STUDY OF ASSOCIATION BETWEEN FUNDAL AND FETAL OUTCOME IN PRE ECLAMPSIA

By

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Dissertation submitted to the

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In partial fulfilment of the requirements for the degree of

MASTER OF SURGERY IN OPHTHALMOLOGY

Under the guidance of

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Dedicated to my closest friend

DR. DHARMISTHA PATEL

Who always stood by and motivated me at every step

ABSTRACT

BACKGROUND: Pre eclampsia is characterised by endothelial dysfunction and vasospasm of vessels which can be observed by an ocular fundal examination. The fundus usually develops changes like hypertensive retinopathy, papilloedema, exudative retinal detachment, vitreous and pre retinal haemorrhages. Retinopathy is associated with placental insufficiency and intra uterine growth retardation.

AIM: To assess the prevalence of fundal changes in preeclampsia and to study the association between degrees of hypertensive retinopathy changes in fundus and fetal outcome.

METHODS: 100 patients presenting at department of obstetrics and gynaecology diagnosed as pre eclampsia at R.L.Jalappa hospital from December 2011-June 2013 were recruited in the study. Patient recruited underwent ocular examination using snellens chart, pupillary examination, slit lamp examination and dilated fundal examination. The retinopathy was graded according to Keith, Wagner and Barker classification. The fetal parameters considered were birth weight, APGAR score, still birth and neonatal death.

RESULTS: Patients age ranged from 17-28 years of age with average of 23.28±3.37. Average systolic and diastolic blood pressures were 156.9±17.961 and 104.88±13.58. All patients had normal anterior segment. Based on retinopathy classification, we found 34 patients with grade 1 and 13 patients with grade 2 hypertensive retinopathy. Only 3 patients presented with grade3 hypertensive retinopathy. There was significant association of retinopathy with proteinuria, serum uric acid levels and the fetal birth weight with p value <0.05.

CONCLUSION: Fundoscopy of retina is a simple, non invasive, safe and reliable procedure to interpret the vascular changes. Therefore, it may be concluded that the degree of hypertensive retinopathy in women with preeclampsia is a valid and reliable prognostic factor that gives valid prognostic information on assessment of the severity of pre eclampsia and neonatal outcome.

KEY WORDS: Pre eclampsia, fetal outcome, hypertensive retinopathy, proteinuria, serum uric acid

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LIST OF ABBREVIATIONS USED

RPE > Retinal pigment epithelium

IOP > Intra ocular pressure

BP > Blood pressure

IUGR > Intra uterine growth retardation

IUD > Intrauterine death

VEGF > Vascular endothelial growth factors

PG I_2 > Prostaglandins

TXA_2 > Thromboxane

TNF > Tumor necrosis factor

IL-6 > Interleukins

ROS > Reactive oxygen species

FFA > Fluorescein fundal angiography

CT SCAN > Computed tomography scan

MRI SCAN > Magnetic resonance imaging

CSCR > Central serous choroidretinopathy

PR > Proliferative retinopathy

INTRODUCTION

INTRODUCTION

Pregnancy causes changes in the metabolism, blood circulation and the hormonal profile of the mother which in turn affects the ocular functions and can also have adverse effect on developing foetus .This study focuses to identify fundal changes occurring in pre eclampsia and any association with fetal outcome.

Pre eclampsia is one of the hypertensive disorders of pregnancy defined as hypertension and proteinuria occuring after 20 weeks of pregnancy. It affects multiple organ system that include cardiovascular changes, haematological abnormalities, neurological or cerebral manifestation, hepatic and renal impairment. Pre eclampsia and its potential impact on ocular fundus has been documented.[1,2]

Pre eclampsia is characterised by endothelial dysfunction and vasospasm of vessels in fundus.[3] The vasospasm activity can be observed by an ocular fundal examination. The fundus develops characteristic changes like hypertensive retinopathy, papilloedema, exudative retinal detachment, vitreous and pre retinal haemorrhages and central serous chorioretinopathy. Retinopathy in pre eclampsia might be associated with placental insufficiency and intra uterine growth retardation. These changes are indicative of the progression of hypertension in the mother and foetal outcome.

As the retinal, cerebral and renal vessels are closely related to each other, the eye serves as a window to study the state of vessels in the brain and parenchyma of the kidneys. The documentation of fundal changes occurring in preeclampsia provides us with good opportunity to study the ocular changes and if any association exists in relation to foetal outcome.

It's a simple, non invasive and cost effective procedure which could be the initial finding in an asymptomatic patient who may require immediate management which

may help in saving lives of both the mother and the baby. The ocular fundus has proved to be valuable and a valid prognostic procedure on assessment of severity of pre eclampsia and neonatal outcome.[4]

AIMS AND OBJECTIVES

AIMS AND OBJECTIVES

1. To assess the prevalence of fundal changes in pre eclampsia
2. To study the association between degrees of hypertensive retinopathy changes in fundus and fetal outcome

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Anatomy of retina and its vasculature[5,6,7]

Retina is a component of what is clinically viewed as fundus. The neuro sensory retina is transparent, the back ground colour being provided by the retinal pigment epithelium and vascular choroid. The retina is divided into number of zones for convenience of recording clinical findings and to permit a precise diagnosis of retinal disorders. On ophthalmoscope examination it can be divided into 3 distinct regions:

1. Optic disc
2. Macula lutea
3. Peripheral retina

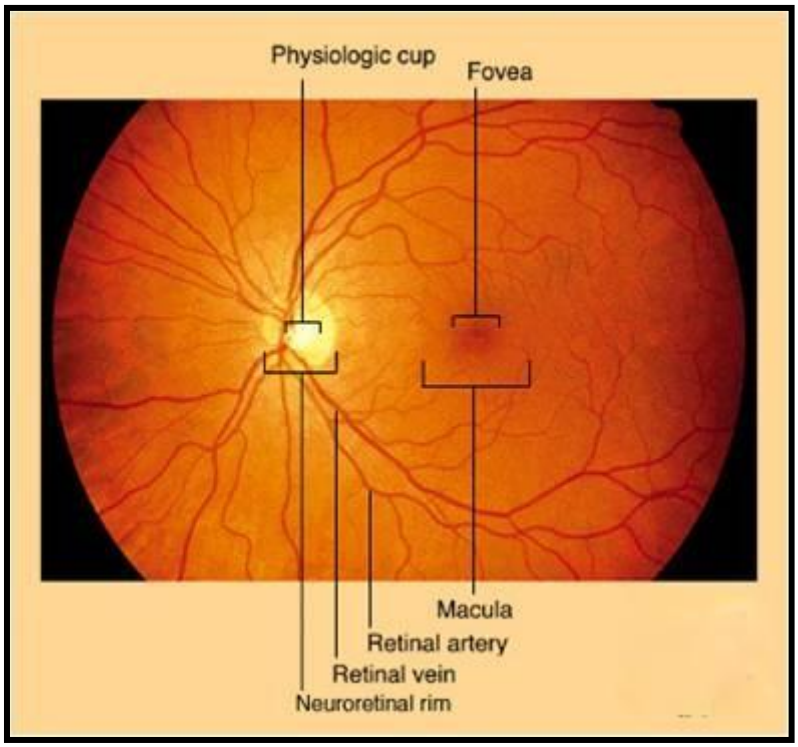

Photo 1: Normal fundus

Examination of the posterior part of retina is undertaken with the use of a direct ophthalmoscope as shown in fig 1.

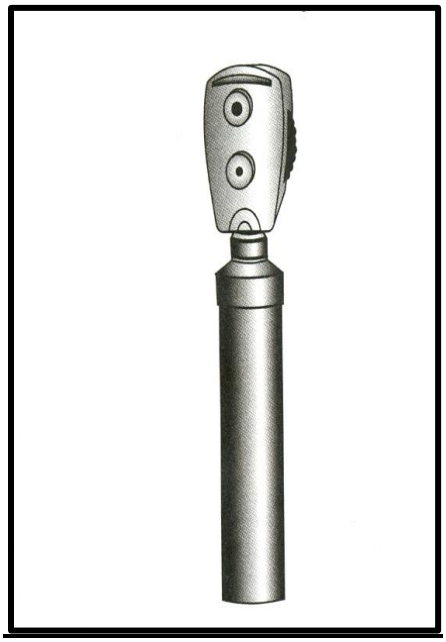

Fig 1:Direct ophthalmoscope

Optic disc: It is pink coloured, well defined circular area of 1.5mm diameter. At the optic disc all retinal layers terminate except the nerve fibres which pass through the lamina cribrosa and run into optic nerve. The depression in the optic disc is called physiological cup. The central retinal artery and vein emerge through the centre of this cup.

Macula lutea: Also called the yellow spot. It is situated temporal to the optic disc and measures 5.5mm in diameter.

Peripheral retina: It is bounded posteriorly by the retinal equator and anteriorly by ora serrata. It is best examined by indirect ophthalmoscopy.

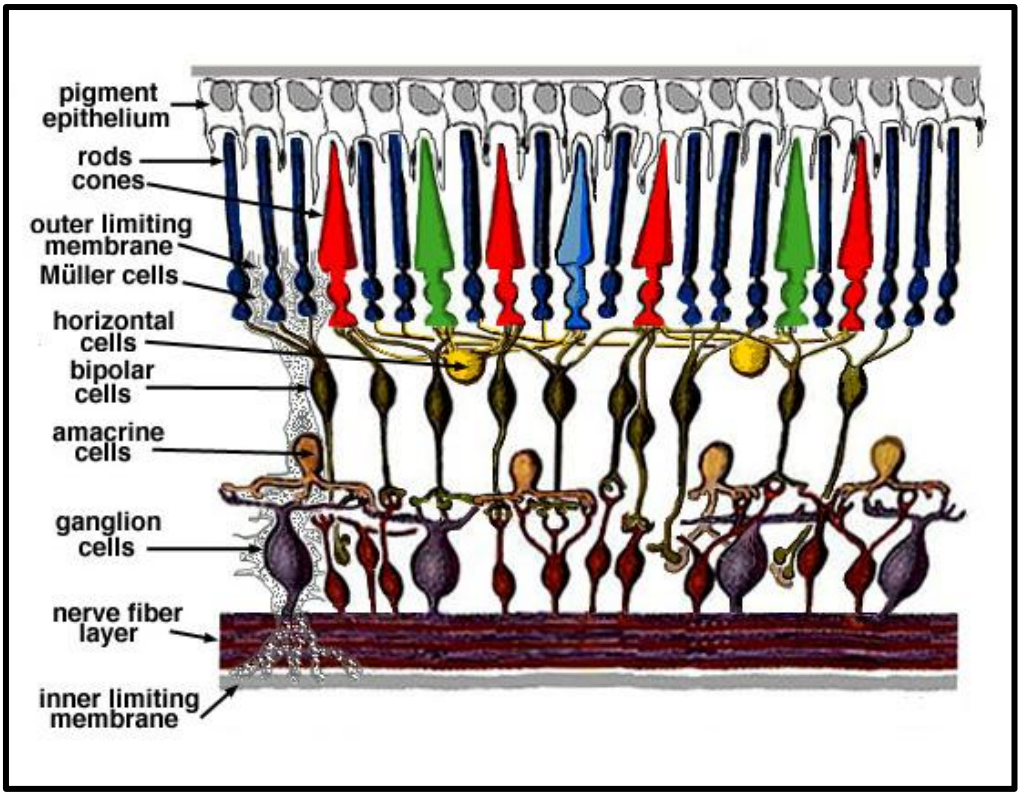

Fig 2: Schematic representation of the retinal layers

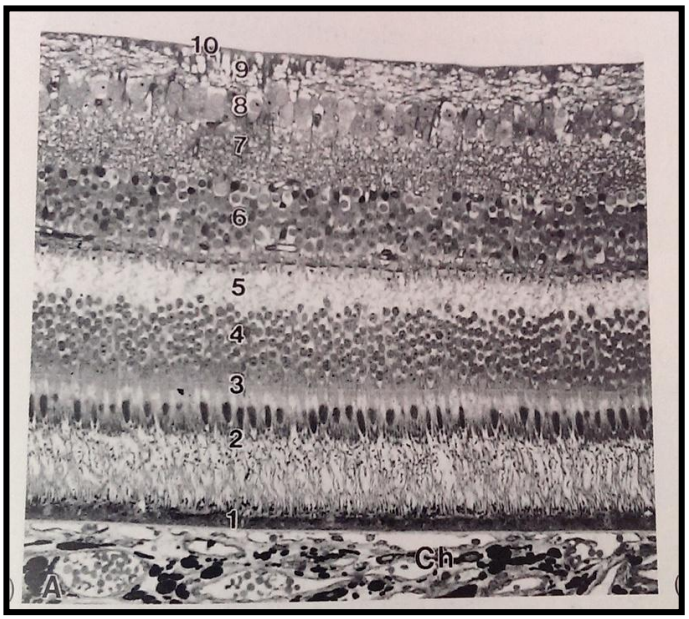

Photo 2: Histology of microscopic layers of retina[8]

Retinal layers:

1. Retinal pigment epithelium
2. Layer of rods and cones
3. External limiting membrane
4. Outer nuclear layer
5. Outer plexiform layer
6. Inner nuclear layer
7. Inner plexiform layer
8. Ganglion cell layer
9. Nerve fibre layer
10. Internal limiting membrane

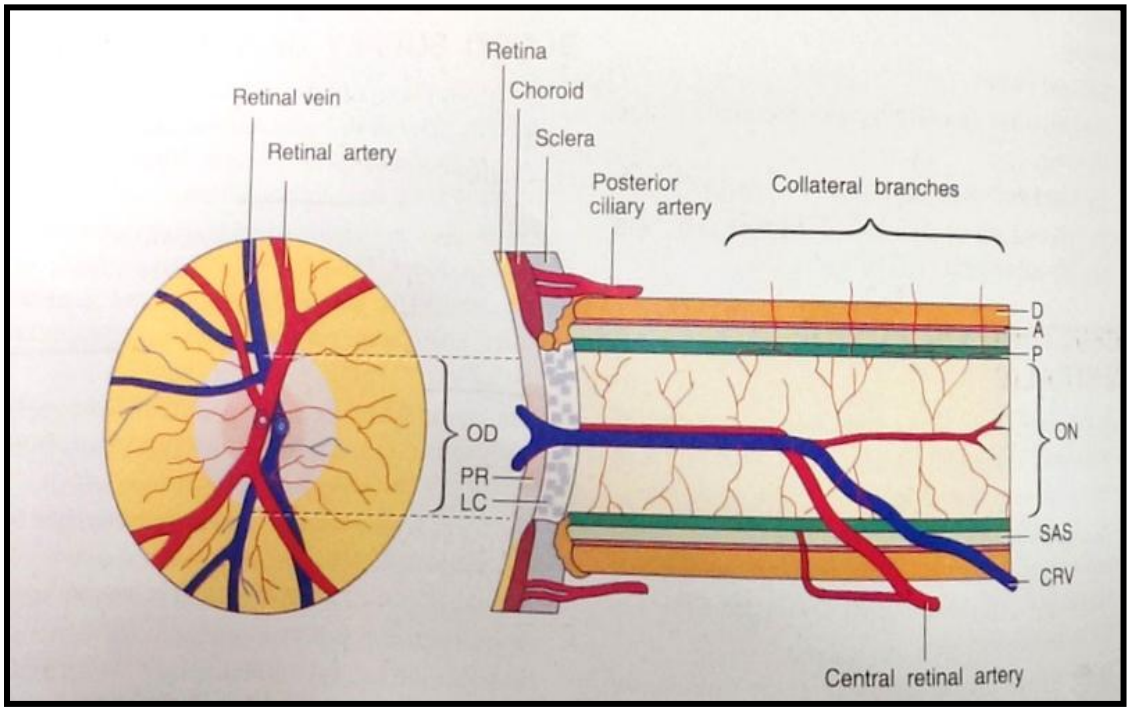

Fig 3:Central retinal artery

The retinal vessels are derived from the central retinal artery and vein which usually divide into 2 branches at or near surface of the disc to form a superior and an inferior trunk. Each trunk divides into two one of which sweeps up towards temporal side, the other up towards nasal side. The four terminal branches of central retinal artery divide dichotomously as they proceed towards towards ora serrata where they end without anastomosis.[13] Arteries are distinguished from veins by being brighter red and narrower. Veins have purple tint and more often convulated.

The retinal veins follow the pattern of the retinal arteries. They drain into cavernous sinus directly or through the superior ophthalmic vein. The only place where retinal system anastomosis with ciliary system is in region of lamina cribrosa.

Ophthalmoscopically what is seen is the blood column and not the vessel wall, which is normally transperant[9]. All retinal vessels may have bright silvery streak running longitudinally down the centre which is more prominent with arteries due to reflection of light from the convex cylindrical surface. The diameter ratio of vein to the arteriole is normally 3:2.The best place to make this determination is about 1 disc dioptre distance from the disc margin, using either the superior temporal vessels or the inferior temporal vessels.[5,10]

In normal condition, no pulsation can be seen in the retinal arteries. 80-90% of people have visible venous pulsations seen at or near the edge of the disc or indeed, wherever the veins take a sharp bend due to effect. This is due to intraocular pressure.[11] The venous pressure is lowest near the disc and there is a certain amount of obstruction to the flow of blood as vessels pass

through the narrow neck of lamina cribrosa. With each arterial pulsation, the intra ocular pressure is slightly raised so that the increased pressure on the outside of the walls of the veins tends to make them collapse. This causes a sudden increased obstruction to the outflow of blood from eye during systole, but venous circulation recovers itself during arterial disastole.[7]

SIGNIFICANCE OF FUNDOSCOPY IN PRE-ECLAMPSIA

Landesman R.et al,stated that the fundus are best single indicator of the progress of the toxemia.Retinal changes are generally associated with severity of the hypertension and evaluation of pre-eclampsia[5,11,12]

Mussey RD and Mundell BJ,concluded that examination of fundus in patients with PIH permits an objective assessment of vascular changes and provides a basis for further obstetric management.[13] Riss B et.al stated that fundus examination helps in identifying early fetal outcome.[18]

PRE-ECLAMPSIA

Hypertensive disorder of pregnancy which includes preeclampsia affects virtually every organ system. Hypertensive disorders complicate 5 to 10 percent of all pregnancies[3]. Pre eclampsia is identified in 3.9% of all pregnancies.

Pre eclampsia is defined as presence of hypertension and proteinuria after 20 weeks of pregnancy. Pre eclampsia affects 5% of primigravida and 10% in multigravida[15,16]. It is characterised by endothelial dysfunction and vasospasm of vessels[3]. Preeclampsia is cause of maternal mortality of 17.2% and causes 22% of foetal mortality.[17] Studies have shown that maternal mortality rate in preeclampsia is upto 16% in developed countries.[3,18]

CLASSIFICATION OF PRE ECLAMPSIA

The diagnosis of hypertensive disorders complicating pregnancy was out lined by working group of the **National High Blood Pressure Education Program (NHBEP), 2000** based on many factors , one being the severity of hypertension as follows[3]

Gestational hypertension:

1) BP > 140/90 mm Hg for first time during pregnancy

2) No Proteinuria

3) BP returns to normal < 12 wks post partum

4) Final diagnosis made only post-partum

5) May have other signs of pre eclampsia e.g. epigastric discomfort or thrombocytopenia.

