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Maternal and fetal effects and outcome of pregnancy induced hypertension at a tertiary care setting in Sri Lanka

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The identification of this clinical entity and effective management play a significant role in the outcome of pregnancy, both for the mother and the fetus hence reducing maternal and perinatal mortality.
To determine the Fetal and Maternal outcome in Pregnancy Induced Hypertension compared with matched normal controls specifically with regard to age, common symptoms, signs, amniotic fluid index, Doppler, delivery details and neonatal outcome.
A retrospective case control study was conducted for one year period (2007/01 to 2008/01) and relevant information were obtained from consecutive consenting mothers who were admitted and managed at ward 03 and ward 15. Measurement of blood pressure was standardized and matched with a controlled group.Statistical analysis was performed with chi-square test, regression analysis and McNemar test within the Statistical Package For Social Sciences Software.
The age of mothers ranged from 16 to 40 years. The mean age was 30.1 years (SD = 4.9 years). The highest proportion (35.6%) of mothers was in 31 –35 year age group. The smallest proportion (4.0%) of mothers were in 16 – 20 year age group. Majority (38.6%) of the mothers were primigravidae. Of the hypertensives 50.5% had BMI over 25 kg/m 2. The majority (66.3%) of the patients have developed PIH between 33 weeks to 37+6 weeks. The occurrence of late hypertension is significant with a correlation coefficient (r) of = 0.45, p<0.001.) Nearly 20% of the cases were asymptomatic. The occurrence of classical symptoms like headache, oedema, visual disturbances and epigastric pain were very significant (p< 0.001) among the severe hypertensives. There was no significant relationship between the AFI and EFW in both groups of mothers before 38 weeks of gestation (r = 0.43 P = 0.16, r = 0.35, P = 0.09). There was a significant relationship between the AFI and EFW after 38 weeks' gestation (r = 0.61; P = 0.03). A positive relationship between the AFI and EFW was noted late in gestation. There were significant abnormalities in the Doppler indices seen in PIH (p <0.01) although the sample was too small.
The identification of this clinical entity and effective management play a significant role in the outcome of pregnancy, both for the mother and the fetus hence reducing maternal and perinatal mortality.

Key words: Pregnancy Induced Hypertension, Fetal and maternal outcomes, Case control study

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INTRODUCTION

Pregnancy induced hypertension is one of the common and serious complications encountered in pregnancy and contributes significantly to the maternal and perinatal morbidity and mortality (deJong et al., 1999). In pregnancy induced hypertension, hypertension is a sign of underlying pathology which appear during pregnancy.

Pre-eclampsia may develop from 20 weeks gestation (it is considered early onset before 32 weeks, which is associated with increased morbidity) and its progress differs among patients; most cases are diagnosed antenatally (Bailey and Walton, 2005).

Diagnosis

Pre-eclampsia is diagnosed when a pregnant woman develops high blood pressure (two separate readings taken at least 6 hours apart of 140/90 or more) and 300 mg of protein in a 24-hour urine sample (proteinuria). A rise in baseline BP of 20 systolic or 15 diastolic, while not meeting the absolute criteria of 140/90 is still considered important to note but no longer diagnostic. Swelling, or edema, (especially in the hands and face) was originally considered an important sign for a diagnosis of pre-eclampsia, but in current medical practice only hypertension and proteinuria are necessary for a diagnosis (Rosalind and John, 2004). However, pitting edema (unusual swelling, particularly of the hands, feet, or face, notable by leaving an indentation when pressed on) can be significant (Drife et al, 2009).

Management

The standard protocol for management includes when pre-eclampsia develops remote from term (that is, <34-36 weeks' gestation), attempts often are made to prolong the pregnancy to allow for further fetal growth and maturation. In this setting, both maternal and fetal status must be very closely monitored in a high-risk obstetric centre (Xiong et al., 1999). Fetal testing should be performed at least twice weekly, using a combination of biophysical profiles and non-stress testing supervised by an obstetrician. Facilitated delivery should occur if either maternal or fetal deterioration is noted, with the mode of delivery decided by obstetric indications based on the severity of the condition and bishop score. It may also occur up to six weeks post-partum (44%). It is the most common of the dangerous pregnancy complications which may affect both the mother and the fetus (Courtney et al., 2006).

Common associations

Pre-eclampsia occurs in as many as 10% of pregnancies, usually in the second or third trimester, and after the 32nd week. Some women will experience pre-eclampsia as early as 20 weeks, though this is rare. It is much more common in women who are pregnant for the first time, and its frequency drops significantly in second and subsequent pregnancies. While change of paternity (Hjartardottir et al., 2004) in a subsequent pregnancy is now thought to lower risk except in those with a family history of hypertensive pregnancy, since increasing maternal age raises risk (Crowther et al., 1992) it has been difficult to evaluate how significant paternity change actually is and studies are providing conflicting data on this point (Zang, 2007).

Pre-eclampsia is also more common in women who have preexisting hypertension, diabetes, autoimmune diseases like lupus, various inherited thrombophilias like Factor V Leiden, or renal disease, in women with a family history of pre-eclampsia, obese women, and in women with a multiple gestation (twins, triplets, and more). The single most significant risk for developing pre-eclampsia is having had pre-eclampsia in a previous pregnancy (Sarah et al, 2003).

Pre-eclampsia may also occur in the immediate post-partum period or up to 6-8 weeks post-partum. This is referred to as "postpartum pre-eclampsia." The most dangerous time for the mother is the 24-48 hours postpartum and careful attention should be paid to identify signs and symptoms of early pre-eclampsia.

Justification

The identification of this clinical entity and effective management play a significant role in the outcome of pregnancy, both for the mother and the fetus. In developing countries with a minimal cared pregnancy, this entity remains undetected till major complications supervene. This study will helps to identify and compare the maternal and fetal complications associated with Pregnancy induced hypertension and normal uncomplicated pregnancies. This study will further evaluate the usefulness of routine serum tests, ultrasound for growth, Doppler, and biophysical profile in the fetal assessment in a tertiary care setting in Sri Lanka.

