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Original Research Article

Comparative study of neuroimaging features and clinical symptoms in patients with eclampsia

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ABSTRACT

Background: Eclampsia is a life-threatening emergency that remains a major cause for fetomaternal morbidity and mortality. The purpose of our study was to assess various computed tomographic scan (CT) findings in eclampsia patients and compare neurological symptoms with radiological findings.

Methods: A prospective analytical study was undertaken in department of obstetrics and gynecology, J. K. Lon hospital, Kota during the period of 2019-2020. Women who presented as eclampsia and admitted in indoor wards were included in the study. Data analyzed included various maternal and fetal parameters, CT scan findings and outcome of pregnancy.

Results: The incidence of eclampsia was 1.1% of total deliveries. High risk factors associated with eclampsia were primigravida (70%), maternal age (70% in 21-25 years age group), illiteracy (64%), inadequate antenatal care (96%), early gestation (68%). On CT scan findings 52% patients had abnormal CT scan findings of which most common was cerebral edema (57.7%). Parieto-occipital lobe was most common region to be affected. Altered sensorium was found to be significantly associated with abnormal CT scan findings.

Conclusions: Eclampsia is a major cause of fetal and maternal morbidity and mortality. CT scan in eclampsia has a significant role in early diagnosis of patients with cerebral pathologies and these CT scan findings were associated with the level of consciousness and number of convulsive episodes. Thus, CT scan helps in further management of these patients by multidisciplinary approach.

Keywords: Eclampsia, CT scan, Blood pressure, Neurological complications in pregnancy

INTRODUCTION

Hypertensive disorders are one of the most common medical complications of pregnancy affecting between 5-10% of all gestations.¹ It accounts for approximately a quarter of all antenatal admissions. These disorders continue to be the major cause of maternal and perinatal morbidity and mortality worldwide.² Pre-eclampsia is estimated to affect about 3.9% of deliveries while eclampsia affects about 1.4% of deliveries.³ Due to improved medical care in the developed countries, the rate of eclampsia is about 1 in 2,000 deliveries to 1 in 3,448 pregnancies in the western world where as in developing

countries the incidence of eclampsia is much higher between 1 in 30 to 1 in 500 deliveries.⁴ Mortality in eclampsia is around 1%.¹ In our institute, JK LON hospital Kota, incidence of gestational hypertension is 7.6% of total deliveries out of which 2.4% is preeclampsia and 1.1% is eclampsia.

Preeclampsia is a complex multi organ disorder characterized by pregnancy induced hypertension and proteinuria beyond 20 weeks (exception GTD and multiple pregnancy). Eclampsia is defined as new onset generalized tonic clonic seizures in pregnancy beyond 20-week gestation to 48 hours postpartum unrelated to other

cerebral conditions. Eclampsia is preceded by preeclampsia in all cases but sometimes the signs of severe preeclampsia go unnoticed.¹

Cerebral complications in eclampsia patients are major causes of death in these patients. Eclampsia along with hyper coagulopathy of pregnancy is a high-risk factor for patient in respect of development of cerebrovascular thrombosis/ ischemic strokes and intracranial haemorrhage.⁵⁻⁹

The brain is normally protected from extremes of blood pressure by an auto regulation system of small arteries and arterioles that ensures constant perfusion over a wide range of systemic pressures, in response to the systemic hypotension, cerebral arterioles dilate to maintain adequate perfusion. Whereas vessels constrict in response to high pressure. Above the upper limit of auto regulations, hypertensive encephalopathy may occur.

The most common cause of convulsions developing in association with hypertension or proteinuria during pregnancy or immediately postpartum is eclampsia. Rarely, other aetiologies may mimic eclampsia it includes pre-existing epilepsy, cerebrovascular accidents (cerebral venous thrombosis, cerebral infarction, haemorrhage) space occupying conditions (tumour, brain abscess), CNS infections (meningitis, encephalitis), metabolic disorders (hypoglycaemia, hypocalcaemia, water intoxication), neurocysticercosis, amniotic fluid embolism, post-dural puncture cephalgia, and ruptured cerebral aneurysm during late pregnancy and the puerperium. A careful clinical evaluation and appropriate investigations would help to distinguish eclampsia from such conditions. Neuroimaging gives a more accurate assessment of the degrees of CNS involvement in these cases.¹⁰

The neurological symptoms seen in eclampsia are headache, visual abnormalities, vomiting, confusion, hyperreflexia, loss of consciousness, coma.