Preeclampsia:

1. Minimum Criteria

a) BP > 140/90 mmHg after 20 wks gestation

b) Proteinuria >300mg/24hr or >1+dipstick

2. Increased certainty of preeclampsia

a) BP >160/110mmHg

b) Proteinuria 2.0gm/24Hb or >2+dipstick

c) Serum Creatinine >1.2gm/dl unless known to be previously elevated

d) Platelets < 1,00,000/mm3

e) Microangiopathic hemolysis (increase lactate dehydrogenase)

f) Elevated alanine aminotransferase or aspartate aminotransferase

g) Persistent headache or other cerebral or visual disturbance

h) Persistent epigastric pain

Eclampsia:

Seizures that cannot be attributed to other causes in women with pre eclampsia.

Super imposed pre eclampsia (on chronic hypertension):

New onset proteinuria >300mg/24hrs in hypertensive woman but no proteinuria before 20 weeks of gestation. A sudden increase in proteinuria or blood pressure or platelet count <1,00,000/mm^3 in women with hypertension and proteinuria before 20 weeks gestation.

Chronic hypertension:

BP >140/90mmHg before pregnancy or diagnosed before 20 weeks gestation Or Hypertension first diagnosed after 20 weeks gestation and persistent after 12 weeks post-partum.

AETIOPATHOGENESIS OF PRE ECLAMPSIA

Inspite of vast amount of research the etiology of pre eclampsia still remains unsolved. It is likely that abnormal changes which characterize toxemia of pregnancy might be precipitated by a number of different stimuli in individuals who by some unknown mechanism have appeared to respond by developing sodium and water retention, hypertension, altered renal functions and convulsions.

Pre eclampsia is associated with vasospasm and pathological vascular lesions in multiple organ systems including the uteroplacental vascular bed, increased platelet activation with platelet consumption and subsequent activation of coagulation system in microvasculature.

Risk factors- pre eclampsia[19]

1. Primigravide (young and elderly)
2. Family history
3. Placental abnormalities
    a. Poor placentation- decreased trophoblast invasion
    b. Hyperplacentosis
    c. Placental ischemia
    d. Molar pregnancy
4. Genetic
5. Immunologic phenomenon
6. New paternity
7. Pre existing vascular or renal disease
8. Thrombophilias

Changes occuring in normal pregnancy:

Increased vasodilatation

Decreased platelet aggregation

Increased uteroplacental blood flow

Changes in pre eclampsia:

1. Increased vasoconstriction ⇨ hypertension
2. Decreased organ perfusion:
    a. Uteroplacental ⇨ IUGR
    b. kidneys ⇨ oliguria
    c. liver ⇨ ischemia
    d. Brain ⇨ seizures
3. increased vascular permeability ⇨ oedema, proteinuria
4. activation of coagulationsystem ⇨ thrombocytopenia
5. Haemoconcentration

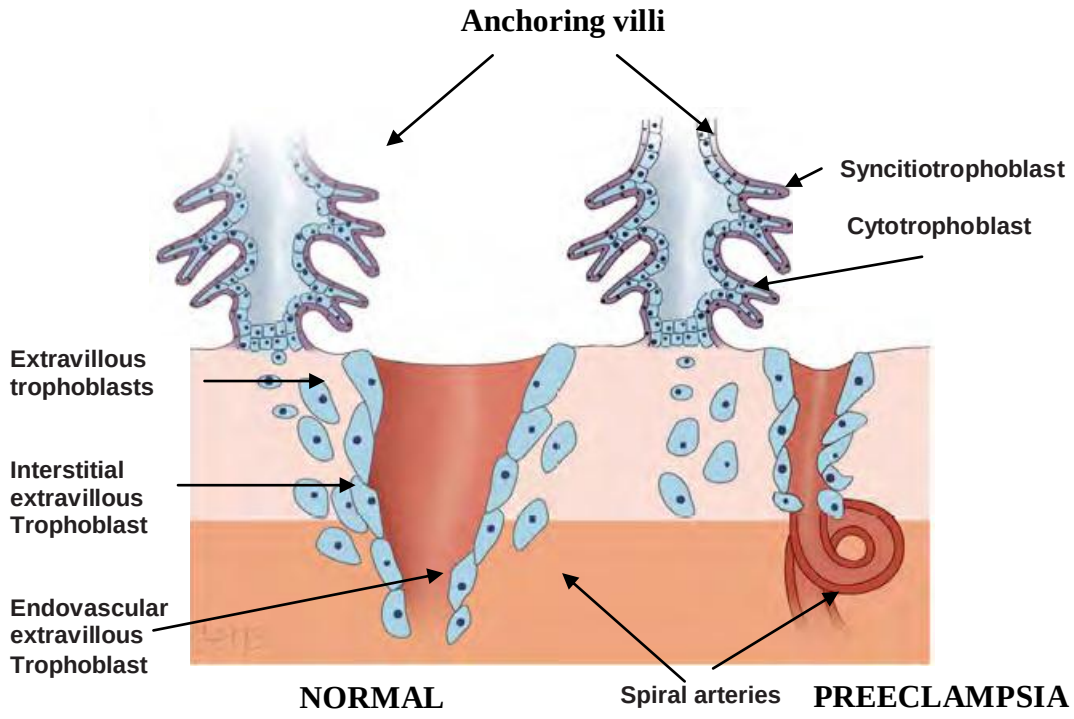

Fig 4: Abnormal placentation [3]

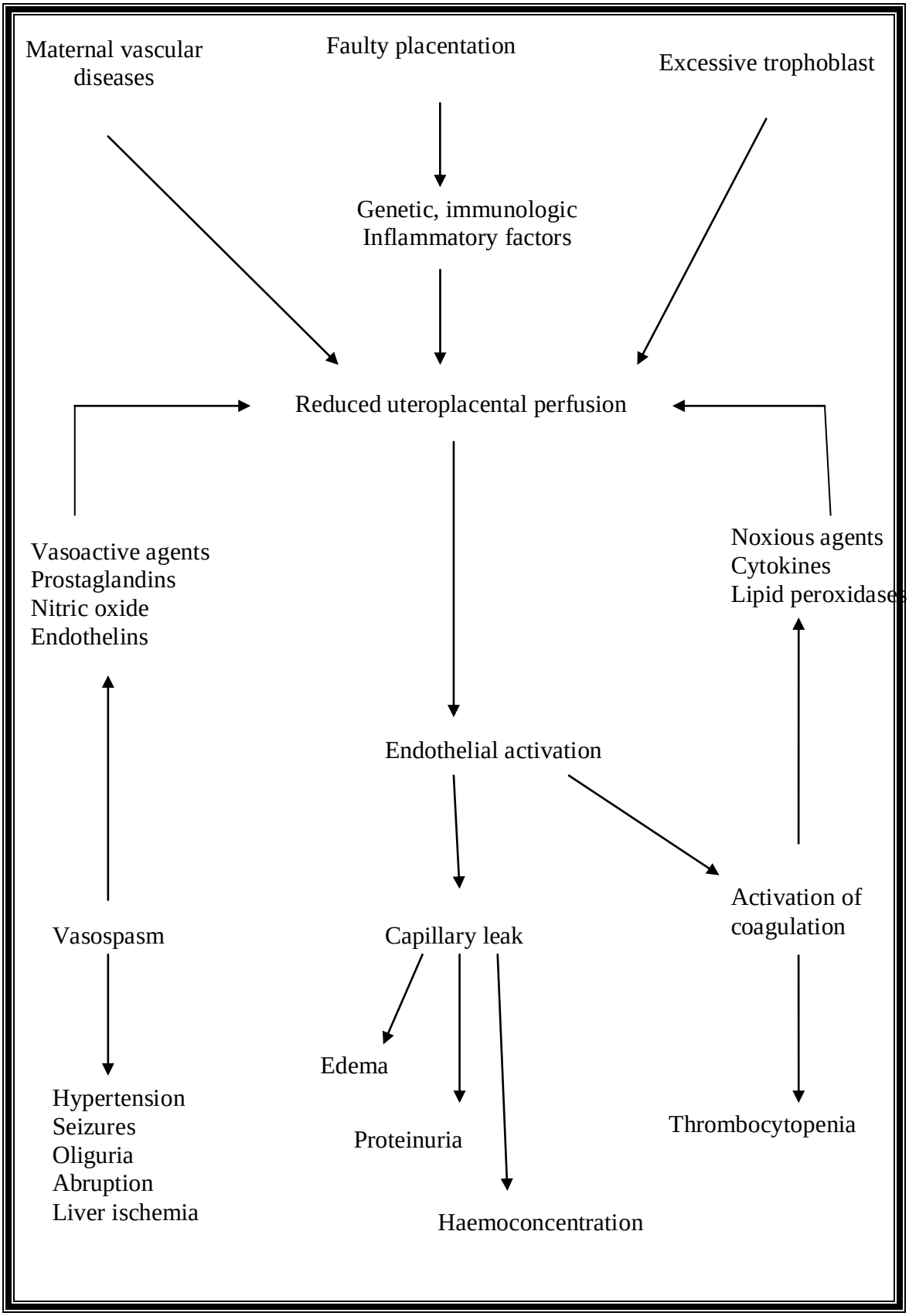

Fig. 5. Etiopathogenesis of pre eclampsia

Pre eclampsia is characterised by endothelial dysfunction and vasospasm. The severity of retinal arteriolar changes is more closely related to degree of underlying vasospasm and may or may not be associated with blood pressure. Vasospasm results from imbalance between vasodilators and vasoconstrictors.

In normal individuals endothelial derived relaxing factor (EDRF) is constantly released at low levels and controls the blood pressure. In pre eclampsia the endothelial cells suffer considerable injury due to the toxic lipid peroxides and free radicals, which leads to reduction of EDRF.[14] Injured endothelium produce vasoconstrictors, increased membrane permeability, clot formation, vasospasm and blood vessel remodeling. This vital response to disruption of vascular integrity can cause serious physiologic disturbances.[3]

The concept of vasospasm was advanced by Volhard (1918) based on his direct observations of small blood vessels in the nail beds, ocular fundi, and bulbar conjunctivae. Vascular constriction causes increased resistance and subsequent hypertension.[20] At the same time, endothelial cell damage causes interstitial leakage through which blood constituents, including platelets and fibrinogen, are deposited subendothelially.

Wang and colleagues (2002) have also demonstrated disruption of endothelial junctional proteins. Suzuki and co-workers (2003) described ultrastructural changes in the subendothelial region of resistance arteries in preeclamptic women. With diminished blood flow because of maldistribution, ischemia of the surrounding tissues would lead to necrosis, hemorrhage and other end-organ disturbances characteristic of the syndrome.[3] Due to vasospasm, the vascular endothelial damage in systemic and uteroplacental circulation causes

enhanced platelet activation and fibrin generation and there is significant decrease in platelet levels in pre eclampsia as platelets are used in intravascular coagulation.

In pre eclampsia, the refractoriness to vasoactive agents is lost first followed by the loss of vasoconstriction, which results in a decrease in intravascular volume, which in turn, shunts to the extravascular spaces. There is also an imbalance between proangiogenic and antiangiogenic factors during preeclampsia. The two important antiangiogenic factors implicated in preeclampsia are soluble vascular endothelial growth factor (VEGF) and soluble endoglin. Nitric oxide signaling is involved in vascular relaxation and is reduced in pre eclampsia.[21,22]

In pre eclampsia, there is an **imbalance** in different components of prostaglandins- relative or absolute deficiency of vasodilator prostaglandins(PG I_2) from vascular endothelium and increased synthesis of thromboxane(TXA_2), a potent vasoconstrictor in platelets. There is increased vascular sensitivity to the pressor agent angiotensin 2. Angiotensinase activity is depressed, following proteinuria with elimination of α_2 globulin.[3]

Nitric oxide synthesised in the vascular endothelium and syncytiotrophoblast from L-arginine. It significantly relaxes vascular smooth muscle, inhibits platelet aggregation and prevents intervillous thrombosis. Deficiency of nitric oxide contributes to development of hypertension.[19] **Endothelin-1** synthesised by endothelial cells and it is potent vasoconstrictor compared to angiotensin 2. It also contributes to the cause of hypertension.[19] **Inflammatory mediators** cytokines[tumor necrosis factor (TNFα), interleukins(IL-6) and others] derieved stress. Lipid peroxides, reactive oxygen species(ROS) and superoxide anion radicals- causes endothelial injury and dysfunction. Platelet and neutrophil activation, cytokines, superoxide radical production and endothelial damage are in a vicious cycle.[19]

Diagnosis of pre eclampsia

HYPERTENSION is diagnosed empirically when appropriately taken blood pressure exceeds 140 mm Hg systolic or 90 mm Hg diastolic. Disappearance of sounds while measuring, Korotkoff phase V is used to define diastolic pressure.[3] A rise of 20mmHg of mean arterial pressure over the previous reading or when mean arterial pressure is 105mmHg or more should be considered significant. Blood pressure is measured on the right arm,with the patient lying on her side 30 degree to the horizontal. Usually measured in sitting posture and the occluded brachial artery should be kept at the level of heart.[19]

EDEMA is also no longer used as a diagnostic criterion because it is too common in normal pregnancy to be discriminant.[3] Edema is a classic feature of the disease, however it is no longer considered as a diagnostic feature given its lack of sensitivity or specificity.[21,22] The cause of excessive accumulation of fluids in the extracellular tissues is not clear. The most probable explanation given is the increased oxidative stress causes endothelial injury which causes increased capillary permeability.

PROTEINURIA is the surrogate objective marker that defines the system wide endothelial leak, which characterizes the pre eclampsia syndrome. Even so, when blood pressure increases appreciably, it is dangerous to both mother and fetus to ignore this rise because proteinuria has not yet developed. Proteinuria is defined by 24-hour urinary protein excretion exceeding 300 mg, a urine protein:creatinine ratio of $\geqq$ 0.3, or persistent 30 mg/dL (1+ dipstick) protein in random urine sample.[3] These were described by Lindheimer and colleagues in 2008. The probable chain of events is as follows. Spasm of the afferent glomerular arterioles ⇨ anoxic change to the endothelium of the glomerular tuft ⇨glomerular endotheliosis ⇨ increased capillary

permealbility⇨increased leakage of proteins. Tubular resorption is simultaneously depressed.[19]

Urine concentrations vary widely during the day, and so too will dipstick readings. Thus, assessment may even show a 1+to 2+ values from concentrated urine specimens from women who excrete < 300 mg/day. It is likely that determination of a spot urine creatinine ratio will be a suitable replacement for a 24-hour measurement.[19]

HYPERURICAEMIA is established marker of severe pre eclampsia, correlating histologically with severity of renal lesions and clinically adverse fetal outcome. Elevated uric acid levels are one of the most consistent and earliest detectable changes in preeclampsia and have been reported as a better predictor of fetal risk than blood pressure. It has also been speculated that hyperuricemia contributes to the vascular damages in pre eclampasia.[23] It is significantly associated with higher rate of all maternal complications and small for gestational age babies than babies with lower average birth weights than normal plasma uric acid levels.[24] It remains a useful marker of pre eclampsia, but women with normal serum uric acid levels and preeclampsia may still develop complications.

OCULAR CHANGES IN PRE-ECLAMPSIA

Chloasma

Called mask of pregnancy is blotchy,brown discolouration that can occur around the eyelids. It is caused by increased pigmentation related to increased estrogen and progesterone. These changes tend to fade in the postpartum period.[25]

Ptosis

Often unilateral, has been reported in pre eclampsia. Result of defects that develop in the levator aponuerosis, due to fluid retention and hormonal changes. It requires no treatment.[25]

Cornea

Corneal sensitivity has been found to decrease in most pregnant women and it usually returns to normal by eight weeks postpartum. This can be related to an increase in corneal thickness and curvature caused by corneal edema.[28, 30] These changes occur later in pregnancy and produce temporary alterations in refraction,and contraindications to refractive surgery.[26]

One study showed decrease in tear production occurred during the third trimester of pregnancy in approximately 80% of pregnant women. The alteration of dry eye maybe due to disruption of lacrimal acinar cells.[27]

Intraocular pressure and visual fields

Decrease in IOP is reported.[25] In patients with ocular hypertension, it may greatly decrease. Possible mechanisms include increased aqueous outflow, decreased episcleral venous pressure, decreased sclera rigidity and generalized acidosis during pregnancy.[28]

Changes in visual fields have been reported occasionally. The studies conducted report findings of concentric constriction, bi temporal constriction, homonymous hemianopia and central scotoma. The proposed mechanism of is an increase in size of the pituitary gland but only when affecting the optic chiasma.[25]

Conjunctiva

Fundamental work of Lee and Holze on the bulbar conjunctival vessels showed changes in vessels in pre eclampsia.[29]

Knisely and his co workers described reduction of flow rate in conjunctival vessels and granularity in vessels.[30] This granularity reaches a peak at about the same time that the reduction in flow rate is at the maximum. Changes in plasma protein by increase in globulin and reduction in albumin may be partly be responsible for granular appearance.[31,32]

In normal pregnancy, there are gradual changes in the vascular pattern and characteristics of flow. In the first trimester, the arteriolar flow is very rapid, the venules are filled and the capillary beds clearly visualized. After the twentieth week, there is a gradual reduction in the rate of blood flow. This slowing appears maximum several weeks before labour, during labour and in the first three days postpartum. Concomitantly with the

reduction in the flow rate, there is appearance of granularity in the venules.[10,29]

In toxemia of pregnancy, ischemia of the capillary bed is seen in the peripheral vascular bed. As term approaches, number of capillaries visualized gradually reduces. In severe pre eclampsia, localized areas of the capillary bed in the bulbar conjunctiva for all practical purpose may completely become absent. In first 6 months of normal pregnancy, there is no evident arteriolar spasm in the conjunctival vessels. Vasomotion, which is fine wave like activity, may be seen in vessels. In 20% of the normal patients, a mild spasm may be noted in the last trimester, during labour and last week of postpartum. The period of pregnancy, in which spasm is first noted, maybe significant. The presence of moderate spasm in the first trimester is indicative of hypertensive disease. In toxemias that occur late in pregnancy, the arterioles become extremely attenuated and are thinned out due to generalized hypertonicity of the vessel wall, bulbs and areas of spasm are not discernible because of incomplete filling of the vessels. In eclampsia, area of conjunctiva show complete blanching.[5,11]

