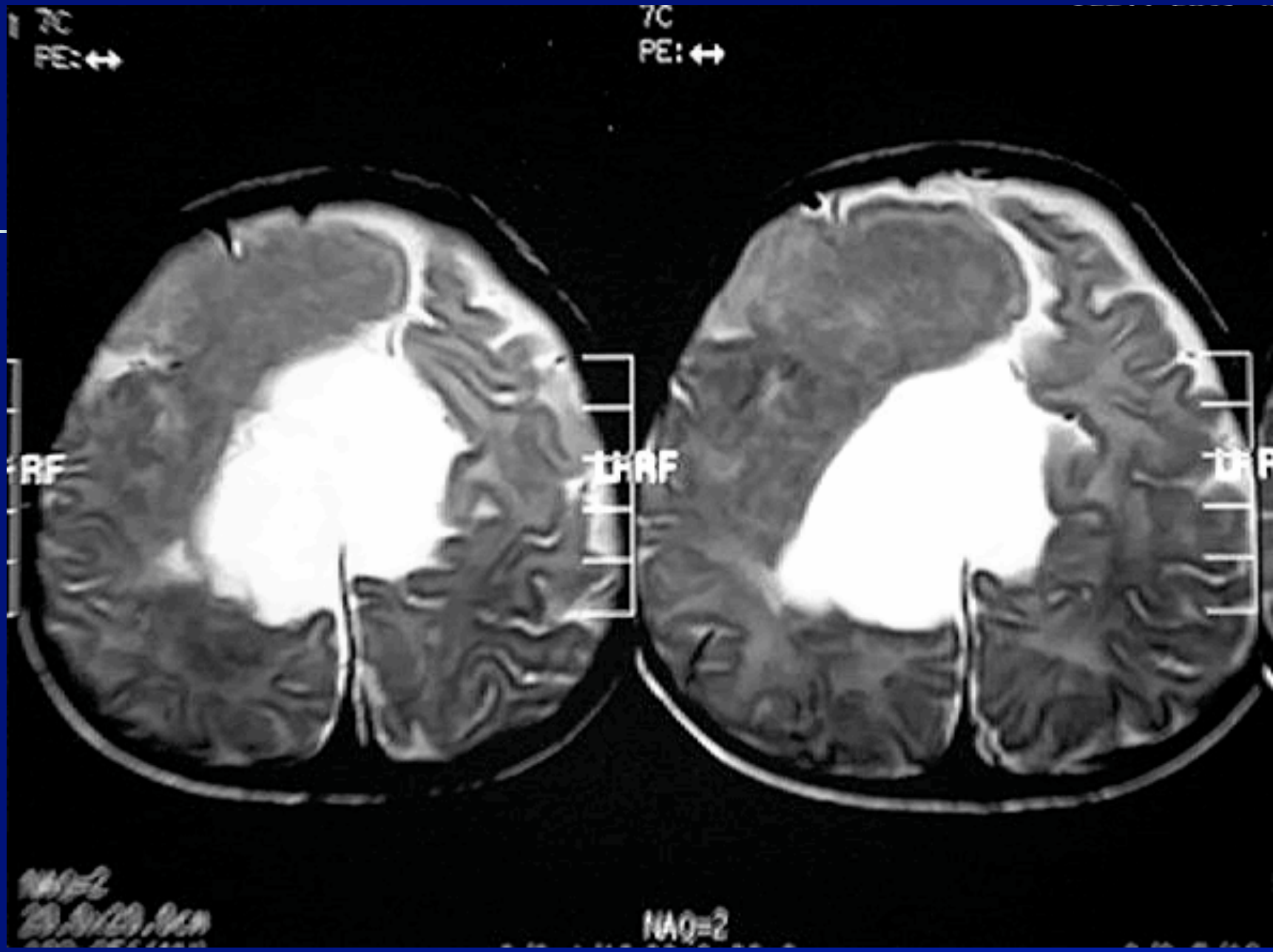
Schizencephaly

- There is a gray matter lined cleft extending from the lateral ventricle through the cortex to the pia.
- In the close lip the cleft occurs when the walls of the cleft are in opposition whereas in open lip the walls of the cleft are separated.

Heterotopia

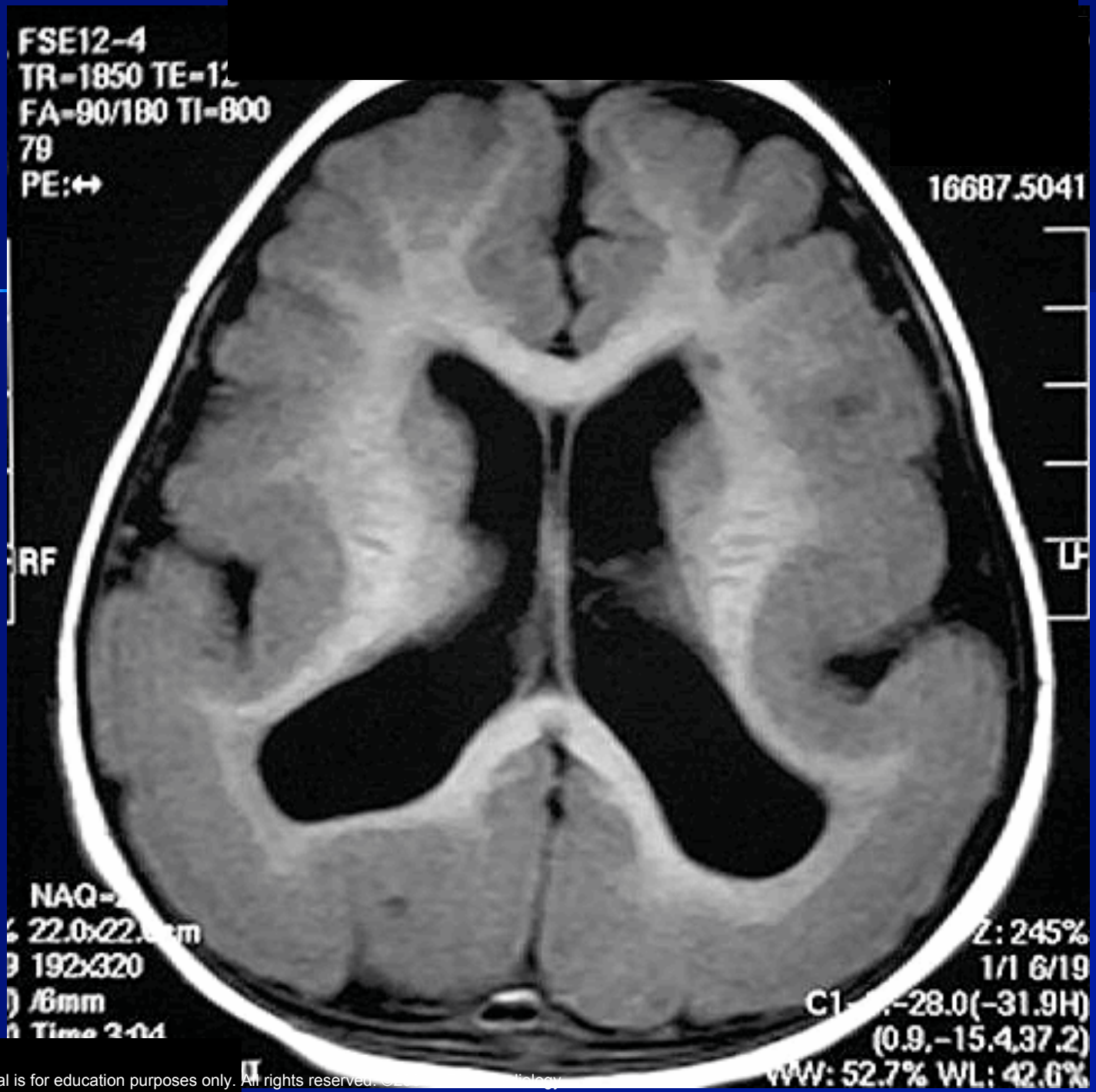
- In subependymal heterotopia the seizure is usually amiable to medical therapy.
- This is ectopic location of grey matter.
- Subcortical heterotopias have a range clinical presentations.





Lissencephaly and Pachygyria

- Pachygyria is less severe form of lissencephaly.
- Lissencephaly is complete lack of gyral formation.

