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Research Article

Comparison of neuroimaging by CT and MRI and correlation with neurological presentation in eclampsia

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ABSTRACT

Background: The objective of the study was to compare computed tomography (CT) and magnetic resonance imaging (MRI) findings of eclampsia patients with respect to neurological signs and symptoms.

Methods: This is a prospective observational study, 25 patients of eclampsia were studied, statistical analysis was done by Fishers' exact and chi square test.

Results: All patients in our study presented with antepartum or intrapartum eclampsia with neurological features ranging from headache, altered consciousness to coma. On neuroimaging by MR transiently high T2 signal intensity in the cerebral cortex and sub cortical white matter was seen, including edema. With MR angiography generalized vasospasm was also seen in 40% cases. MRI was found to be co-relating more than CT with the neurological presentation and had 90% sensitivity and 100% sensitivity.

Conclusions: Symptoms like visual blurring, loss of vision and ophthalmological signs in eclampsia suggest occipital lobe involvement. Magnetic resonance imaging abnormalities in eclampsia correlate well with clinical findings as compared to CT and can be better imaging modality in eclampsia patients.

Keywords: Eclampsia, MRI, PRES

INTRODUCTION

Eclampsia represents advanced stages of pregnancy induced hypertension and is associated with considerable morbidity and mortality of pregnant women. Though it is a multi system complex hypertensive disorder, central nervous system involvement is common in these women¹ and is frequently evident when specifically evaluated.² The most common neuro-pathologic change seen is multi focal petechial hemorrhage at the grey-white matter junction.³ Abnormal findings on neuroimaging have been noted in as many as 90% of women with eclampsia. Most common lesions are seen in the parieto-occipital lobes in the distribution of posterior cerebral arteries. MRI studies of eclampsia describe these as a result of vasogenic edema induced by vasospasm and other changes contributing to pathophysiology of eclampsia.⁴

One goal of cerebral imaging is to define abnormalities that may be treated to help decrease the morbidity and mortality associated with the condition.

METHODS

The study was carried out in the Department of Obstetrics and Gynecology, Vardhman Mahavir Medical College and Safdarjang Hospital, from November 2007 to April 2008 New Delhi, India. The study was performed on 25 patients, who fulfilled the diagnostic criteria for eclampsia like documented generalized seizures, hypertension (blood pressure $\geq 140/90$ mm of mercury) and significant proteinuria. Patients with known cause of seizures, migraine, intracranial lesions, having metallic implants anywhere in the body and claustrophobia were excluded from the study. 23 patients had no antenatal record available at the time of admission, 2 patients were registered with us with a single antenatal visit at second trimester only, in both the patients, and no significant

finding was noted at that time. A total of 18 patients had undergone MRI followed by CT in the post partum period. Of the 18 patients 1 had presented as preterm intrauterine death of fetus, 10 presented in active labour but had delivered within 2-3 hours of admission, 7 patients had intrapartum eclampsia. In 7 patients MRI was done before delivery and CT after delivery as the fetus was alive. In these patients labour was induced, MRI was done once the patient was stabilized and CT was done only after delivery as fetus was alive in all 7 patients. A detailed history was recorded, complete general physical, antenatal, neurological and ophthalmological examination was done on each patient. Each of these patients was investigated for complete blood count, platelet count, urine albumin, serum electrolytes, liver function tests, kidney function tests, serum uric acid, blood sugar and coagulation profile. The patients were managed as per hospital protocol for eclampsia, Pritchard regime of magnesium sulfate was started when indicated. Once the patient was stabilized and was found fit to undergo the procedure, MR followed by CT imaging was done on each of these patients within two days of the onset of seizures and reviewed prospectively. Obstetric management was done as per existing protocol.

Magnetic resonance imaging of brain was performed using a 1.5 Tesla machine on each of these patients with eclampsia within two days of the onset of seizures once the patient was co-operative to undergo the procedure. All studies included sagittal T1 weighted images using TSE (turbo spin echo technique) and axial and coronal images using T2 weighted TSE technique. For better appreciation T2 weighted FLAIR (fluid attenuation inversion recovery) images were obtained in axial and sagittal planes. To appreciate cerebral vasospasm PC MRA (phase contrast magnetic resonance angiography) and MR venography was also done. Non contrast CT Imaging of brain was performed within two days of the onset of seizures in all patients. The CT scans were performed on Somatom 6 with 9 mm acquisition in axial slices, reconstructed to 3 mm slices in sagittal, coronal and axial planes, all patients had scans without intravenous contrast medium.

The results were compiled and statistically analyzed using Fischer's exact test and chi square test. Institutional approval was taken for conducting the study. Information sheet was provided and written informed consent was obtained from all patients or guardians of those patients who were clinically unstable.

