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INTRACEREBRAL CHANGES DETECTED BY CT SCAN OF BRAIN IN POST DELIVERY ECLAMPSIA PATIENTS

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ABSTRACT

Introduction: Eclampsia is an extremely severe form of preeclampsia. CT scan of brain can provide useful intracerebral information to detect different brain lesions in eclampsia which may have different prognosis with residual effect and may need specific modifications in management protocol to prevent long term neurologic sequels and reduce maternal mortality and morbidity. **Aiims and Objectives**: The aim of the study is to evaluate the different neurological changes in brain by CT scan in eclampsia and their relation with different neurologic symptoms. The different findings of CT scan were also correlated with other parameters like gravid status, gestational age, number of convulsions, associated obstetrical complications etc. **Materials and Methods**: This is a prospective cross sectional study of CT scan findings of brain in cases of eclampsia including both antepartum and postpartum, admitted in a tertiary care hospital. **Results:** Mean age of the eclamptic mothers was found to be of 24.14 years. The most common region affected which constitutes 80% of number of cases are parietal and occipital lobes combined together. Cerebral oedema was the most common predominant lesion which constitutes 60% of the total abnormal CT scan findings, followed by cerebral infarction/ischemia which accounts for 28% of total patients. 50 had neurological symptoms(64%), Headache or Head reeling were the most common neurological symptoms. From those 32, 20 cases(62.5%) had abnormal CT scan findings while 12 eclamptic mothers(37.5%) had normal CT scan findings No significant difference of CT scan findings between the patients who delivered within 12 hours of development of eclampsia from the patients who delivered after 12 hours of onset of eclampsia. **Conclusion**: Cerebral oedema is the most common cerebral lesions followed by cerebral infarction and cerebral haemorrhage. Parieto-occipital regions of the brain are the most common affected area. Those who have lesions are significantly related to level of consciousness(GCS SCORE) and number of convulsive episodes. Most common neurological finding is headache followed by altered sensorium, coma and visual disturbances.

KEYWORDS: Eclampsia, CT Scan, Intracerebral.

INTRODUCTION

Eclampsia is defined as the development of generalised tonic clonic seizures that cannot be attributed to any other causes and/or unexplained coma during pregnancy or puerperium in a woman with pre-eclampsia.[1] Approximately between 1 in 2000 deliveries to 1 in 3448 pregnancies in the western world are affected by this conditions, where as in developing countries the incidence of eclampsia is much higher between 1 in 30 to 1 in 500 deliveries.[2] The frequency of timing of eclampsia reported in literature ranges from 38-53% antepartum, 15-20% intrapartum and 11-44% in the postpartum period.[3] Most antepartum eclampsia occurs in the third trimester(90%). Approximately 5-7% of all pregnant woman develop eclampsia, maternal mortality due to eclampsia occurs in 1 to 5%.

Cerebral complications are the major causes of death in eclampsia; still the neuro-pathophysiology of eclamptic seizure is mostly unknown. There are two distinct but related types of cerebral pathology in the patients of eclampsia.[5] The first is gross haemorrhage due to ruptured arteries caused by severe hypertension of any cause, not necessarily only by preeclampsia or eclampsia. The second type of post-mortem lesions are edema, hyperemia, ischemic micro infarcts and petechial haemorrhages. The neurologic manifestations of severe eclampsia are identical to those of hypertensive encephalopathy;[5] which is clinically manifested as generalized tonic-clonic seizure and usually preceded by neurologic symptoms like brisk reflexes, altered sensorium, headache, visual changes and even coma.

Most common lesions are seen in parieto-occipital lobes in the distribution of posterior cerebral arteries. This lesion occurs as a result of vasogenic edema induced by endothelial damage and other changes contributing to pathophysiology of eclampsia.[6] Eclampsia is associated with elevated maternal and fetal morbidity and mortality.

Preeclampsia and eclampsia are the causes of approximately 20% of all maternal deaths.[7]

Major maternal complications of eclampsia include placental abruption(7-10%), DIC(7-11%), HELLP syndrome(9-20%), acute renal failure(5-9%), pulmonary oedema(3-5%), aspiration pneumonia(2-3%), cerebral haemorrhage and cardiopulmonary arrest(2-5%).[8]

The most common causes of maternal death are intracranial bleeding and acute renal failure secondary to abruptio placentae. The risk of death is higher for women developing antepartum eclampsia, at more than 30 years of age and those without prenatal care but it is greatest when eclampsia develops before 20 weeks of gestation.