Objectives

General objective

To determine the Fetal and Maternal outcome in Pregnancy induced hypertension compared with matched normal controls.

Specific objectives

- To determine the age and period of gestation of developing Pregnancy induced hypertension
- To determine the common maternal symptoms and signs associated with Pregnancy induced hypertension

- To assess the usefulness of the amniotic fluid index and the Doppler ultrasound in determining the timing of delivery
- To determine the period of gestation and mode of delivery in Pregnancy induced hypertension compared with the controls
- To determine specific maternal and fetal complications and birth weight of the babies compared with the controls

METHODS

Study design

A retrospective case control study was carried out to determine the fetal and maternal outcome in Pregnancy Induced Hypertension.

Study period

The study was carried out for one year from January 2007 to January 2008.

Study setting

The study was done in two wards at the De Soyza Hospital for Women, Colombo.

Study population

Antenatal mothers who were admitted to the two wards at the De Soyza Hospital for Women, Colombo.

Study group

100 Antenatal mothers who were admitted with PIH (diastolic blood pressure ≥ 90 mmHg in two consecutive readings 4 hours apart) to WD 15 and WD 03 during the above mentioned time period. All the mothers consecutively consenting were taken until the total sample was completed.

Control group

101 Antenatal mothers attended DMH clinic (patients who were antenatally complicated) who were matched for age, parity and Body Mass Index (BMI) were randomly selected.

Exclusion criteria

Patients who have chronic hypertension and equivocal diagnosis and patients who got diastolic blood pressure ≥ 90 mmHg; but not in two consecutive readings were excluded.

Data collection

The relevant information was obtained retrospectively from the perusal of the patients notes and relevant information was recorded. Blood pressure measurements were taken after keeping the patients in the sitting position for 5-10 minutes.

Standardization of the measurement of blood pressure

Blood pressure should be measured in the sitting position, with the cuff at the level of the heart. Inferior vena caval compression by the gravid uterus while the patient is supine can alter readings substantially, leading to an underestimation of the blood pressure. Blood pressures measured in the left lateral position similarly may yield falsely low values if the blood pressure is measured in the higher arm, unless the cuff is carefully maintained at the level of the heart.

Korotkoff sounds I (the first sound) and V (the disappearance of sound) should be used to denote the systolic blood pressure (SBP) and DBP, respectively. In about 5% of women, an exaggerated gap exists between the fourth (muffling) and fifth (disappearance) Korotkoff sounds, with the fifth sound approaching zero. In this setting, both the fourth and fifth sounds should be recorded (eg, 120/80/40 with sound I = 120, sound IV = 80, sound V = 40) as the fourth sound will more closely approximate the true DBP.

Maternal SBP greater than 160 mm Hg or DBP greater than 110 mm Hg denotes severe disease; depending on the gestational age and maternal status, delivery should be considered for sustained BPs in this range.

Data analysis

Data were entered into a SPSS data sheet and analyzed using SPSS software.

Statistical analysis was performed with chi-square test, regression analysis and McNemar test within the Statistical Package for Social Sciences Software. Statistical significance was considered if $p<0.05$.

RESULTS

Demographic profile of the study sample

The age of mothers ranged from 16 to 40 years (Table 1). These findings are contradictory to standard occurrence of hypertension in the extremes of age. This effect may be possibly due to low representation of hypertensives in extremes of age i.e.16 to 20 years and more than 36

Table 1. Age distribution of the study sample

Age in years	No.	%
16 – 20	4	4.0
21 – 25	15	14.8
26 – 30	33	32.7
31 – 35	36	35.6
≥36	13	12.9
Total	**101**	**100.0**

Mean ±SD = 30.1±4.9,
Median = 30, Min/Max=16/40

Table 2. Distribution of parity in the study sample

Parity	No.	%
1	39	38.6
2	33	32.7
3	18	17.8
≥4	11	10.9
Total	**101**	**100.0**

Table 3. Distribution of PIH category by BMI

Level of BMI	PIH category						Total	
	Mild		Moderate		Severe			
	No.	%	No.	%	No.	%	No.	%
Underweight	2	16.7	2	16.7	8	66.7	12	100.0
Normal	7	18.4	13	34.2	18	47.4	38	100.0
risk for Overweight	9	32.1	6	21.4	13	46.4	28	100.0
Obese	11	47.8	5	21.7	7	30.4	23	100.0
Total	**29**	**28.7**	**26**	**25.7**	**46**	**45.5**	**101**	**100.0**

Table 4. The International classification of adult underweight, overweight and obesity according to BMI and occurrence of hypertension.

Level of BMI	No.	%
<18.50	12	11.9
18.50 – 24.99	38	37.6
25.00 – 29.99	28	27.7
≥30	23	22.8
Total	**101**	**100.0**

years in our study sample. Preeclampsia is more common at the extremes of maternal age (<18 y or >35 y). The increased prevalence of chronic hypertension and other comorbid medical illnesses in women older than 35 years may explain the increased frequency of preeclampsia among older gravidae.

The distribution of parity of mother is given in the Table 2. It is seen that only 10.9% of mothers have 4 or more parity in the study sample. Majority (38.6%) of the mothers were primigravidae. The minimum parity of women in the study was 1 while the maximum parity was 8. The median was 2. These findings are consistent with standard high incidence of PIH among primigravidae.