RESULTS

In our study majority of patients belonged to 20-25 years age group (60%), most of the patients were primiparas (56%), mild grade of blood pressure was found in 56% while remaining had severe grade of blood pressure. Proteinuria (Table 1) up to 100mg/dl (2+) was found in 40%, up to 300mg/dl (3+) was found in 24%, up to

2gm/dl (4+) was found in 20% and 30mg/dl (1+) in 16% of patients showing that majority of patients had proteinuria of up to 100mg/dl (2+). Fundus examination showed (Table 2) that majority patients had normal fundus, papilloedema was seen in 3 (12%) and the rest had grade I or II changes. Even though eclampsia seems to occur more frequently in young females with low parity, there was no correlation found between occurrence of eclampsia and severity of hypertension, amount of proteinuria and changes on fundoscopy. All patients had delivered vaginally. 7 patients had developed intrapartum eclampsia in our hospital, while 18 had come with history of throwing fits.

Table 1: Range of proteinuria.

Urine albumin	Number of patients	Percentage of patients
1+	4	16
2+	10	40
3+	6	24
4+	5	20

Table 2: Fundus examination findings.

Fundus examination findings	Number of patients	Percentage of patients
Grade I	4	16
Grade II	4	16
Grade III	2	8
Grade IV	Nil	0
Papilloedema	3	12
Normal	10	40
Not done	2	8

Neurological presentation with neuro-radiological correlation

All patients of eclampsia presented with generalized tonic clonic seizures in our study out of which 7 (28%) had single episode whereas 18(72%) had multiple episodes. None of the patients had recurrent convulsions after starting magnesium sulphate regimen in the hospital. All patients were given the same regimen.

Headache was the most common presenting symptom in 19(76%) of patients, while 11(44%) of patients had slurring of speech and 8(32%) of patients were disoriented, had altered consciousness when examined within 48 hours of seizure onset (Table 3). Visual disturbances were seen in 15 (60%) of patients in the form of blurring of vision, hemianopsia, nystagmus and cortical blindness. Majority of them experienced only blurring of vision with no visual field defect, one patient had blurring of vision initially which progressed to cortical blindness, another patient had hemianopsia and the third patient had nystagmus. All the three had papilloedema on fundoscopy. Interestingly, all these

symptoms got reversed clinically. Other than visual disturbances, 5 (20%) of the study patients developed focal neurological deficit as well. Three patients developed ataxia, dysarthria and disconjugate gaze after generalized seizures, one patient developed hemiparesis and the other one had asymmetrical reflexes (left > right).

Table 3: Patients with neurological signs and symptoms.

Neurological signs and symptoms	Number of patients	Percentage of patients
Single episode of seizure	7	28
Multiple episodes of seizures	18	72
Altered consciousness and disorientation	8	32
Speech abnormality	11	44
Gait abnormality	2	8
Headache	19	76
Visual complaints	15	60
Mono/hemiparesis	5	20
Comatose	3	12

CT scan of above patients showed (Table 4) ill-defined hypo densities in grey white areas suggestive of brain edema except in one patient who had normal scan. Three patients had generalized brain edema. Rest all showed bilateral symmetrical parieto-occipital hypo dense lesions involving more of white matter than the grey. In five patients, lesions extended to the parieto-temporal areas of both sides but never extended anteriorly beyond the sylvan fissure. In two patients lesions could be detected in the basal ganglia and external capsule. These patients had areas of hyper density within the hypo dense areas suggesting hemorrhages.

Table 4: CT findings.

CT findings	Number of patients
Ill-defined hypodensities in grey-white area (brain edema)	24
Basal ganglia and external ganglia (hemorrhage)	2
Generalized edema	3
Parieto-occipital hypodensities	22
Parieto-temporal area involvement	5
Ill-defined hypodensities in frontal region	2
Normal	1

MRI of these patients showed (Table 5) bilateral parieto-occipital sub cortical white matter hyper intensity, white matter edema in temporal and parieto-occipital region suggestive of posterior reversible encephalopathy syndrome (PRES). The patients with visual disturbances had significant findings on MRI in the parieto-occipital lobes. Bilateral white matter edema in occipital and parietal lobes suggestive of PRES, hyperdense lesion in occipital and parietal lobes with supratentorial and periventricular hypo-intensification, generalized vasospasm, and increased T2 system in posterior cortical and sub cortical region. These may be due to hypertension induced insult in occipital lobes.

Table 5: MRI findings.

MRI findings	Number of patients
Symmetrical lesions in occipital area with some extension to temporal region	25
Lesions extending to frontal area	3
Extension also to external capsule, basal ganglia, globus palladium, periventricular area	4
Bilaterally symmetrical lesion	22
Lateralised to one side	3
Features consistent with PRES	8
Generalised vasospasm	10

MRI features were suggestive of generalized vasospasm, extensive sub cortical white matter hyper intensification in right caudate nucleus, globus pallidus, putamen, internal and external capsule and supratentorial area in patients with neurological deficit. Neurological evaluation of cranial nerves, motor and sensory system was in normal limits.

None had signs of meningeal irritation. On statistical analysis 20 out of 25 MR scans were found to be correlating with neurological signs and symptoms as compared to 18 out of 25 on CT scans.