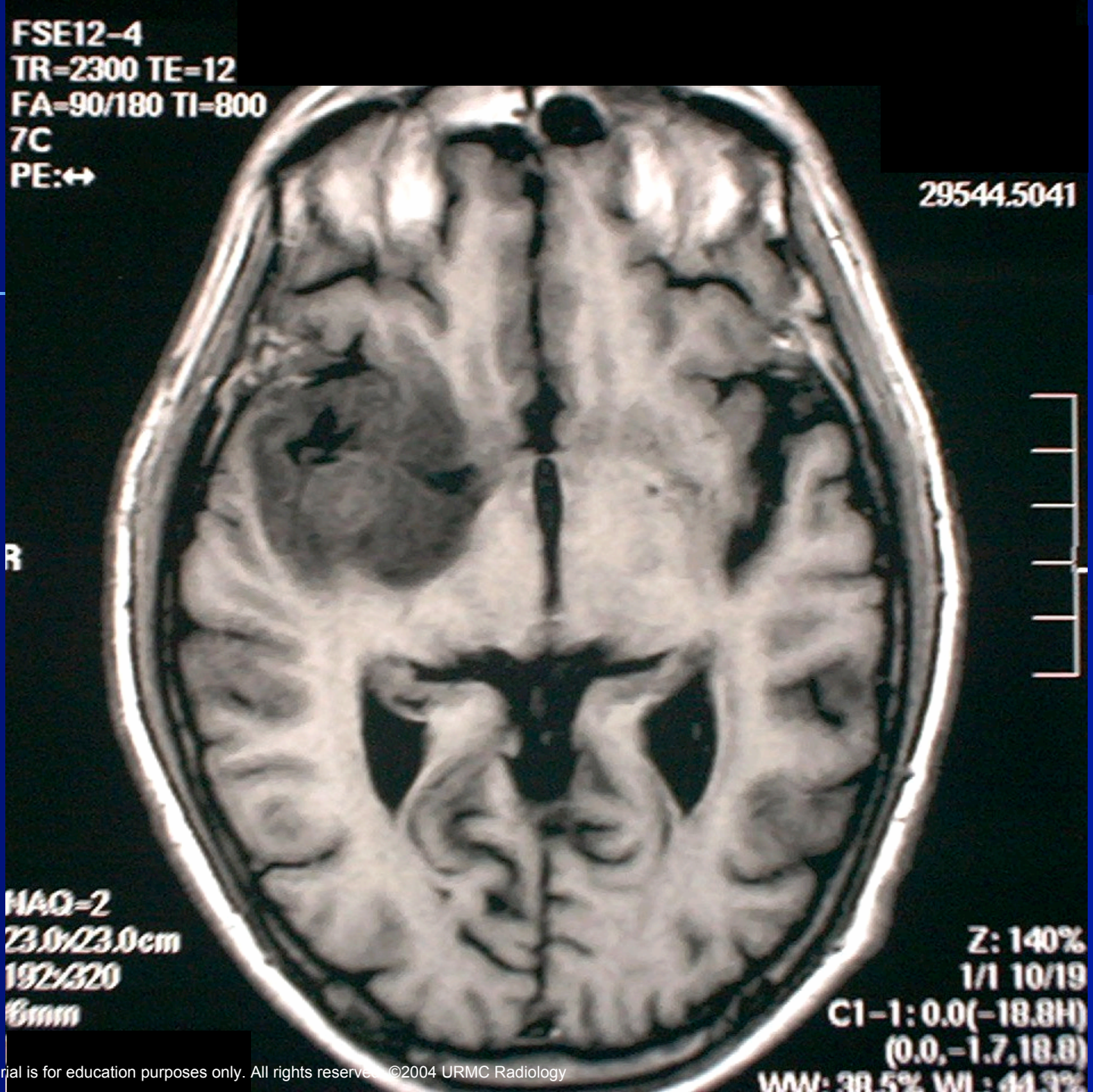


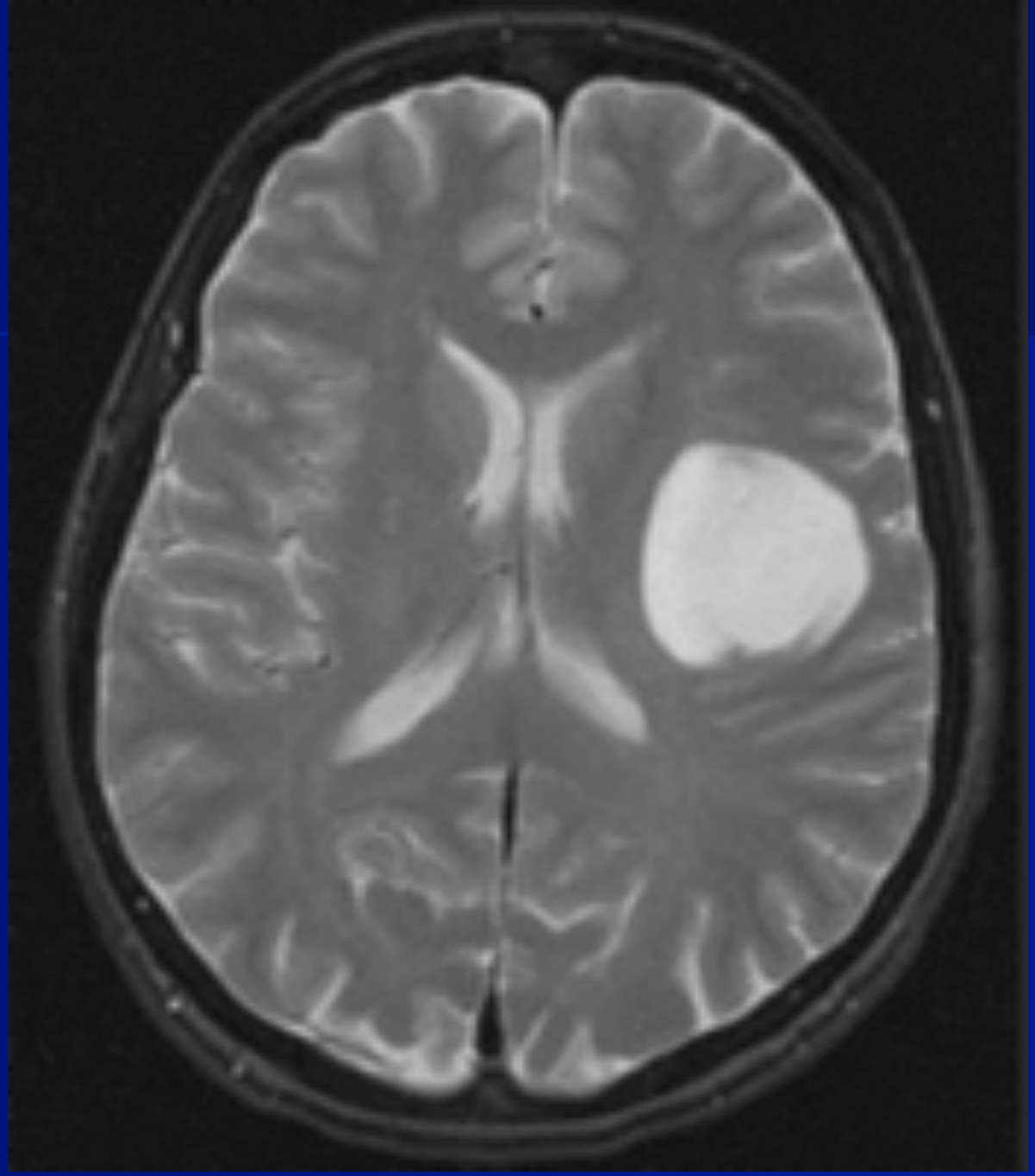
Hemimegaencephaly

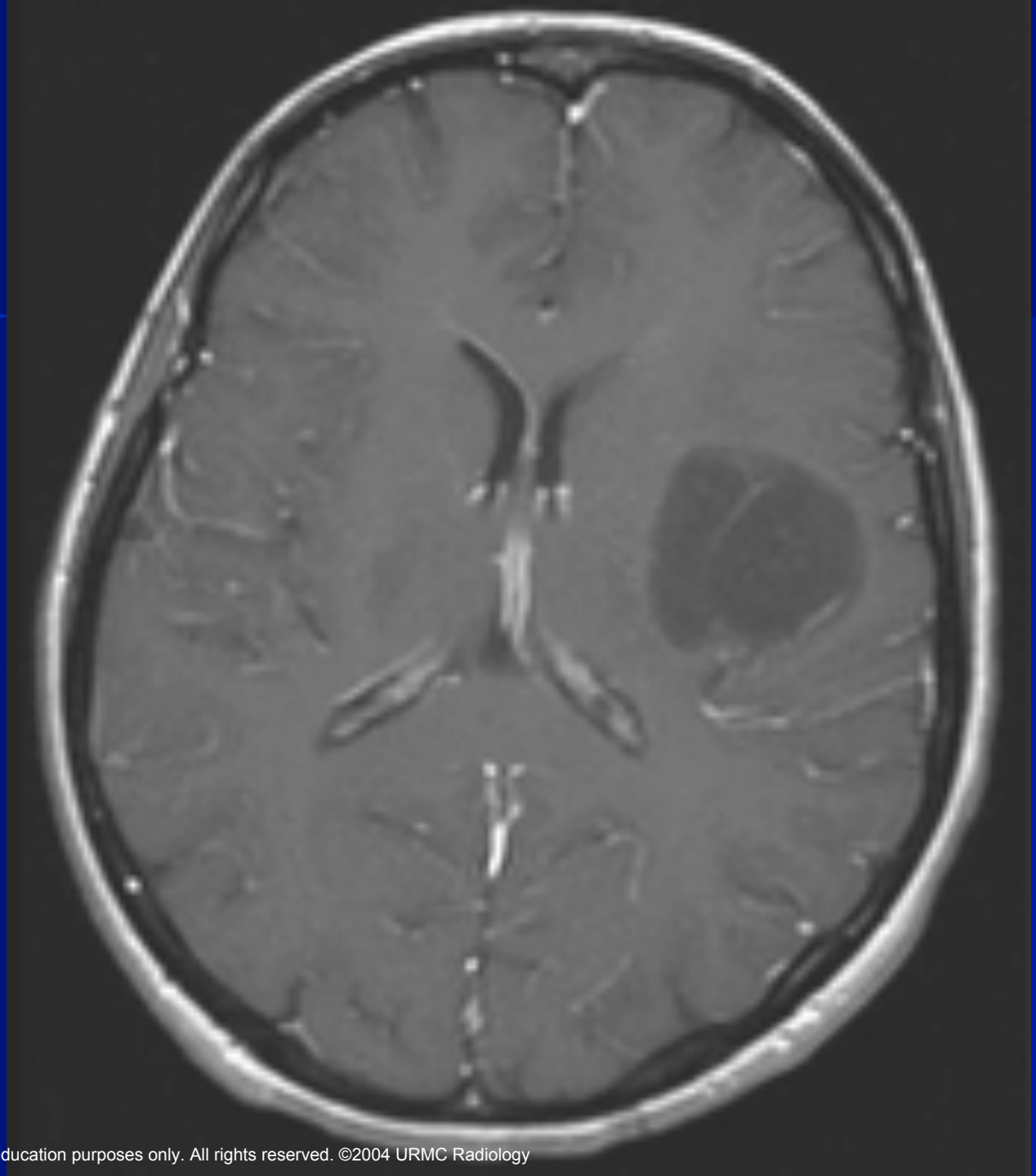
- MR images show unilateral enlargement of all or part of a hemisphere associated with ipsilateral ventriculomegaly.
- Hemispherectomy may be performed in patients with severe motor deficits.

Dysplastic Lesions & Low Grade Tumors

- Brain tumors are responsible for seizures in 2-4% of the general population.
- 50-76% of the patients with cerebral neoplasms present with seizures.
- In a study seizure occurred in 92% of oligodendrogliomas, 70% of astrocytomas and 35% of glioblastomas.