The Body Mass Index or BMI is used to assess the weight status of individuals. The BMI (the weight in kilograms over the square of the height in meters) is one of the best ways to correlate the weight to pathological entities. It also indirectly quantifies the total body fat. In adults, the weight status based on the BMI is as follows:

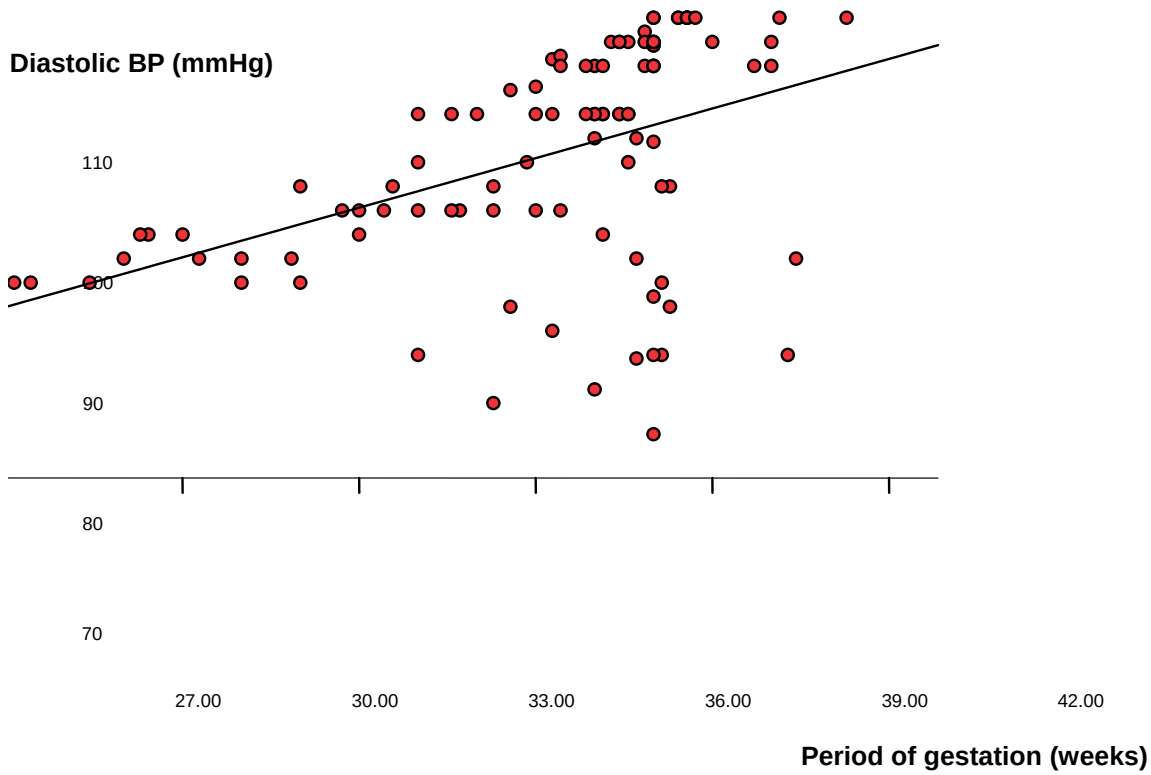
BMI less than 18.5 = Underweight
BMI 18.5 - 24.9 = Normal
BMI 25 – 29.9 = risk for Overweight
BMI over 30 = Obese

Even though obesity is a known factor associated with developing hypertension most of the severe hypertensives were in the underweight category (Table 3).

Table 4 illustrates the occurrence of hypertension Vs BMI. It is apparent nearly 50% of the hypertensives had BMI over 25. However we could not establish a direct association of increased BMI with Pregnancy induced hypertension.

In Figure 1, the majority of the patients have developed PIH between 33 to 37 weeks. Since this period is considered as period of viability we have obtained low perinatal deaths in the management of our cases. The occurrence of late hypertension is significant with a correlation coefficient (r) of = 0.45, p <0.001. In contrary the diagnosis of severe hypertension or preeclampsia in the first or early second trimester necessitates exclusion of gestational trophoblastic disease and/or molar pregnancy. We have not encountered abnormal conceptions as our study group consists of patients who were 27 weeks of gestation. Women diagnosed with severe or early preeclampsias (in the second trimester or early third trimester) have a higher prevalence of thrombophilias. This is another area that we should focus as we have limited local literature.

Figure 2 is another illustration about the occurrence of hypertension according to ultrasound based period of gestation. All our study group patients had ultrasound scans done for their gestational age between 12 to 20



r = 0.45, p<0.001, Significant

Figure 1. Relationship between Diastolic BP and POG in weeks

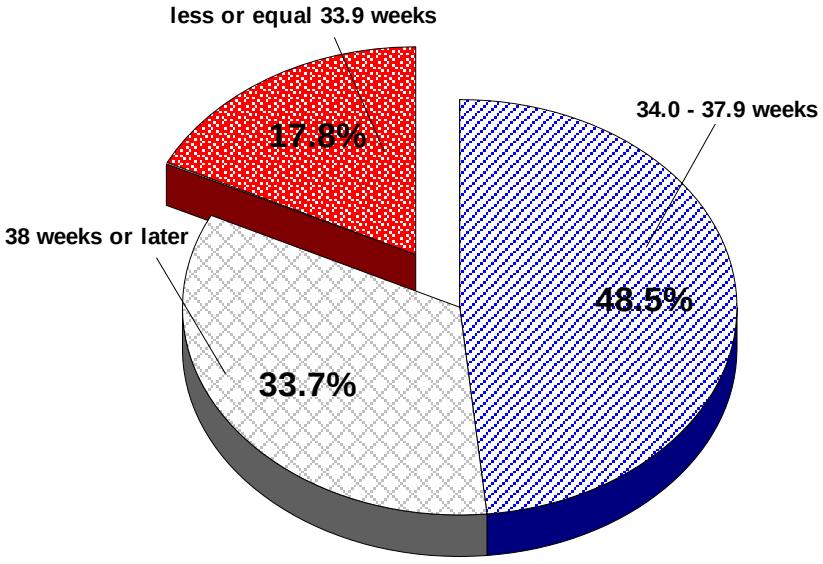


Figure 2. Distribution of 3 categories of the Period of Gestational (POG) according to the ultrasonographic dates

Table 5. Analysis of symptoms

Symptoms	cases	controls	Comment
Asymptomatic	20	49	p< 0.001 sig.
Headache	40	06	p< 0.001 sig.
Oedema	42	05	p< 0.001 sig.
Visual disturbances	12	02	p< 0.0001 sig.
Epigastric pain	12	03	p< 0.0001 sig.
Rapid weight gain	18	02	p< 0.0001 sig.
others	08	12	