Various neurological changes occurring in eclampsia can be assessed by several neuro diagnostic tests such as electroencephalography (EEG), computed axial tomographic scan (CT), cerebral Doppler velocimetry, FLAIR, magnetic resonance imaging have been studied in women with eclampsia. On the basis of cerebral imaging findings, attention has been directed to hypertensive encephalopathy, cerebral oedema, infarction and cerebral haemorrhage as a model for the central nervous system abnormalities in eclampsia.¹¹⁻¹³

CT scan is easily available, cost-effective imaging modality. The characteristic CT findings in eclampsia are:¹ Normal, cerebral oedema, diffuse white matter low density areas, patchy area of low density, occipital white matter oedema, loss of normal cortical sulci, reduced ventricular size, acute hydrocephalus and cerebral haemorrhage: intraventricular haemorrhage and parenchymal haemorrhage

(high density) and cerebral infarction: low attenuation areas and basal ganglia infarction.

In India eclampsia remains a high contributor towards maternal mortality and morbidity and also poor perinatal outcome. Thus, timely prediction of the onset of eclampsia and starting appropriate treatment as early as possible is important for favourable maternal and perinatal outcome. CT head is easily available in Indian scenario and very cost effective as compared to other neurological investigations. So far, a very few studies were done in Indian population on CT findings in eclampsia so this study was designed to know clinical significance of CT of head in eclampsia.

METHODS

This was a prospective, comparative and analytical study conducted at the tertiary centre, government medical college of Kota in one year from the period of 2019-2020. All eclampsia patients of any parity beyond 20 weeks of gestation up to 48 hours postpartum were taken as cases.

Inclusion criteria

All eclampsia patients (of gestation age beyond 20 weeks and blood pressure more than 140/90 mm of Hg) were included in the study.

Exclusion criteria

Women who were known case of epilepsy, seizures due to metabolic disturbances, space occupying lesions, intracerebral infections, poisoning, trauma and women with gestation age <20 weeks were excluded from study.

Detailed geographical, obstetrical and medical history of patients including age, parity and gestational age, previous medical history and history of convulsion like duration, time, number of convulsion and presence of premonitory symptoms were sought.

General physical and obstetrical examination of patient was done. Routine investigations like blood pressure, urine for proteinuria measuring (by dipstick) and CBC, BT, CT, serum urea, serum creatinine, LFT, RFT were investigated. Standard MgSO₄ protocol (Pritchard regime) given to all eclampsia patients. Termination of pregnancy was done either by induction of labour or caesarean section after assessing bishop score. CT scan of head was performed within 48 hours of confinement of foetus and after stabilizing the mother. Non-contrast-enhanced CT scan was performed with 5mm and 10mm section in the axial plain. The CT scan findings were collected, evaluated and compared to clinical sign and symptoms. Then combined neuroimaging and clinical diagnosis was assessed to see maternal outcome-whether mortality or morbidity. P<0.05 is considered for statistical significance. Follow up CT scan was not performed as it was not included in the study protocol.

RESULTS

A total of 50 patients with eclampsia were included in study who underwent CT scan of head. The most common age group to present as eclampsia was 21-25 years with 64% patients and the mean and standard deviation was 23.72 years and 3.28 years respectively.

The distribution of patients on the basis of socio-demographic profile demonstrates eclampsia was more common in patients belonging to rural areas (68%), illiterates (64%), 96% patients had un-booked pregnancy and 79.16% patients were referred (Table 1).

Table 1: Distribution of patients on basis of residence, education, antenatal care status, referral status.

Variables	Frequency	%	
Residence	Urban	16	32
	Rural	34	68
	Total	50	100
Education	Literate	18	36
	Illiterate	32	64
	Total	50	100
Pregnancy status	Booked	2	4
	Un-booked	48	96
	Total	50	100
Referral status	Referred	38	79.16
	Direct	10	20.83
	Total	48	100

Greater number of patients (70%) were primigravida and only 30% patients were multigravida. Majority of patients (56%) were from gestational age group of 29-36 weeks, 20% presented at term, 6% were less than 28-week pregnancy and 18% were postpartum. 82% patients had antepartum eclampsia while 18% patients had postpartum eclampsia (Table 2).

Table 2: Distribution on the basis of parity and period of gestation.

Variables	Frequency	%
Gravida		
Primi	35	70
Multi	15	30
Total	50	100
POG (weeks)		
20-28	3	6
29-36	28	56
37-40	10	20
Post-partum	9	18
Total	50	100

The 52% patients delivered through lower segment c-section while 48% delivered vaginally. Out of these 68% delivered preterm while 32% delivered at term gestation. The 16% intrauterine deaths were observed (Table 3).

Table 3: Distribution on basis of mode of termination of pregnancy.