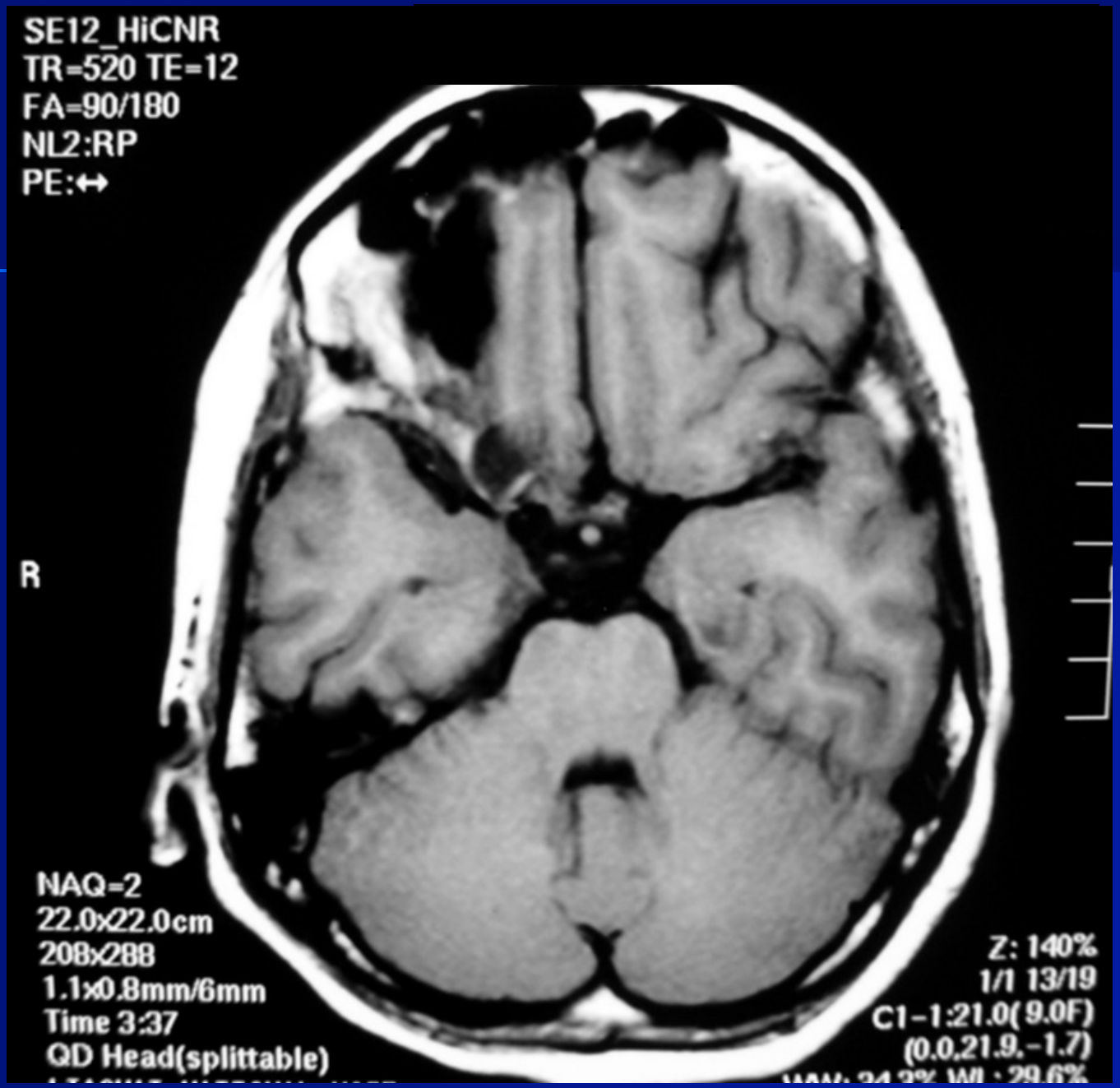


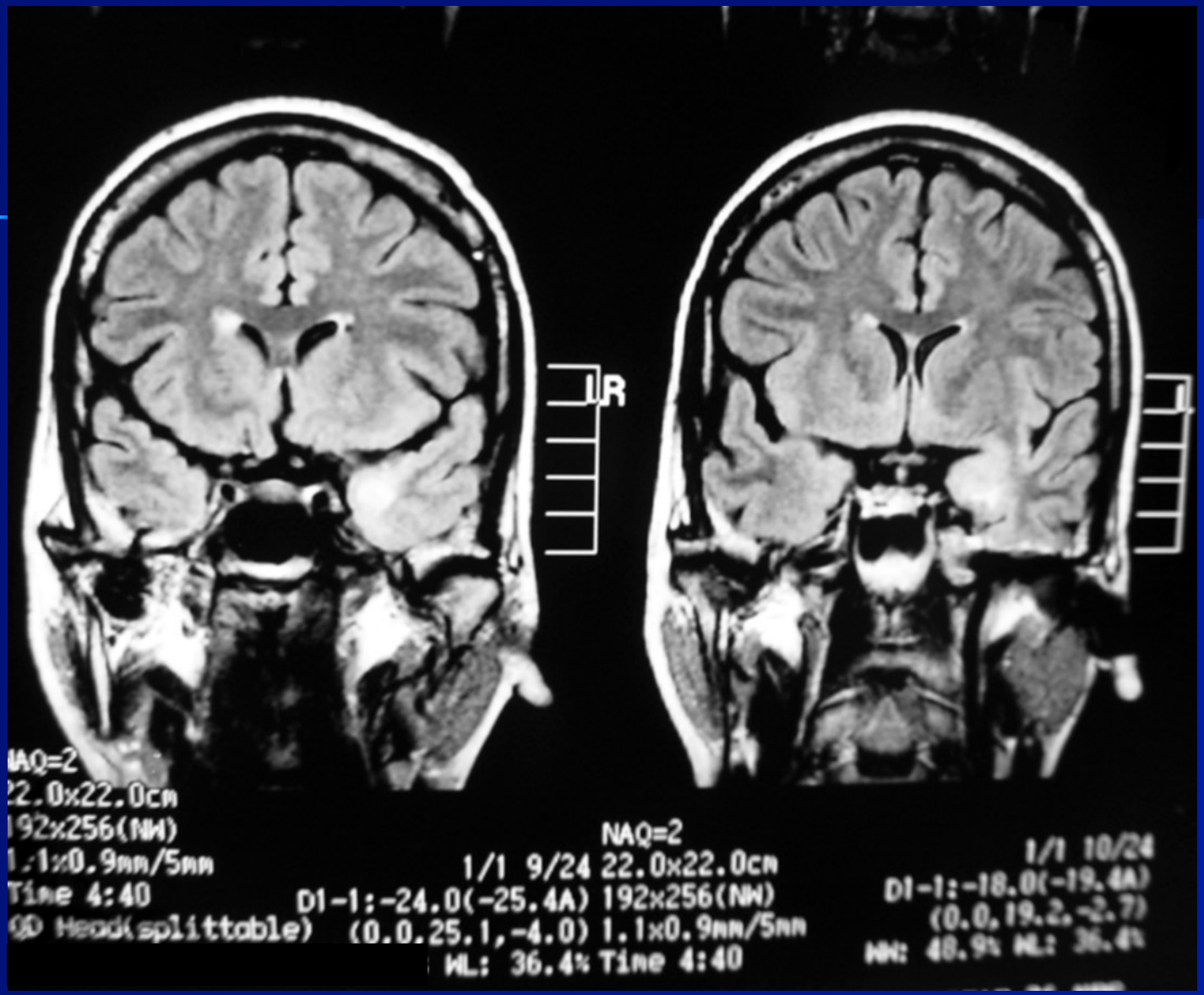




Gangliogliomas

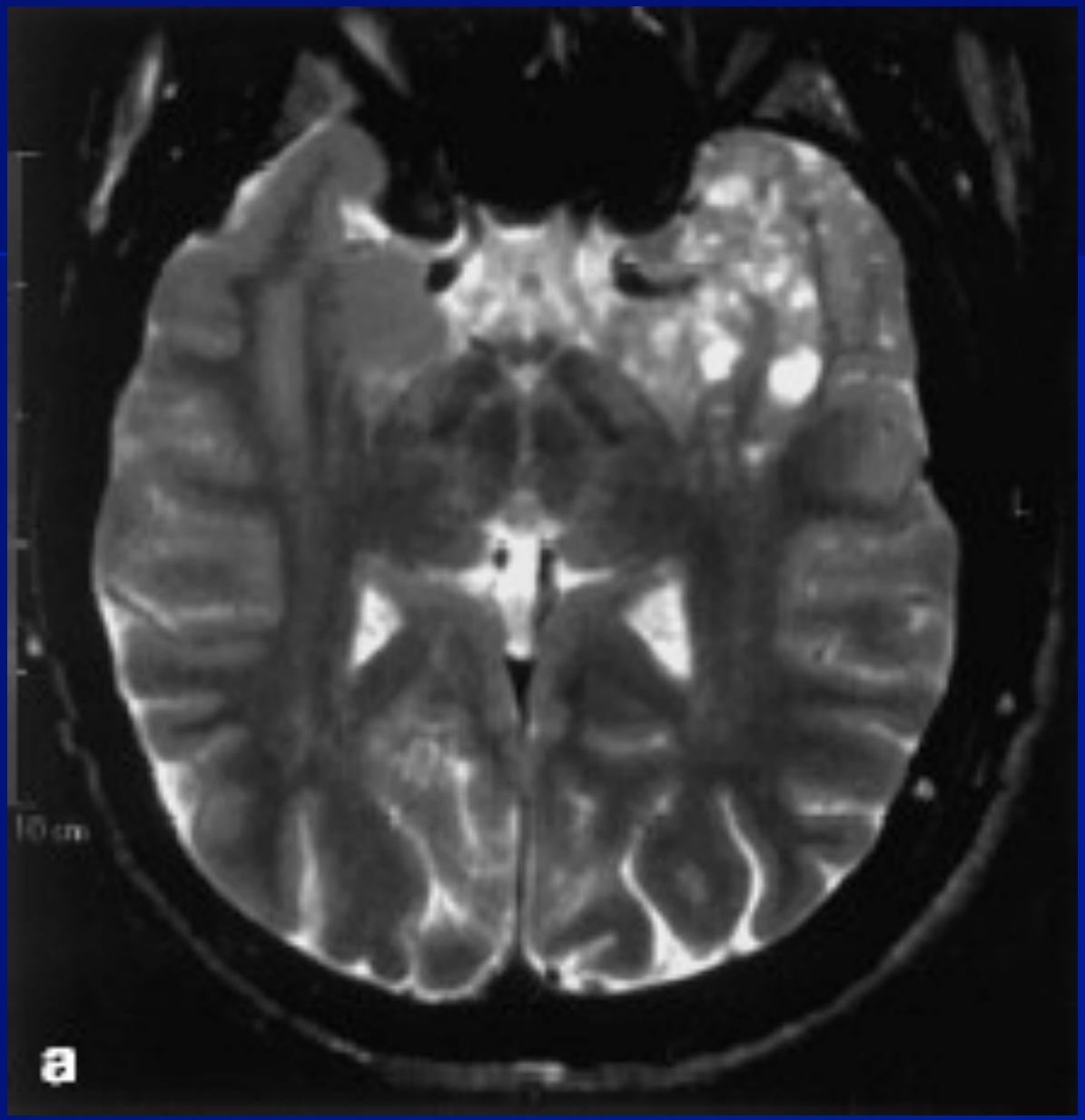
- Rare in general population
- Most frequent in 1st and 2nd decade.
- Often well circumscribed, cystic, calcified and may contain a mural nodule.
- Temporal lobe is most common site
- Hypo on T1 and hyper on T2.



