INTRODUCTION

Hypertensive disorders are one of the most common medical complications of pregnancy. These disorders continue to be a major cause of maternal and perinatal morbidity and mortality worldwide.

Around 50,000 deaths were reported annually due to eclampsia. Eclampsia is defined as seizures that cannot be attributed to other causes in a woman with preeclampsia. Eclampsia affects all the major systems that include cardiovascular, haematological, renal, hepatic and the central nervous system, of which CNS involvement is the most serious complication. When promptly recognised and treated, symptoms and radiological changes can be reversed. In some women it can progress to ischemia, massive infarction and death.

Besides clinical presentation, neuroimaging is the only mode to assess the CNS involvement. Neuroimaging gives a more accurate assessment of the degrees of CNS involvement in these cases.

Various techniques used for neuroimaging in eclampsia are computed tomography scanning of brain, magnetic resonance imaging of the brain (MRI), magnetic resonance (MR) angiography, magnetic resonance (MR) venography, cerebral angiography, transcranial Doppler
study, single photon emission computed tomography (SPECT). Of these the most common and the most useful techniques are the computed tomography (CT) scan of brain and MRI of brain. CT scan majorly helps in diagnosing cerebral oedema and suggestive features of hypertensive encephalopathy.3

Vascular changes in organs that occur during pregnancy have been the subject of intense study. Understanding how pregnancy and the postpartum state affect the structure and function of the cerebrovascular bed may provide important clues as to how eclampsia develops and to potential treatments of this devastating condition.

The present study was conducted with the aim to analyse and to identify the prevalence of neurovascular complications and neurovascular changes in eclampsia.

METHODS

This was a prospective study of CT scan findings of brain conducted on 100 cases of eclampsia admitted at Institute of Obstetrics And Gynaecology, Egmore, Chennai during the period from August 2008 to August 2009. All patients in intensive care unit with a provisional diagnosis of eclampsia were screened for enrolment into the study. Patients with known history of chronic hypertension alone, epilepsy, cerebral tumours and renal disorders were excluded from the study.

After getting approval from institutional ethics committee, informed consent in the form of written consent was obtained from the patients or relatives (in situations where patients is indisposed) after explaining the procedure. Patient’s medical history, obstetric history with complication, demographic details were noted in a pre-designed proforma. On admission, patients were first stabilised with antihypertensives and MgSO4 therapy. In all the patients’ neuroimaging was done through computed tomographic (CT) scan. CT scan brain was done within 1 week in the postpartum period. Patients with positive findings in the CT scan brain were followed up after 2 months. All the data was expressed in frequencies and percentages. Chi-square test was used for comparing CT scan positive findings with negative findings. P values less than 0.05 was considered significant statistically.

RESULTS

CT scan of brain was taken for 100 patients with eclampsia. The demographic details of the patients were presented in Table 1. The most common age group in present study was in the range of 20 to 30 years (78%). Primigravida (68%) constituted the majority in present study. Majority of the patients had a normal body mass index of 19.8 to 26 (69%). Most of the patients were in the antenatal period at the time of presentation. 42% of the patients were in the gestational age of 29 to 36 weeks. 27% of the patients were in the postpartum period.

| Variables          | Frequency | Percentage |
|--------------------|-----------|------------|
| Age in years       |           |            |
| <20                | 15        | 15         |
| 20-30              | 78        | 78         |
| >30                | 7         | 7          |
| Parity             |           |            |
| Primi              | 68        | 68         |
| G2                 | 21        | 21         |
| G3                 | 9         | 9          |
| G4                 | 2         | 2          |
| Body mass index    |           |            |
| <19.8              | 4         | 4          |
| 19.8-26            | 69        | 69         |
| 26-29              | 17        | 17         |
| >29                | 10        | 10         |
| Gestational age in weeks |   |            |
| 20-28              | 7         | 7          |
| 29-36              | 42        | 42         |
| 37-40              | 24        | 24         |
| Post-partum        | 27        | 27         |

Table 2 presents the clinical characteristics of the patients. In present study 75% of the patients with eclampsia had diagnosed hypertension only at the time of presentation.