DISCUSSION

The central nervous system changes in eclampsia represent a form of hypertensive encephalopathy. Even though the two conditions share many clinical, radiological, and pathological features, the precise pathogenesis remains uncertain.^{5,6-9} There is a failure of normal cerebral blood flow auto regulation in patients with hypertensive encephalopathy and probably in patients with eclampsia.¹⁰ Vasospasm which follows vasoconstriction as a result of severe hypertension is thought to cause local ischemia, arteriolar necrosis, and disruption of the blood brain barrier, which leads to cerebral edema and has been demonstrated in several angiographic case reports in eclampsia.¹¹ Conversely, some data favor the forced dilation theory at increased

arterial pressure, initially some vessels dilate and some remain constricted. According to the vasodilatation theory, areas of vasodilatation allow local hyper perfusion which disrupts the blood brain barrier causing cerebral edema. It is possible that both theories are operant in patients with end result of cerebral edema.^{7,10} Such changes are responsible for various symptoms in patients of eclampsia and become evident on CT and more so on MRI as observed in our study, in two patients the CT did not show any abnormal feature that might have correlated to clinical presentation of having one episode of seizures and headache. Both these patients had only one episode if seizures.

The early radiology literature before 1960 dealing with the CT findings of eclampsia is confusing. There are a few case reports describing the cerebral MRI changes in eclampsia.^{10,12,13-16} transiently high T2 signal intensity is especially common in the cerebral cortex and sub cortical white matter. The abnormalities can occur in many areas of the brain, including the basal ganglia and brainstem in more critically ill patients, such findings were found on MRI in four patients and on CT in two of our patients. The abnormalities were frequently observed in the posterior hemisphere in all patients on MRI and in 22 patients on CT, most of these patients had visual disturbances, especially in the vascular watershed areas where the anterior, middle and posterior cerebral arteries meet. Generalized vasospasm could cause such a global ischemia¹³ and resultant abnormalities and was found in 10 patients only on MRI.

Magnetic resonance imaging could pick up abnormalities in the deep white matter or basal ganglia that correlated more closely with changes in mental status. It has also demonstrated lesions of the deep white matter and basal ganglia in several patients who did not develop a focal neurological deficit. This demonstrates the sensitivity of MRI in the detection of abnormalities in patients with eclampsia, even in those patients without neurological deficits. In this study in 8 cases the images were reported to be consistent with PRES with characteristic MRI imaging findings. MRI has 90% sensitivity and 100% specificity when analyzed statistically using Fisher’s exact test (Table 6). Thus MRI is a useful modality of investigating eclamptic patients.

Table 6: Sensitivity and specificity of CT and MRI.

	MRI positive	MRI negative	Total
CT positive	18	0	18
CT negative	2	5	7
Total	20	5	25

MRI: sensitivity is 90 %, CI (66.9 -98.2), specificity is 100%, CI (46.3-100), positive predictive value is 100% and negative predictive value is 71.4%.
 CT: sensitivity is 100%, specificity is 71%, positive predictive value is 90% and negative predictive value is 100%.

Table 7: Correlation of neurological findings and imaging by CT and MRI.

Signs & symptoms*	CT	MRI
Headache (n=19)	Ill-defined hypo densities in frontal region, generalised edema, basal ganglia and external capsule (haemorrhage) in all patients	Symmetrical lesions in occipital area with some extension to temporal region, lesions extending to frontal area Features consistent with PRES, Generalised vasospasm
Visual disturbances (n=15)	Hypodensity in white matter in parieto-occipital region (edema). Normal scan in 1 patient	Significant MRI findings in parieto-occipital lobes of all patients
Neurological deficit (n=29)	Ill-defined calcified region in parietal , frontal parenchyma, bilateral parietal and extensive occipital hypo densities, only generalised edema in one patient	Vaso spasm in sinuses, signs of PRES, bilateral white matter edema, extensive sub cortical white matter hyper intensification in right caudate, globus pallidus, putamen, internal and external capsule and supratentorial area

*There was an overlap of signs & symptoms.

The study also tried to detect cerebral vasospasm known to occur in eclampsia. With MR angiography generalized vasospasm was seen in 40% cases. Presumably the affected cerebral vessels suffered very transient insult. Such information was of therapeutic importance, calcium channel blocker with selective cerebral vasodilating properties was given to these patients.¹⁷ Discussion of therapeutic aspects is beyond the scope of this article. Limitations of our study were that we had a small sample size to be evaluated upon and the patients were not randomized, role played by clinical bias and other confounding variables like duration of hypertensive illness or vascular insult before, cannot be ruled out, also MRI followed by CT could not be done in same sitting in

all patients. Larger controlled studies are required to come to a conclusion.

CONCLUSIONS

Symptoms like visual blurring, loss of vision and ophthalmological signs in eclampsia suggested clinically of occipital lobe involvement and this fact was supported by CT and MRI imaging that showed posterior region of brain was affected often in our patients. Magnetic resonance imaging abnormalities in eclampsia correlated well with clinical findings as compared to CT. MRI demonstrated generalized vasospasm in many such patients. MRI has an added advantage that it could be done on pregnant patients eliminating the radiation hazards pertinent to CT and had 90% sensitivity and 100% specificity as compared to CT; on the other hand CT failed to show some of the abnormalities that were picked up by MRI, hence it is a better option of imaging in an eclamptic patient.

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Ethical approval: The study was approved by the institutional ethical committee

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