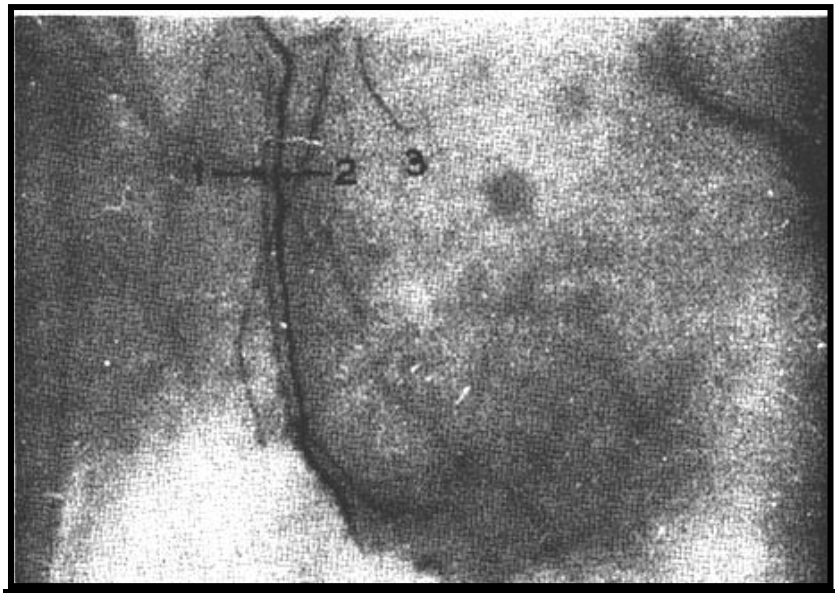

Photo 3: Changes in conjunctival vessels

1.arteriole 2.venule 3.capillary bed

Lens

The curvature of crystalline lens can increase causing a myopic shift in refraction. A transient loss of accommodation has been seen during and after pregnancy.[25]

Effect on vision

The visual system in pre eclampsia may be affect 30-100% of the patients.[15,33] Visual symptoms is seen in 25% of patients with severe pre eclampsia and 50% of patients with eclampsia.[21] Blurred vision is the most frequent symptom. Other signs such as photophobia, visual spots, sudden inability to focus and diplopia seen may be attributed to post cerebral artery with vasospasm with ischemia or cerebral edema in the occipital area.[15,22]

Although visual disturbances are quiet common, complete blindness is rare, with an incidence of 1–3%.[12] Blindness in pre eclampsia/eclampsia syndrome can be due to the involvement of the occipital cortex, retina or optic nerve. In the past, most cases of blindness in pre eclampsia and eclampsia were commonly attributed to retinal pathology including vascular abnormalities, edema or detachment and acute ischemic optic neuropathy as a result of decreased blood supply to the pre laminar portion of the optic nerve. Nowadays, more emphasis is being placed on cortical blindness.[12]

If visual loss is present in pre eclampsia and the fundus examination is normal, it usually recovers over period varying from 4 hours to 8 days, although bilateral inferior scotoma and visual field defects have been reported to perists for several months postpartum.[26]

Hypertensive retinopathy

Hypertension is associated with cardiovascular risk and systemic target organ damage. Retinopathy is considered one of the indicators of target organ damage.[34] Retinopathy consists of a spectrum of retinal vascular changes that are pathologically related to both transient and persistent microvascular damage from elevated blood pressure.The primary response of the retinal arterioles to systemic hypertension is narrowing (vasoconstriction).[34]

From 1895 to 1924, various authors reported the presence of retinal haemorrhages and transudates in toxemia of pregnancy. Volhard in 1921 was responsible for theory that these retinal changes resulted from arteriolar spasm which produced areas of ischemia and secondary hemorrhage. Prior to that date, the general impression was that the retinal abnormalities were related to renal disease and associated albuminuria. Haselhorst and MyliusO clearly recognized the presence of localized and diffuse arteriolar spasm which was reversible in eclampsia.[5, 11]

The effect of hypertension extends to involve the vasculature of the retina, choroids and optic nerve head.[35] Jaffe and Schatz found significant relationship between reduced arterioles to vein ratio and pre eclampsia suggesting retinal vasospasm and resistance to blood flow as a possible explanation for visual symptoms.[36]

Addis accepted the hypothesis that arterial spasm is a frequent pathogenic factor underlying and uniting the various symptoms of late toxemia. He suggested that these manifestations are the result not of varying causes but of the kind of tissue on which the single cause acts and that vascular spasm is the factor, which underlies and unites all the manifestations of pre eclampsia and eclampsia.[13]

Spasm of retinal arterioles

Retinopathy occurring during toxemia of pregnancy generally shows the features of hypertensive retinopathy [36].The first changes observed in the normal retinal arterioles during the toxemia of pregnancy is attenuation of retinal arterioles. It is associated with a rise in the diastolic blood pressure. This attenuation usually occurs first in the nasal periphery but gradually spreads towards the disc and become generalized. Once it has developed it usually persists until pregnancy is terminated.[36,38]

In generalized arteriolar constriction instead of the normal diameter ratio of vein to arteries i.e. 3:2, in toxemia the arterioles are constricted so that the ratio is 2:1. As the severity of the toxemia progress, the arterioles are usually seen to become more constricted until the ratio increases to 3:1 or more. In estimating the vein arteriole ratio, the examiner compares the diameter of a principal vein and its corresponding arteriole.[36]

Arteriolar narrowing is the defining quality of hypertensive retinopathy and is due to vasoconstriction as an autoregulatory response. Vasoconstriction can be regarded as an autoregulatory attempt to control the volume of blood received by the retinal capillary bed. It is most commonly seen in the early phase of hypertension.[36]

Haselhorst and Mylius in 1928, and Masters and Hallum later recognized marked retinal spasm which was at times transient or persistent, localized or diffuse. They associated this with severe toxemia and the arterial spasm was found to antedate retinopathy. After the pregnancy the spasm disappeared in many cases.[5]

Wagener in 1933, reported the study of a series of 40 cases of hypertensive toxemia of pregnancy and concluded that spastic lesions of the arterioles were the most frequent and usually the primary sign of retinal involvement.[5]

Retinal vasoconstriction is the most obvious fourth sign in preeclampsia along with classic symptom triad of hypertension, edema and proteinuria. Toxemia of pregnancy in its earlier stages is associated with angiospasm and increased tonus of the central retinal arterioles. The retinopathy, which develops in its later stages, is characterized by the presence of hemorrhages and exudates frequently accompanied by edema. Masters in 1933, found a passive congestion of the retinal veins in the early months of pregnancy. He noted arteriolar spasm in most toxemias with systolic blood pressure over 150 mmHg and in only several was spasm noted with a blood pressure below 150.[5,36]

CLASSIFICATION OF RETINAL ARTERIOLAR SPASM[10]

Classification of retinal arteriolar spasm is based on the degree of arteriorlar spasm and usually indicates the severity and duration of toxemia.[15]

GRADE 1: the spasms are localized in nature, maybe limited to one points. They are usually seen in the proximal portion of the arterioles. The general diameter ratio of vein to arteriole is the normal ratio of 3: 2, or there might be a slight increase in this ratio.

GRADE 2: the aretrioles show a generalized constriction so that the diameter ratio of vein to arteriole 2: 1.usually there are also localized constrictions of the arteriole.

GRADE 3: the degree of generalized arteriolar constriction is increased. Until the diameter ratio of vein to arteriole is 3: 1.Fine localized constrictions in the arterioles are usually present, but are difficult to distinguish.

GRADE 4: the degree of generalized arteriole constriction is progressed until the diameter ratio of vein to arteriole is 3: 1 or more, and there is some degree of retinopathy.

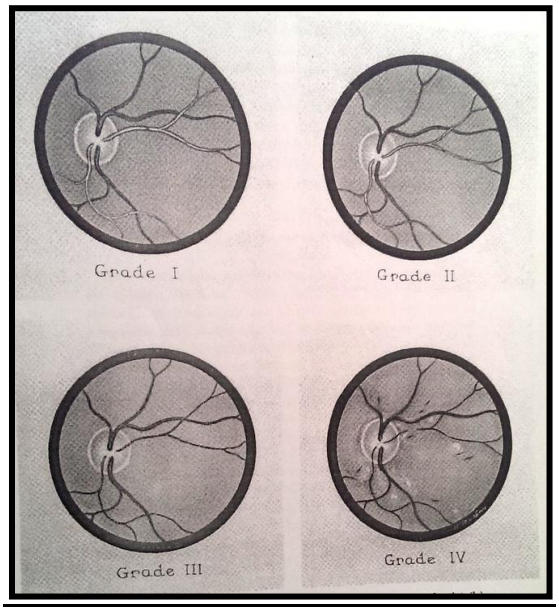

Fig 6 : Classification of arteriole spasm[10]

GRADING OF HYPERTENSIVE RETINOPATHY KEITH WAGENER'S CLASSIFICATION [13,39]

Grade 1 : Mild-to-moderate narrowing or sclerosis of the arterioles

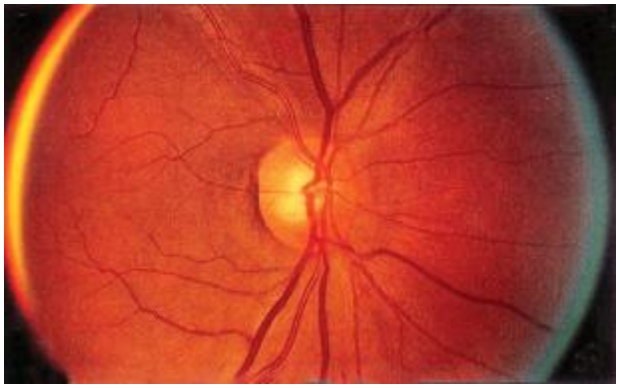

Photo4: Grade 1 hypertensive retinopathy[39]

Grade 2 - Moderate to marked narrowing of the arterioles

Local and/or generalized narrowing of arterioles

Exaggeration of the light reflex

Arteriovenous crossing changes

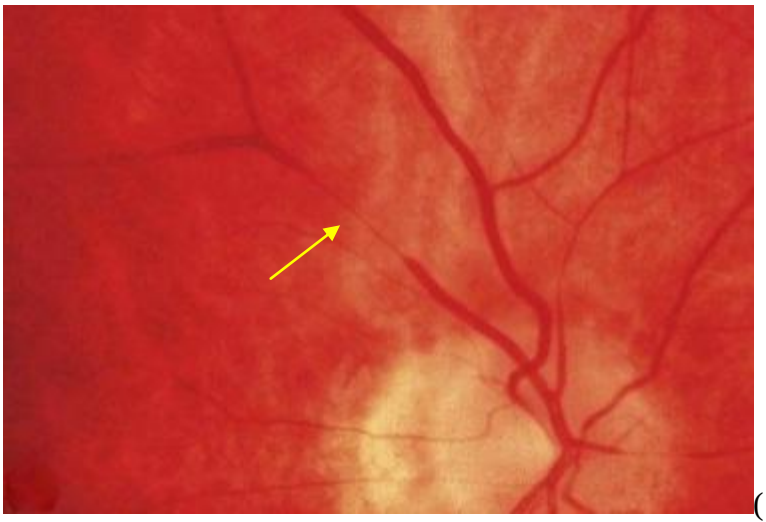

Photo 5: Grade 2 retinopathy with Focal arteriolar attenuation[39]

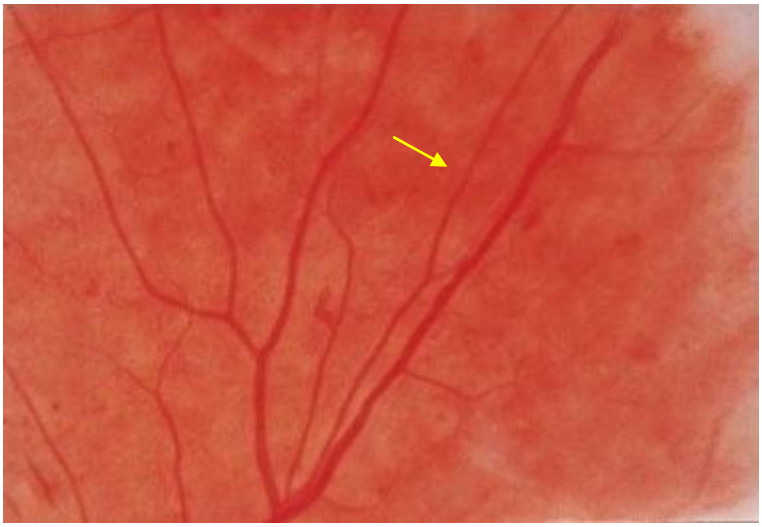

Photo 6: Grade 2 hypertensive retinopathy with generalized arteriolar attenuation[39]

Grade 3 - Retinal arteriolar narrowing and focal constriction

Retinal edema

Cotton-wool patches

Hemorrhage

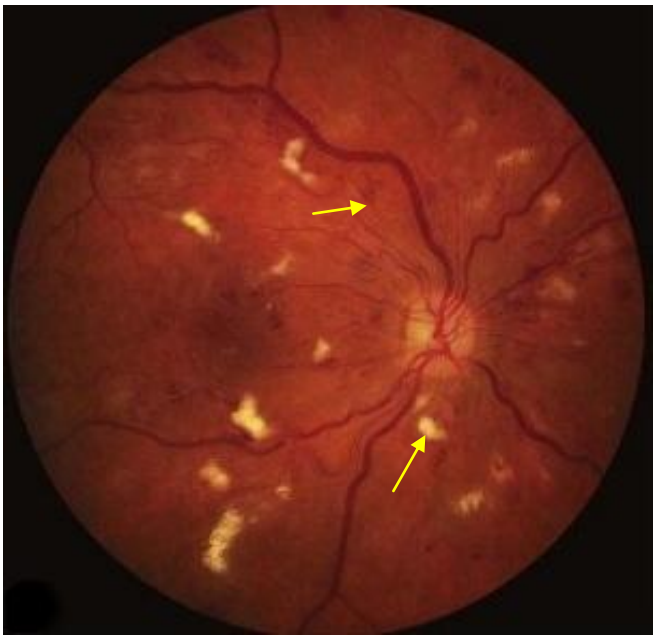

Photo7: Grade 3 hypertensive retinopathy[3]

Grade 4 - As for Grade 3, plus papilledema

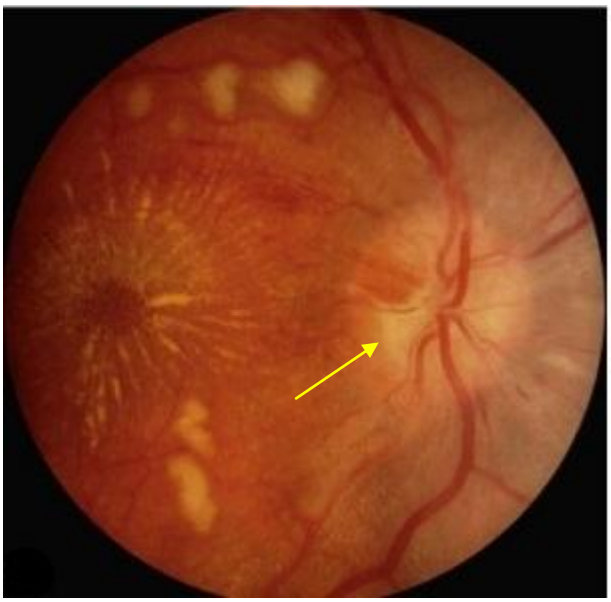

Photo 8: Grade 4 hypertensive retinopathy with papilloedema[39]

Changes occuring at arteriovenous crossings[10,38]

Due to vasospastic changes occurring in vasculature of retina, changes do occur at arteriovenous crossings. Arteriolosclerosis involves thickening of the vessel wall characterized histologically by intimal hyalinization, medial hypertrophy and endothelial hyperplasia.[39]

The most important clinical sign is the presence of changes at arteriovenous crossings. Mild changes at arteriovenous crossings are seen in patients with involutional sclerosis in the absence of hypertension. The presence of generalized retinal arteriolar narrowing and possibly arteriovenous nipping are related to previously elevated blood pressure, independent of current blood pressure level.

The grading of arteriolosclerosis is shown as follows[39]

Grade 1: subtle broadening of the arteriolar light reflex, mild generalized arteriolar attenuation, particularly of small branches, and vein concealment.

Grade 2: obvious broadening of the arteriolar light reflex

Deflection of vein:

The artery and vein shares a common adventitial sheath surrounded by a glial tissue with fusion of basement membrane and surrounding muscular layer. Normally at crossing of the vessel there is no evidence of their depression or elevation. In hypertension, there is a deflection in the course of the vein which is called **salu's sign**.[38]

The usual type of deflection in hypertension is lateral. Instead of crossing under artery obliquely, the veins do so at right angles taking apparently the shortest possible route.[38]

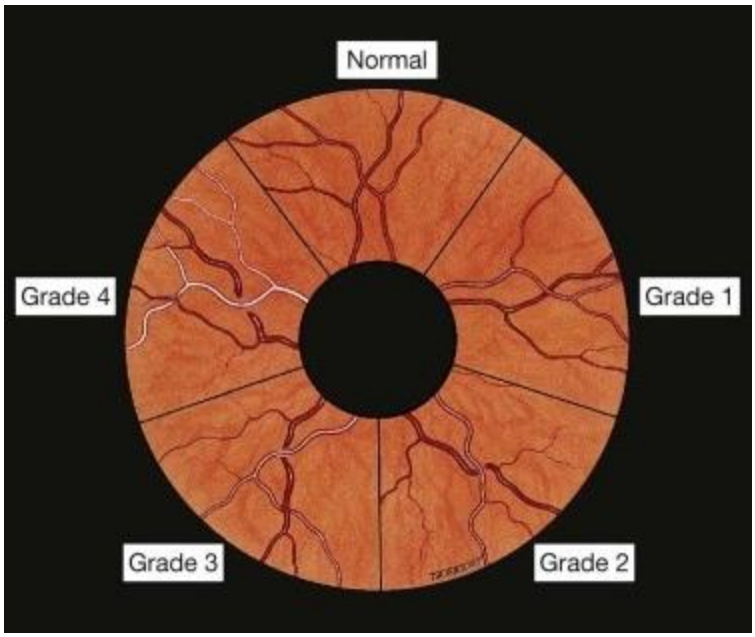

Fig 7: Grades of arterio-venous changes[39]

Grade 3:

- 'Copper-wiring' of arterioles
- **Compression of the vein**: Banking of veins distal to arteriovenous crossings (**Bonnet sign**). Banking of blood column distal to the crossing is seen in the advanced stages of hypertension.[38]
- Tapering of veins on both sides of the crossings (**Gunn sign**) and right-angled deflection of veins.

  Simple nicking – when there is simple deflection of the vein out of its course.[38]

  Moderate nicking – when vein appears to be partially cut and blood column is obstructed and banked upon the peripheral side of the crossing.[38]

  Definite nicking – when the vein is apparently completely cut leaving a blank space on either side of the artery. The narrowing of the lumen is partly due to encroachment of the common vascular wall into the lumen of the vein and partly due to constriction of venous lumen partly due to an obstruction of the blood column by optical effects of thickened walls.[38]

GRADE 4: 'Silver-wiring' of arterioles associated with grade 3 changes.