Mode of termination of pregnancy	Preterm	Term	Total
Vaginal delivery	14	10	24
%	28	20	48
LSCS	20	6	26
%	40	12	52
Total	34	16	50

The 52% patients with eclampsia had abnormal changes detected on CT scan while 48% patients had normal CT scan findings. The most common CT scan finding observed in patients with eclampsia was 57.7% patients had cerebral oedema (PRES), 15% had infarction, 11.53% showed sign of haemorrhage (Table 4). Majority of patients with 26.92% had parieto-occipital region affected. Parietal lobe was most commonly involved brain region (53.85%) with maximum 26.92% sole parietal lobe involvement (Table 5).

Table 4: Frequency and distribution on the basis of CT scan findings.

CT scan findings	Frequency	%
Cerebral edema	15	57.7
Infarct	4	15.4
Haemorrhage	3	11.53
Cerebral ischemia	1	3.84
ICH, PRES	1	3.84
B/L cerebral multiple infarcts, PRES	1	3.84
Tentorial herniation, brain stem twist	1	3.84
Total	26	100

Table 5: Distribution of patients on the basis of lobar involvement on CT scan.

Area of brain involved	Frequency	%
Parieto-occipital	7	26.92
Temporo-occipital	4	15.38
Parietal	4	15.38
Temporal	4	15.38
Parieto-temporal	2	7.69
IVH	2	7.69
Fronto-parieto-occipital	1	3.86
Tentorial herniation	1	3.86
Left ganglio capsular area	1	3.86

The 44% patients were in irritable/drowsy state at time of admission, rest were in conscious or unconscious state with 28% patients in each category. Maximum number patients (64.28%) who had abnormal CT scan findings were those who were unconscious after convulsions at time of presentation. $P=0.02$, which is statistically significant (Table 6).

A significant association between gestational age and CT scan finding (p=0.008) was observed. Abnormal CT scan finding were more likely in patients with eclampsia in early pregnancy (Table 7).

There was significant association between systolic BP and MAP with CT scan finding with p=0.003 and 0.025 respectively (Table 8).

The 52% patients had imminent signs before convulsions while 48% did not observed any symptom. Majority of patients with 57.14% had headache. The 7.14% had complaint blurring of vision, only 3.57% had epigastric pain. Out of 26 patients with imminent signs of eclampsia 46.2% patients had abnormal CT findings while 58.3% patients with no history of imminent signs had abnormal CT scan findings with p=0.389 (>0.05), statistically significant association could not be proved (Table 9).

The 86% patients had less than 5 fits. 71.4% patients among those with >5 convulsions had abnormal CT scan findings. (p=0.267) (Table 10).

All patients of eclampsia were admitted in ICU/ HDU. Mechanical ventilation was required in 20% cases while 80% recovered spontaneously. The 52% cases required

ICU/ HDU stay for <3 days, the mean duration of stay was 3.58 days. Six percentage patients were shifted to neurology interventional ICU (NIICU) for further management while 6% mortality was noticed. Majority of patients who required mechanical ventilation had positive CT scan findings, p=0.007, which is statistically significant. Also, most of patients who required ICU/HDU care >5 days had positive CT scan findings, p=0.04, which is statistically significant (Table 11).

In our study 6% (3/50) mortality was recorded. First patient had antepartum eclampsia, was delivered by preterm cesarean section had associated antepartum hemorrhage, HELLP syndrome with acute renal failure and DIC. CT scan brain showed tentorial herniation with brain stem rotation and deviation of axis with cerebral edema. Second patient had antepartum eclampsia, unconscious at time of presentation, delivered by preterm cesarean section and later developed DIC, CT scan brain revealed acute parenchymal hemorrhage with intraventricular hemorrhage in all ventricles. Third patients presented with postpartum eclampsia and developed associated complications HELLP syndrome, acute renal failure and pulmonary edema (MODS) expired on 2 day of admission her CT scan showed intracranial hemorrhage with intraventricular hemorrhage on left side.

Table 6: Distribution on the basis of general condition of patient.

Conditions	N	%	CT normal	%	CT abnormal	%	P value
Conscious	14	28	11	78.57	3	21.42	0.02
Irritable/ Drowsy	22	44	8	36.36	14	63.63	
Unconscious	14	28	5	35.71	9	64.28	

Table 7: CT scan association with period of gestation.

CT	Mean (weeks)	SD	P value
Normal	35.667	2.389	0.008
Abnormal	33.115	3.922	

Table 8: CT scan association with blood pressure.