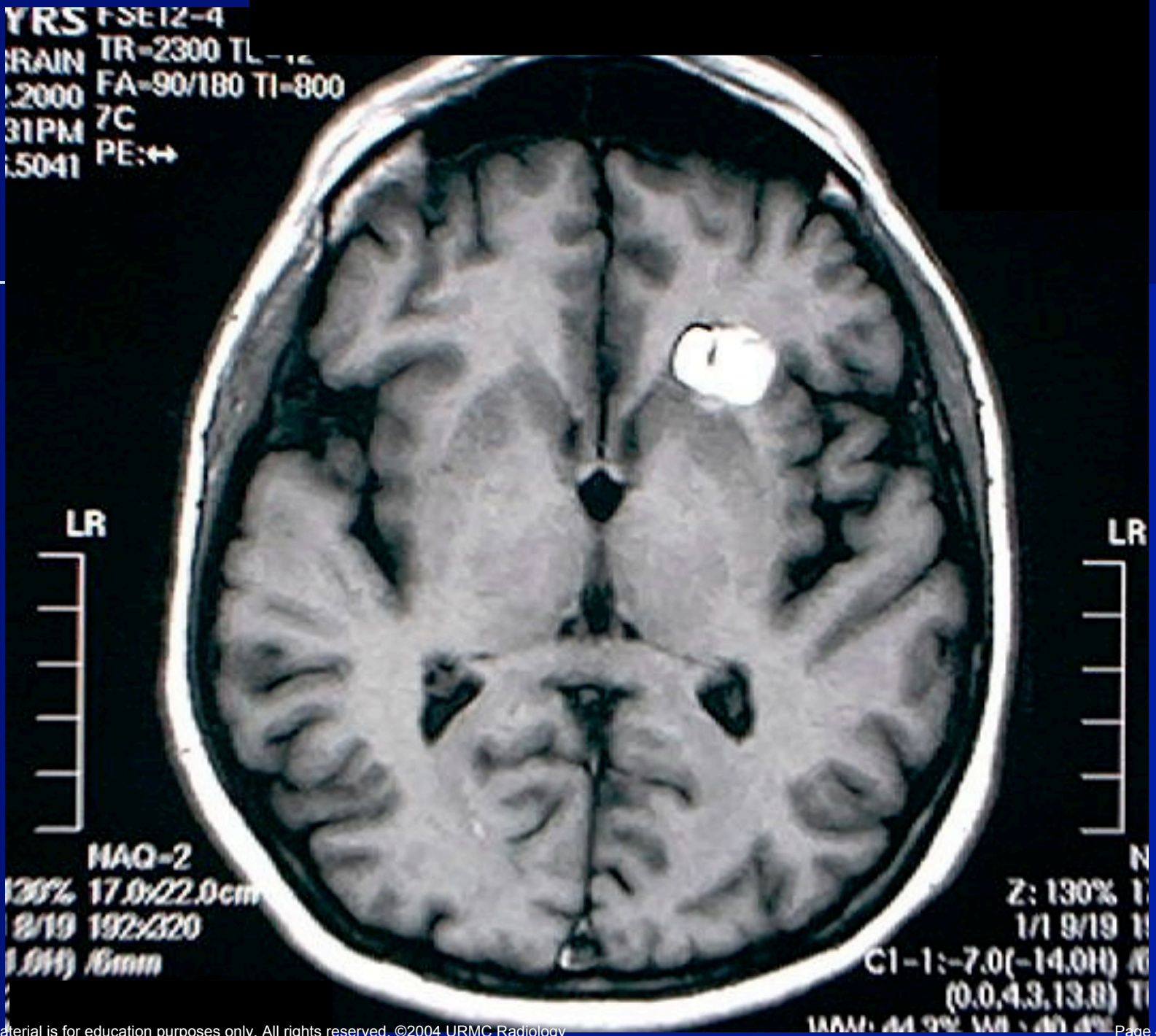


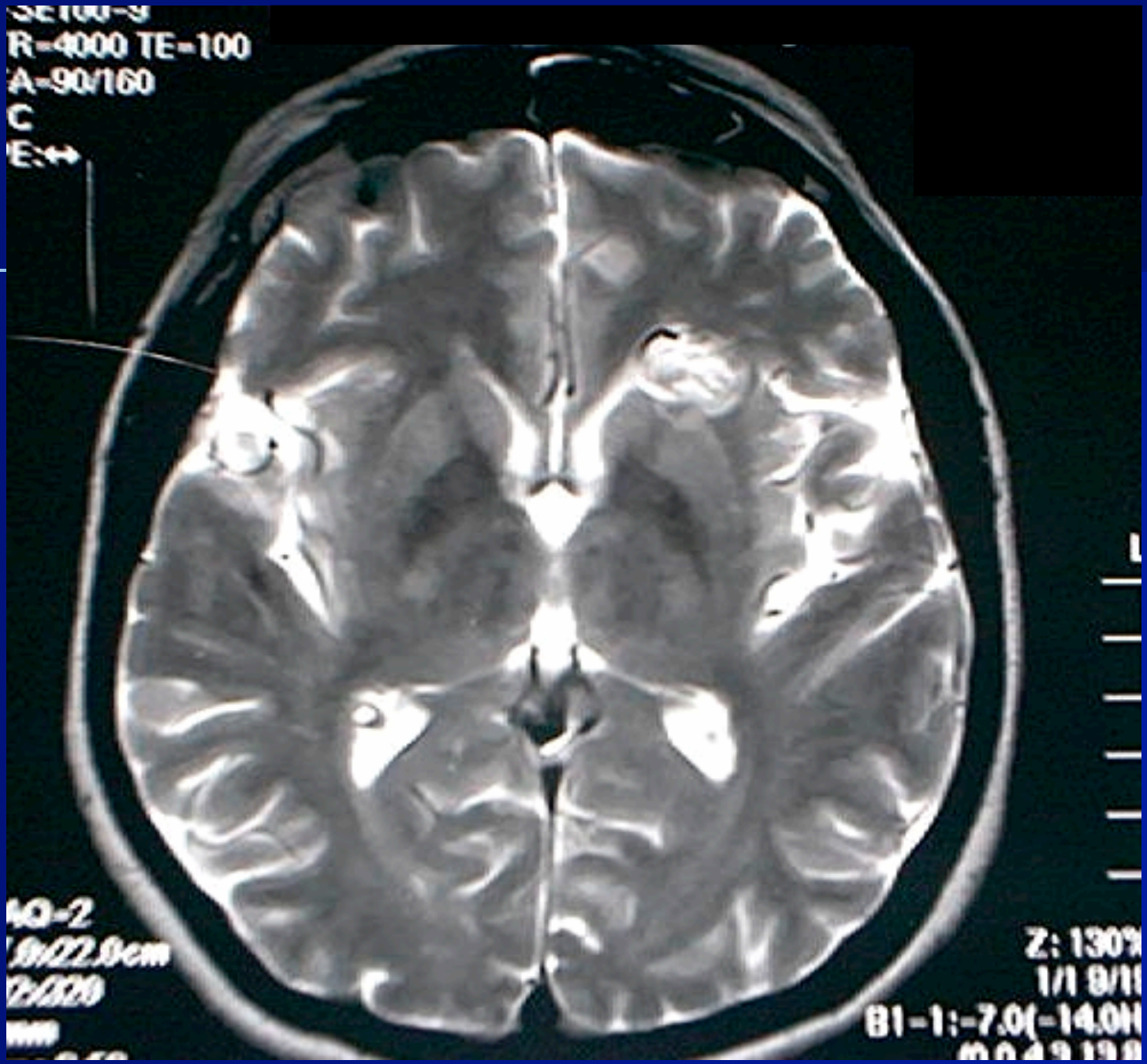
Dysembryoplastic Neuroepithelial Tumors

- Rare, usually present in childhood and have a long seizure history with no focal neurological deficits.
- MRI: Focal lobulated cortical mass of low signal on T1 and high signal on T2 without adjacent edema in temporal lobe.
- A nodular gyriform thickening has been reported as unique feature.
- Muticystic appearance.