Generalized arteriolar narrowing is the most common ocular finding in pre eclampsia syndrome. Areas of non perfusion or arterial and venous occlusive disease may also develop.[16]As retinal arterioles become more constricted there are signs of retinal ischemia, oedema of retina, haemorrhages and transudates. Vasoconstriction

and haemorrhagic changes may decrease blood flow, leading to choroidal ischemia. Choroidal dysfunction and primary choroicapillaries ischemia is the underlying mechanism which leads to compromised fluid transport by retinal pigment epithelium leading to accumulation of sub retinal fluid and consequent serous nuero sensory detachment.[40]

HELLP syndrome:

10% of women with severe pre eclampsia develop HELLP syndrome, characterized by hemolysis, elevated liver enzymes and low platelet count. Associated with poor maternal and fetal outcome, it includes bilateral serous retinal detachment with yellow/ white subretinal opacities and sometimes vitreous haemorrhages.[25]

Retinal detachment:

Retinal detachment is a rare complication of pre eclampsia afftecting 1-2% of patients with its severe form and 10% in of those with eclampsia.[41,42] It is unusual visual loss in pre eclampsia first described by Von Graefe in 1855. Soranus from Ephesus first described acute blindness in association with toxemia of pregnancy in 120 A.D. After the discovery of ophthalmoscope, retinal detachment associated with toxemia was described in 1856.

Among 8400 hospitilized pregnant women, schiotz in 1921 observed 680 with toxemia of pregnancy. Of these, 35 had fundus changes and three retinal detachment.[43] Landau et al in 1960 and Dornan et al in 1982 also reported cases with retinal detachment in pre eclampsia.[43]

It involves separation of the nuerosensory retina from the pigmented retinal epithelium and is one of the emergency situations in ophthalmology.[44] It is usually observed in absence of significant retinal vascular abnormities and retinal breaks. Hayreh et al suggested that serous retinal detachment in pre eclampsia may be caused by choroidal ischemia secondary to accelerated hypertension.[45]

Clinically presents with sudden loss of vision, seen bilaterally, bullous in nature. It can present at anytime of during pregnancy, mostly appear before or soon after delivery.[46] The pathogenesis is related to choroidal ischaemia secondary to an intensive arteriolar vasospasm.[41,42,47] Due to pre eclampsia, the choroidal vascular insufficiency can lead to lesions in retinal pigment epithelium which causes fluid transudation and focal retinal detachment depending on severity.[15] Trophoblasts are rich in thromboplastin and 90-95% of this procoagulant activity is present on the surface of the cells.In pre eclamptic patients and particularly in abruptio placentae, placental thromboplastin is released into the maternal circulation, interacts with coagulation factor VII and calcium ions resulting in activation of the extrinsic coagulation system. This is responsible for choroidal ischaemia and consequent retinal detachment.[15]

Some authors agree that presence of serous retinal detachment in mother has no prognostic implication on foetal life. Others however state that maternal and fetal prognosis are worse when there are fundoscopic alterations.[15,46] Majority of patients who manifest serous detachment during pregnancy, have and with clinical management completely recover within weeks after delivery, not needing any surgical intervention.[42,47] Spontaneous

resolution usually occurs within few weeks and visual prognosis is excellent. After delivery, the sub retinal fluid is reabsorbed by the retinal pigment epithelium and visual acuity should return to pre-detachments levels within weeks.[36] Some macular sequence may present specially in retinal pigment epithelium. Severe pre eclampsia may be left with permanent visual loss due to extensive retinal pigment epithelium necrosis.[36] Fluorescein angiographic findings support the hypothesis that retinal detachment in pre eclampsia is secondary to choroidal ischaemia from intense arteriolar vasospasm.[26]

Hypertensive choroidopathy

The relationship of choroidal changes and retinal detachment in toxemis of pregnancy was first described by Verdehaeme in 1911. Hypertensive choriodopathy is seen typically in young patients with pliable vessels that are not yet sclerotic from long term hypertension.[3]

Toxemia of pregnancy, renal disease, pheochromocytoma, accelerated hypertension and connective tissue disorder can manifest hypertensive choriodopathy.[48] In accelerated or malignant hypertension the arteries and arterioles of the choroids undergoes fibrinoid necrosis. Fibrinoid necrosis represents replacement of smooth muscle fibres by fibrin platelet and other plasma protein materials. It occurs when severe hypertension causes vessel wall damage from severe narrowing. This results in patchy non-perfused areas of choriocapillaries. The overlying retinal pigment epithelium appears yellow (focal ischemic infarcts) in acute phase and with time becomes irregularly pigmented with depigmented halos (Elschings spots). They are typically in mid periphery and in vicinity of the optic disc. In fluorescein angiography, choroidal vasculopathy is demonstrated by irregular filling patterns,

delay in filling time and areas of diffuse leakage or window defects depending on the stage of Elschings spot formation.[48] In patients with chronic hypertension, Siegerts streak are seen. They represent areas of hyperpigmentation overlying sclerotic choroidal arteries in compressed and attenuated choricapillaries. Seigerts lesions imply advanced generalized vascular sclerosis with poor prognosis. Acute hypertension has greater effect on the choroidal circulation than on retinal circulation. Much of the damage to the endothelium and musculature of the choroidal arterioles is the result of this increase in blood pressure that overwhelms the compensatory tone.[48]

Papilloedema

The optic nerve is enclosed upto lamina cribrosa within meningeal sheaths common to the brain. Hence any rise in intracranial pressure becomes equally evident. There is blurring of the margins of the optic disc. The blurring starts at upper and lower margin and extend around nasal side and at the end the temporal margin becomes blurred.[48]

Hypertensive optic neuropathy

Malignant hypertension can lead to optic nerve head swelling with plasma leakage and disruption of nerve fibres, which ultimately lead to loss of axons with subsequent gliosis. The pathophysiologic mechanism of hypertensive disc edema is controversial. Few propose that secondary encephalopathy is the mechanism of hypertensive papilloedema. Others believe that disc edema is secondary to ischemic changes of optic disc. Despite its complex vasculature, the optic nerve head is susceptible to ischemia by virtue of its tightly arranged nerve fibres within non expandable intrascleral canal. Both the mechanical factors and ischemia may play role in the development of disc edema in hypertensive optic neuropathy.[48]

Cortical blindness

Acute cortical blindness is one of the most dramatic presentations of pre eclampsia and is historically known to be reversible. Cortical blindness affects about 15% of pre eclampsia is often preceded by headache, hyperreflexia and paeresis.[49]

Davis and Dana studies in 2000 have demonstrated to have observed conjunctival vascular abnormalities, hypertensive retinopathy, exudative retinal detachment, vitreous and pre retinal haemorrhage, ischaemic optic neuropathy, hypertensive choroidopathy, reversible cortical blindness and extraocular palsy in patients with pre eclampsia.[48]

It is defined as blindness occurring in association with normal fundoscopy and pupillary function.[49] The exact mechanism of cortical blindness in pre eclampsia/ eclampsia is unclear. It may result from cerebral vasospasm and ischemic injury or it may arise from vasogenic edema due to increased capillary permeability. Previous reports suggested that cortical blindness in association with pre eclampsia/eclampsia may result from petechial hemorrhages and focal edema in the occipital cortex.[49,50]

Recently, single-photon emission tomography studies supported the finding that elevated capillary permeability and vasogenic edema are involved in patients with cortical blindness.[49] Cortical blindness is manifested in 1–15% of patients with severe preeclampsia and eclampsia.[50] It may occasionally be the first clinical symptom preceding seizures by 4–7 hours. Cortical lesions are usually bilateral and are often in the posterior cortical areas.[49]

Neuroimaging findings in cortical blindness range from normal to typical findings. Typically, there are bilateral cortical occipital lesions with hypodensity on computed tomography scan or hyperdensity on T2-weighted magnetic resonance imaging. Fortunately, blindness due to occipital lesions is reversible and the lost

vision is usually regained within 4 hours to 8 days.[49] Reversibility of lesions seen in parieto-occipital area has been documented on follow up imaging.

The constellation of findings- headache, seizures, cortical blindness and altered mental status associated with preeclampsia is referred to as reversible POSTERIOR LEUKOENCEPHALOPATHY SYNDROME.[26]

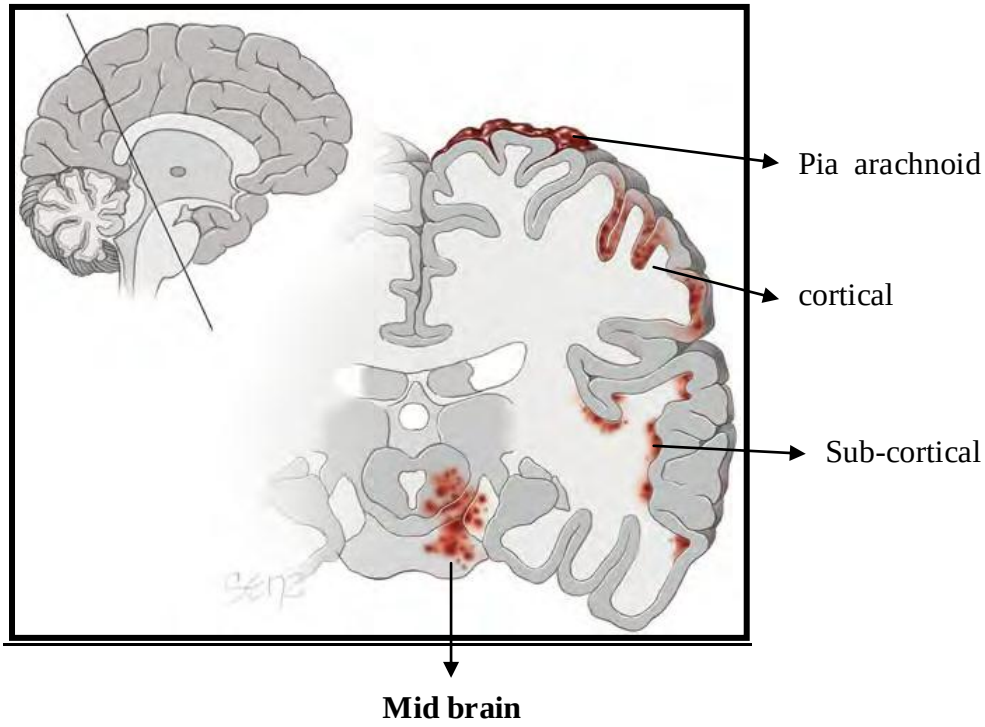

Fig 8 : showing location of cerebral hemorrhages and petechial in women with eclampsia[3]

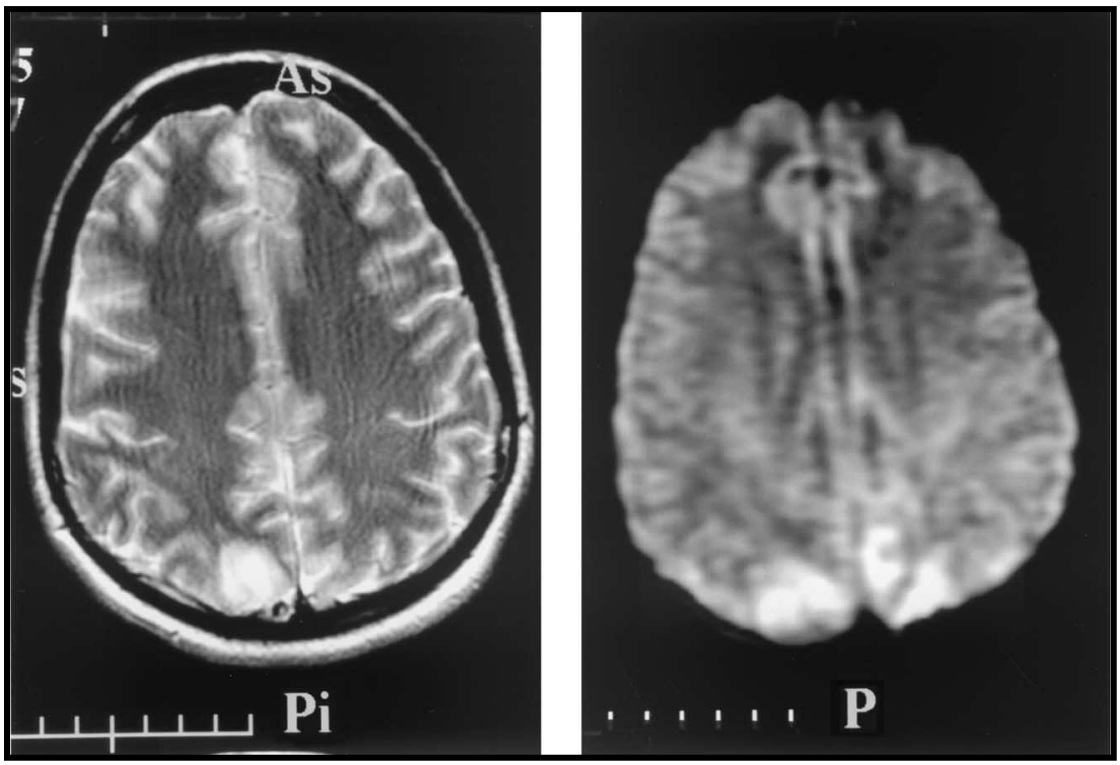

Photo 9: Magnetic resonance imaging in a patient with cortical blindness with contrast of the head and orbits revealed high intensity signals in both occipital lobes(left) T_2 weighted images and (right)diffusion weighted images.[49]

Central serous choroidretinopathy

This is characterised by the accumulation of subretinal fluid at the posterior pole of the fundus, creating a circumscribed area of serous retinal detachment. The onset of visual symptoms usually occurs during the third trimester in pre eclampsia. The woman typically develops metamorphopsia (image distortion), a positive scotoma and micropsia (images appear smaller) if the central macular area is involved, otherwise the woman is usually asymptomatic.[51]

Elevated levels of endogenous cortisol are thought to lead to increased permeability in the blood retinal barrier, choriocapillaries and RPE. White fibrous subretinal exudates are found in 90% of central serous choroidretinopathy in pre eclampsia.[51]

Purtscher like retinopathy

Obstruction by complement-induced leukocyte aggregation has been documented in immediate postpartum period of pre eclampsia.[26]

Late complications

Permanent changes include narrowing of arteriolar caliber, retinal pigment epitheliopathy and patches of choroidal atrophy.[52] Other late complications include proliferative retinopathy (PR). The occurrence of PR is rare and is thought to be a consequence of ischemia following micro thrombus formation in the periphery of the retinal microcirculation. The latter was related to hemorrhagic alterations and activation of the thromboplastin–fibrinogen system that occur in pre eclampsia.[53]

Rare ocular complications of pre eclampsia/eclampsia that have been previously reported include; choroidal infarcts, papillophlebitis, retinal artery and vein occlusion, ischemic optic neuropathy, optic atrophy, optic neuritis, thrombosis of the central retinal artery and purtscher-like retinopathy.[54]

ASSOCIATION WITH PREECLAMPSIA AND FETAL OUTCOME

Due to vasospasm of utero-placental circulation, it can affect growth of the foetus leading to intra uterine growth retardation (IUGR) and intra uterine death (IUD). In Pre-eclampsia, the vasospasm activity can be observed by an ocular fundal examination. Retinal haemorrhages in acute toxaemia is associated with a 33% fetal mortality rate.[20]

In benign hypertension with a blood pressure elevation at moderate levels (diastolic pressure of 90 to 109mmHg), minimal retinal arteriolar changes may be observed. If superimposition of toxemia does not occur, retinal observations are only of use as a baseline for the evaluation of later changes. In severe hypertension, in which the diastolic pressure is above 110 mmHg, the retinal arterioles contribute important information for fetal prognosis, and may indicate further exacerbation of the toxemic process. If albuminuria and severe hypertension are associated with Grade II retinal arteriolar changes (severe local and generalized spasm), fetal growth usually ceases and intrauterine death may be anticipated in an average of three weeks after the onset of superimposition.[5,11] The presence of Grade III changes in the retinal vessels associated with essential hypertension is a serious complication in patient. Hemorrhages and transudates associated with essential hypertension usually result in a 75% infant mortality.[5]

If chronic nephritis is associated with retinal arteriolar changes, the prognosis for a living infant is poor.[9] On the other hand, if albuminuria is present with good renal function and normal retinal vessels, the outlook for a live infant is good. When extensive renal disease is evident, essential hypertension is almost invariably associated with marked retinal arteriolar variations of Grade II or more. This combination should contraindicate pregnancy because of the hopeless prognosis for a

live infant and the usually short duration of maternal life. If the diagnosis of renal disease is made late in pregnancy the absence of retinal abnormalities is a good sign for the infant, whereas extensive retinal involvement will usually be associated with reduced fetal growth and intrauterine death.[11]

Hazards of fetal outcome in preeclampsia

The fetal risk is related to the severity of pre eclampsia, duration of disease and degree of proteinuria. The important hazards on fetal outcome:

Prematurity : Due to spontaneous preterm onset of labour or due to preterm induction. They are physiologically immature, compared to infants born at term and are at significant risk for a broad range of complications.[56] Neonatal and infant mortality rates are consistently higher in late-preterm infants than in term infants. The authors showed that mortality and the relative risk of death decreases with each increasing week in gestational age. Neonatal and infant mortality rates were 5.5 and 3.5 times greater in late pre term group.[56] Specifically, the infant mortality rates in pregnancies delivered at 34, 35, and 36 weeks gestation were 12.5, 8.7, and 6.3 times higher, respectively, compared to term (40 weeks) controls.[56]

Several studies have shown that late preterm infants are at increased risk for respiratory distress syndrome (RDS), transient tachypnea of the newborn (TTN), persistent pulmonary hypertension (PPHN) and respiratory failure compared to term infants . Evidence suggests that late-preterm infants have a nine times greater incidence of respiratory distress syndrome than term infants.[57]

Still born and intrauterine death due to spasm of utero-placental circulation leading to accidental hemorrhage or acute red infarction. Stillbirth represents an important cause of fetal loss in the late-preterm infant Although greater than 90% of fetal deaths occur in the first 20 weeks of gestation, the rate of stillbirth is approximately 3 per 1000 live births beyond 28 weeks gestation. Severe pre eclampsia represents significant risk factor for intrauterine fetal demise, with estimated stillbirth rate of 21 per 1000.[58]

Intra uterine growth retardation due to chronic placental insufficiency. Pregnancies complicated by intrauterine growth retardation, defined as a pathological process of reduced fetal growth, have been associated with an increase in perinatal mortality. Pre eclampsia, a condition characterized by decreased utero placental blood flow and ischemia, is a significant risk factor in the development of IUGR and represents the most common cause of IUGR in the nonanomalous infant.[60]