Imaging is interesting for better understanding of pathophysiology of eclampsia. Patients with focal neurological deficit or signs of mass effect or decrease in the level of consciousness should undergo CT as a first choice in order to exclude haemorrhagic lesions or other major complications. Cerebral CT may be normal or may reveal transient white matter hypodensities.[9] Occasionally haemorrhagic lesions can be found in more severe forms.

AIIMS AND OBJECTIVES

The aim of the study is to evaluate the different neurological changes in brain by CT scan in eclampsia and their relation with different neurologic symptoms. The different findings of CT scan were also correlated with other parameters like gravid status, gestational age, number of convulsions, associated obstetrical complications etc. In this study, CT scan methodology has been adopted because it is less expensive and easily available.

MATERIALS AND METHODS

Study was carried out in the department of obstetrics and gynaecology of VIMSAR, burla. Cases were chosen by random sampling, the patients of eclampsia admitted through emergency and also indoor patients in O&G department. This was a prospective cross sectional study of CT scan findings of brain in cases of eclampsia. The study protocol was approved by VIMSAR institutional research and ethics committee(VIREC). After taking informed written consent from the eclamptic patients 50 number of eclamptic mothers had undergone CT scanning and studied.

Inclusion criteria: Patients with eclampsia (at least one episode of seizure in women with more than 20 weeks of gestation or in the postpartum period of less than 6 weeks with urine albumin of more than 0.3gm/L) both antepartum and postpartum.

Exclusion criteria

1. Pregnant women with known case of hypertension, epilepsy.
2. Seizures due to metabolic disturbances, intracerebral space occupying lesions(ICSOL), intracerebral infections.

Total 50 eclamptic mothers are chosen according to inclusion criteria. Basic information including age, parity and gestational age, previous medical and obstetrics history will be taken. Detailed history of convulsion like duration, time and number of convulsions and presence of premonitory symptoms are sought followed by detailed neurological examinations. Basic investigations like urine for proteinuria were measured and complete haemogram, platelet count, serum uric acid, renal function test, liver function test, serum electrolytes are measured. Standard magnesium sulphate protocol was given to all eclamptic mothers.

CT scan of brain was performed within 48hours of eclampsia after confinement of fetus and after stabilizing the mother. The CT scans of brain are performed with plain and intravenous (non ionic) contrast enhancement(if necessary) with 5mm and 10mm section in the axial plane. The CT scan findings were evaluated with neurological characteristics. Level of consciousness was classified according to Glasgow coma scale(<8 severe,>8 mild). Statistical analysis was performed with SPSS. Follow up CT scan was not performed as it was not included in the study protocol.

OBSERVATIONS

Out of 50 eclamptic mothers included in the study, 45 patients (90%) were in the age group of 20-29years, rest 5 patients being of higher age groups. So the mean age of the eclamptic mothers was 24.14years, Median age 25.5years with standard deviation of 3.61years.

Table 1: Gravida Wise Prevalence of Eclampsia Patients.

Gravida	Normal CT Scan	Abnormal CT Scan		
		Cerebral Edema	Cerebral Infarction	Cerebral Haemorrhage
PRIMIGRAVIDA (25 no. of patients)	11(44%)	7(28%)	4(16%)	3(12%)
MULTIGRAVIDA (25 no. of patients)	14(56%)	8(32%)	3(12%)	0(0%)

There was no statistically significant difference seen between primigravida and multigravida in the CT scan findings (p=0.396, i.e. >0.05).

Table 2: CT Scan Findings Among Eclamptic Mothers in Relation To Gestational Age.

Gestational Age	Normal CT Scan	Cerebral Edema	Cerebral Infarction	Cerebral Hemorrhage
TERM (≥37 WEEKS)	5(34%)	5(34%)	4(26.66%)	1(6.66%)
PRETERM (<37 WEEKS)	20(58%)	10(28.6%)	3(8.6%)	2(5.7%)

Out of 50 eclamptic mothers 25 patients (50%) had normal CT scans and 25 (50%)patients have abnormal CT scans. 15(30%) patients have cerebral edema, 7(14%) patients have cerebral infarction and 3(6%) have cerebral haemorrhage.

Table 3: Different Areas of Brain Involved In Abnormal CT Scan Findings.