CT	Normal			Abnormal			P value
	N	Mean	SD	N	Mean	SD	
SBP	24.00	153.33	17.11	26.00	169.62	16.37	0.003
DBP	24.00	107.50	10.73	26.00	113.08	17.38	0.243
MAP	24.00	122.78	11.49	26.00	131.92	15.92	0.025

Table 9: Distribution of patients on the basis of imminent signs of eclampsia.

Imminent signs	N (%)	Symptoms	Frequency (%)		P value
			Normal	Abnormal	
Present	26 (52)	Headache	14 (53.8)	12 (46.2)	0.389
		Vomiting			
		Blurring of vision			
		Epigastric			
Absent	24 (48)	--	10 (41.7)	14 (58.3)	-

Table 10: Distribution of patients on the basis of number of convulsions and its association with CT scan findings.

Number of convulsions	CT			P value
	Normal	Abnormal	Total	
<5	Count	22	21	0.267
	%	51.2	48.8	
>5	Count	2	5	
	%	28.6	71.4	
Total	24	26	50 (100)	

Table 11: Distribution on the basis of critical care required and its association with CT scan, (n=50).

Mechanical ventilation	Frequency	%	CT normal	%	CT abnormal	%	P value
Present	10	20	1	10	9	90	0.007
Absent	40	80	23	57.5	17	42.5	
ICU duration (Days)							
<5	43	86	23	53.48	20	46.51	0.04
>5	7	14	-	0	7	100	
Shifted to NIICU	3	6	-		3		
Mortality	3	6	-	0	3	100	
Present	10	20	1	10	9	90	0.007
Absent	40	80	23	57.5	17	42.5	

DISCUSSION

In present study, 64% (32/50) patients of eclampsia were from the age group of 21-25 years which is consistent with the results in other studies conducted by Pradhan et al, Rajeshwari et al and Agrawal et al.¹⁴⁻¹⁶

In present study, the maximum number of patients (48/50) were un booked out of which 79.16% (38/48) were referred cases, 20.83% (10/48) came directly and only 4% patients were booked and had supervised pregnancy. Similar findings were observed in study by Jain et al, Parihar et al and Chibbar et al where majority of patients were un booked and lacked antenatal care.¹⁷⁻¹⁹ While Dasgupta et al in their study observed majority of eclamptic patients were booked pregnancy.²⁰ In the present study the incidence of eclampsia was more among rural patients, 68% (34/50) compared to urban area women, 32% (16/50). Our results were supported by study conducted by Agrawal et al, Jain et al and Haque et al.^{17,21,22} In the present study 64% (32/50) patients were illiterate and did not have primary education while 36% (18/50) patients were literate. In contrast to this, the study conducted by Nazeen et al shows 17.7% patients were illiterate while 82.3% patients were literate.²³ As majority of eclamptic patients were from rural area, due to their low socio-economic status and family background they did not had access to educational institute.

The patients from referred category did not had supervised pregnancy, thus timely diagnosis and management of gestational hypertension and preeclampsia was not done. While the booked patients could not recognize the signs of imminent eclampsia on time and became eclamptic.

The incidence of eclampsia was found to be more in primigravida than in multigravida in the present study, 70% (35/50) patients were primigravida. A similar outcome was shown in the studies conducted by Rajeshwari et al, Dasgupta et al, Brouh et al, Khandaker et al and Brewer et al.^{15,24-27} While Khandaker et al in their study found the incidence of eclampsia more in multigravida patients.²⁵

In this study we observed 82% (41/50) patients were in antepartum state when became eclamptic while 18% (9/50) were postpartum. No patient had intrapartum seizures. When timing of eclampsia is considered, our study is in accordance with all the previous studies by Khandaker et al, Gurjar et al and Parihar et al this correlates with the fact that incidence of postpartum eclampsia is less than that of antepartum eclampsia, however the percentage of cases differ and this may be due to small number of sample size taken in studies.^{18,25,27}

In the present study majority of patients with 56% (28/50) presented in the group where period of gestation was between 29-36 weeks. 20% (10/50) cases presented at term pregnancy (37-40 weeks) while 6% (3/50) cases had eclamptic convulsions in early preterm pregnancy in 20-28 weeks gestation. This was supported by the studies conducted by Khandaker et al, Rajeshwari et al and Pradhan et al where majority of patients had preterm pregnancy.^{14,15,25}

In the present study 52% (26/50) patients delivered by cesarean section while 48% (24/50) delivered through normal vaginal route after induction of labor. Khandaker et al, Brewer et al, Chibbar et al and Dasgupta et al support same findings with majority of eclampsia patients

delivered by cesarean section.^{19,20,25,26} While Parihar et al shows greater number of normal deliveries comparatively.¹⁸ This is because maximum number of patients had eclampsia in 29- 36 weeks of gestation with poor bishops score so delivery of these patient with induction of labor would have taken more time which might have resulted in further deterioration of patient condition. Besides that, consequences of lack of antenatal care are further compounded and as a result of which these patients receive the obstetric care in emergency often resulting in surgical delivery. This formed over half of the patients in this study which were similar to other reports.