| Clinical characteristics | Frequency | Percentage |
|--------------------------|-----------|------------|
| Duration of hypertension since diagnosis |   |            |
| 0 (at presentation)      | 75        | 75         |
| <4                       | 19        | 19         |
| 5-12                     | 5         | 5          |
| 13-20                    | 1         | 1          |
| Imminent symptoms        |           |            |
| Present                  | 73        | 73         |
| Absent                   | 27        | 27         |
| Haemoglobin measurement (in g %) |   |            |
| ≥11                      | 14        | 14         |
| 10-10.9                  | 22        | 22         |
| 7-10                     | 62        | 62         |
| 4-7                      | 2         | 2          |
| Convolusions             |           |            |
| Antepartum eclampsia    | 69        | 69         |
| Postpartum eclampsia    | 36        | 36         |
| Both                     | 5         | 5          |

Only 1% of patient had hypertension for more than 13 weeks. 73% of patients had imminent symptoms. 62% of patients with eclampsia in present study had Hb% in the range of 7 to 10 g%.

In present study 69% of patients had antepartum eclampsia and 36% of patients had postpartum eclampsia. In them, 14 and 2 had 4 or more episodes of convulsions respectively.
Table 3: CT scan findings.

| Findings         | Frequency (n=100) | Percentage |
|------------------|-------------------|------------|
| Normal           | 85                | 85         |
| Abnormal         | 15                | 15         |
| Cerebral oedema  | 7                 | 7          |
| Haemorrhage      | 5                 | 5          |
| Infarction       | 2                 | 2          |
| Not related      | 1                 | 1          |

| Areas of brain affected | Frequency (n=15) | Percentage |
|-------------------------|------------------|------------|
| Diffuse                 | 4                | 26.6       |
| Fronto-temporal         | 2                | 13.3       |
| Parietal                | 6                | 40         |
| Occipital               | 2                | 13.3       |
| Brainstem               | 1                | 6.6        |

As shown in Table 3, out of 100 eclamptic patients 15 patients had positive findings (abnormality) in the CT scan brain. Cerebral oedema was the most common abnormal finding noticed in the group.

Out of 15 women, 7 had cerebral oedema followed by cerebral haemorrhage (5), cerebral infarction (2). 1 patient had an unrelated finding i.e. old calcified lesion in parietal region.

Parietal region of the brain was the most affected. 6 (40%) patients had lesion in the parietal region, 4 (26.6%) patients had diffuse involvement of the brain, 2 (13.3%) patients had fronto-temporal region involvement, 2 (13.3%) patients had occipital lobe involvement and 1 (6.6%) patient had brain stem lesion.

As given in Table 4, 13.3% in the positive findings group and 2.4% in the negative CT findings group had past history of eclampsia or thrombocytopenia. 33.3% of patients in the positive CT findings group were unconscious at the time of presentation. 56.5% in negative CT findings group and 80% in positive CT findings group had systolic BP in the range of 140-160 mm of Hg.

None in the positive CT finding group had systolic BP <140 or >200 mm of Hg. 44.7% in negative CT findings group and 33.3% in positive CT finding group had MAP >126 mm of Hg. Grade -3 fundus changes were seen in 13.3% of patients in positive CT findings.

73.3% of patients in positive CT findings group and 30.6% in negative CT findings group had proteinuria of 2+. 20% in positive CT findings group had platelet count less than 1 lakh/mm3. 20% in positive CT findings group and 1.2% in negative CT group had altered liver function test.

Only 1.2% in negative CT group had altered renal function test. 73.3% in positive CT group and 71.87% in negative CT group were treated with standard dose regimen.

73.3% in positive CT group and only 35.3% in negative CT group were treated with phenytoin in addition to MgSo4 regimen. Maternal outcome was presented in Table 5.

After treatment complete recovery was seen in negative CT scan group. In positive CT scan group, 7 (46.7%) patients showed complete recovery, 1 patient recovered with sequelae and 7 patients died.

Of the expired patients (7), 5 of them expired due to brain haemorrhage, and 2 patients died with cerebral oedema and brain infarction in each case respectively.

Parietal region of brain was affected in about 3 cases out of 7 dead patients. Fronto-temporal region was affected in 2 cases and occipital and brain stem region in each case. Out of 8 patients who were alive in the positive findings group, lesion disappeared in 6 cases (75%). In 1 patient (12.5%) lesion persisted and 1 patient lost follow-up (Table 6).