OTHER CHRONIC BENIGN TUMORS

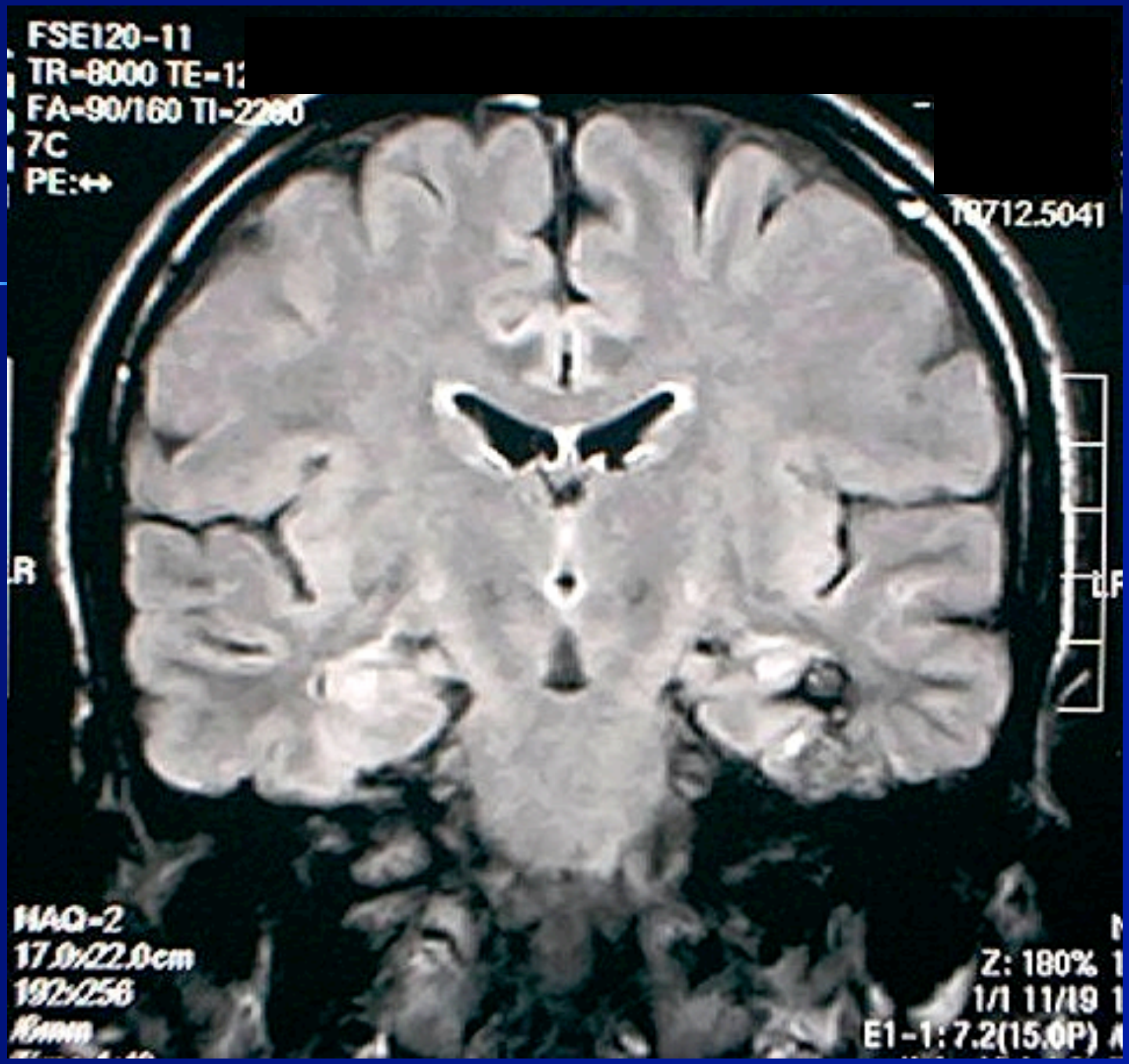




Vascular Malformations

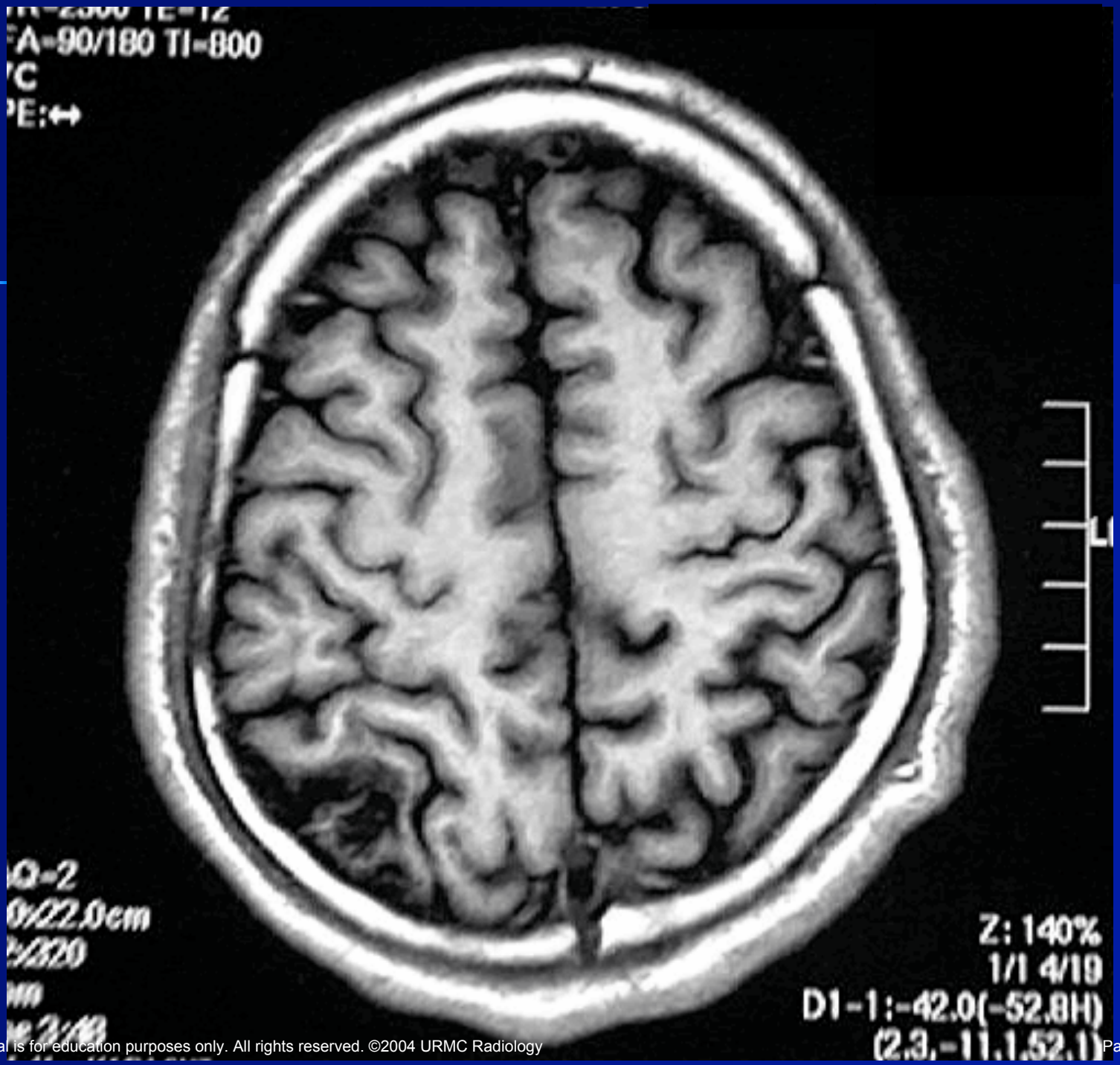
CAVERNOUS MALFORMATIONS

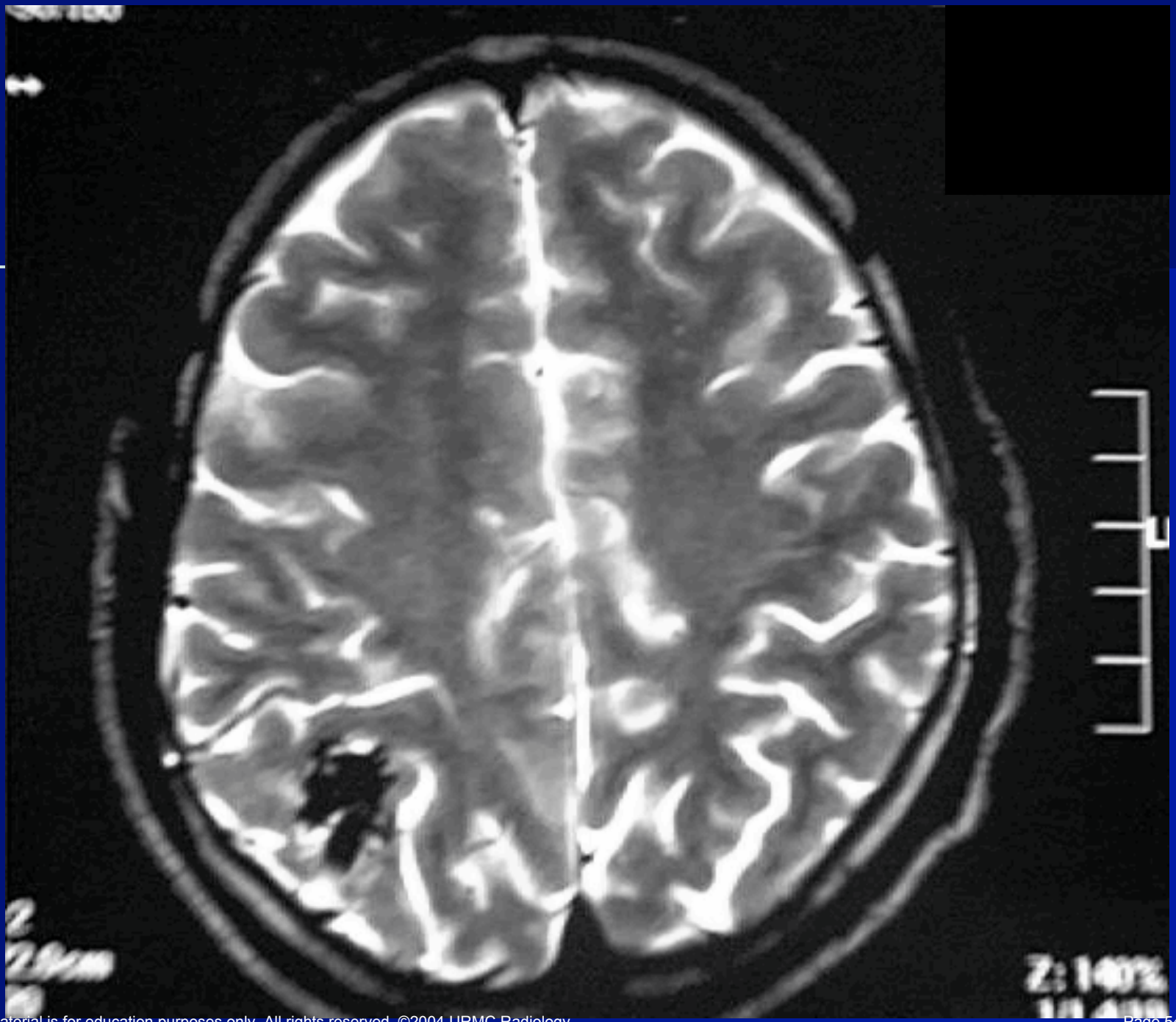
- Their angiographic appearance is usually normal (occult vascular malformation).
- Occult Vascular Malformations have characteristic MRI features.
  - **A reticulated hyperintense focus within the centre of the lesion indicative of sub acute/chronic hemorrhage.**
  - **This is surrounded by a rim of signal void representing paramagnetic hemosiderin from prior hemorrhage.**



Arteriovenous Malformation

- These are the most common congenital vascular malformations.
- An AVM consists of a group of vessels that form direct AV shunt without an intervening capillary network.
- The association of epilepsy with AVM may be due to
  - Focal cerebral ischaemia
  - Adjacent hemosiderin deposits.





Infections

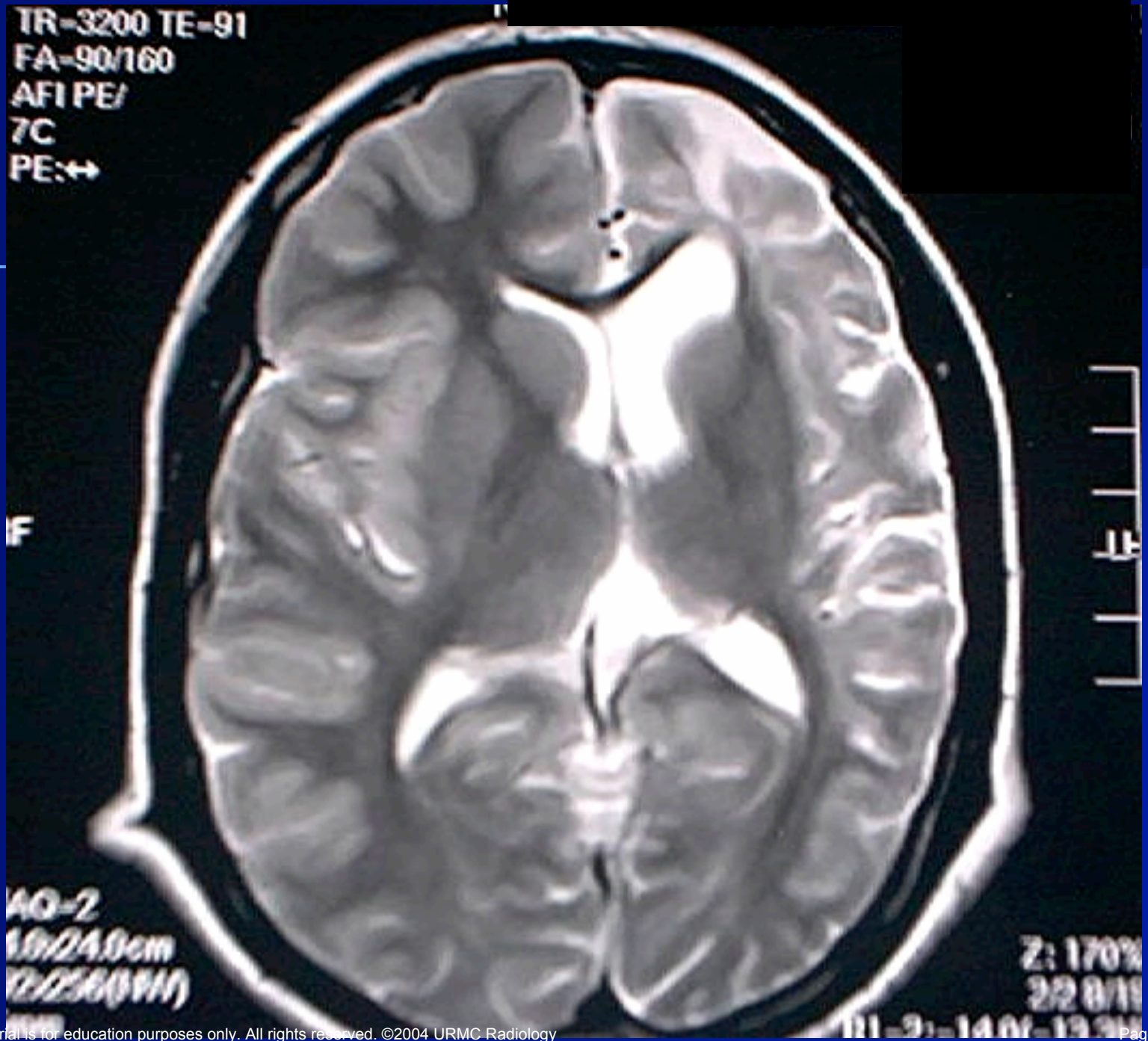
- Infection are a frequent cause of seizure worldwide.
- TB is the commonest cause of infective etiology of epilepsy in Pakistan.
- Neurocysticercosis is common in western world.

Tuberculomas

- These constitute 10-40% of intracranial mass lesions in the developing nations.
- As fibrosis and gliosis increase there is a tendency for granulomas to become more hypointense on T2 weighted.
- Post-contrast nodular or ring like enhancement.