Areas Of Brain	No. of Patients	Cerebral Oedema	Cerebral Haemorrhage	Cerebral Infarction
PARIETAL	9(36%)	4	3	2
OCCIPITAL	3(12%)	3	-	-
PARIETO-OCCIPITAL	8(32%)	5	-	3
PARIETO-FRONTAL	2(8%)	2	-	-
FRONTAL	1(4%)	1	-	-
GLOBAL ISCHAEMIA	2(8%)	-	-	2
TOTAL NO. OF PATIENTS	25(100%)	15(60%)	3(12%)	7(28%)

The most common region affected which constitutes 80% of number of cases are parietal and occipital lobes combined together. Cerebral oedema was the most common predominant lesion which constitutes 60% of the total abnormal CT scan findings, followed by cerebral infarction/ischemia which accounts for 28% of total patients.

Table 4: Distribution of Neurological Symptoms Among Eclampsia Patients.

Neurological symptoms	Number of patients
Headache/head reeling	13 (40.6%)
Altered sensorium	11 (34.3%)
Visual disturbances	3 (9.3%)
Coma	5 (15.6%)
Total number of patient	32 (100%)

32 patients out of 50 had neurological symptoms(64%), Headache or Head reeling were the most common neurological symptoms. From those 32, 20 cases(62.5%) had abnormal CT scan findings while 12 eclamptic mothers(37.5%) had normal CT scan findings. Also from the rest 18 eclamptic mothers, 5 patients (27.77%) had abnormal CT findings.

There is a significant difference statistically between the patients those have neurological symptoms from those who have no neurological symptoms by Chi-square test having p value 0.012($p<0.05$).

Table 5: CT SCAN Findings Among Different Neurological Symptoms.

Neurological Symptoms	Normal Ct Scan	Cerebral Oedema	Cerebral Haemorrhages	Cerebral Infarction	Total No. of Patients
HEADACHE/HEAD REELING	6	3	0	4	13
ALTERED SENSORIUM	4	6	0	1	11
VISUAL DISTURBANCES	1	2	-	-	3
COMA	1	-	3	1	5
TOTAL NO. OF PATIENT	12	11	3	6	32

Out of which headache/head reeling is the predominant neurological symptoms with 13/32(40.62%). While altered sensorium is the second predominant neurological symptomatic findings with 11/32 (34.37%). 3 cases have visual disturbances which is 9.37% and 5 patients have presentation of coma (15.6%).

19 eclamptic mothers had convulsion episodes of 5 or more times which constitutes 38% of the total patient studied while 31 eclamptic mothers (62%) were affected with convulsion episodes of less than 5. Where number of convulsions were 5 or more, in these cases 6 patients(31.57%) had normal CT scan while 13 patients (68%) had abnormal CT scan findings. Where number of convulsions were 5 or less, in those cases 19 patients (61.2%) had normal CT scan while 12 patients (38.7%) had abnormal CT scan findings.

Table 6: Distribution of GCS Score Among Eclamptic Mothers In Different Cerebral Lesions.

GCS Score	Normal CT Scan	Cerebral Oedema	Cerebral Haemorrhage	Cerebral Infarction	Total No. of Patients
<8	5(29.4%)	6(35.2%)	3(17.64%)	3(17.64%)	17
≥ 8	20(60.6%)	9(27.2%)	0(0%)	4(12.2%)	33

Table 7: Association of CT Scan Findings In Eclampsia Delivery Intervals.

Eclampsia Delivery Intervals	Normal CT Scan	Cerebral Oedema	Cerebral Haemorrhage	Cerebral Infarction	Total Number of Patients
<12 hrs	16(53.33%)	9(30%)	2(6.66%)	3(10%)	30
>12 hr	8(50%)	5(31.25%)	1(6.25%)	2(12.5%)	16

In this study; 4 patients developed eclampsia in the postpartum period while 46 patients had antepartum eclampsia.

Out of the 46 patients; 30 eclamptic mothers delivered(65%) within 12 hours from the onset of eclampsia while 16 patients(35%) delivered after 12hrs from the onset of eclampsia.

Those who delivered within 12 hours of development of eclampsia have following findings on CT scan-
16 eclamptic mothers (53.3%) have no abnormality on CT scan. 9 have(30%) cerebral oedema. 2 patients (6.66%) and 3 patients (10%) have cerebral haemorrhages and cerebral infarction respectively.