Table 6. Distribution of category of PIH by age in years

Age in years	PIH category						Total	
	Mild		Moderate		Severe			
	No.	%	No.	%	No.	%	No.	%
16 – 20	1	25.0	2	50.0	1	25.0	4	100.0
21 – 25	2	13.3	4	26.7	9	60.0	15	100.0
26 – 30	9	27.3	7	21.2	17	51.5	33	100.0
31 – 35	13	36.1	10	27.8	13	36.1	36	100.0
≥36	4	30.8	3	23.1	6	46.2	13	100.0
Total	**29**	**28.7**	**26**	**25.7**	**46**	**45.5**	**101**	**100.0**

≤35 and >35 were categorized for chi-square test
χ^2 = 2.17, df = 2, p=0.34, Not Significant

weeks. This estimation had helped us in assessing growth of the baby and detecting subsequent Intra Uterine growth restriction (IUGR).

The occurrence of classical symptoms like headache, oedema, visual disturbances, epigastric pain were very significant in the study group compared to the controls (Table 5). However, nearly 20% of the cases were asymptomatic indicating the need for screening using blood pressure with standard settings.

Severity of hypertension

In Table 6, There were 46, 26, 29 patients in who had severe, moderate and mild hypertension respectively. There had been an apparent increase in severe hypertension among 31 to 35 and more than 36 age groups. However this increase was not seemed to be significant most probably due to small sample size. Paul Gibson et al 2005 have clearly shown a significant relationship between severe pre-eclampsia with advancing maternal age.

The lower maternal age is another risk factoring the same series but we could not establish the relationship due to a small number of cases with PIH between 16 to 20 years.

The numbers were zero in a few cells and the significance was not looked in to. It is apparent that in our sample (Table 7) that all early pregnancy induced hypertension cases were within the severe category. Mild and moderate hypertensions were identified after 34 weeks. In our study there were nearly 46%patients with severe hypertension. Hypertensive disorders in pregnancy are the 2nd leading causes of maternal mortality, along with medical disorders, thromboembolism, hemorrhage and obstetric injuries.

Fetal outcome

Hypertensive disorders are the commonest cause for the placental insufficiency. This may result in chronic intrauterine hypoxia leading to poor fetal wellbeing, low birth weight and subsequent early and late neonatal complications. We have assessed liquor content by uss measurement of 4 quadrant liquor termed amniotic fluid index, fetal weight and umbilical artery Doppler flow velocities as markers of fetal well being and placental

Table 7. Severity of PIH by POG in weeks

Period of Gestational age (weeks)	PIH category						Total	
	Mild		Moderate		Severe			
	No.	%	No.	%	No.	%	No.	%
27 - 33.9	0	0.0	0	0.0	18	100.0	18	100.0
34 – 37.9	15	30.6	15	30.6	19	38.8	49	100.0
38 or later	14	41.2	11	32.4	9	26.5	34	100.0
Total	**29**	**28.7**	**26**	**25.7**	**46**	**45.5**	**101**	**100.0**

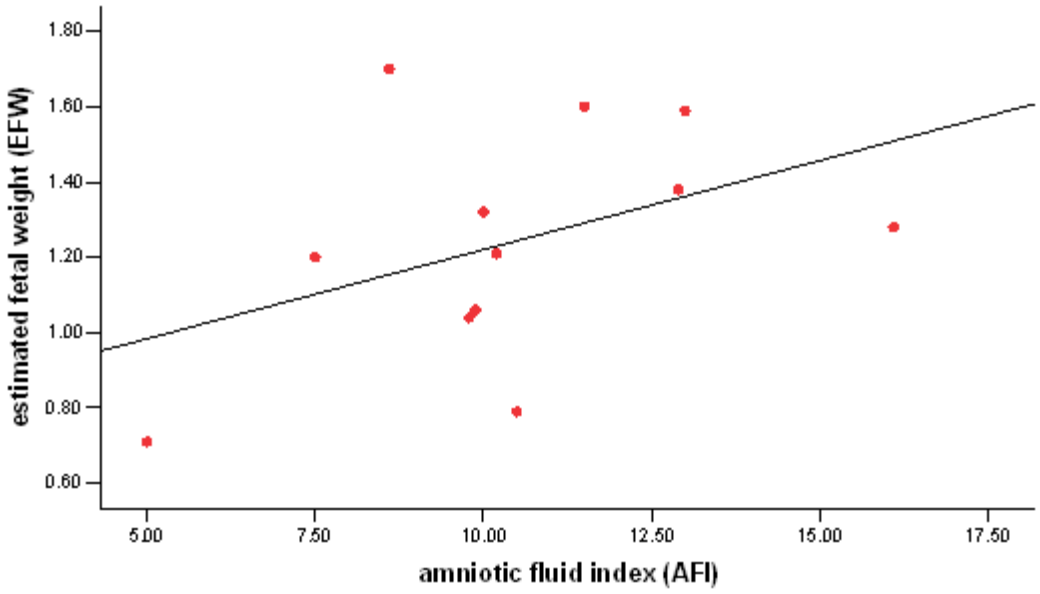


Figure 3. The correlation of ultrasound determined amniotic fluid index and estimated fetal weight (EFW) in <=33.9 weeks

r = 0.43, p=0.16, Not Significant

The correlation of the amniotic fluid index (AFI) with estimated fetal weight (EFW) is not significant (Figure 3).

function Figure 3 .

The correlation of the amniotic fluid index (AFI) with estimated fetal weight (EFW) is not significant (Figure 3). Correlation of the amniotic fluid index (AFI) with estimated fetal weight (EFW) in POG 34.0 – 37.9 weeks is not significant (Figure 4) (Table 8).