In present study, normal CT scan of head was found in 48% (24/50) cases while abnormal findings were present in 52% (26/50) patients of which 57.7% (15/26) had cerebral edema, 15.4% (4/26) had infarct, 11.53% (3/26) had hemorrhage and cerebral ischemia, intracranial hemorrhage with PRES and bilateral cerebral multiple infarcts with PRES were present in 3.84% (1/50) patients each. This observation is supported by studies conducted by Khandekar et al, Harandou et al, Akan et al and Dasgupta et al showing majority of patients having abnormal findings on CT scan of head with cerebral edema as most common finding.^{20,25,26,28} Pradhan et al in their study observed equal number of patients had normal and abnormal CT scan findings.¹⁴ While Millez et al in their study observed 41% patients to have abnormal CT scan findings.³⁰

Parietal lobe was the most common brain region involved in present study. The 26.92% (7/26) patients had parieto-occipital lobe involvement while temporo-occipital, parietal and temporal lobe involvement seen in 15.38% (4/26) patients in each. The 3.86% (1/26) patients had fronto-parieto-occipital lobes involvement, tentorial herniation, and left ganglio-capsular region. Similar results were observed by Pradhan et al, Rajeshwari et al, Khandaker et al, Gurjar et al while Dasgupta et al in their study found diffuse brain involvement to be the most common finding.^{14,15,20,25,27}

In present study mean SBP was 153.33 mm of Hg in CT normal patient group and 169.62 mm of Hg in CT abnormal patient group ($p=0.003$) with statistically significant association. Mean diastolic BP in CT normal group was 107 mm of Hg and in CT abnormal group was 113.08 mm of Hg ($p=0.243$). MAP in CT normal group was 122.58 mm of Hg and in CT abnormal group was 132.80 mm of Hg with $p=0.025$, which is statistically significant.

Rajeshwari et al in they observed no significant association between CT scan finding and blood pressure. ($p>0.005$).¹⁵

In present study no association was found between area of lesion and imminent symptom. While Khandaker et al in their study observed significant association between some of neurological symptoms (coma and visual disturbances) and CT scan finding.²⁵ This may be due to the fact most of

the patients presented in irritable/ unconscious state and were not able to recall their symptoms properly.

In present study 46.2% (12/26) patients who had imminent signs of eclampsia had abnormal CT scan findings while 58.3% (14/24) with no signs of imminent eclampsia before seizures had CT abnormal findings showing no association in preceding symptoms with CT scan ($p=0.389$).

While Pradhan et al in their study observed significant difference between CT scan findings of patients with neurological symptoms from those who have no neurological symptoms.¹⁴

Twenty percentage (10/50) patients in present study required intubation/mechanical ventilation while 80% (40/50) patients recovered spontaneously without mechanical ventilation. The 86% (43/50) patients required ICU/HDU stay for 5 or <5 days while 14% (7/50) patients stayed for more 5 days, 6% (3/50) patients were shifted to neurology ICU for further management.

Parihar et al observed in their study that 41% patients received mechanical ventilation while 90% patients received oxygen and advance monitoring, the average duration of stay in obstetric ICU was 5.4 ± 3.1 days.¹⁸ 17.93% mortality rate was noted. While in study by Brouh et al the time of care spent in the ICU was 07.13 ± 4.18 hours (range, 03-20 hours).²⁴ The 46.15% patients needed mechanical ventilation while in 76.9% patient tracheal intubation was performed.

CONCLUSION

Eclampsia and preeclampsia remain a major cause of maternal and perinatal morbidity and mortality in developing world. Inadequate antenatal care, delay in women seeking help, in diagnosis and in referral from peripheral referral centers are major cause for poor outcome. Iatrogenic prematurity is the major cause of prematurity leading to perinatal mortality in eclamptic patients. Timely diagnosis depending upon imminent signs and symptoms and early intervention in high-risk cases can improve maternal outcome in eclampsia. CT scan in eclampsia have a significant role in early diagnosis of patients with cerebral lesions and CT findings are associated with the level of consciousness and number of convulsive episodes. Thus, CT scan helps in further management of these patients by multidisciplinary approach. So, it is emphasized to include CT scan in investigation protocol for eclampsia management in patients with altered sensorium.

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