Rasmussen's Encephalitis

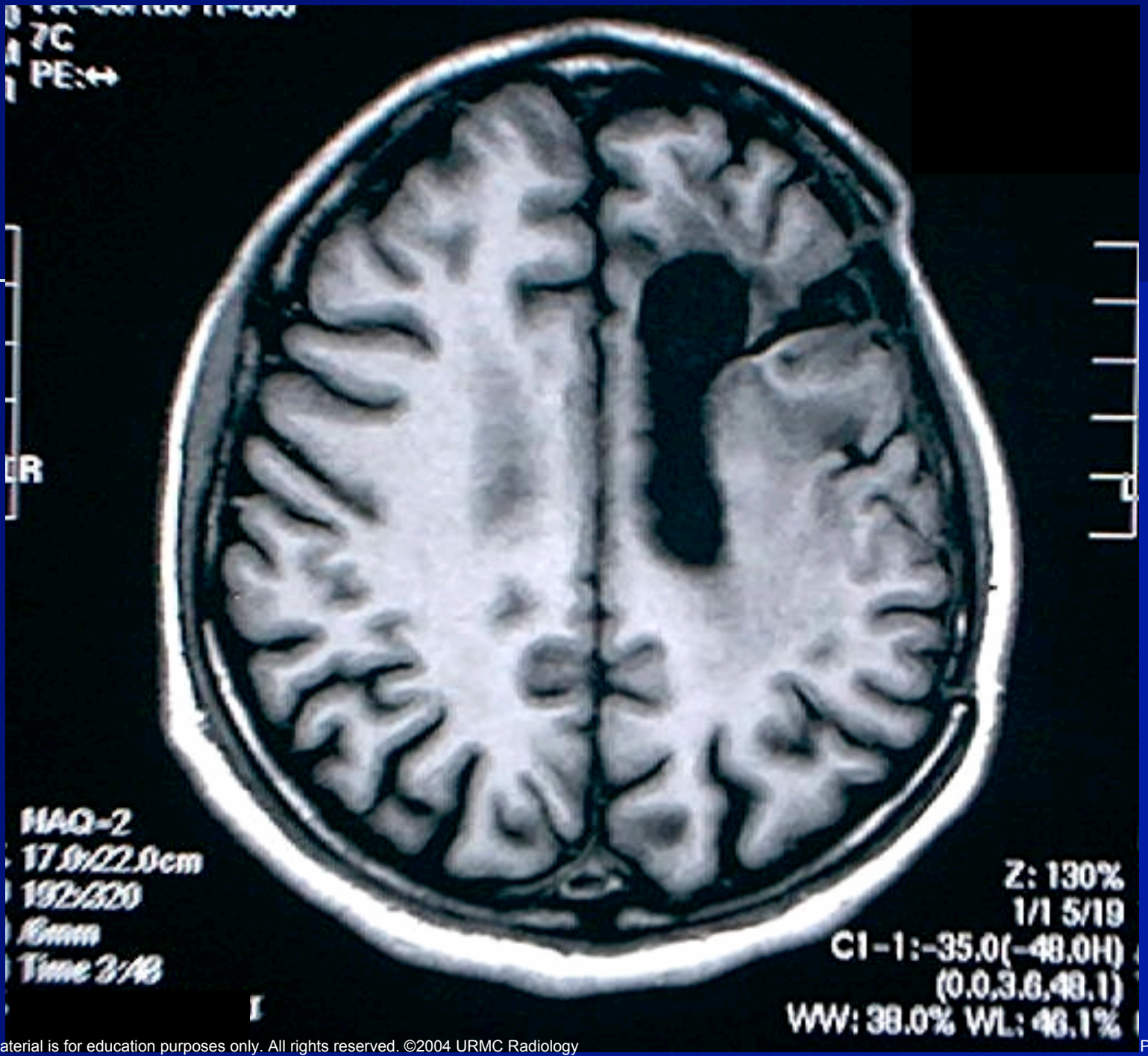
- In acute stage hyperintense signal foci are seen on T2 weighted images.
- In the chronic stage T2 weighted images demonstrate significant unilateral atrophic changes and signal hyperintensities in the periventricular region and the basal ganglia.

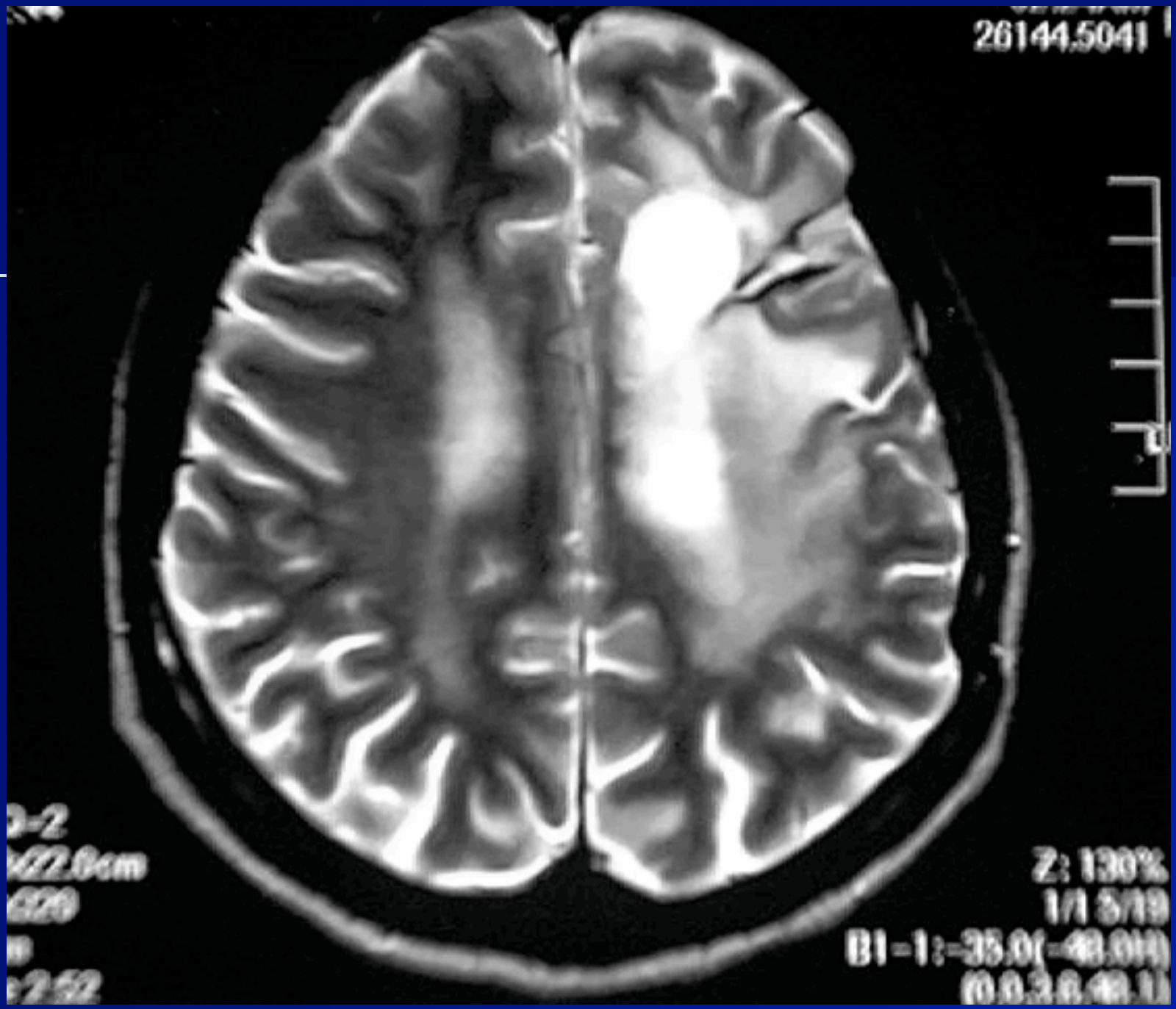


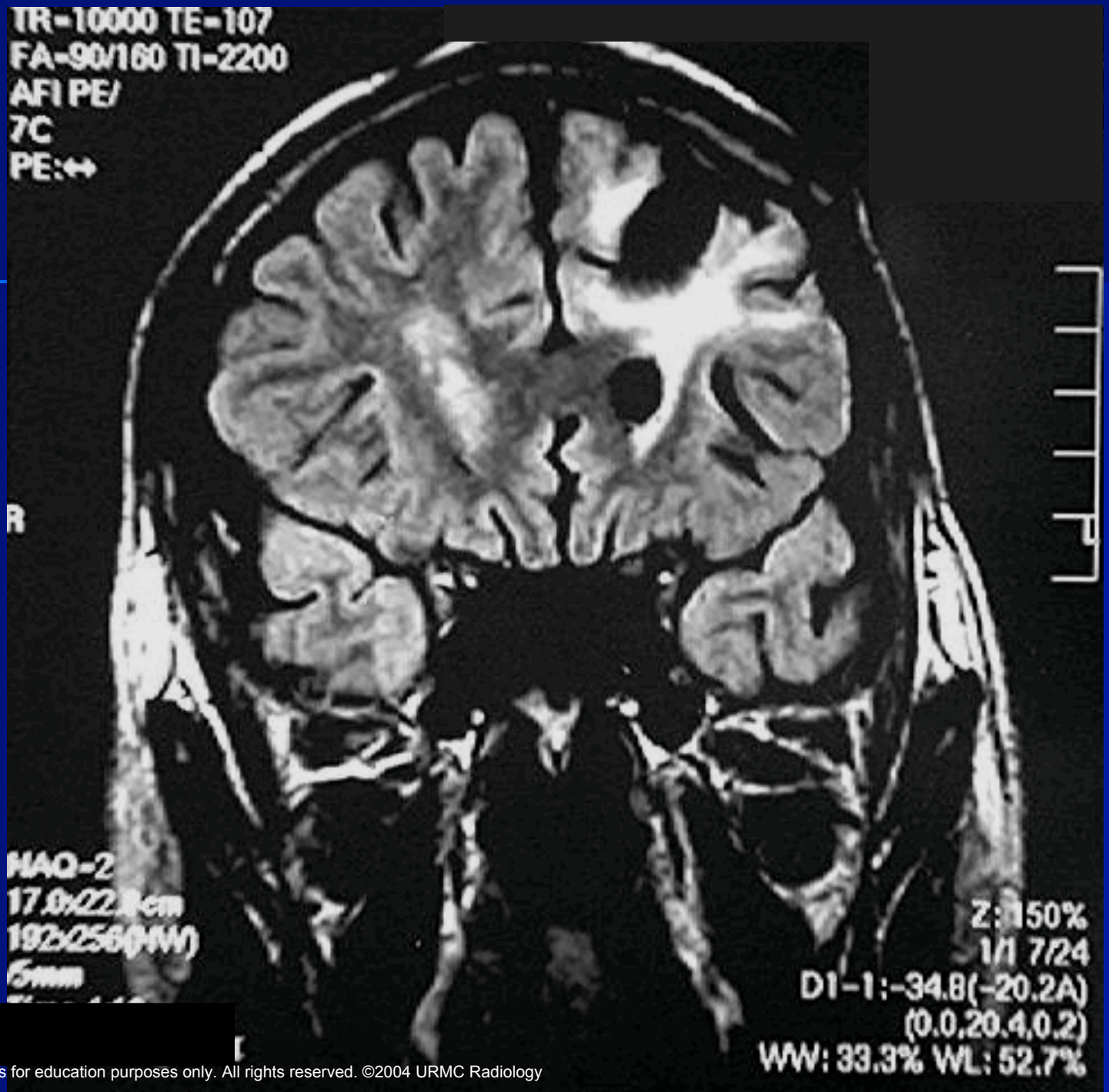
Atrophic Processes

- Tissue loss- focal or diffuse may occur due to
  - **Trauma**
  - **Infarction**
  - **Infections**
- Most focal atrophic processes associated with epilepsy are the result of trauma.

- Infarction is the most common cause of seizure in the elderly.