DISCUSSION

Hypertensive disorders predominantly eclampsia in pregnancy was considered to be the major cause of fetal and maternal morbidity and mortality in developing countries.

The prevalence was as high as 20 times when compared to the figures in developed countries.6-8

In this study 100 women with eclampsia were selected according to the inclusion exclusion criteria and CT scan of brain was done. The findings obtained were analyzed. In present study the most common age group was 20 to 30 years (78%). Majority of the patients were primigravida (68%). This was similar to the findings of Patil et al.3 Many studies claim that postpartum eclampsia is more common nowadays.9

But in present study, majority of the patients were in the antepartum period at the time of presentation (73%), 27% of patients were in the postpartum period at the time of presentation.

In present study majority (75%) had diagnosed hypertension at the time of presentation. This was in contrast to the findings of Chakravarthy et al.10 In his study all patients except one did not show any evidence of pre-eclampsia till the last clinical visit.
Table 4: Lab parameters in negative and positive CT scan groups.

| Findings                      | Negative CT findings group (n=85) | Percentage | Positive CT findings group (n=15) | Percentage | P value |
|-------------------------------|----------------------------------|------------|-----------------------------------|------------|---------|
| **Positive past history**     |                                  |            |                                   |            |         |
| No                            | 83                               | 97.6       | 13                                | 86.7       | 0.045   |
| Yes                           | 2                                | 2.4        | 2                                 | 13.3       |         |
| **Conscious level**           |                                  |            |                                   |            |         |
| Conscious                     | 68                               | 80         | 7                                 | 46.7       | 0.000   |
| Drowsy                        | 17                               | 20         | 3                                 | 20         |         |
| Unconscious                   | 0                                | 0          | 5                                 | 33.3       |         |
| **Blood pressure parameters** |                                  |            |                                   |            |         |
| **Systolic BP (mm of Hg)**    |                                  |            |                                   |            |         |
| <140                          | 3                                | 3.5        | 0                                 | 0          |         |
| 140-160                       | 48                               | 56.5       | 12                                | 80         | 0.371   |
| 161-200                       | 33                               | 38.8       | 3                                 | 20         |         |
| 200                           | 1                                | 1.2        | 0                                 | 0          |         |
| **Diastolic BP (mm of Hg)**   |                                  |            |                                   |            |         |
| 90-100                        | 31                               | 36.5       | 10                                | 66.7       |         |
| 100-110                       | 29                               | 34.1       | 3                                 | 20         | 0.088   |
| >110                          | 25                               | 29.4       | 2                                 | 13.3       |         |
| **MAP (mm of Hg)**            |                                  |            |                                   |            |         |
| 96-116                        | 24                               | 28.2       | 4                                 | 26.7       | 0.568   |
| 116-126                       | 23                               | 27.1       | 6                                 | 40         |         |
| >126                          | 38                               | 44.7       | 5                                 | 33.3       |         |
| **Fundus changes**            |                                  |            |                                   |            |         |
| Normal                        | 77                               | 90.6       | 11                                | 73.3       |         |
| Grade-1                       | 7                                | 8.2        | 0                                 | 0          |         |
| Grade-2                       | 1                                | 1.2        | 1                                 | 6.7        | 0.000   |
| Grade-3                       | 0                                | 0          | 2                                 | 13.3       |         |
| Others                        | 0                                | 0          | 1                                 | 6.7        |         |
| **Proteinuria**               |                                  |            |                                   |            |         |
| 1+                            | 33                               | 38.8       | 3                                 | 20         | 0.015   |
| 2+                            | 26                               | 30.6       | 11                                | 73.3       |         |
| 3+                            | 15                               | 17.6       | 1                                 | 6.7        |         |
| 4+                            | 11                               | 12.9       | 0                                 | 0          |         |
| **Platelet count (lakhs/cu mm)** |                              |            |                                   |            |         |
| <1                            | 0                                | 0          | 3                                 | 20         | 0.000   |
| 1-4.5                         | 85                               | 100        | 12                                | 80         |         |
| **Liver function test**       |                                  |            |                                   |            |         |
| Normal                        | 84                               | 98.8       | 12                                | 80         | 0.001   |
| Altered                       | 1                                | 1.2        | 3                                 | 20         |         |
| **Renal function test**       |                                  |            |                                   |            |         |
| Normal                        | 84                               | 98.8       | 15                                | 100        | 0.673   |
| Altered                       | 1                                | 1.2        | 0                                 | 0          |         |
| **Magnesium sulphate regimen**|                                  |            |                                   |            |         |
| Low dose                      | 22                               | 25.9       | 2                                 | 13.3       | 0.006   |
| Standard dose                 | 61                               | 71.8       | 11                                | 73.3       |         |
| Infusion                      | 0                                | 0          | 2                                 | 13.3       |         |
| Not given                     | 2                                | 2.4        | 0                                 | 0          |         |
| **Anticonvulsant (Phenytoin)**|                                  |            |                                   |            |         |
| Yes                           | 30                               | 35.3       | 11                                | 73.3       | 0.006   |
| No                            | 55                               | 64.7       | 4                                 | 26.7       |         |
In present study majority of the patients (73%) had imminent symptoms of headache, vomiting, epigastric pain, blurring of vision, or decreased urine output. These observations were almost similar to the findings of Khandaker et al.\textsuperscript{11}