Hematological effects: Maternal pre eclampsia can result in neonatal thrombocytopenia, typically defined as a platelet count less than 150,000/uL. In pregnancies complicated by pre eclampsia, thrombocytopenia is generally identified at birth or within the first 2–3 days following delivery, with resolution by 10 days of life in most cases. The pathogenesis of thrombocytopenia among infants born to mothers with pre eclampsia is unknown. One potential mechanisms is that preeclampsia, and the resultant fetal hypoxia, has a direct depressant effect on megakaryocyte proliferation.[61]

In addition to the well-described effects of pre eclampsia on platelets, neonates delivered to women with pre eclampsia have a 50% incidence of neutropenia (defined as absolute neutrophil count less than 500 uL) The biological mechanism for pre eclampsia resulting in neonatal neutropenia has not been fully elucidated. One

potential mechanism is that pre eclampsia, and the resultant uteroplacental insufficiency, inhibits fetal bone marrow production of the myeloid lineage manifested by a decrease in neutrophil production.[61]

Asphyxia and bronchopulmonary dysplasia: pathophysiology of preeclampsia is poorly defined, evidence suggests that abnormal placentation, characterized by shallow invasion of the maternal arteries, compromises uterine blood flow at the expense of the growing placenta and fetus[62] The resulting hypoxia and ischemia may restrict fetal angiogenesis.[63]

Fetal origins of adult disease states: In utero development is characterized by rapid cellular and molecular growth. The ontological processes critical for maturation of the fetus are highly sensitive to alterations in the intrauterine environment . Ongoing evidence suggests that various adult disease states (hypertension, obesity, diabetes) may begin during fetal development, and the insults from preeclampsia exposure accrued during sensitive periods of development may predispose an individual to an increased risk of these disease in adulthood.[62]

Mussey and Mundell in 1939 concluded that persistent arteriolar spasm was a guide to the further management of the toxemia. These authors found varying retinal changes with similar blood pressure and in 44% of toxemia cases, the progressive retinal vessel spasm was the deciding factor in the decision to terminate pregnancy.[5] Wagener and Keith in 1939, further stressed the importance of arteriolar retinal spasm. They stated that diffuse angiospasm may produce sufficient vascular injury to contraindicate further pregnancy.[5]

Studies have shown that retinal changes in pre eclampsia may indirectly indicate the level of placental vascular status and hence, placental insufficiency and fetal birth weight.[35,44] Increasing spasm usually is indicative of a further advancement

in the toxemic process. However, any reduction in the spasm associated with severe pre-eclampsia does not necessarily mean improvement of the toxemic state. At times, a sudden decrease in arteriolar spasm may suggest early fetal death. Retinal hemorrhages and transudates are extremely rare in acute toxemia. Their presence indicates interruption of pregnancy to preserve maternal vision, and continuation of pregnancy will probably not improve the fetal survival rate. In our experience the presence of retinal hemorrhages in acute toxemia is associated with a 33% fetal mortality rate.[5,11]

Ophthalmoscopy is most useful in the diagnosis of severe essential hypertension. Evaluation of essential hypertension prior to, or early in pregnancy, to determine the chances of a successful outcome, should always include bilateral retinal observations. The presence of Grade II spasm, old hemorrhages, transudates, and silver wiring of the vessels indicates a poor prognosis for a living infant. If retinal hemorrhages are evident, pregnancy is contraindicated and therapeutic abortions should be performed.[9] Wagner, Schiotz, Masters and Hallum all agreed that retinopathy may be a definitive indication for interruption of the pregnancy.[5]

MATERIAL AND METHODS

MATERIALS AND METHOD

This study was conducted on patients diagnosed with pre eclampsia in the department of obstetrics and gynaecology at R. L JALAPPA HOSPITAL and RESEARCH CENTER attached to SRI DEVARAJ URS MEDICAL COLLEGE, Tamaka, olar. The duration of study was from December 2011- June 2013.

Inclusion critera:

Diagnosed cases of pre-eclampsia

Exclusion criteria:

1. Cases with pre-existing vascular/renal disease
2. Cases with systemic disorder like diabetes
3. Cases with underlying ocular co-morbidity like glaucoma or cataract
4. Cases with placental abnormalities
5. Cases with congenital defects in foetus
6. Eclampsia

Ethical clearance was obtained from institutional ethics committee. Patients who were willing to give informed written consent were included in the study. A proforma containing detailed information of each patient was designed according to study protocol. Patients underwent ocular examination including detailed clinical history on the presenting day and during antenatal follow upto 6 weeks post partum period. Patients advised for hospitalization were evaluated at the bedside. Patients were examined for pallor, pedal oedema, pulse, blood pressure and urine protein at the time of ocular examination. Patient's blood pressure was recorded before ocular examination and was carried out during each phase of evaluation.

The stable patients who could be mobilized to ophthalmology department underwent ocular examination which included visual acuity using Snellens chart, best corrected visual acuity, pupillary examination, slit lamp examination, and dilated fundal examination with direct and indirect ophthalmoscope. Optic nerve evaluation was done using Volk +90D lens.

Unstable patients were examined bed side. Torch light examination to rule out gross anterior segment abnormalities, visual acuity at bed side and fundoscopic examination with direct ophthalmoscope followed with indirect ophthalmoscopy.

One to two drops of 1% plain tropicamide eyedrops were instilled in both the cul-de sac. The patient was asked to apply digital pressure on lacrimal sac for 2-3 mins to avoid systemic absorption. Fundoscopic examination was carried out in semi dark room after 30 mins to allow full dilatation of pupil to achieve a clear view of fundus.

Interpretation of fundus examination:

The fundoscopic examinations of both eyes were documented. The hypertensive retinopathy was graded and staged according to **KEITH WAGNER classification**:[13,39]

Grade 1: mild-moderate narrowing or sclerosis of the arterioles

Grade 2: moderate to marked narrowing of the arterioles, Local and /or generalised narrowing of the arterioles,exaggeration of the light reflex, arteriovenous crossing changes

Grade 3: Retinal arteriolar narrowing and focal constriction,retinal edema, cotton wool spots, haemorrhages.

Grade 4: as Grade 3, plus papilloedema

The urine protein was tested by multiple reagent strip (dipstick) method as table below: [3]

Table no1. Grades of proteinurea

Trace	**0.1gm/L**
1+	**0.3gm/L**
2+	**1.0gm/L**
3+	**3.0gm/L**
4+	**10.0gm/L**

The fetal outcome was assessed under birth weight, APGAR score at 1 minute and 5th min, still birth and neonatal death.

The evaluation of new born assessment was done using modified **APGAR SCORING** system: [55]

Table no 2. APGAR Score

Sign	**0**	**1**	**2**
Heart rate	Absent	<100	>100
Respiratory effort	Absent	Slow,irregular	Good,crying
Muscle tone	Limp	Some flexion of extremities	Active motion
Response to catheter in nostril	No response	Grimace	Cough or sneeze
Colour	Blue,pale	Body pink, extremities blue	Complete pink

Assessment of fetal birth weight:[55]

Depending on the weight, the neonates are termed as low birth weight(less than 2500g) , very low birth weight (less than 1500g) or extremely low birth weight(less than 1000g). the aberrant growth pattern was assessed by plotting the weight against the gestational age on a standard gestational age on a standard intrauterine growth curve.

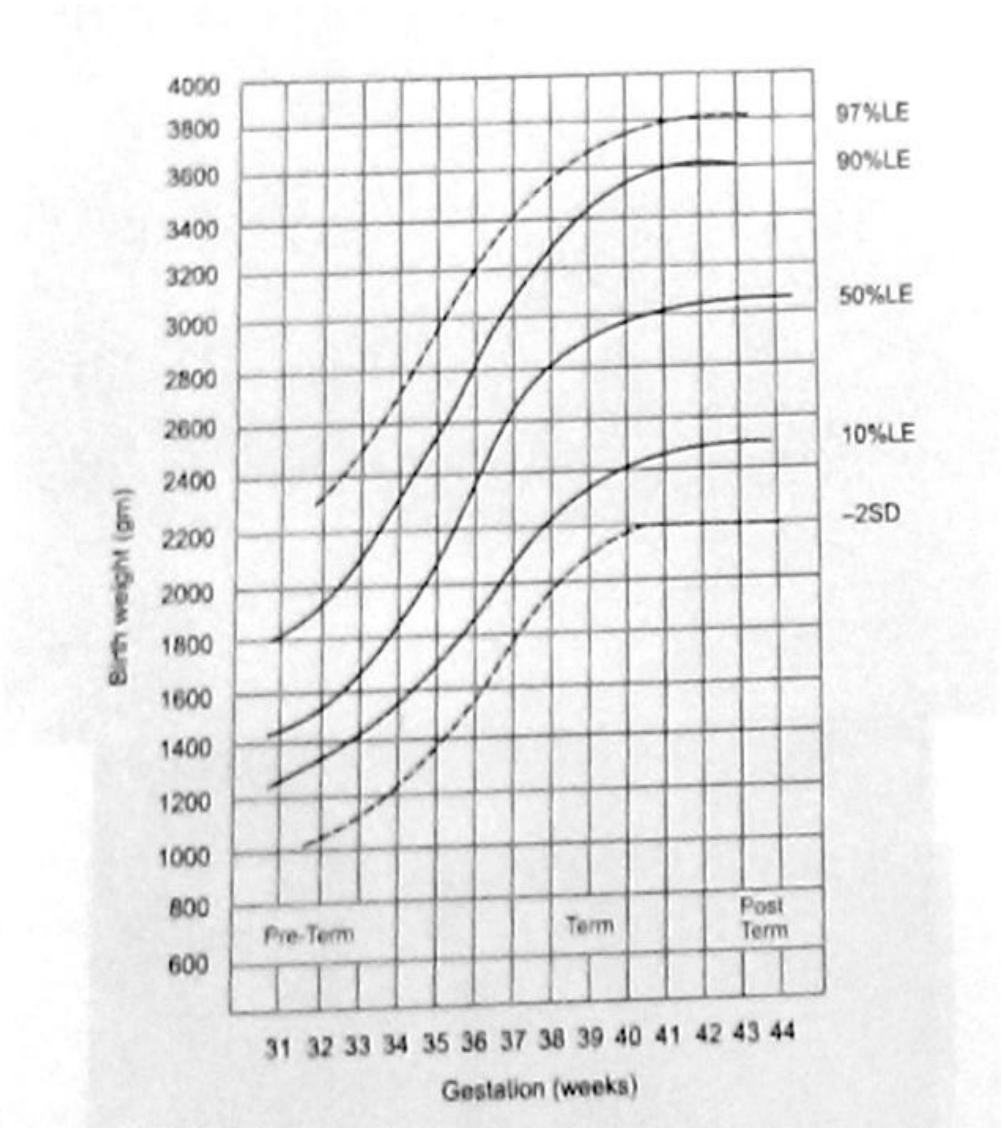

Fig 9: Comparision of birth weight and gestation in weeks for percentile[55]

STATISCAL ANALYSIS

The demographic data was analysed using descriptive statistics and expressed as mean ± standard deviation. Categorical data was analyzed by chi square test. P value of 0.05 or less was considered statistically significant.

RESULTS

RESULTS

A total of 100 patients who satisfied the inclusion criteria and clinically diagnosed as preeclampsia were included in the study. The collected data was analyzed as follows:

Table 3: Age distribution

Age	No. of patients	Percentage	Retinopathy (%)
≤19	6	6%	2 (33.3%)
20-29	88	88%	43 (48.86%)
≥30	6	6%	5 (83.3%)

The mean age of the patients was 23.28± 3.37 years. Majority of the patients were between the age group of 20-29 years.

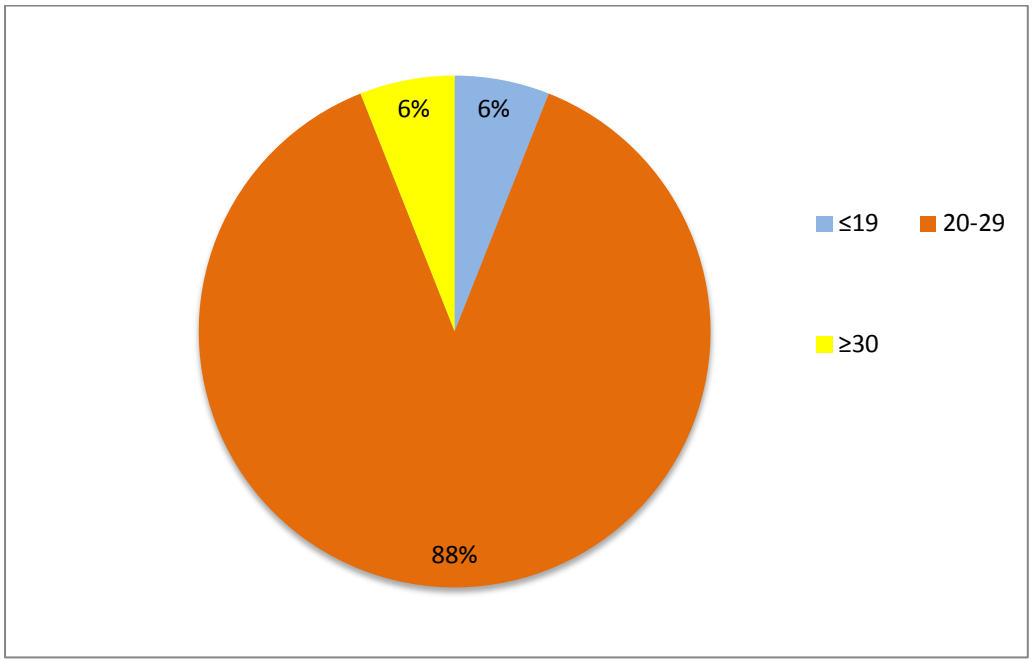

Fig 10 : Distribution according to age

Table 4: Mean values of different maternal variables

Variables	Mean±SD
Age	23.28± 3.37
Systolic blood pressure	156.9±17.961
Diastolic blood pressure	104.88±13.58
Blood urea levels	19.29±5.87
Serum uric acid levels	5.69±1.77

The maternal parameters assessed were age, systolic and diastolic blood pressure, and blood urea and serum uric acid.

Table 5: Mean values of different fetal variables

Variables	Mean±SD
Birthweight	2300.20±616.75
Apgar score at 1 min	6.63±2.34
Apgar score at 5^{th} min	8.5±2.95

The foetal parameters assessed were birthweight and APGAR score at 1 minute and 5^{th} minute.

Table 6: Gravidae distribution

Gravida	No. of patients	Percentage	Retinopathy (%)
Primigravidae	74	74%	36(48.6%)
Mutigravidae	26	26%	14(53.8%)

In the present study of 100 cases, 74% were primigravidas followed by 26% multigravidas.

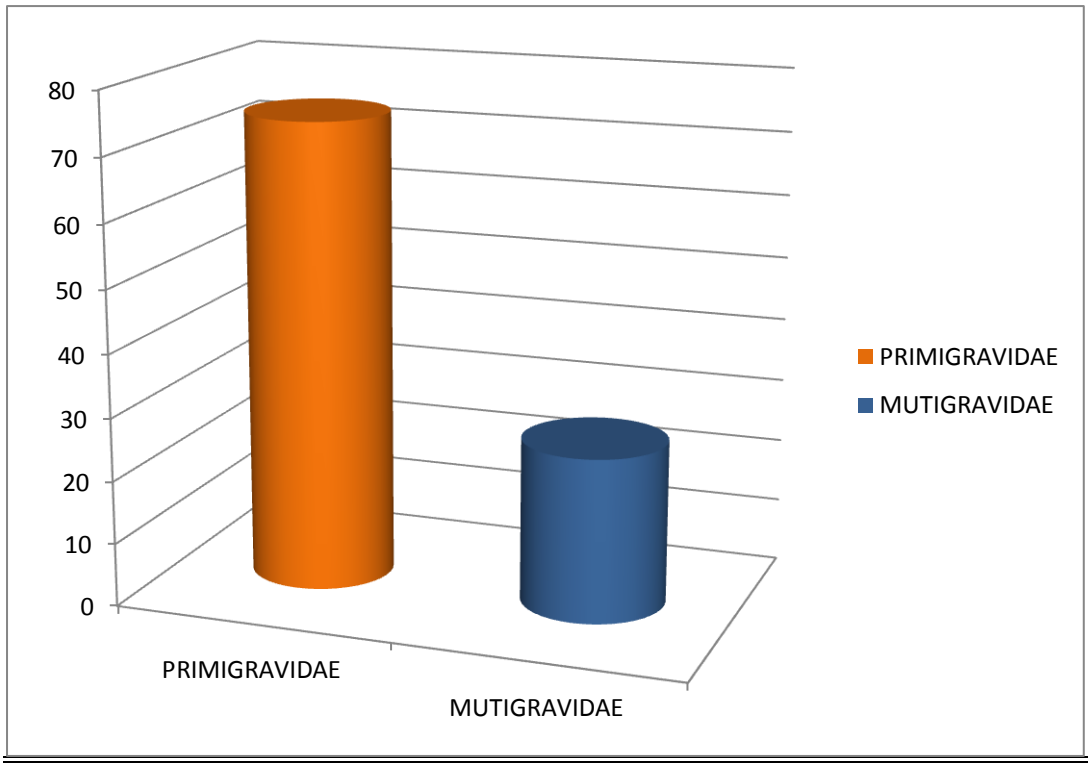

Fig 11: Distribution according to gravida

Table 7: Distribution of symptoms

SYMPTOMS	PERCENTAGE
Blurred vision	13%
Pedal edema	28%
Headache	35%
Flashes of light	0
Diplopia	1%
Convulsions	0

In the present study of 100 cases, 28% of the patients complained of pedal edema followed by 35% of patients, headache and 13% had blurring of vision.