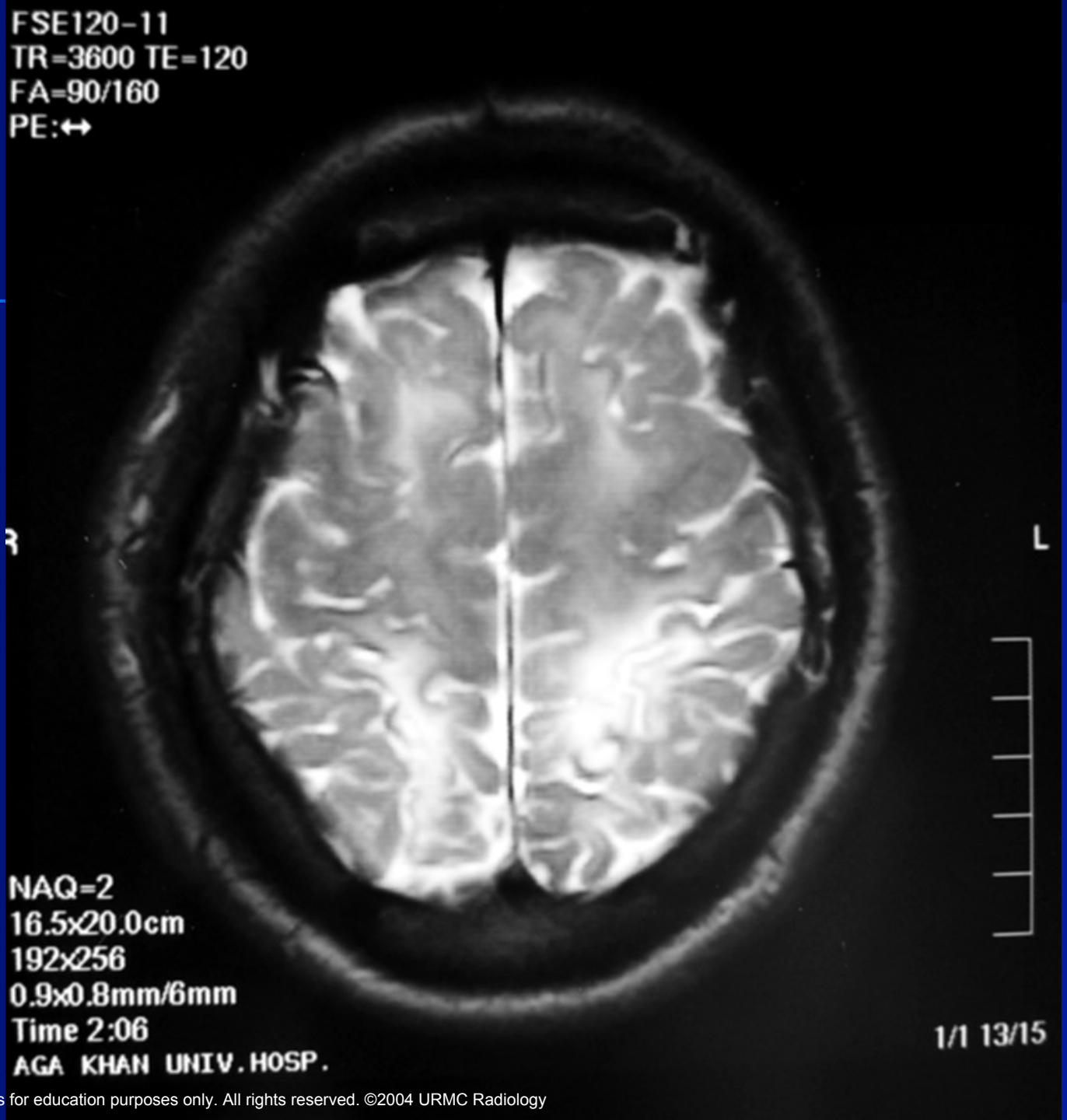


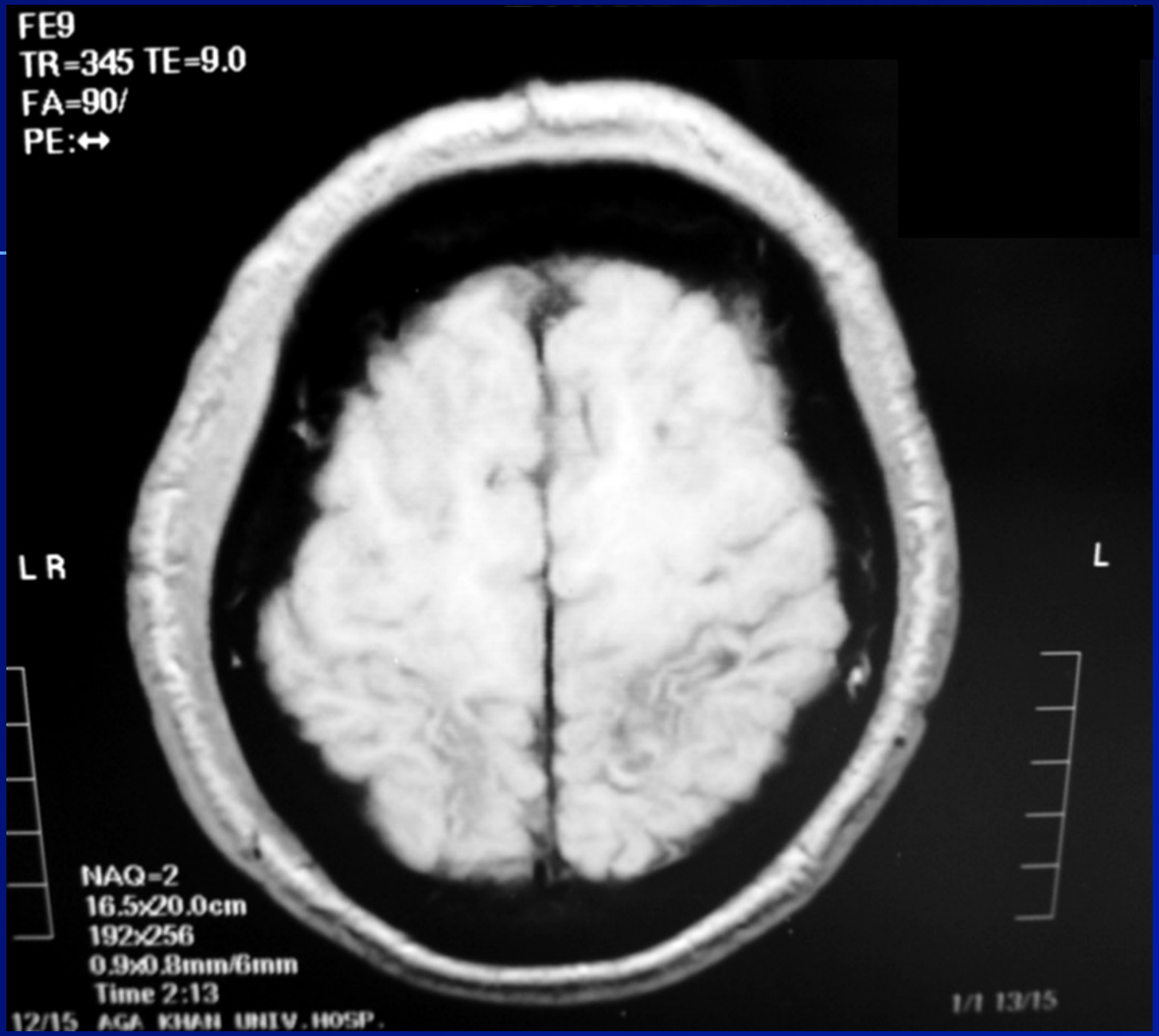




Perinatal Insults

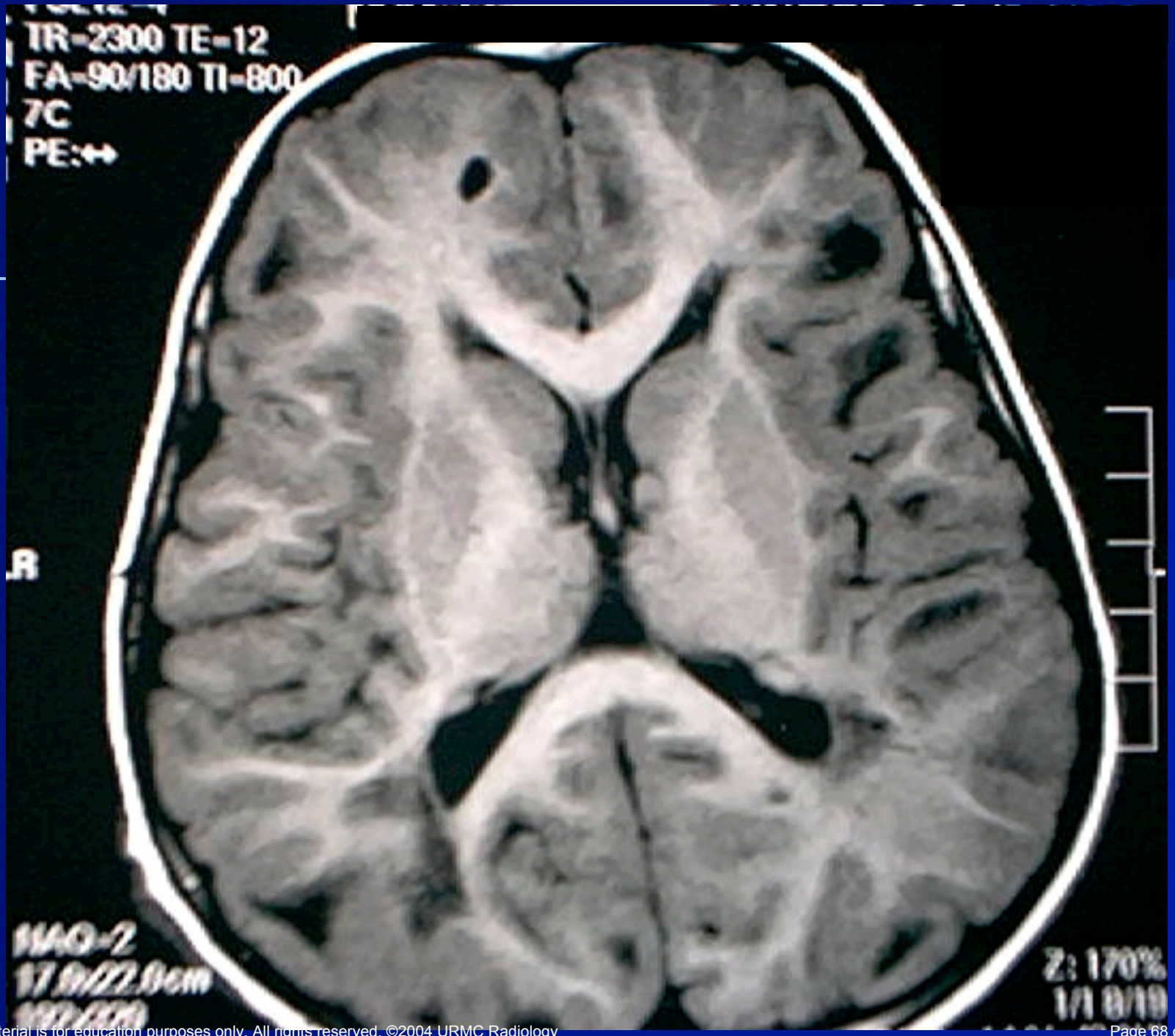
- Seizure foci arise from viable tissue at the penumbra of the injury site, regions that are hyperintense on long TR, short TE images.