### Table 5: Maternal outcome with type and areas of brain affected.

| Findings       | Recovered | Percentage | Recovered with sequelae | Percentage | Expired | Percentage | P value |
|----------------|-----------|------------|-------------------------|------------|---------|------------|---------|
| Normal (n=85)  | 85        | 100        | 0                       | 0          | 0       | 0          | P<0.05  |
| Abnormal (n=15)|           |            |                         |            |         |            |         |

**Types**
- Cerebral oedema: 6 (85.7) 0 0 1 14.2
- Haemorrhage: 0 0 0 0 0 5 100
- Infarction: 0 0 1 50 1 50
- Not related: 1 100 0 0 0 0

**Areas**
- Diffuse: 4 100 0 0 0 0
- Fronto-temporal: 0 0 0 0 0 2 100
- Parietal: 2 33.31 1 16.7 3 56 0.000
- Occipital: 1 50 0 0 1 50
- Brainstem: 0 0 0 0 0 1 100

In present study majority of the patients (69%) had antepartum eclampsia. 36% of patients had postpartum eclampsia and 5% of patients had both antepartum and postpartum eclampsia. 16 patients had 4 or more convulsions. This was in contrast to the findings of Khandaker et al.\textsuperscript{11} In his study, 31.6% have ante partum eclampsia, 39.8% have intra partum eclampsia and 28.9% have postpartum eclampsia.

Table 6: Follow–up in alive positive CT findings group.

| Follow-up                   | Frequency (n=8) | Percentage |
|-----------------------------|-----------------|------------|
| Lesion disappeared          | 6               | 75         |
| Lesion persisted            | 1               | 12.5       |
| Lost follow-up              | 1               | 12.5       |

In a study conducted by Milliez j et al, CT scan brain was done for 44 women with eclampsia, 18 (40%) had pathological abnormalities in CT scan. Observations of present study also demonstrated similar trends.\textsuperscript{12} In present study 15 patients i.e.15% had positive CT scan findings, remaining 85 patients had normal finding. In another conducted by Harandou et al normal findings were observed in 15.78%.\textsuperscript{13}

The main difference between these studies and present study is that, present study was a prospective study done in 1-year period. Almost 70% of patients with eclampsia admitted to our hospital were included in the study to find out the prevalence of CT scan abnormalities in these patients. In order to find out the prognosis and associated factors, patients were divided into 2 groups based on the positive or negative CT findings and the results obtained were compared and analyzed.

In present study 13.3% in the positive CT group and none in negative group had positive past history of eclampsia or thrombocytopenia with the p value of <0.05 which is statistically significant difference was observed between the groups in terms of positive past history. This indicates the severity and recurrence of preeclampsia and eclampsia.