Those patients delivered after 12 hours of development of eclampsia have-
8 patients (50%) have no abnormality on CT scan. 5 patients (31.25%) have cerebral oedema. 1 patient (6.25%) and 2 patients (12.5%) have cerebral haemorrhages and cerebral infarction respectively.

There is no significant difference between the patients those delivered <12 hours from the onset of eclampsia from those delivered after 12 hours from eclampsia by CT scan findings as per Chi-square test having p value of 0.831 ($p>0.05$).

Blood pressure pattern were studied between those with normal CT scan findings and abnormal CT scan findings:-
Those with normal CT scan findings have systolic blood pressure 147.8mmHg(mean) and diastolic blood pressure 92mmHg(mean).

Hose with abnormal CT scan findings have systolic blood pressure 151.6mmHg(mean) and diastolic blood pressure 96mmHg(mean).

DISCUSSION

Mean age of the eclamptic mothers was found to be of 24.14 years and Median age of the eclamptic mothers is 25.5 years with standard deviation of 3.61 years as studies of A.chakrabarty; SD.chakraborty[71] found the age group of 24 to 30 years.

When timing of eclampsia is concerned our study is in accordance with all the previous studies (Khandekar et al[70], Gurjar B. et al[9], A. Chakrabarty et al[71]) of 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 other studies.

Gestational age at which eclampsia develops is an important deciding factor to determine the line of management. In this study eclamptic mothers are divided into term(35cases,70%) and preterm(15 cases, 30%). Among the preterm patients 58% cases had normal CT scan findings; 28.57% had cerebral oedema; 8.57% have cerebral infarction while 5.7% patients have intracerebral haemorrhages in our study.

In the study of Khandekar et al[70]; authors found that 14.3% patients were detected normal on CT scan; 42.9% cases have cerebral oedema; 28.6% have cerebral infarction and 14.3% have cerebral haemorrhages.

Among the term patients 33.33% cases have normal CT scan findings; 33.33% patients have cerebral oedema, 26.66% have cerebral infarction while 6.66% have cerebral haemorrhages in this present study.

Khandekar et al[70] found in his study that 67.4% cases have normal CT scan findings while 17.6% cases have cerebral oedema and 15% have cerebral infarction as CT scan findings. No patient in this group is detected with cerebral haemorrhage.

+preterm patients in our study as well as in the previous study also and cerebral infarction is the second most common followed by cerebral haemorrhage.

Table 8.

Different Studies	Normal CT Scan	Cerebral Oedema	Cerebral Infarction	Cerebral Haemorrhage
PRESENT STUDY	50%	30%	14%	6%
KHANDEKAR et al	36.8%	31.6%	23.7%	7.9%
GURJAR B. et al	8.33%	75%	8.33%	8.33%
MILLEZ j.et al	59%	34%	-	6.8%
Harandou et al	15.78%	73.68%	15.78%	10.53%
Akan .H. et al	18.18%	50%	13.63%	9.09%

Table 9: CT Scan Finding Among Different Neurologic Symptoms; Khandekar et al.

Neurologic symptoms	Normal CT finding	Cerebral oedema	Cerebral infarction	Cerebral haemorrhage
Headache/head reeling	26.9%	30.8%	30.8%	11.5%
Altered sensorium	38.5%	46.2%	15.4%	0%
Visual disturbances	14.3%	28.6%	42.9%	14.3%
Coma	7.1%	35.7%	35.7%	21.4%

Table 10: Involvement of different region of brain in different studies in tabular form.

Areas of Brain	Present Study	Khandekar's Study	B. Gurjar et al
Parietal	36%	66.66%	83.33%
Occipital	12%	8.3%	58.33%
Parieto-occipital	32%	16.6%	--
Parieto-frontal	8%	--	--
Frontal	4%	--	33.33%
Global ischaemia	8%	--	--
Brain stem	--	8.2%	--

Blood pressure pattern were studied between those with normal CT scan finding and those do not have any positive finding on CT scan. In our study eclamptic mothers who had normal CT scan finding had systolic blood pressure found to be 147.8mmHg (mean) with standard deviation of 11.4mmHg and diastolic blood pressure is 92mmHg(mean) with standard deviation of 6.8mmHg.

Eclamptic mothers having abnormality on CT scan have systolic blood pressure of 151.6mmHg(mean) with standard deviation of 12.3mmHg and diastolic blood pressure is 96mmHg with standard deviation of 6.4mmHg (mean). So what we found is here is no difference between blood pressure distribution between those who have CT scan finding than those who have no positive CT scan findings which was also supported by the study of Khandekar et al.[70]

Table 11: Khandekar et al study finding.