PHAKOMATOSIS
Tuberous Sclerosis

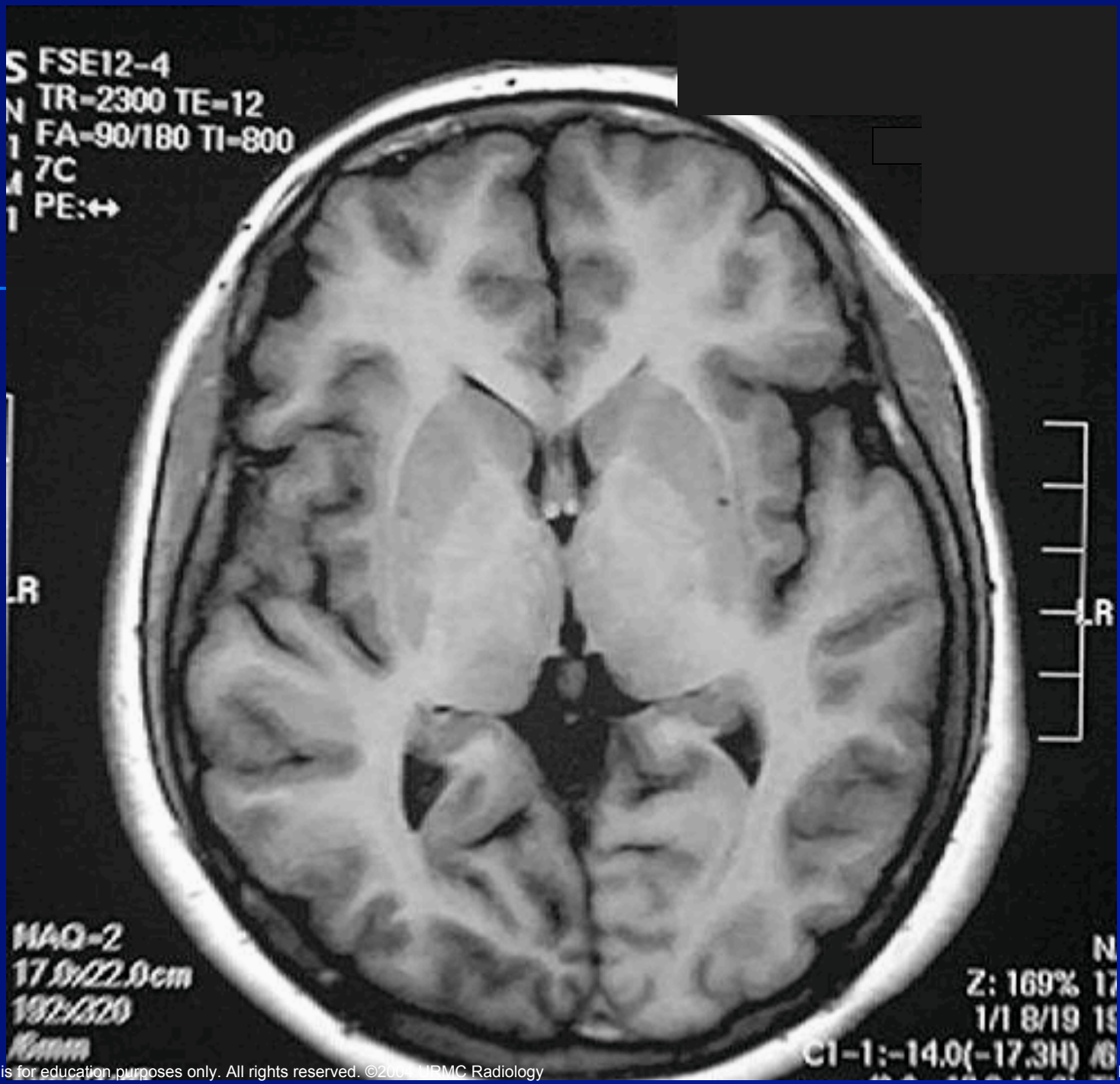
- Cortical tuber or hamartoma (hallmark).
- White matter abnormalities and subependymal giant cell astrocytomas can also be seen on MRI.

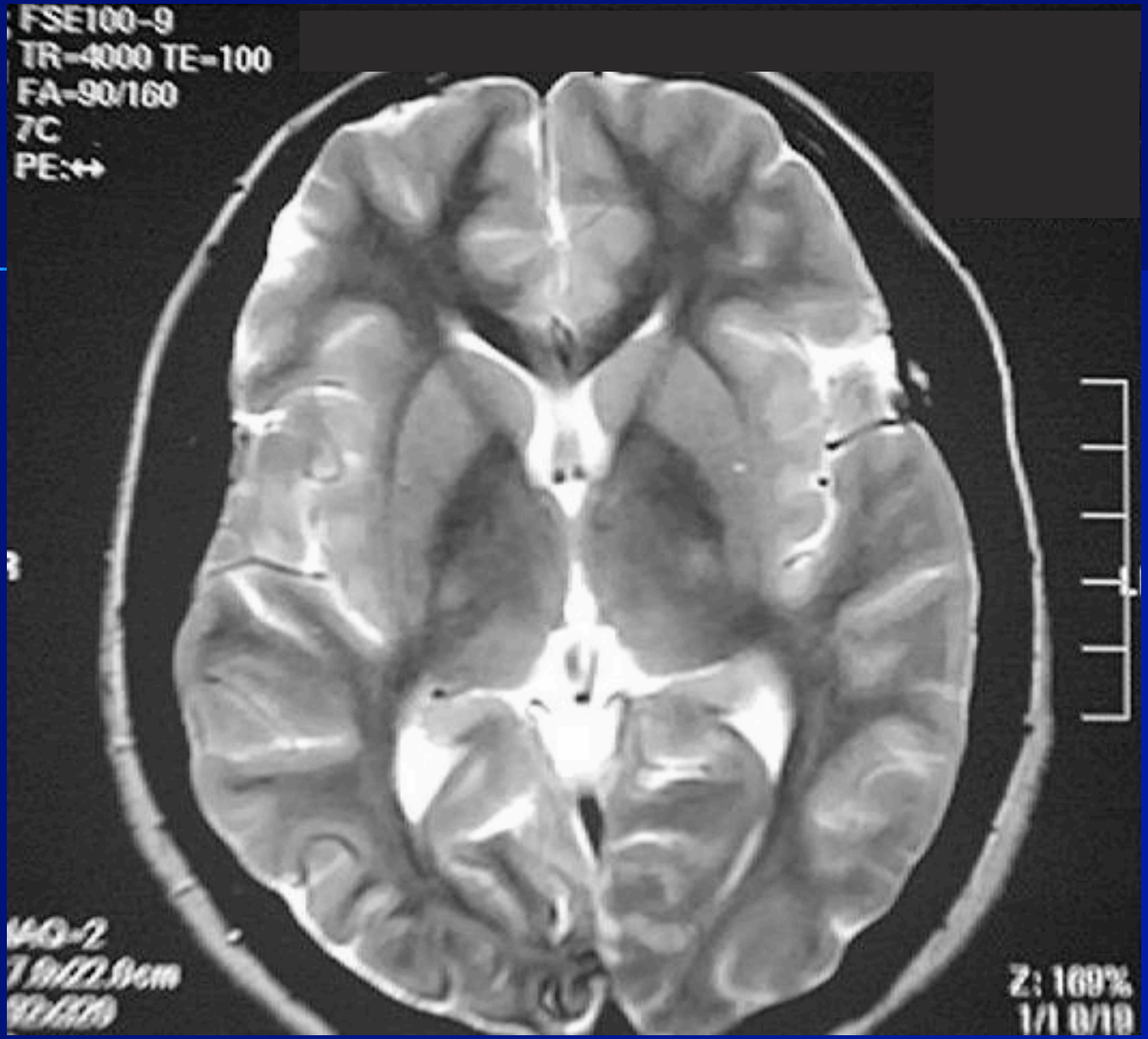


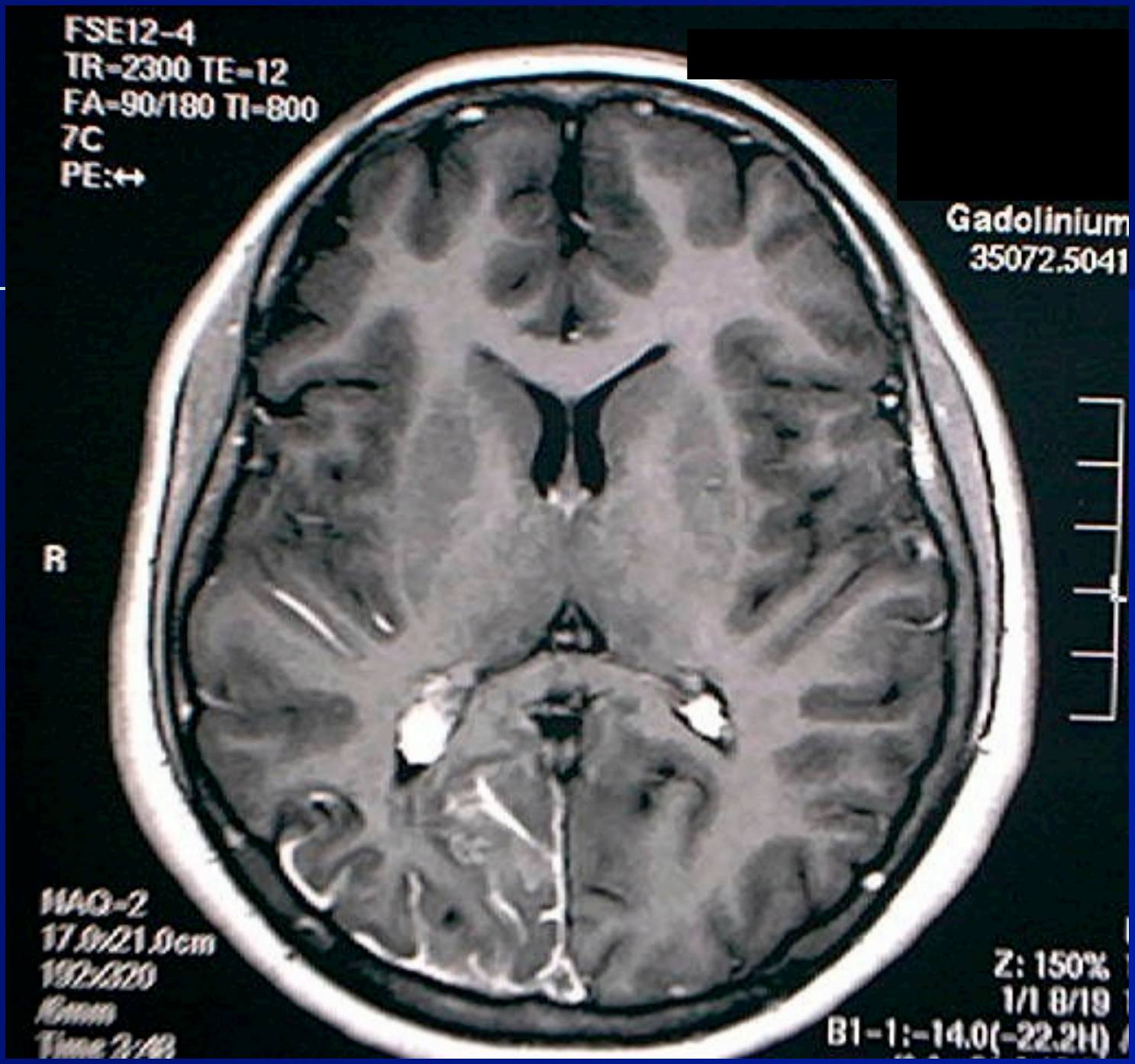
Sturge Weber Syndrome

MRI findings may include:

- Hemiatrophy
- Cortical calcification
- Enhancement of pial angioma







CONCLUSION

In the diagnosis of epilepsy, MR techniques have obtained a leading diagnostic role. MRI gives exquisite morphological information. MR perfusion studies show regional cerebral blood flow.

MRA demonstrates vascular abnormalities. MR spectroscopy provides metabolic information and functional MR imaging helps to define the eloquent areas of the brain.