An amniotic fluid index in Figure 5, 10cm is a good reflection of placental function, hence optimal fetal growth. Most of our patient had amniotic fluid indexes above 8 cm. However the relationship between EFW and AFI was not significant (correlation coefficient-r^2= 0.35) possible due to small overall sample size. Therefore we adjust the scatter in to 34- 37.9 and 38 weeks onwards taking the cutoff as 8cm.

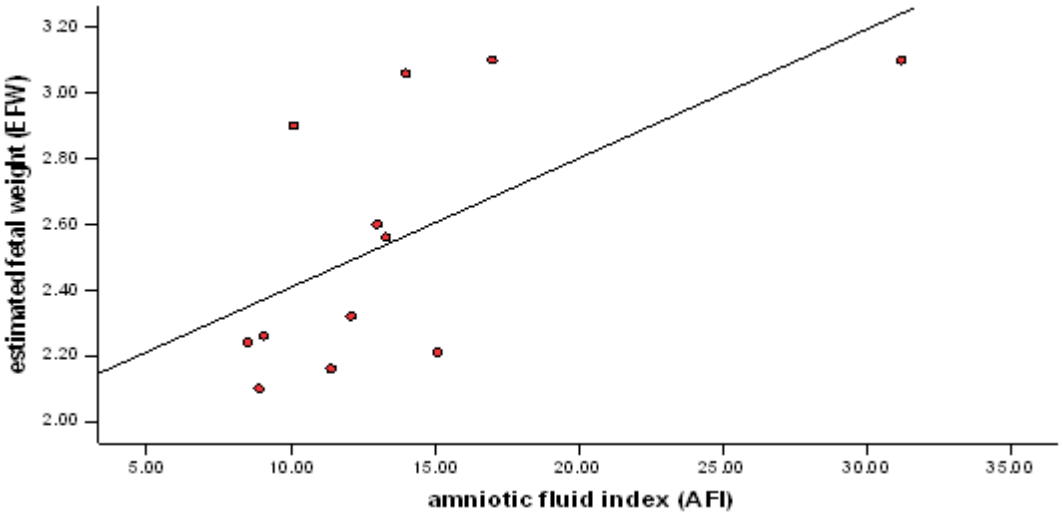
Outcome of PIH among cases and controls

In Table 9, 23 mothers in the study group had special care following the delivery compared to 14 cases a seen among the controls. Almost of these mothers were managed in ICU probably severe category requiring antenatal admission to ICU. They were subsequently managed after the delivery in the same setting. When study group was compared with the controls there was no significant difference among both groups. This effect may

Table 8. Distribution of complications in the study

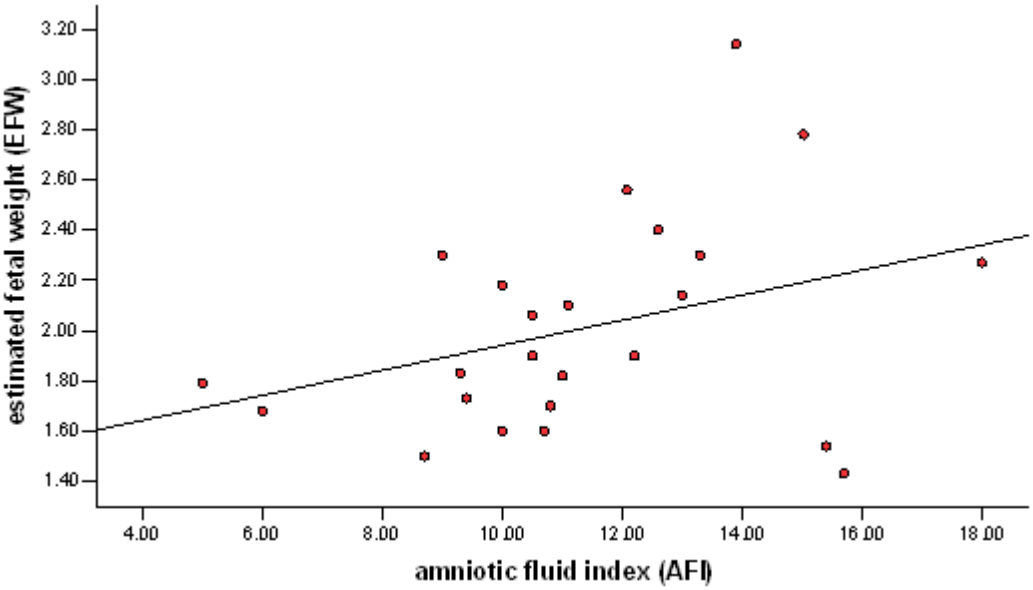
Complications	No.	%
Protein urea		
Yes	40	39.6
No	61	60.4
Oedema		
Yes	73	72.3
No	28	27.7
Fits		
Yes	3	3.0
No	98	97.0
Abruption		
Yes	3	3.0
No	98	97.0
IUGR		
Yes	29	28.8
No	72	71.2
IUD		
Yes	1	1
No	100	99
Total	**101**	**100.0**

The most common complication was oedema in the study (Table 8).



r^2 = 0.35, p=0.09, Not Significant

Figure 4. Correlation of the amniotic fluid index (AFI) with estimated fetal weight (EFW) in POG 34.0 – 37.9 weeks



r = 0.61, p=0.03, Significant

Figure 5. Correlation of the amniotic fluid index (AFI) with estimated fetal weight (EFW) in POG 38 weeks or later.

Table 9. Comparison of maternal outcome among cases and controls

Maternal outcome	Study group				Significance
	Cases		Control		
	No.	%	No.	%	
Special care given	23	22.8	14	13.9	χ^2 =2.68
Routine care	78	77.2	87	86.1	df=1 ,p=0.10,NS
Total	**101**	**100.0**	**101**	**100.0**	

NS=Not Significant,

Table 10. Comparison of fetal outcome among cases and controls

Fetal outcome	Study group				Significance
	Cases		Control		
	No.	%	No.	%	
Observation at PBU	39	38.6	11	10.9	χ^2 =30.12
Neonatal care with ventilation	12	11.9	5	5.0	df=1 ,p<0.001,S
Neonatal death	2	2.0	0	0.0	
Given to mother	48	47.5	85	84.2	
Total	**101**	**100.0**	**101**	**100.0**	

S=Significant, Rows 1,2 and 3 were amalgamated for chi-square test
OR =5.87 (2.89 – 12.03)

be due to proper antenatal management, timely delivery before the occurrence serious complications.