Blood Pressure	Normal CT Scan Finding	Abnormal CT Scan Finding
SYSTOLIC	155.7mmHg	166.25mmHg(mean)
DIASTOLIC	107mmHg	113.33mmHg(mean)

This finding is correlated with the findings of Schwartz et al. 19 austin.

Glasgow Coma Scale Score Distribution

In the present study eclamptic mothers were classified into two groups according to Glasgow coma scale score(GCS SCORE). When general condition of the patient is not good or clinically when the patient is severe as evident by GCS score; such patients having low GCS score were detected to have increased percentage of cases having abnormal CT scans than cases having GCS score>8(60.6% vs 29.4%) as discussed above.

In both the group cerebral oedema is the most common abnormality.

Khandekar et al[70] study has the following finding:- 55.3% eclamptic mothers have GCS score<8 during admission among them 33.3% develop oedema, 33.3% develop infarction, 14.3% have cerebral haemorrhage and 19% have no positive CT scan findings. 44.7% eclamptic mother has GCS score>8 among them 29.4% develop cerebral oedema, 11.8% develop infarction while 58.8% have no CT scan finding.

Our present study findings are corroborative with the finding of abovesaid study significantly. Mothers who had developed coma with Glasgow coma scale<8 develop more findings in CT scan.

Convulsive Episodes

Eclamptic mothers, whose number of episode of convulsion is less than 5; among them 61.3% have normal CT scan; 25.8% have cerebral oedema, 9.6% have cerebral infarction and 3.22% have cerebral haemorrhage.

Eclamptic mother whose number of episode of convulsion is more than 5; among them 31.58% have normal CT scan findings, 36.8% have cerebral oedema, 10.52% have cerebral haemorrhage and 21% develop cerebral infarction.

Khandekar et al[70] study has the following findings:-
Eclamptic mother whose number of episodes of convulsion is less than 5; among them-
61.9% have no findings in CT scan, 28.6% have cerebral oedema, 9.5% have cerebral infarction and none has cerebral haemorrhage, whereas eclamptic mothers whose number of episodes of convulsion is more than 5 in that group.

35.3% have cerebral oedema, 41.2% develop cerebral infarction, 17.6% develop cerebral haemorrhage and 6% have normal CT scan findings.

Mother with recurrent episodes (>5 times in number) of convulsion develop more findings in CT scan. This finding is correlated to study of Richards et al showing severity of oedema is related to duration 0f intermittent seizures.

Correlations of CT Scan Findings In Eclampsia-Delivery Intervals

From the data and discussions it can be seen that there is no significant difference of CT scan findings between the patients who delivered within 12 hours of development of eclampsia from the patients who delivered after 12 hours of onset of eclampsia.

Obstetrics Complications

Eclampsia patients more often presented with severe complications like pulmonary oedema, acute renal failure, abruption placentae, coma, HELLP syndrome; in our study complications PPH, Abruptio, ARF, pulmonary oedema are taken into considerations and CT scan findings are analysed on the basis that whether patients affected with obstetrics complications have more positive CT scan findings or patients with complications have more abnormality on CT scan. From the above discussion and analysis it can be concluded that in both the groups those with complications or without any complication the proportion of cases with normal CT scan and abnormal CT scan are almost equal and obstetrics complications and finding of abnormality on CT scan has no direct correlations.

In the present study; CT scan of brain done in the 50 eclamptic mothers after confinement of the fetus and stabilization of the mother.

It is evident from this study that; cerebral oedema is the most common cerebral lesions followed by cerebral infarction and cerebral haemorrhage.

Parieto-occipital regions of the brain is the most common affected area.

Although almost 50% eclamptic mothers do not have cerebral lesions, those who have lesions are significantly related to level of consciousness(GCS SCORE), number of convulsive episodes.

Most common neurological finding is headache followed by altered sensorium, coma and visual disturbances.

CT scan of brain can provide useful intracerebral information to detect different brain lesions in eclampsia which may have different prognosis with residual effect and may need specific modifications in management protocol to prevent long term neurologic sequels and reduce maternal mortality and morbidity.

Hira B and Moodley J(2004) have shown that CT scan does change management in 27% of eclamptic mothers which is statistically significant.