In present study 33.3% of patients in positive CT findings group were unconscious at the time of presentation with p value of 0.000 which is statistically significant. In this study there was no significant difference between the groups in terms of blood pressure parameters. This was in consistent with the findings of Khandaker et al.\textsuperscript{11}

In the present study, significant grade 1–3 hypertensive retinopathy fundus changes were seen in 13.3% in positive CT group compared to the group with negative CT scan findings. On contrast, in the study by Chakravarthy et al all patients had fundus changes.\textsuperscript{10}

Thrombocytopenia and altered liver enzyme levels was observed in 20% of patients each in positive CT findings group. The differences between the two groups were significant statistacally with p value of 0.000 and 0.001 respectively when compared with negative CT findings group. In a study by Hira et al 70% had thrombocytopenia and 7% had altered liver function test.\textsuperscript{14}

In present study only 2 patients were not treated with magnesium sulphate regimen because of renal impairment in one patient, and because of severe hypotension in another patient. Both of them did not have any positive CT finding. 73.3% in positive CT finding group and 71.8% in negative CT group were treated with standard dose magnesium sulphate regimen. But in the
In present study out of 15 patients with positive findings the most common positive CT scan finding was cerebral oedema, it was seen in 7 patients (46%). Next common finding was cerebral haemorrhage observed in 5 patients (33%), 2 patients (13.3%) had cerebral infarction and 1 patient (6%) had an old calcified lesion. out of the 7 with cerebral oedema in 4 patients the findings were suggestive of posterior reversible encephalopathy syndrome (PRES). These findings were in corroborative with the observations of Richards et al in which cerebral oedema was noticed in 63.79% of the patients.

Regarding area of distribution, parietal region was the most common area affected in 6 patients (40%). 4 (26.6%) had diffuse involvement, 2 (13.3%) had lesion in fronto-temporal region, 2 (13.3%) had lesion in occipital region and 1 (6.6%) had lesion in brainstem. Occipital region was the most affected area in the study by Chakravarthy et al with no lesion in brainstem or basal ganglia. In a study by Zhu cerebral lesions were involved at cortical and subcortical area of bilateral parietal and occipital lobes, secondly at deep basal ganglia and the superior sagittal sinus.

All the patients (85; 100%) who did not have any positive findings in CT scan brain recovered completely. whereas in the positive CT findings group only 7 (46.7%) patients recovered completely, 1 (6.7%) patient recovered with hemiparesis and 7 (46.7%) patients expired. In the study by Chakravarthy et al all patients recovered fully.

In present study when we compared the maternal outcome with the type of CT scan changes we found that all 5 (100%) patients who had haemorrhagic lesion had expired. Out of 7 patients with cerebral oedema 6 (85.7%) recovered and 1 (14.2%) patient whose lesion was suggestive of PRES expired. In the 2 patients with cerebral infarction, 1 (50%) recovered with hemiparesis and 1 (50%) expired. 1 patient who had a calcified lesion also recovered fully. P value is <0.05, thus statistically significant difference was noted between the groups. Similar observations were also noted by Milliez et al.

When the maternal outcome was compared with areas of brain affected; all 4 (100%) patients who had diffuse involvement recovered. All 2 (100%) patients who had frontotemporal region involvement expired. Of the 6 patients with parietal region involvement 2 (33.3%) patients recovered, 1 (16.7%) recovered with hemiparesis, 3 (50%) patients expired. Of the 2 patients with occipital region involvement, 1 (50%) recovered, 1 (50%) expired. The 1 (100%) patient with brainstem
involvement expired and the difference noted was statistically significant (P=0.000).

In the present study, out of 8 patients who were alive in the positive findings group, lesion disappeared in 6 cases (75%). In 1 patient (12.5%) lesion persisted and 1 patient lost follow-up. This was in accordance with the findings of Chakravarthy et al.\textsuperscript{10}

**CONCLUSION**

The findings of the study conclude that maternal mortality was high in patients with positive CT scan brain findings with cerebral haemorrhage, involvement of frontotemporal region or brainstem region. Hence prognosis in these patients is poor. Cerebral odema was the most common pathological abnormality detected but recovery in these patients and resolution of the lesions were almost complete. Patients with altered liver function, retinal changes and thrombocytopenia were more prone for developing cerebral lesions. Since majority of patients had hypertension diagnosed only at the time of presentation the need for effective screening of hypertension and its management is emphasised. Thus, it is accentuated that CT scan of brain should be included in the investigation protocol for eclampsia if not for all at least for those patients with complications.

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