It is apparent from this result that there are a significant number of babies who needed special care and ventilation following the delivery (Table 10). This is most probably due to early termination of pregnancy due to

Table 11. Distribution of Birth Weight by period of gestational age in mothers

Period of Gestational age (weeks)	Birth weight				Total		Significance
	< 2.5 Kg		>2.5 Kg				
	No.	%	No.	%	No.	%	
27 - 33.9	17	94.4	1	5.6	18	100.0	χ^2 = 20.9*
34 – 37.9	30	61.2	19	38.8	49	100.0	P<0.001, S
38 or later	10	29.4	24	70.6	34	100.0	
Total	**58**	**57.4**	**43**	**42.6**	**101**	**100.0**	

*S= Significant, * Chi-square for linear trend test was applied*

Table 12. Distribution of PIH category by Birth weight

BW (Kg.)	PIH category						Total	
	Mild		Moderate		Severe			
	No.	%	No.	%	No.	%	No.	%
<2.5	8	13.8	13	22.4	37	63.8	58	100.0
≥2.5	21	48.8	13	30.2	9	20.9	43	100.0
Total	**29**	**28.7**	**26**	**25.7**	**46**	**45.5**	**101**	**100.0**

χ^2 = 21.1, df=2, p<0.001: Significant

Table 13. Distribution of PIH category by Diabetes Mellitus

Diabetes mellitus	PIH category						Total	
	Mild		Moderate		Severe			
	No.	%	No.	%	No.	%	No.	%
Yes	8	42.1	4	21.1	7	36.8	19	100.0
No	21	25.6	22	26.8	39	47.6	82	100.0
Total	**29**	**28.7**	**26**	**25.7**	**46**	**45.5**	**101**	**100.0**

The numbers were <5 in a few cells and therefore could not be applied significance test.

severe hypertension. More than half of the babies in the study group were not given to mother compared to 85% in the control group.

Late development of hypertension always permits appropriate fetal growth, hence good fetal weight. In our study 62% of the babies in the 34 to 38 weeks category had birth weight < 2.5kg (Table 11). This association was significant (p<0.001).

Most of our severe PIH patients were within 27 - 34 category, therefore this significance cannot be commented on as the birth weights were anyway less than 2.5kg (Table 12).

Although there were nearly 19 diabetics in the study group (Table 13) no significant association was detected.

Pitting oedema was significant among the severe category of hypertension which is in consistent with standard features of pre-eclampsia (Table 14).

Doppler indices of umbilical artery

Doppler Resistance Index measurements

The Doppler indices were obtained using a standard Doppler protocol according to International society of Ultrasound in Obstetrics and Gynaecology standards using a Siemens Sonoline S-40 machine. The Fetal medicine Foundation standard gestational age based normograms were followed. The SD ratio was based on the standard normogram and cutoff for Pulsatility Index was set at 1.5 at 34 weeks onwards cutoff for Resistant Index was set at 0.7 at 34 weeks onwards.

Doppler Pulsatility Index measurements

There are abnormalities in the vascular resistance seen

Table 14. Distribution of PIH category by Oedema

Oedema	PIH category						Total	
	Mild		Moderate		Severe			
	No.	%	No.	%	No.	%	No.	%
Yes	8	11.0	19	26.0	46	63.0	73	100.0
No	21	75.0	7	25.0	0	0.0	28	100.0
Total	**29**	**28.7**	**26**	**25.7**	**46**	**45.5**	**101**	**100.0**

χ^2 = 46.6, df = 2, p<0.001, Significant

Table 15. Distribution of level of Doppler PI by period of gestational age in mothers

Period of Gestational age (weeks)	Doppler PI				Total		Significance
	<1.5		≤1.5				
	No.	%	No.	%	No.	%	
34 – 37.9	25	51.0	24	49.0	49	100.0	df=2
38 or later	13	38.2	21	61.8	34	100.0	p=0.51,NS
Total	**46**	**45.5**	**55**	**54.5**	**101**	**100.0**	

*NS=Not Significant, * Chi-square test was applied, <38 and ≥38 were categorized for chi-square test*
Doppler PI = Doppler Pulsatility Index measurements

Table 16. Distribution of level of maternal outcome by Doppler RI

Doppler RI	Maternal outcome				Total		Significance
	Sent to WD		Special care given				
	No.	%	No.	%	No.	%	
<0.70	21	87.5	3	12.5	24	100.0	χ^2 =1.89
>0.70	57	74.0	20	26.0	77	100.0	df=1 ,p=0.17,NS
Total	**78**	**77.2**	**23**	**22.8**	**101**	**100.0**	

NS=Not Significant, Doppler RI = Doppler Resistance Index measurements

in PIH however the number our study was too small to arrive at significance (Table 15).

Doppler indices of umbilical artery and outcome

The measurements of uteroplacental blood flow (Merja et al., 2005) velocity waveforms at the second trimester are not sensitive enough to be an early screening tool for PIH and Small for Gestational age (SGA) in the low risk, non-selected pregnancy population (Alghazali et al., 1988). The fact suggests that in most gravidas complicated with PIH and SGA, the physiological process of trophoblastic invasion in the spiral artery was not prevented before the 25th gestational week. The S/D ratio of Umbilical Artery is the most sensitive and specific index in predicting major perinatal adverse outcome (Hernandez-Andrade et al., 2002). The pulsatility index (P.I) is the most specific index (90.9%) for predicting in any adverse perinatal outcome (Mires et al., 1998). The sensitivity of the Doppler studies can be significantly increased by studying multiple vessels (Zimmermann et al., 1997). However in our study there were no significant associations of Doppler with adverse perinatal out come probably due to small sample size (Table 16, 17 and 18).