REFERENCES

1. Practical guide to high risk pregnancy and delivery; Arias 4th, 2015; 13: 186-230.
2. Matter F; Sibai BM; Eclampsia viii risk factors for maternal morbidity, Am J obst. gynecol, 2000; 182: 307-312.
3. Sibai BM, Hauth J, Caritis S et al. hypertensive disorders in twin verses singleton pregnancies. Am j. obst. gynecol., 2000; 182: 938-942.
4. Practical obstetrics problem.Ian Donald 7th ed., 2014; 8: 143-174.
5. Barton JR, Sibai BM, Cerebral pathology in eclampsia, clin. Perinatal, 2001; 18: 891-910.
6. Schwartz RB, Feske SK, Polak JF, Degirolami U, Beckner KM et al, Preeclampsia-eclampsia. clinical and neuroradiographic correlates and insights into the pathogenesis of hypertensive encephalopathy. Radiology, 2000; 217(2): 371-6.
7. Mackay AP, Beg CJ, Atarsh HK. Pregnancy related mortality from preeclampsia and eclampsia. obstet gynecol, 2001; 97: 533-538.
8. Sibai BM:Diagnosis. differential diagnosis, management of eclampsia. obstet gynecol, 2005; 105: 402-410.
9. Gurjar B, Rawat RP. CT scan findings in patients of eclampsia. Int, J. reprod. contracept. obstet gynecol, 2017; 6: 3405-8.
10. Marques R, Braga J, Leite l, Jorge CS(neurological involvement in preeclampsia/eclampsia the role of neuroimaging) Acta Med. port., 2007; 10: 585-588.
11. Harandou M, Madani N, Labibe S, Messouak O, Boujraf S, Benkirane S, et al. [Neuroimaging findings in eclamptic patients still symptomatic after