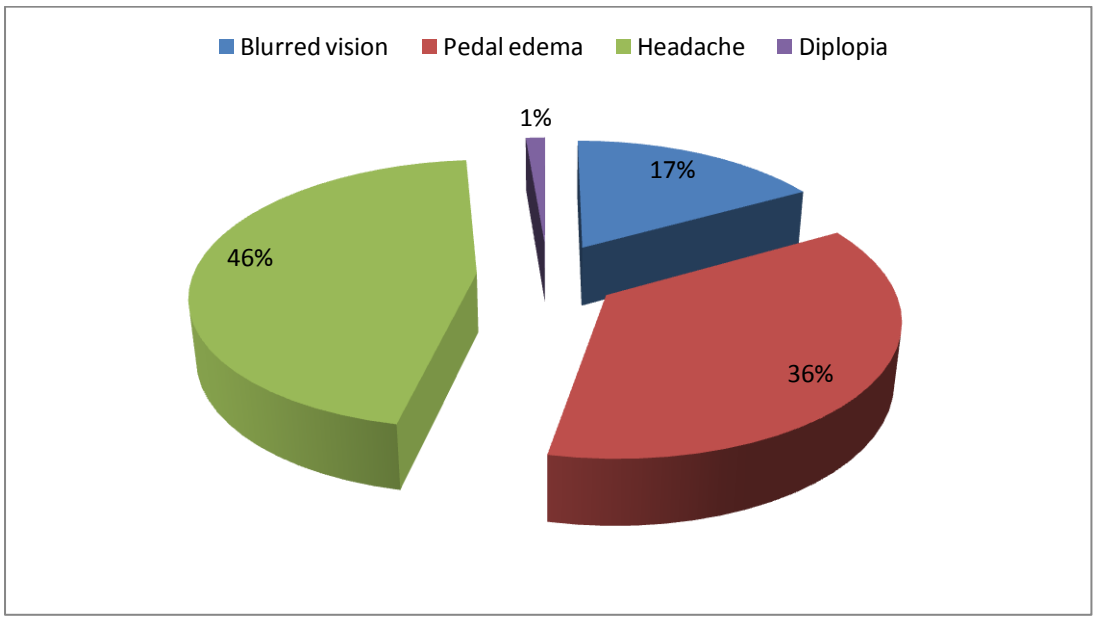

Fig 12: Distribution of symptoms

Table 8: Severity of pre eclampsia

Severity of pre eclampsia	No of patients	Percentage
Mild pre eclampsia (≤160/110 mmHg)	54	54%
Severe pre eclampsia (>160/110 mmHg)	46	46%

In the present study of 100 cases, 54 % of the patients had mild pre eclampsia and 46 % had severe pre eclampsia

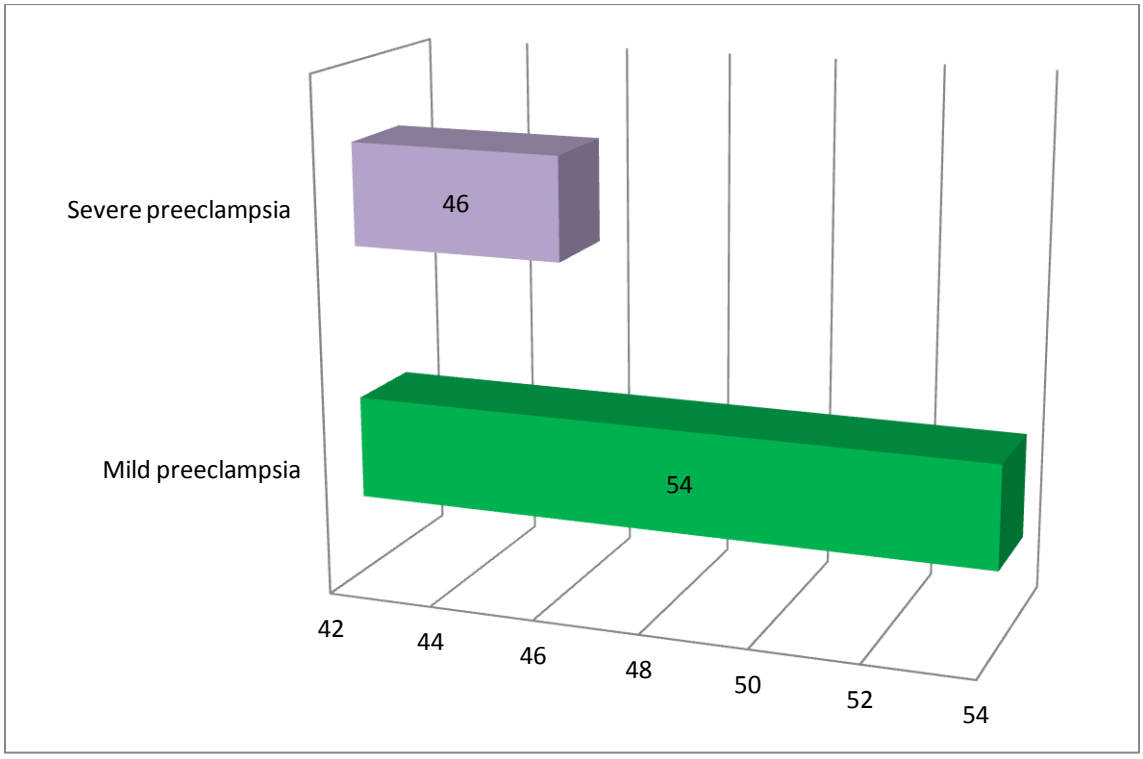

Fig 13: Distribution of severity of pre eclampsia

Table 9: Fundus changes according to grades of retinopathy

Grades	No of patients	Percentage
No retinopathy changes	**50**	**50%**
Grade 1 retinopathy	**34**	**34%**
Grade 2 retinopathy	**13**	**13%**
Grade 3 retinopathy	**3**	**3%**
Grade 4 retinopathy	**0**	**0**

50% of patients had normal fundus. Among 50 patients who had retinopathy changes, Majority had grade 1 hypertensive retinopathy.

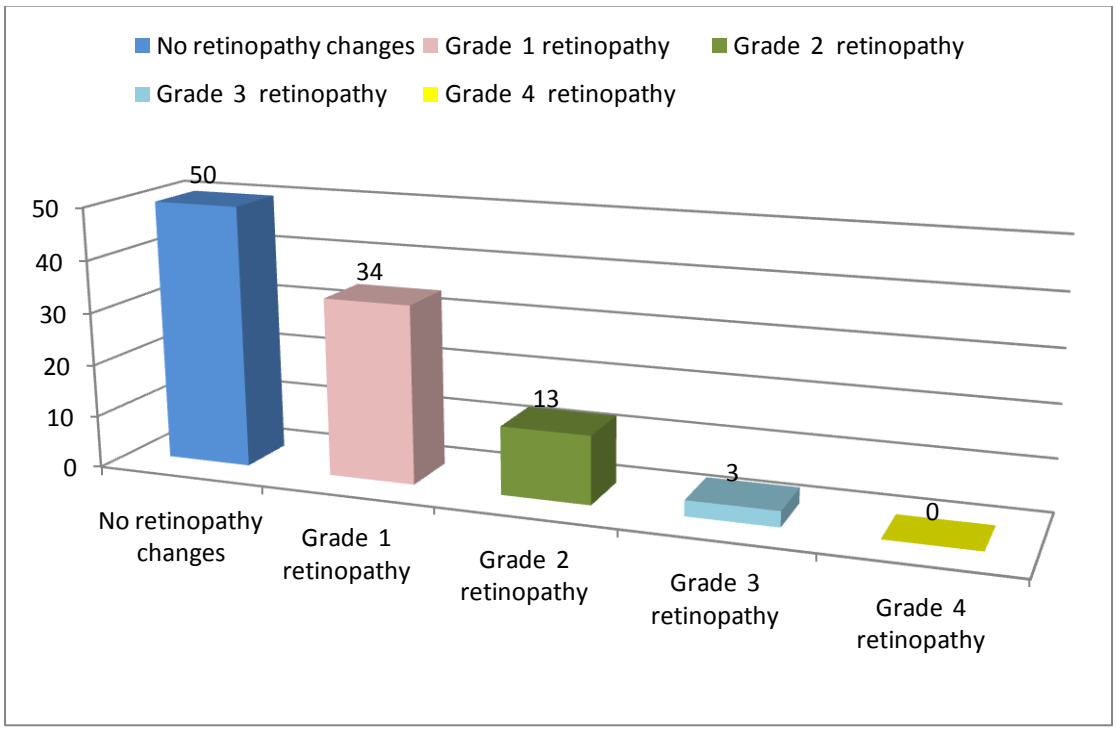

Fig 14: Distribution of grades of retinopathy

Table 10: Severity of arteriolar narrowing

Arteriolar narrowing	No of patients	Percentage
Normal	46	46%
Focal arteriolar constriction	3	3%
Mild generalized arteriolar constriction	31	31%
Severe generalized arteriolar constriction	20	20%

20 patients had severe generalized arteriolar narrowing while 31 patients had mild generalized arteriolar narrowing. Only 3 patients had focal arteriolar constriction.

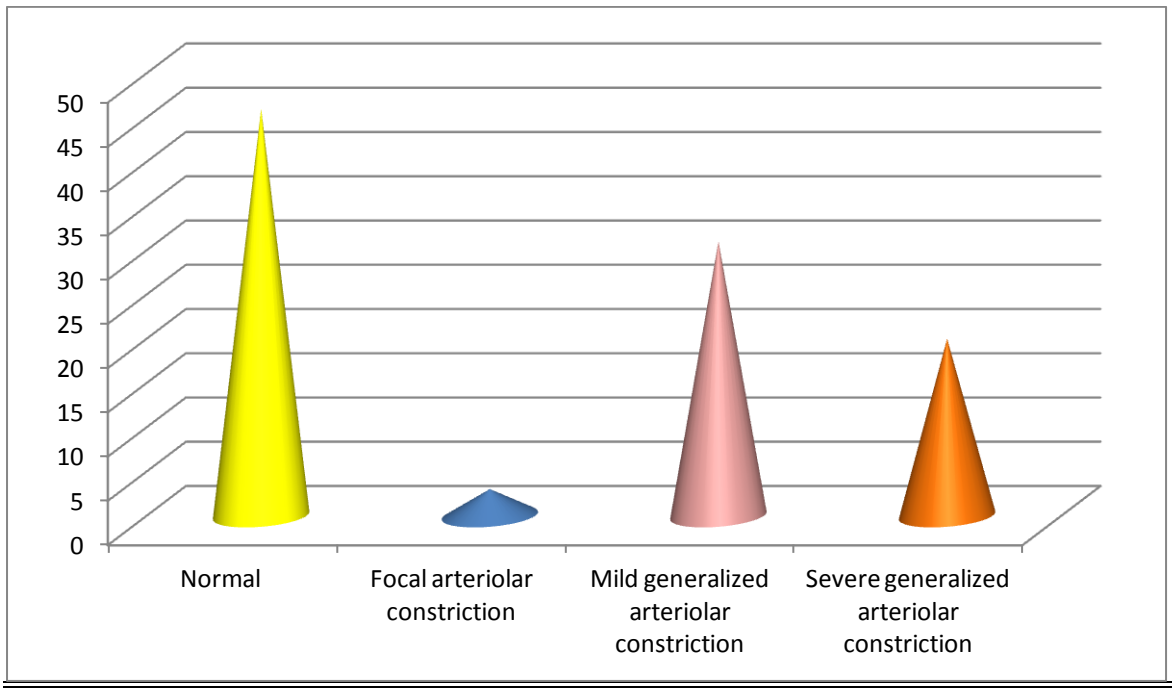

Fig 15: Distribution of severity of arteriolar narrowing

Table 11: Distribution of severity of retinopathy in mild pre-eclampsia

Grades	No of patients	Percentage
Normal fundus	35	64.8%
Grade 1	16	29.6%
Grade 2	3	5.5%
Grade 3	0	0
Grade 4	0	0

29.6 % with Grade I hypertensive retinopathy was the majority in mild preeclampsia group.

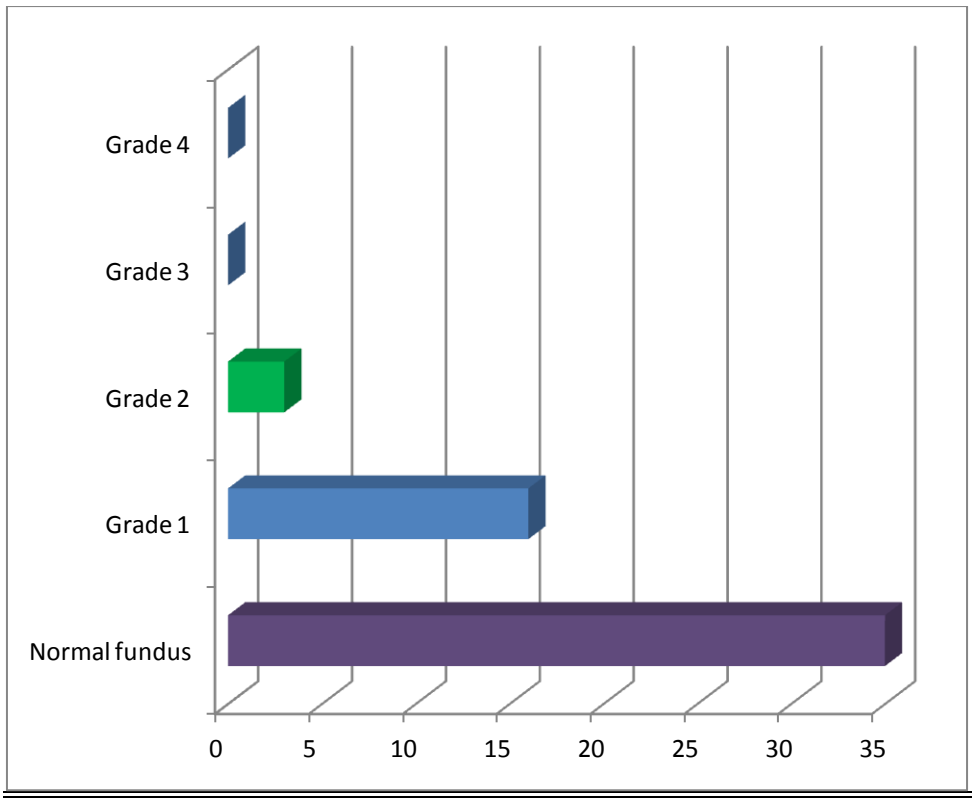

Fig 16: Distribution of retinopathy in mild preeclampsia

Table 12: Distribution of severity of retinopathy in severe pre-eclampsia

Grades	No of patients	Percentage
Normal fundus	15	32.6%
Grade 1	18	39.1%
Grade 2	10	21.7%
Grade 3	3	6.5%
Grade 4	0	0%

46 patients had severe pre eclampsia. Out of these, 39.1% had Grade I Retinopathy while normal fundus was seen in 32.6 % of patients. Grade II and III Retinopathy were seen in 21.7% and 6.5% of patients respectively.

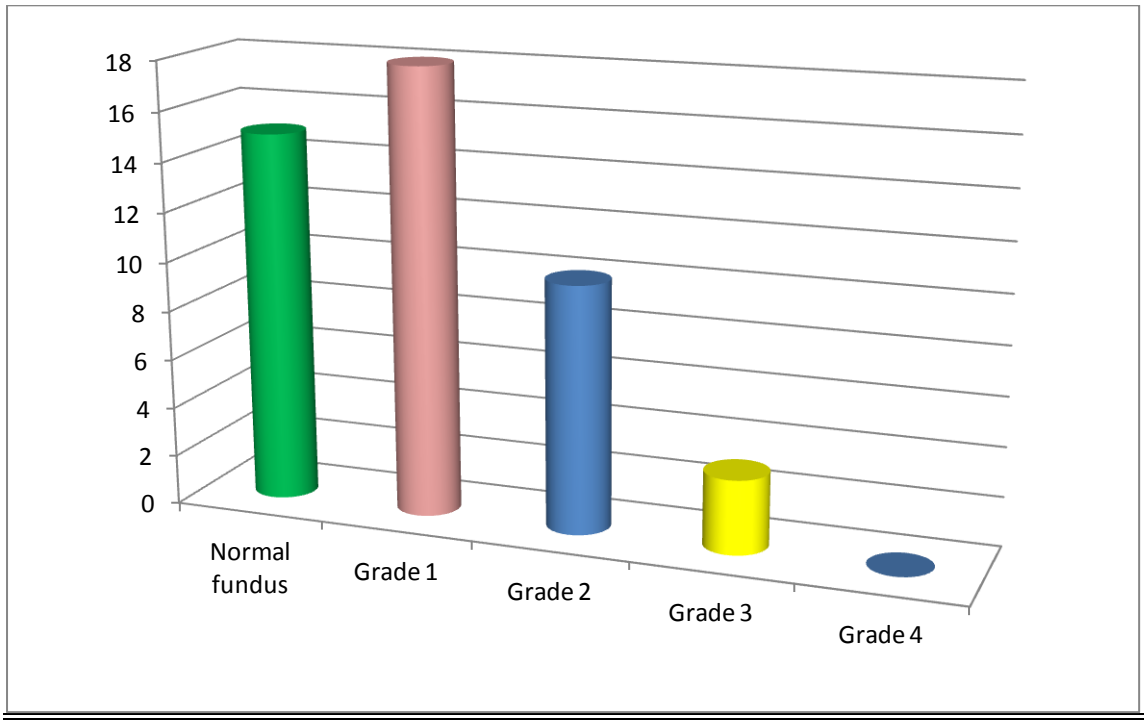

Fig 17: Distribution of severity of retinopathy in severe pre eclampsia

Table 13: Proteinuria and association with retinopathy

Protienuria	No of patients	Percentage	Retinopathy (%)	P value
+	65	65%	30(46.8%)	
++	25	25%	10(40%)	**0.03**
+++	7	7%	7(100%)	
++++	3	3%	3(100%)	

64% of patients had 1+ proteinuria on urine dipstick test followed by 25% patients having 2+ proteinuria. Patients with 3+ and 4+ proteinuria constituted 7% and 3% respectively. There was significant association between retinopathy grade and proteinuria with P value of 0.03

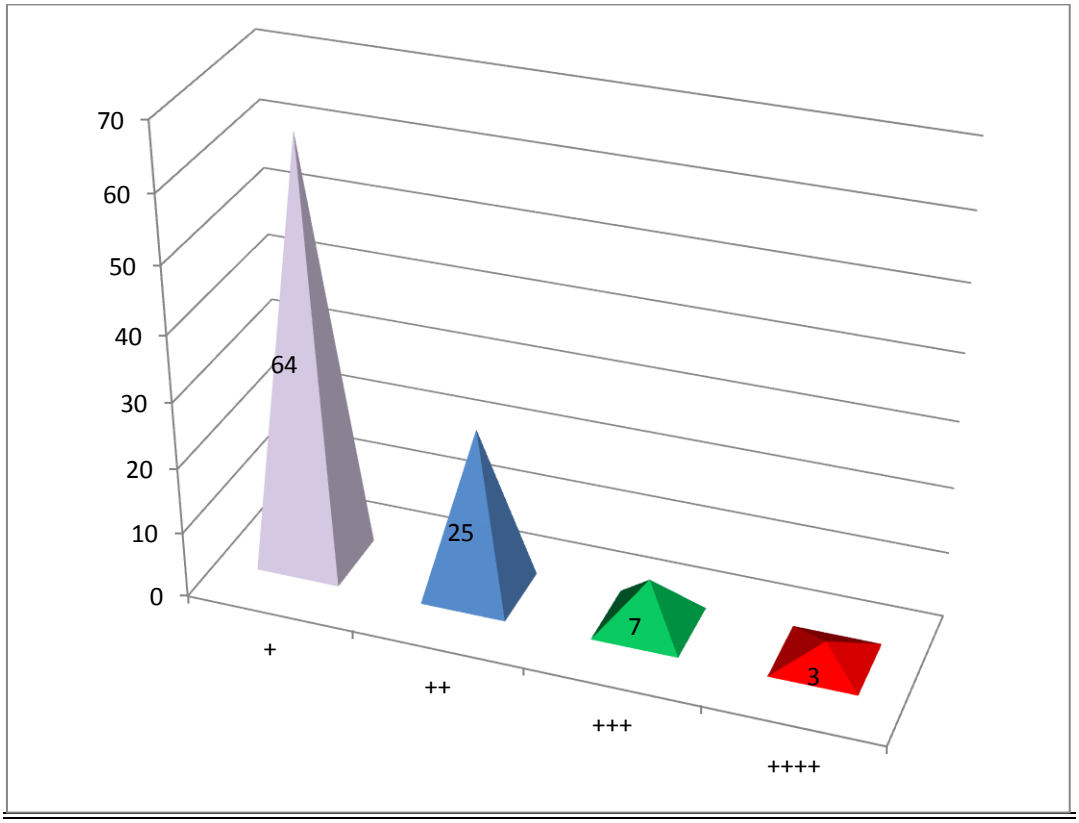

Fig 18: Distribution of pre eclampsia

Table 14: Blood urea value in & severity of pre eclampsia

Severity of pre eclampsia	Blood urea levels(mg%)		Mean
	Maximum	Minimum	
Mild pre eclampsia	10	34	18.7
Severe pre eclampsia	10	34	19.7

In present study, blood urea in mild pre-eclampsia group ranged from 10 to 34 mg.% with an average of 18.7mg % whereas it ranged from 10 to 34 mg.% with an average value of 19.7 mg % in severe pre-eclampsia.