A Case control study

For the other 101 mothers age, parity and Body Mass Index (BMI) matched controls were selected randomly from among those who have attended DMH clinic. Using this control group a matched analysis was carried out to describe risk factors for maternal and fetal outcome of PIH.

The mean POG in the study group was 36.14 and control is 38.70 weeks. This effect is probably due to

Table 17. Distribution of level of maternal outcome by Doppler S/D ratio

Doppler S/D ratio	Maternal outcome				Total		Significance
	Sent to WD		Special care given				
	No.	%	No.	%	No.	%	
<2.0	2	100.0	0	0.0	2	100.0	*
– 3.0	12	80.0	3	20.0	15	100.0	
>3.0	64	76.2	20	23.8	84	100.0	
Total	**78**	**77.2**	**23**	**22.8**	**101**	**100.0**	

NS=Not Significant, Doppler RI = Doppler Resistance Index measurements
**The numbers were <5 in a few cells and therefore could not be applied significance test.*

Table 18. Distribution of level of maternal outcome by Doppler PI

Doppler PI	Maternal outcome				Total		Significance
	Sent to WD		Special care given				
	No.	%	No.	%	No.	%	
<1.5	37	80.4	9	19.6	46	100.0	χ^2 =0.49
≤1.5	41	74.5	14	25.5	55	100.0	df=1 ,p=0.48,NS
Total	**78**	**77.2**	**23**	**22.8**	**101**	**100.0**	

NS=Not Significant, Doppler PI = Doppler Pulsatility Index measurements

Table 19 a & b: Comparative analysis of POG at delivery in both groups

Cases= n	101
mean	36.14
median	37.00

Controls= n	79
mean	38.70
median	39.00

disease termination process as the part of the management. However compared to Chalmers et al 2004.Who has studied 248 pre-eclamptics with a mean POG of 33+ 6 weeks. Our patients delivered with a mean of 36.14. This effect could be attributed to late occurrence of hypertension among the majority Table 19 and 20).

There were 82 caesarian sections among the study group compared to 11 caesarian sections in the control group, this is probably due to high incidence of failure induction and increased number of severe category hypertension requiring caesarian section. This difference was very significant with a p< 0.0001. Table 21

Maternal outcome

There was a significant difference in the care between cases and controls for the fact that PIH mothers were managed at different settings and continued towards the pueparium. There were no maternal deaths in both groups. Table 22.

There were significant different outcomes in terms of observation at PBU, neonatal care with ventilation and neonatal death. These effects were rarely seen among the new borns of the control group and difference was significant 4.05, p=0.04. Table 23

DISCUSSION

In our study The age of mothers ranged from 16 to 40 years. The mean age was 30.1 years (SD = 4.9 years). The highest proportion (35.6%) of mothers was in 31 –35 year age group. The smallest proportion (4.0%) of mother was in 16 – 20 year age group (Table 3.1.1). These findings are contradictory to standard occurrence of hypertension in the extremes of age. This effect may be possibly due to low representation of hypertensives in extremes of age i.e.16 to 20 years and more than 36 years in our study sample.

Table 20 c & d: Comparative analysis of mean POG at delivery in both groups

One-Sample Test

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
	Lower	Upper	Lower	Upper	Lower	Upper
POG at delivery-contr	399.926	79	.000	38.70000	38.5556	38.9403
POG at delivery-cases	110.572	101	.000	36.14000	35.4232	36.7176

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
POG at delivery-contr	79	38.7479	.94930	.09689
POG at delivery-cases	101	36.0704	3.27844	.32622

Table 21. a & b: Comparative analysis of mode of delivery in both groups

Controls= n	79
NVD	66
AVD	02
EL LSCS	09
EM LSCS	02

Cases= n	101
NVD	17
AVD	02
EL LSCS	45
EM LSCS	37

NVD = Normal vaginal delivery
AVD = Assisted vaginal delivery
EL LSCS = Elective caesarian section
EM LSCS= Emergency caesarian section

Table 22. Distribution of cases and controls by maternal outcome with PIH

	Maternal outcome	**Control**		**Total**	**Significance test**	
		Yes	**No**		**McNemar test** $\chi^2_{McN,Corrected\ ,\ (1df)}$ **p-value**	**OR (95%CI)**
Case	Special care given	10	18	28	4.00 , p=0.04	2.57(1.02 – 7.67)
	Sent to the Ward	7	66	73		
	Total	**17**	**84**	**101**		

Preeclampsia is more common at the extremes of maternal age (<18 y or >35 y). The increased prevalence of chronic hypertension and other co-morbid medical illnesses in women older than 35 years may explain the increased frequency of preeclampsia among older gravidae (Rosalind and John, 2004).

Table 23. Distribution of cases and controls by fetal outcome with PIH

	Fetal outcome	Control		Total	Significance test	
		Yes	No		McNemar test $\chi^2_{McN,Corrected,(1df)}$ p-value	OR (95%CI)
Case	Abnormal	8	15	23	4.05 , p=0.04	3.01(1.02 – 9.42)
	Given to mother	5	73	78		
	Total	**13**	**88**	**101**		

Observation at PBU, neonatal Neonatal care with ventilation, Neonatal death

The distribution of parity of mother is given in the Table 5. It is seen that only 10.9% of mothers have 4 or more parity in the study sample. Majority (38.6%) of the mothers were primigravidae. The minimum parity of women in the study was 1 while the maximum parity was 8. The median was 2. These findings are consistent with standard high incidence of PIH among primigravidae (Robbins and Cotran and kumar, 2005).

Even though obesity is a known factor associated with developing hypertension most of the severe hypertensives were in the underweight category. There were nearly 50% of the hypertensives with a BMI over 25. However we could not establish a direct association of increased BMI with Pregnancy induced hypertension.