24 hours: a descriptive study about 19 cases]. Ann Fr Anesth Reanim, 2006; 25: 577- 583.
12. James PR, Nelson-piercy C.Management of hypertension before, during and after pregnancy. Heart, 2004: 1499-1504.
13. Berg CJ, Harper MA, Arkinson SM.et al Preventability of pregnancy-related deaths. Obstet gynecol, 2005; 106: 1228-1234.
14. Cantwell R, et al. saving Mothers lives: Reviewing maternal deaths to make motherhood safer: 2006-2008 the eighth report of the confidential enquiries into maternal deaths in united kingdom.
15. Berg CJ, Mackay AP, Qin C, et al. overview of maternal morbidity during hospitalization for labor and delivery in the united states: obstet gynecol, 2009; 113: 1075-1081.
16. Fiona M, Chris R, James W. et al. The preeclampsia community guideline(PRECOG):how to screen for and detect onset of preeclampsia in the community. BMJ, 2005; 30: 576-580.
17. Hauth JC, Ewell MG, Levine RL, et al. Pregnancy outcome in healthy nulliparous women who subsequently develop hypertension. obstet gynecol, 2000; 95: 24-48.
18. Buchbinder A, Sibai BM, Caritis S, et al. Adverse perinatal outcomes are significantly higher in severe gestational hypertension than in mild preeclampsia. Am j obstet gynecol, 2002; 186: 66-71.
19. Saudan P, Brown MA, Buddle ML et al. Does gestational hypertension become pre-eclampsia? Br j obstet gynecol, 1998; 105: 1177-1184.
20. National institute of health and clinical excellence. 2010. hypertension in pregnancy: the management of hypertensive disorders during pregnancy.CG no 107.
21. Duley L.pre-eclampsia and the hypertensive disorders of pregnancy. Br med j, 2003; 67: 161.
22. Sibai B, Dekker G, Kupfermine M: preeclampsia. Lancet., 2005; 365: 785-799.
23. Sibai BM. Hypertension. In gabbe SG, Niebyl JR, Galan H, et al (eds) obstetrics: normal and problem pregnancies, 6th ed. New York: Elsevier, 2012; 779-822.
24. Redman CWG, Sargent H, Roberts JM, Immunology of abnormal pregnancy and preeclampsia, Chesley's hypertensive disorders of pregnancy 3rd ed. Newyork Elseiver, 2009; 129.
25. Hibbard JU, Shroff SG, Lang RM. Cardivascular changes in preeclampsia. Semin. Nephrol, 2004; 24: 565-570.
26. Royal college of Obstetricians and Gynaecologists. The management of severe preeclampsia/eclampsia. Evidence based clinical guideline No.10(A). London: RCOG Press, 2006.
27. Koopmans CM, Bijlenga D, Groen H, et al. Induction of labour Versus expectant monitoring for gestational hypertension or mild preeclampsia after 36 weeks of gestation(HYPITAT); a multicenter open labeled randomized controlled trial. Lancet., 2009; 374: 979-88.
28. SOGC Practice guideline No. 2006. March 2008. Diagnosis, evaluation and management of the hypertensive disorders of pregnancy, J Obstet Gynaecol Can. Vol 30(3), Supplement I.
29. Thiagarajah S, Bourgeois FJ, Harbert GM, et al: Thrombocytopenia in preeclampsia: Associated abnormalities and management principles. Am J Obstet Gynecol, 1984; 150: 1-5.
30. Fonseca JE, Mendez F, Catano C, et al: Dexamethasone treatment does not improve the outcome of women in HELLP Syndrome: A double blind, placebo-controlled, randomized clinical trial. Am J Obstet Gynecol, 2005; 193: 1591-1598.
31. American College of Obstetricians and Gynecologists. Diagnosis and Management of Preeclampsia. Practice Bulletin No.33. Washington, DC: ACOG, January 2002.
32. Magpie trial collaborative Group:Do women with preeclampsia and their babies, benefit from magnesium sulfate? The Magpie Trial: A randomized placebo-controlled trial. Lancet, 2002; 359: 1877-1890.
33. Eclampsia trial collaborativr group: Which anticonvulsant for women with eclampsia? Evidence from the collaborative eclampsia trial. Lancet, 1995; 345: 1455-1462.
34. Doyle LW, Couther CA, Middleton S, et al. Magnesium sulfate for women at risk of preterm birth for neuroprotection of the fetus. Cochrane Database of Systemic reviews 1: CD004661, 2009.
35. Lucas MJ, Leveno KJ, Cunninghham FG. A comparison of magnesium sulfate with phenytoin for the prevention of eclampsia. N Engl J Med., 1995; 333: 201-205.
36. Martin JN, Thigpen BD, Moore RC, et al. Stroke and severe preeclampsia and eclampsia: a paradigm shift focusing on systolic blood pressure. Obstet Gynecol, 2005; 105: 246-254.
37. Magee LA, Cham C, Waterman EJ, et al. Hydralazine for treatment of severe hypertension in pregnancy: A meta-analysis. Brit Med J., 2003; 327: 955.
38. Pregnancy Hypertension. In Cunningham FG, Leveno KJ, Bloom SL, et al (eds) Williams Obstretics, 23rd ed. New York: Mcgraw-hill, 2010: 706-756.
39. Sibai BM, Taslimi m, Abdella TN, et al. Maternal and perinatal outcome of conservative management of severe preeclampsia in mid trimester. Am J Obstet Gynecol., 1985; 152: 32-37.
40. Magee LA, Yong PJ, Espinosa V, et al. Expectant management of severe preeclampsia remote from term: a structured systemic review. Hypertens pregnancy, 2009; 28: 312-347.
41. Paulino VG, Osvaldo RT, Andres CM, et al. Expectant management of severe preeclampsia remote from term: the MEXPRE latin study, a randomized, multicenter clinical trial. Am J Obstet Gynecol, 2013; 209: 425-425.