Table 15: Uric acid level in & severity of pre eclampsia

Severity of pre eclampsia	Uric acid levels(mg%)		Mean
	Maximum	Minimum	
Mild pre eclampsia	2.5	11	5.76
Severe pre eclampsia	2.7	9	5.60

Serum uric acid in mild pre-eclampsia group ranged from 2.5 to 11.0 mg % with an average of 5.76mg % whereas range of serum uric acid in severe preeclampsia was from 2.7 to 9 mg % with an average value of 5.60 mg %.

Table 16: Association between blood pressure and retinopathy in pre eclampsia

Blood pressure	Retinopathy present	Retinopathy absent	P value
Systolic(≥160)	31	15	**0.001**
Diastolic(≥110)	18	4	**0.001**

In our study we found statistically significant association between the systolic and diastolic pressure with severe preeclampsia (p value 0.001)

Table 17: Association between fetal birth weight and retinopathy

Birth weight	Retinopathy absent	Retinopathy present	P value
<2.5	24	39	**0.002**
>2.5	26	11	

There was significant association between retinopathy and birth weight. Low birth weight (<2.5kg) was significantly more in subjects with preeclampsia

Table 18: Association of retinopathy changes with Apgar score at 1 min

APGAR SCORE at 1 min	Retinopathy present	Retinopathy absent	P value
<5	10	5	**0.161**
≥5	40	45	

There was no association between pre eclampsia and APGAR score at 1 minute.

DISCUSSION

DISCUSSION

Age distribution

Mean age of the patients in this study was 23.28± 3.37 years and 88% of the patients were between the age groups of 20-29 and 6% were aged between 30-35 years who had retinopathy findings of 48.8% and 83.3% respectively.(table 3)

In Tadin et al study, out of 40 women with pre-eclampsia 45% showed abnormalities of the fundus. The average age was 29.1 years.[4] Studies have shown those in younger and older age groups are associated with higher risk factors for developing pre eclampsia.[21] In another study by Jaeffe and Schatz, mean age of patients with pre - eclampsia was 28 years.[12] our study were comparable to these studies.

Gravida

In the present study of 100 patients with preeclampsia 74 % of patients were primigravidas and 48.6%. of them had retinopathy changes.(table 6)

Pre-eclampsia in otherwise healthy women is a disease of first pregnancy.[12,21] This result was comparable to previous studies, which have concluded that preeclampsia is more common in primigravidas.[28]

Symptoms

In the present study, 35% of patients had headache as one of the complaints while 14% of patients complained of visual symptoms like blurred vision and diplopia(table 7). In our study no patients presented with symptoms of flashes of light or black spot in visual field.

Visual disturbances such as scotoma, diplopia and dimness of vision are seen in 30-50% of patients with eclampsia and 20-25% of patients with pre eclampsia.[28] Ober RR has reported that headache has long been known to be harbinger of eclamptic convulsions.[68] Belfort MA concluded that headache is most common symptom among patients with preeclampsia.[64]

This result of our study co-relates with earlier study that headache was the most common symptom among the patients

Blood pressure

In our study there was association between blood pressure and retinopathy changes, especially in severe preeclampsia patients.this was also observed in studies by Tandin et al and Vanden Born et al.[4]

Our data contradicted Gupta et al, Kaliaperumal et al and Rasdi et al, studies who reported that severity of retinopathy might be independent of systemic blood pressure.[35,65,66]

Vision

Visual system are affected in 30-100% of patients with preeclampsia.[15, 33] Visual symptoms are few in patients with preeclampsia and often absent unless macula is involved.[15]

In our study, 98% of patients had visual acuity of 6/6 and 2% had vision of 6/9. All the patients gained vision of 6/6 during postnatal follow up. There was no patient with visual acuity of 6/12 or worse during all assessment period.

In Karki e al study, 153 cases did not show any signs of visual disturbances. Most of them had visual acuity between 6/6 to 6/9.[67] In A.R Rasdi study, 96.7% of patients had visual acuity of 6/6 in both eyes and 3.3% had visual acuity of 6/9.[66]

Severity of pre eclampsia

In the present study, most of the patients 54% had mild pre-eclampsia with blood pressure ≤ 160/100mm of Hg. 46% of patients in this study had severe pre eclampsia with blood pressure >160/100mm Hg.(table 8)

In a study conducted by Ober RR et al and Sunness J, the overall incidence of PIH in obstetric patients was found out to be 5%. Approximately 5% of these patients developed eclamptic seizures.[21,68]

Anterior segment examination

In present study, all our patients had normal findings including conjunctival vessels, pupillary response and extraocular movement.

Hallum study have shown mild arteriolar spasm involving bulbar conjunctival vessels has been observed in normal pregnancy, but in pre eclampsia, the vasospasm can be severe and result in local ischemia.[10] Karki et al study reported normal anterior segment examination including extraocular movements and pupillary response in their patients.[67]

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Retinal changes

Literature studies have considered the progression of retinal vascular changes a sign of increasing severity of preeclampsia and have correlated with fetal mortality. Our findings support the preexisting data on fundoscopic signs of hypertensive disorders in pregnancy.

Table 19: Comparision of prevalence of retinal changes in pre eclampsia in other studies [4, 66,67,75,76]

Study	Prevalence rate
Tadin et al	45%
Rasdi et al	21.5%
Karki et al	13.7%
Reddy et al	53.4%
Sagli reddy study	59%
Our study	**50%**

Fundus changes according to grades of retinopathy

In our study, 50% of patients with pre eclampsia had retinal changes, which correlates with studies reported by Sunness JS and Beck RW et al in which retinal changes were observed in 40-100% patients with preeclampsia.[21,69] In our study 34% of patients belonged to grade 1 hypertensive retinopathy, followed by 13% patients of grade 2 hypertensive retinopathy and 3 patients with grade 3 retinopathy.(table 9)

In our study, majority of the patients had arteriolar narrowing which were supported by studies conducted by Hallum where the most common ocular finding

was constriction of arterioles occurring in approximately 60% of patients with pre-eclampsia.[37] Beck R W reported hallmark of abnormal ocular findings is terminal arteriolar vasospasm.[69] Wagener reported spastic lesions of retinal arterioles in 70% cases of pre eclampsia.[70] Arteriolar narrowing of generalized nature is seen later and may resolve following pregnancy.[21] Our study co-relates with previous study which states arteriolar narrowing is the most common fundus finding in patients with pre eclampsia.[53]

Our study revealed retinal hemorrhages, a: v nipping, silver wiring of vessels and cotton wool spots. The absence of hard exudates in this present study is supported by Jaffe and Schatz.[12] Presence of multiple hard exudates in retina may indicate albuminuric retinopathy and possibility of damage of the kidney. Jaffe and Schatz from USA reported significant co relation between the reduction in a: v ratio, number of focal arteriolar constrictions and severity of preeclampsia.[12] Rasdi et al study reported retinal changes like arteriolar narrowing, cotton wool spots, retinal hemorrhages and serous retinal detachment.[66]

In this present study we did not find any case of serous retinal detachment or other conditions like cortical blindness, purtschers like retinopathy. Retinal detachment was seen in 1-2% of all patients with pre eclampsia[65] Studies by Prado and Reddy et al did not reported cases with vitreous hemorrhage, serous retinal detachment, purtscher like retinopathy or cortical blindness.[71] Reddy et al study also reported presence of macular edema or papilloedema or retinal detachment which are warning signs for termination of pregnancy to save vision of the mother.[71.]

Severity of proteinuria

Proteinuria is an important sign of pre eclampsia. The minimum criteria for diagnosis of preeclampsia are hypertension and proteinuria which may be minimal or severe.[72]

In our study, all 100 patients had proteinuria and it ranged from 1+ to 4+. Patients with severe proteinuria (4+) have greater chance of developing retinopathy than less severe proteinuria. There is significant association was found between retinopathy grade and proteinuria with P value of 0.03.

Blood urea levels and severity of pre eclampsia

In present study, blood urea levels in mild pre-eclampsia group ranged from 10 to 34 mg% with an average of 18.7 mg % whereas in severe pre eclampsia it ranged 10 to 34 mg% with an average value of 19.7 mg%. (table 14)

The result of our study correlates with the studies by Tandon and Kishore, the increasing level of mean blood urea level is seen with increasing severity of preeclampsia.[73] In their study the blood urea level in mild preeclampsia ranged from 19.5 to 30.0 mg% with an average of 24.6 mg% while in severe preeclampsia group it ranged from 24.0 to 103.0 mg%. [73]

Knowledge of blood urea level offers information which is useful in complicated cases of toxemia. The rising level is almost always associated with increasing severity of toxemia and falling levels with improvement. In complicated cases this additional means of assessment can be of considerable assistance in management.[73]

Serum uric acid value in & severity of pre eclampsia

In the present study, the mean value of blood uric acid in mild and severe preeclampsia is 5.76 mg% and 5.60 mg% respectively. There was an increase in the mean value of blood uric acid with increase in severity of preeclampsia.(table 15)

In study by Tandon and Kishore, serum uric acid level in mild preeclampsia ranged from 4.6 to 6.4 mg% with an average of 5.2 mg% whereas in severe preeclampsia it ranged from 4.2 to 8.0 mg% with a mean value of 5.63 mg%. [73]

Our study is also supported Gupta et al study which reported that retinopathy was found to be significantly associated only with serum uric acid levels among all lab parameters. They showed retinal changes showed a positive association with uric acid. [55]

Thus,it may be inferred that there is a clinico-biochemical correlation with respect to blood uric acid levels and severity of pre eclampsia and that blood uric acid level are of considerable value in predicting severity of pre eclampsia.

Fetal outcome

Our study showed that presence of fundus changes in a patient of pre eclampsia was not significantly associated with fetal outcomes in terms of APGAR score at 1 minute, still birth and intra uterine death. There was significant association between birth weight and fundal changes. Four intrauterine deaths and eight still born were reported, but they were not associated to retinopathy changes.(table 17 and 18)

Karki et al showed presence of fundal changes in pregnancy was not associated significantly with fetal outcomes in terms of gestational age,APGAR score 1,still birth and neonatal death but it was associated with

low birth weight and they assessed the fetal outcome in these patients and concluded that retinal and optic nerve head changes were associated with low birth weight.[67] They also reported that choroidal and optic nerve head changes were associated with low APGAR score. They concluded that choroidal and optic nerve head changes were associated with low APGAR score.[67]

Our study contradicted Gupta et al study which reported that the outcome of pregnancy in terms of fetal birth weight was inversely associated with the severity of retinopathy. They also stated that low birth weight was due to intrauterine growth retardation.[35]

The severity of maternal retinopathy may reflect the state of the placental vasculature and hence might correlate with the severity of preeclampsia and fetal morbidity. Study done by Oliver M observed that changes that can be observed in the retinal vasculature like vasospasm may indirectly indicate the level of placental vascular status and hence placental insufficiency and fetal birth weight.[74]

CONCLUSION

CONCLUSION

Our study was conducted on 100 diagnosed cases of preeclampsia. Fundoscopy of retina is a simple, non invasive, safe and reliable procedure to interpret the vascular changes.

Our study revealed that a retinopathy change was more common in primigravidae and older age group. Headache was the most common symptom encountered. Systolic and diastolic blood pressures were both significantly associated with retinopathy.

Our study reported that common retinal findings was grade 1 hypertensive retinopathy and generalized arteriolar narrowing. Serum uric acid was significantly associated with retinopathy findings. The retinal changes were more often seen in patients with severe hypertension, severe proteinuria and severity of pre eclampsia in our study. Retinal changes was not associated with APGAR score at 1 min but was significantly associated with fetal birth weight.

Our findings suggest the degree of hypertensive retinopathy in women with preeclampsia is a valid and reliable prognostic factor that gives valid prognostic information on assessment of the severity of pre eclampsia and neonatal outcome.

SUMMARY

SUMMARY

One hundred patients with pre eclampsia, who were referred to Department of Ophthalmology, were included in this study. Detailed ocular examination including fundoscopy was done in all patients and results were interpreted.

In our study, the mean age of the patients was 23.28± 3.37 years. 88% of patients belonged between age groups of 20-29 years.48.86 % of the patients in that age group had retinopathy findings. 6% of patients belonged to patients aged above 30 years and.83.3% of them presented with retinopathy findings. 74% of patients were primigravida and 26% were multigravida.

28% of our patients complained of pedal edema. 35% patients complained of headache along with pedal edema. 13% complained of blurring of vision. All our patients had good vision. 54% had mild preeclampsia while 46% had severe preeclampsia. A mean systolic blood pressure was 156.9±17.96 and mean diastolic blood pressure was 104.88±13.58.

Out of 100 cases, 50% of cases had no retinopathy findings. Thirty four (34%) patients had grade I hypertensive changes. Grade II and Grade III changes were seen in 13% and 3% respectively. The percentage of patients developing retinopathy due to preeclampsia increased as we moved from mild preeclampsia group to severe preeclampsia. Our study revealed retinal hemorrhages, a: v nipping of blood vessels, silver wiring, and cotton wool spots. We did not encounter any cases of retinal detachment or cortical blindness.

All patients had proteinuria of varying severity ranging from 1+ to 4+ with patients with severe proteinuria of 4+ having greater chance of developing retinopathy. In this study, it was found that with increasing severity of preeclampsia the mean value of biochemical investigations like blood urea and serum uric acid is

also increased. Thus, these investigations can be of additional advantage in assessing the severity of pre eclampsia.

The fetal outcomes to pre eclamptic mother were also assessed. The mean birthweight was 2300.20±616.75. Fetal birth weight was less than 2500g of 63 of mothers, out of which 69 mothers, 39 of them had retinopathy changes. They were significantly associated.

Therefore the examination of ocular fundus is a necessary procedure in determining the cause and appropriate treatment for mothers with pre eclampsia which may help in saving lives of both the mother and baby.

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ANNEXURES

PROFORMA

Date:

1) Name of the patient: I.P. No:

2) Age: DOA:

3) Sex:

4) Address:

5) Chief complaints:

6) History prior to pregnancy

a) Vision prior to pregnancy Normal / Decrease

b) H/O spectacle use prior to pregnancy YES / NO

c) H/O blurring of vision YES / NO

d) H/O flashes of light YES/NO

e) H/O black spots in visual field YES / NO

f) H/O Convulsions YES/NO

g) H/O seeing single object as two YES / NO

h) H/O episodes of transient loss of vision YES / NO

i) H/O swelling of legs YES/NO

j) H/O Diabetes YES/NO

k) H/O Hypertension YES/NO

l) H/O Rash, joint pains YES/NO

7) HISTORY - DURING PREGNANCY (After 20 weeks)

a) Vision at present Normal/Decrease

b) Use of spectacles now YES / NO

c) H/O Convulsions YES/NO

d) H/0 blurring of vision YES/NO

e) H/O Flashes of light YES / NO

f) H/O Headache YES / NO

g) H/O black spots in visual field YES / NO

h) H/O seeing single object as two YES / NO

i) H/O episodes of transient loss of vision YES /NO

j) H/O leg swelling YES / NO

k) Any of the above complaints in previous pregnancy :

8) EXAMINATION:

i) Palor: yes/no

ii) Pedal edema: yes / no If yes, pitting / non-pitting

iii) Pulse:

iv) BP at admission:

9)SYSTEMIC EXAMINATION:

CVS:

RS:

P/A:

CNS:

10) OCULAR EXAMINATION:

OD **OS**

i) Vision:

ii) Adenexa:

iii) Sclera:

iv) Conjunctiva:

v) Cornea:

vi) Anterior chamber:

vii) Iris:

viii) Pupil

ix) Lens:

x) Extra ocular movements:

11) FUNDUS EXAMINATION

a. Glow

b. Media

c. Disc

d. Cup : disc ratio

12) BLOODVESSELS

a) Focal constriction of arterioles:

b) Generalized arteriolar narrowing:

c) Arterio-venous crossing changes:

d) A : V Ratio:

e) Any other positive finding:

13) BACKGROUND:

a) Haemorrhages:

b) Cotton-wool spots;

c) Hard Exudates:

d) Any other positive finding :

14) MACULA:

15) INVESTIGATION

a) urine protein

b) haemoglobin%

d) platelet count

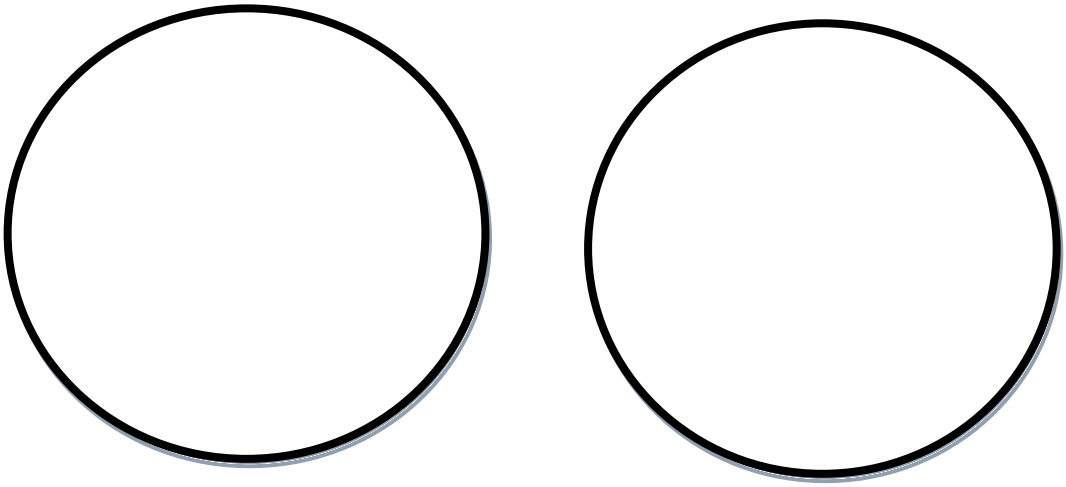
e) blood urea

f) serum creatinine

g) serum uric acid

16) FUNDUS PICTURE

OD **OS**



17) FOETAL OUTCOME:

Delivery details:

Live/still born/iud/preterm

Birth weight:

Apgar score: At 1 minute:

At 5 minute:

18) DIAGNOSIS:

INFORMED CONSENT FORM

STUDY OF ASSOCIATION BETWEEN FUNDAL CHANGES AND FOETAL OUTCOME IN PREECLAMPSIA

Since you have been diagnosed as a case of raise in blood pressure due to pregnancy (Pre eclampsia), you are eligible to be a part of the above study and hence asked to participate. It is characterized by endothelial dysfunction and vasospasm which can affect growth of the fetus leading to intra uterine growth retardation and intra uterine death. This research is about retinal changes occurring in eye due to rise in blood pressure caused by pregnancy. The result of this study may be helpful in preventing ocular problems which ranges from slight burning of vision to total loss of vision.