The majority of the patients have developed PIH between 33 to 37 weeks. Since this period is considered as period of viability we have obtained low perinatal deaths (Brne, 2007) in the management of our cases. The occurrence of late hypertension is significant with a correlation coefficient (r) of = 0.45, $p<0.001$. In contrary the diagnosis of severe hypertension or preeclampsia in the first or early second trimester necessitates exclusion of gestational trophoblastic disease and/or molar pregnancy (Robbins and Cotran and kumar, 2005). We have not encountered abnormal conceptions as our study group consists of patients who were 27 weeks of gestation. Women diagnosed with severe or early preeclampsia (in the second trimester or early third trimester) have a higher prevalence of thrombophilias. This is another area that we should focus as we have limited local literature.

The occurrence of hypertension according to ultrasound based period of gestation

All our study group patients had ultrasound scans done for their gestational age between 12 to 20 weeks. This estimation had helped us in assessing growth of the baby and detecting subsequent Intra Uterine growth restriction (IUGR).

The occurrence of classical symptoms like headache, oedema, visual disturbances, epigastric pain were very significant in the study group compared to the controls. However, nearly 20% of the cases were asymptomatic indicating the need for screening using blood pressure with standard settings (Bailey and Walton, 2005).

There were 46, 26, 29 patients in who had severe, moderate and mild hypertension respectively. There had been an apparent increase in severe hypertension among 31 to 35 and more than 36 age groups. However this increase was not seemed to be significant most probably due to small sample size. Paul Gibson et al 2005 have clearly shown a significant relationship between severe pre-eclampsia with advancing maternal age.

The lower maternal age is another risk factoring the same series but we could not establish the relationship due to a small number of cases with PIH between 16 to 20 years.

It is apparent that in our sample the all early pregnancy induced hypertension cases were within the severe category. Mild and moderate hypertension were identified after 34 weeks. In our study there were nearly 46%patients with severe hypertension. Hypertensive disorders in pregnancy are among the leading causes of maternal mortality, along with thromboembolism, hemorrhage and non-obstetric injuries.

While maternal diastolic blood pressure (DBP) greater than 110 mm Hg is associated with an increased risk for placental abruption and fetal growth restriction (Ohkuchi et al., 2000), superimposed preeclamptic disorders cause most of the morbidity due to chronic hypertension during pregnancy. Severe maternal complications include eclamptic seizures, intracerebral hemorrhage, pulmonary oedema due to capillary leak or myocardial dysfunction, acute renal failure due to vasospasm, proteinuria greater than 4-5 g/d, hepatic swelling with or without liver dysfunction, and disseminated intravascular coagulation and/or consumptive coagulopathy (rare). Consumptive

coagulopathy usually is associated with placental abruption and is uncommon as a primary manifestation of preeclampsia.

Fetal complications include abruptio placentae, intrauterine growth restriction (Geipel et al., 2002), premature delivery, and intrauterine fetal death. In our study almost all complications like abruption, HELLP syndrome, eclampsia, intrauterine growth restriction and intrauterine death were seen among severe category of hypertension. Even though complications are likely in any category our study has shown a clear occurrence of complications in severe hypertension than in other categories.

An amniotic fluid index above 10cm is a good reflection of placental function, hence optimal fetal growth. Most of our patient had amniotic fluid indexes above 8 cm. However the relationship between EFW and AFI was not significant (correlation coefficient-r^2= 0.35), possibly due to small overall sample size. Therefore we adjusted the scatter in to 34- 37.9 and 38 weeks onwards taking the cutoff as 8cm.

There was no significant relationship between the AFI and EFW in the entire two groups of POG of mothers (r = 0.43 *P* = 0.16, r = 0.35, *P* = 0.09,). There was a significant relationship between the AFI and EFW after 38 weeks' gestation (r = 0.61; *P* = 0.03). A positive relationship between the AFI and EFW was noted late in gestation.

23 mothers in the study group had special care following the delivery compared to 14 cases a seen among the controls. Almost of these mothers were managed in ICU probably severe category requiring antenatal admission to ICU. They were subsequently managed after the delivery in the same setting. When study group was compared with the controls there was no significant difference among both groups. This effect may be due to proper antenatal management, timely delivery before the occurrence serious complications.

It is apparent from this result that there are a significant number of babies who needed special care and ventilation following the delivery. This is most probably due to early termination of pregnancy due to severe hypertension. There were more than half of the babies in the study group were not given to mother compared to 85% in the control group.

Late development of hypertension always permits appropriate fetal growth, hence good fetal weight. In our study 62% of the babies in the 34 to 38 weeks category had birth weight < 2.5kg. This association was significant.(P<0.001) Most of our severe PIH patients were within 27 to 34 category, therefore this significance cannot be commented on as the birth weights anyway less than 2.5kgs.

There are abnormalities in the vascular resistance seenin PIH however the number in our study was too small to arrive at significance.

The measurements of uteroplacental blood flow velocity waveforms at the second trimester are not sensitive enough to be an early screening tool for PIH and Small for Gestational age (SGA) in the low risk, non-selected pregnancy population (Ohkuchi et al., 2000). The fact suggests that in most gravidae complicated with PIH and SGA, the physiological process of trophoblastic invasion (Moffett and Hiby, 2007) in the spiral artery was not prevented before the 25th gestational week (BBC News, 2007). The S/D ratio of Umbilical Artery is the most sensitive and specific index in predicting major perinatal adverse outcome. The pulsatility index (P.I) is the most specific index (90.9%) for predicting in any adverse perinatal outcome. The sensitivity of the Doppler studies can be significantly increased by studying multiple vessels (Hung et al., 1997). However in our study there were no significant association of Doppler with adverse perinatal out come probably due to small sample size.

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External links

- Preeclampsia Foundation - U.S. based organization which promotes research, raises awareness and provides individual support.
- Action on Preeclampsia - U.K. based organisation.
- Australian Action on Pre-eclampsia
- Hellp Syndrome Society - Based in U.S. with worldwide membership.
- Interprea, International Preeclampsia Alliance - an international alliance of preeclampsia health advocacy groups funded primarily by APEC. Dedicated to providing access to known interventions, such as magnesium sulfate, etc. to areas of the world that do not currently have access to them.