42. Abalos E, Duley L, Steyn DW, et al. Antihypertensive drug therapy for mild to moderate hypertension during pregnancy. Cochrane database of systemic reviews 2007, Issue 1.
43. Hibbard LT. Maternal mortality due to acute toxemia. Obstet Gynecol, 1973; 42: 263-270.
44. Sibai BM, Barton JR: Expectant management of severe preeclampsia remote from term: patient selection, treatment and delivery indication. Am J Obstet Gynecol, 2007; 196: 14-16.
45. Blackwell SC, Redman ME, Tomlison M, et al. Labour induction for the preterm severe preeclamptic patient: is it worth the effort. J Matern Fetal Med., 2001; 10: 305-311.
46. Douglas KA, Redman CW. Eclampsia in United kingdom. BMJ, 1994; 309: 1395-1400.
47. Riskin-Mashiah S, Belfort MA. Preeclampsia is associated with global cerebral haemodynamic changes. J Soc Gynecol Investing, 2005; 12: 253-256.
48. Ascarelli MH, Jhonson V, McCreary H, et al. Postpartum preeclampsia management with furosemide: A randomized clinical trial. Obstet Gynecol, 2005; 105: 29-33.
49. Sibai BM, Abdella TN, Spinnato JA, et al. Eclampsia IV: the incidence of non-preventable eclampsia. Am J Obstet Gynecol, 1986; 154: 581-586.
50. Pritchard JA, Pritchard SA. Blood pressure response to estrogen-progestin oral contraceptive after pregnancy induced hypertension. Am J Obstet Gynecol., 1977; 129: 733-739.
51. Conde-Agudelo A, Romero R, Lindheimer MD: Tests to predict preeclampsia. In Lindheimer MD, Roberts JM, Cunningham FG (eds). Chelsey Hypertensive disorders of pregnancy. 3rd ed. New York: Elseiver, 2009: 191.
52. Papageorghiou AT, Leslie K: Uterine artery Doppler in the prediction of adverse pregnancy outcome. Curr opin Obstet Gynecol, 2007; 19: 103-107.
53. Duley L, Henderson-Smart DJ, Kinng KM. Antiplatelet agents for preventing pre-eclampsia and its complications. Cochrane Data based syst Rev., 2007; issue 4.
54. Askie LM, Henderson Smart DJ, Stewart LA. Antiplatelet agents for the prevention of pre-eclampsia: A metaanalysis of individual data. Lancet, 2007; 369: 179-180.
55. Levine RJ, Hauth JC, Curet LB, et al. Trial of calcium to prevent preeclampsia. N Engl J Med., 1997; 337: 69-76.
56. Atallah AN, Hofmeyr GJ Duley L. Calcium supplementation during pregnancyfor preventing hypertensive disorders and related problems. Cochrane database syst Rev., 2002; issue 1.
57. Chappell LC, Seede PT, Briley AL, et al. Effects of antioxidants on the occurance of preeclampsia in women at increased risk : a randomized trial. Lancet, 1999; 354: 810-816.
58. Beazley D, Ahokas R, Livingston J, et al. Vitamin-C and E supplementation in women at high risk for preeclampsia: a double blind placebo controlled trial. Am J Obstet Gynecol, 2005; 192: 520-521.
59. Roberts JM, Redman CWG. Pre-eclampsia - more than. Pregnancy induced hypertension. Lancet, 1993; 341: 1447-51.
60. Royburt M, Seidman DS, Serr DM, Mashiach S. neurologic involvement in hypertensive disease of pregnancy. Obstet Gynecol Surv., 1991; 46: 656-64.
61. Will AD, Lewis KL, Hinshaw DB Jr, Jordan K, Cousins LM, Hasso AN, et al. Cerebral vasoconstriction in toxaemia. Neurology, 1987; 37: 1555-7.
62. Strandgaard S. The lower and upper limits for autoregulation of cerebral blood flow. Stroke, 1973; 4: 323.
63. Benedetti TJ, Quilligan EJ. Cerebral oedema in severe pregnancy- induced hypertension. Am J Obstet Gynecol, 1980; 137: 860.
64. Qurashi AI, Frankel MR, Ottenlips JR. Cerebral haemodynamics in pre-eclampsia and eclampsia. Arch Neurol, 1996; 53: 1226-31.
65. Gant NF, Daley GL, Chand S Whalley PJ, MacDonald PC. A study of angiotensin II. Pressure response throughout primigravida pregnancy. J Clin Invest., 1973; 52: 2682.
66. Truwit CL, Denaro CP, Lake JR, De Marco T. MR Imaging of reversible cyclosparin A induced neurotoxicity. Am J Neuroradiol, 1991; 12: 651-9.
67. Beausang-Linder M, Bill A. Cerebral circulation in acute arterial hypertension- -protective effects of sympathetic nervous activity. Acta Physiol Scand., 1981; 111: 193-199.
68. Koch S, Rabinstein A, Falcone S, Forteza A. Diffusion-weighted imaging shows cytotoxic and vasogenic edema in eclampsia. Am J Neuroradiol, 2001; 22: 1068-1070.
69. Covarrubias DJ, Luetmer PH, Campeau NG. Posterior reversible encephalopathy syndrome: prognostic utility of quantitative diffusion-weighted MR images. Am J Neuroradiol, 2002; 23: 1038-1048.
70. Khandaker S, Haldar M and Munshi S. Intra Cerebral Changes Detected by CT Scan of Brain in Eclampsia. Austin J Obstet Gynecol, 2014; 1(3): 4.