If you agree to participate we would ask you relevant clinical history and do examination, especially fundus examination for which we have to dilate both your pupils by putting eye drops 2 or 3 times so as to have a clear view of entire retina. We will collect the treatment details about you and your new born from your hospital record. The information collected will be used only for dissertation and publication. The study has been reviewed by the institutional ethical committee. The care you will get will not change if you don't wish to participate. Further you may withdraw from this study at any time.You are required to sign/ provide thumb impression only if you voluntarily agree to participate in the study.

I have read or have been read to me and understand the purpose of the study, the procedure that will be used, the risk and benefits associated with my involvement in the study and the nature of information that will be collected and disclosed during the study. I have had the opportunity to ask my questions regarding various aspects of the study and my questions are answered to my satisfaction. I the undersigned agree to participate in this study and authorize the collection and disclosure of my personal information for dissertation

Subject name and signature/ thumb impression Date:

Signature of the person taking consent Date:

MASTER CHART

KEY TO MASTER CHART

SL NO > Serial no

I.P NO > Inpatient no

P > Present

C > Clear

N > Normal

GAN > Generalized arteriolar narrowing

FAN > Focal arteriolar narrowing

IUD > Intrauterine death

SH > Superficial hemorrhages

CWS > Cotton wool spots

RE > Retinal edema

GS > Gunn sign

SL NO	NAME	I.P NO	AGE	GRAVIDA	SYSTOLIC	DIASTOLIC	PALLOR	PEDAL EDEMA	HEAD ACHE	BLUR VISION
1	padmamma	780151	30	2	200	120	-	+	-	-
2	FARATH	786829	17	1	140	90	-	+	-	-
3	NAGAVENI		22	1	170	120	-	-	-	-
4	RADHA	787472	23	1	140	90	-	-	+	-
5	RADHA	787183	20	1	160	100	-	+	-	-
6	ASHWINI	817204	24	1	170	90	-	-	-	-
7	RENUKA	769478	22	1	140	80	-	-	-	-
8	SALURA BEGUM	797057	26	1	190	110	-	+	-	-
9	KALAI SELVI	802442	27	1	200	90	-	-	+	-
10	SHOBHA	801862	28	1	140	70	-	-	-	-
11	SHILPA	791815	22	2	150	110	-	+	-	+
12	WAHEEDA	791791	25	2	150	100	-	+	-	-
13	KALAVATHI	792134	23	1	140	100	-	-	-	+
14	MOSINA TAJ	792227	30	2	210	140	-	+	+	-
15	USHA	789492	25	1	180	80	-	-	-	-
16	RAZIYA SULTAN	789528	30	2	150	120	-	+	-	-
17	NAVEEN TAJ	789263	25	2	150	110	-	+	+	-
18	ASHA	790513	20	2	140	100	-	+	-	+
19	AMBIKA	790567	21	1	140	90	-	+	-	-
20	RATHNAMMA	779808	23	2	140	90	-	+	-	-
21	BHAGYAMMA	785274	24	1	140	100	-	-	-	-
22	KOKILA	785969	30	1	210	140	-	+	-	+
23	NETHRA	787467	19	1	150	108	-	-	-	-
24	MANJULA	788708	23	1	160	110	-	+	-	-
25	MANOHARI	774934	24	2	180	110	-	+	-	-
26	SAVITHA	775561	25	1	170	130	-	-	-	-
27	VEDHA	769750	20	1	160	100	-	-	-	-
28	LALITHA	777835	23	1	160	100	-	-	-	-
29	LAKSHMIDEVAM	764176	20	2	150	90	-	-	-	+
30	ROJA	763074	18	1	150	130	-	+	-	+
31	LAKSHMIDEVAM	757167	20	1	170	110	-	-	-	-
32	AKILA BEGUM	767845	22	2	140	100	-	+	-	+
33	MUNIRATHNAMMA		22	1	150	110	-	+	-	-
34	GIRIJA	755729	20	1	140	100	-	+	+	-
35	ZAIBA	790476	18	1	160	120	-	+	-	+
36	LATHA	776208	24	1	170	130	-	-	-	-
37	CHITRA	777939	20	1	150	120	-	-	-	-
38	SUDHA RANI	779658	25	1	150	110	-	-	-	-
39	SHAZAMA SULT	762241	26	2	180	110	-	-	+	-
40	SUNITHA	762359	23	1	150	110	-	-	-	-
41	RATHNAMMA	763654	35	1	150	110	-	+	+	+
42	SUJATHA	761152	22	1	140	110	-	+	-	-
43	MANJU	760039	22	2	180	130	-	+	-	-
44	YASHODA	758479	21	1	130	100	-	+	+	-

45	VENKATALAKSH	759192	20	1	170	110	-	+	-	-
46	bharathi	907675	26	2	140	90	-	-	-	-
47	NOOHIRA	915979	22	1	140	90	-	-	-	-
48	SHOBHA	823381	20	1	150	100	-	-	-	+
49	TRIVENI	776410	23	1	160	110	-	+	-	-
50	LAKSHMI	774612	23	2	180	110	-	-	-	-
51	LAKSHMI SAND	771329	19	1	160	110	-	-	-	-
52	RABIYA	824485	20	1	140	90	-	-	-	-
53	RAMAMANI	834029	20	1	170	110	-	+	-	-
54	SHALINI	856199	21	1	180	110	-	+	-	-
55	PADMA	866873	20	1	140	90	-	-	-	+
56	VENMADI	908060	28	1	160	120	-	-	-	+
57	ASHWINI	909455	23	1	170	110	-	-	-	-
58	NIRMALA	907437	21	1	140	90	-	-	-	+
59	ARUNA	908115	22	1	180	120	-	-	-	-
60	SHYLA	908045	20	1	140	90	-	-	+	-
61	PUSHPA	910304	25	2	160	110	-	-	-	-
62	ANJANA	917892	20	1	170	110	-	-	-	-
63	HASEENA	918254	20	1	140	90	-	-	-	-
64	ARPITHA	917864	20	1	200	120	-	-	-	-
65	SALMA	821716	29	2	150	100	-	-	-	-
66	SHABANA	890526	23	2	170	120	-	-	-	-
67	ANUSHA	897290	20	1	170	120	-	-	-	-
68	SAVITRI	894259	25	2	180	110	-	-	-	-
69	SHANAZ	893217	23	1	160	110	-	-	-	-
70	KAVITHA	894440	28	1	160	110	-	-	-	-
71	MANJULA	894769	20	1	140	90	-	-	-	-
72	AYESHA	793065	20	1	140	90	-	-	-	-
73	SHABANA	898896	30	1	200	120	-	-	-	-
74	MAMATHA	897608	25	1	140	90	-	-	-	-
75	padmamma	903235	22	2	150	100	-	-	-	-
76	ANUSUYA	898299	28	2	170	110	-	-	-	-
77	CHANDRAMMA	816872	20	1	140	90	-	-	-	-
78	SHILPA	817531	23	1	150	100	-	-	-	-
79	NAVITHA	794160	28	1	160	110	-	-	-	-
80	PALLAVI	795001	21	1	160	120	-	-	-	-
81	PARIMALA	818626	29	1	140	90	-	-	-	-
82	FATHIMA	908031	26	2	160	110	-	-	-	-
83	BHARATHI	917635	25	2	140	90	-	-	-	-
84	GIRIJA	907866	20	1	140	90	-	-	-	-
85	SHANKARAMM	917521	26	2	140	90	-	-	-	-
86	KAMALA	861209	28	1	160	120	-	-	-	-
87	ASHA	897260	25	1	140	90	-	-	-	-
88	LAKSHMI	903026	26	2	140	90	-	-	-	-
89	SHIVARANJINI	770373	20	1	150	110	-	-	-	-
90	ESHWARAMMA	787195	22	1	140	90	-	-	-	-
91	SHYMALAMMA	788498	27	1	140	100	-	-	-	-

92	PAVITRA	759218	23	1	150	120	-	-	-	-
93	GANGARAJAMM	787866	19	1	160	100	-	-	-	-
94	ASMATH TAJ	791862	20	1	150	90	-	-	-	-
95	MERIMA TAJ	792227	22	1	160	120	-	-	-	-
96	NAGEENA	798629	27	1	150	110	-	-	-	-
97	SUJATHAMMA	801863	24	1	140	100	-	-	-	-
98	MUNILAKSHMI	807432	25	1	170	120	-	-	-	-
99	Sudha	792453	23	2	140	90	-	-	-	-
100	Nagamani	756435	24	1	160	110	-	-	-	-

		OCULAR EXAMINATION FUNDOSCOPY										DIAGNOS	
FLASHES	VISION	ANT SEG	GLOW	MEDIA	DISC	C:D RATIO	Bld Ves	A-V CROSSING	A.V RATIO	ACKGROU	MACULA	EXAM 1	EXAM 2
-	>6/60	NIL	P	C	N	0.3	GAN+	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN ++	SS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN ++	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+++	SH,CWS,RE	1 : 2	N	N	3	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	GAN +	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	N	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN++	SH	1 : 2	N	N	3	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN++	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN++	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.4	N	NIL	2:3	N	N	0	N

-	>6/60	NIL	P	C	N	0.3	GAN++	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	GAN++	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN++	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+	SS,GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN++	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.4	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+++	SH,RE	1 : 2	N	N	3	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	N	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	GAN+	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N

-	>6/60	NIL	P	C	N	0.3	GAN+	GS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.4	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN++	SS	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.4	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N
-	>6/60	NIL	P	C	N	0.3	GAN++	NIL	1 : 2	N	N	2	N
-	>6/60	NIL	P	C	N	0.3	N	NIL	2:3	N	N	0	N
-	>6/60	NIL	P	C	N	0.3	GAN+	NIL	1 : 2	N	N	1	N

SIS	INVESTIGATIONS							FOETAL OUTCOME				
EXAM 3	PROTEINURIA	AEMOGLOBI	RBS	BLOOD UREA	CREATININE	URIC ACID	LFT	WEIGHT	APGAR 1 mi	PGAR 5 m	IUD	STILL BORN
N	3+	8.9	91	28	1	8.4	N	2240	6	9	-	-
N	1+	8	82	29	1	6	N	2300	6	9	-	-
N	2+	13.5	69	13	0.78	8.6	N	1660	4	4	-	-
N	1+	11.6	62	11	0.51	9.1	N	2500	7	9	-	-
N	1+	13	58	18	O.74	4.4	N	2250	7	9	-	-
N	1+	12	68	18	1	8.9	N	2500	8	9	-	-
N	2+	11.2	66	23	0.7	3.1	N	2100	5	7	-	-
N	3+	10.8	129	23	0.7	6.2	N	2200				
N	2+	11.8	120	17	1	5.5	N	2000	7	8	-	-
N	1+	12.7	90	11	0.7	6.9	N	2400	7	8	-	-
N	4+	10.6	60	23	0.9	5	N	1700	7	8	-	-
N	1+	12	60	23	0.7	6.1	N	3620	8	9	-	-
N	1+	12	80	18	0.7	5.8	N	2000	7	9	-	-
N	1+	13.9	100	19	0.8	5.3	N	1500	7	9	-	-
N	1+	10.4	80	23	1	6.5	N	2680	7	9	-	-
N	3+	13.6	88	21	0.78	6.6	N	200	-	-	+	-
N	2+	12	100	34	1	11	N	2500	-	-	-	+
N	1+	11.5	67	23	0.78	5.7	N	2400	8	9	-	-
N	2+	4.9	90	12	1	4.6	N	2350	8	9	-	-
N	1+	10.5	100	23	1	10	N	2200	8	9	-	-
N	1+	10.9	67	15	0.54	5.9	N	2100	7	9	-	-
N	3+	12.4	76	23	0.78	4.9	N	700	-	-	+	-
N	2+	12	82	13	0.52	2.5	N	2800	6	9	-	-
N	2+	8	68	22	1	2.7	N	2900	-	-	-	+
N	1+	12	82	23	0.52	3.2	N	3500	8	9	-	-
N	1+	9.8	37	19	0.78	9	N	2800	6	9	-	-
N	2+	12	90	31	0.87	5.6	N	2100	7	9	-	-
N	2+	12.5	76	10	0.78	3.8	N	2700	8	9	-	-
N	2+	11.9	70	14	0.48	4.5	N	1320	6	7	-	-
N	3+	10.5	76	26	0.7	4.8	N	1800	4	7	-	-
N	1+	12	56	13	0.78	6.3	N	2000	6	8	-	-
N	1+	11	83	10	0.78	5.6	N	2500	-	-	-	+
N	1+	13	97	20	0.69	3.8	N	2000	-	-	-	+
N	1+	12	81	19	0.52	5.1	N	800	-	-	-	+
N	4+	10.5	78	16	0.5	6.3	N	1900	-	-	-	+
N	1+	13.4	37	19	0.78	5.6	N	2500	7	9	-	-
N	1+	9.8	78	23	1	3.8	N	2500	8	9	-	-
N	1+	11.9	38	20	0.5	5.1	N	2200	8	8	-	-
N	2+	10.8	79	18	0.93	5.1	N	1100	6	9	-	+
N	1+	11	88	19	0.5	6.6	N	2800	8	9	-	-
N	2+	12.2	76	23	0.78	5.1	N	2200	4	5	-	-
N	1+	12	74	22	0.71	4.9	N	2200	6	5	-	-
N	1+	11	56	20	0.5	5.6	N	-	-	-	+	-
N	2+	10	93	10	0.47	2.9	N	2250	7	9	-	-

N	4+	11	98	34	0.74	5.3	N	1750	6	8	-	-
N	1+	12.1	91	23	0.78	5.6	N	2000	-	-	+	-
N	1+	11.3	69	12	0.48	2.9	N	2800	6	9	-	-
N	1+	7.4	90	23	0.7	6.5	N	2200	7	9	-	-
N	2+	8	80	15	0.78	3.6	N	2500	7	9	-	-
N	1+	9.4	88	23	0.78	5.9	N	2450	7	9	-	-
N	1+	10	76	13	0.69	3.6	N	3500	7	9	-	-
N	1+	12	100	22	0.52	5.8	N	2400	6	8	-	-
N	1+	10.2	67	23	0.5	7.4	N	1800	5	6	-	-
N	1+	11.8	68	19	0.78	6.6	N	2100	7	9	-	-
N	2+	10	66	31	1	4.1	N	2450	8	9	-	-
N	1+	9	80	10	0.7	5.2	N	2500	7	9	-	-
N	2+	13.6	88	14	0.7	6.4	N	1600	-	-	-	+
N	1+	8	90	26	1	7.9	N	2100	6	9	-	-
N	1+	12	96	13	0.7	4.8	N	2500	7	9	-	-
N	1+	8.8	74	10	0.9	2.6	N	3700	7	9	-	-
N	1+	11	58	20	0.7	4.7	N	2200	6	9	-	-
N	1+	12	76	19	0.7	6.8	N	2500	7	9	-	-
N	2+	9.8	67	16	0.8	7.6	N	2800	6	9	-	-
N	2+	12.4	97	29	1	2.8	N	2100	5	6	-	-
N	1+	10.5	80	13	0.78	5	N	2500	8	9	-	-
N	3+	12	74	11	1	6.8	N	2350	7	9	-	-
N	1+	11	66	18	0.78	3.6	N	2200	7	9	-	-
N	1+	9.4	68	18	1	5.3	N	2800	6	8	-	-
N	1+	12	90	23	1	5	N	2900	6	9	-	-
N	2+	11	90	23	0.54	8.3	N	2400	7	9	-	-
N	1+	10.6	80	17	0.78	4.6	N	2900	7	9	-	-
N	2+	9.8	88	11	0.52	7.2	N	3600	5	9	-	-
N	1+	12	76	23	1	2.9	N	3200	7	8	-	-
N	1+	12	70	23	0.52	9.1	N	2400	6	8	-	-
N	2+	13.4	76	18	0.78	5	N	2600	7	9	-	-
N	3+	12	100	19	0.87	5.8	N	3000	6	9	-	-
N	1+	12.7	80	23	0.78	5.8	N	2350	6	9	-	-
N	1+	9.8	88	21	0.48	9	N	2200	7	9	-	-
N	1+	12.5	74	34	0.7	6.1	N	2700	5	5	-	-
N	3+	10.9	78	23	0.78	4.3	N	2400	6	9	-	-
N	1+	10.6	60	13	0.78	6.2	N	2500	7	9	-	-
N	1+	8	74	22	0.69	6.5	N	2500	6	9	-	-
N	2+	12	78	23	0.52	4.9	N	1200	7	9	-	-
N	1+	12.4	80	19	0.5	4.7	N	1900	7	9	-	-
N	1+	12.1	115	31	0.78	9.6	N	2500	5	9	-	-
N	1+	10	90	10	1	5.8	N	2900	6	9	-	-
N	2+	9.8	64	14	0.5	9	N	1800	6	9	-	-
N	1+	12.5	78	26	0.93	6.3	N	2800	7	9	-	-
N	1+	7.4	90	13	0.51	5.1	N	1600	7	7	-	-
N	1+	9	80	10	O.74	4.3	N	2400	6	9	-	-
N	1+	12	80	20	1	6.6	N	2200	7	9	-	-

N	1+	12	88	19	0.7	7.4	N	2100	6	8	-	-
N	1+	8	94	16	0.7	6.6	N	2400	8	9	-	-
N	2+	12.7	90	19	1	5.2	N	3000	7	9	-	-
N	1+	12	68	23	0.7	6.4	N	1800	7	7	-	-
N	2+	10.8	64	20	0.9	2.6	N	2100	6	9	-	-
N	1+	8	78	18	0.7	5.1	N	2000	7	9	-	-
N	1+	8	88	19	0.7	5	N	2400	8	9	-	-
N	1+	7.4	90	13	0.51	5.1	N	2200	8	9	-	-
N	1+	9	80	10	O.74	4.3	N	2000	7	9	-	-