



## Original Article

# Prospective evaluation of maternal renal artery resistivity and pulsatility index in normal pregnant women and women with pregnancy induced hypertension

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### ARTICLE INFO

#### Keywords:

Pulsatility index

Resistivity index

Pregnancy Induced Hypertension

### ABSTRACT

**Aims and objectives:** To establish normal range of Resistivity Index(RI) and Pulsatility Index(PI) values of renal artery in normal pregnant woman and to compare RI and PI of renal artery in normal pregnant woman and woman with PIH. **Material and methods:** Study consisted of 50 pregnant women divided in two groups control(30) normotensive pregnant women and Test Group (20) women with PIH. Colour Doppler studies for each subject was done three times (initially at 24-31 weeks then at 32-36 weeks and 37-39 weeks). Resistivity Index(RI) and Pulsatility Index(PI) calculated and compared between normotensive pregnant women and women with PIH. A p value of  $<0.05$  was considered to be statistically significant. **Results:** Based on the mean values of renal artery Resistivity, Pulsatility index, a cut off value of 0.7 for RI & 1.2 for PI was taken to differentiate between normal and abnormal values. Normal range of RI & PI was 0.50-0.69 & 1-1.20 in control group. **Conclusion:** There is difference between the renal artery Doppler indices in normotensive pregnant women and in women with PIH. And this difference is significant. Doppler study of maternal renal artery is a noninvasive method and most important achievements of modern obstetrics.

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## Introduction

Pregnancy is a bliss; both, for the female and the family, but, any complication leads to great anguish.

The concept of 'high risk obstetrics', has been an increasingly important one. Appropriate identification, evaluation and intensive treatment can service to reduce existent risk for many Individuals. In normal pregnancy many physiological changes occur in the body. During pregnancy there is a marked rise in the blood volume. In urinary system; There is dilatation of renal pelvis a large increase in renal plasma flow and glomerular filtration rate occurs as a result of renal vasodilation which decreases slightly in the 3rd trimester<sup>1</sup>. In 1842, Christian Johann Doppler described Doppler effect. First application of Doppler ultra sound in obstetrics was described by Fitzgerald and Drumm in 1977<sup>2</sup>.

Initial studies were directed at umbilical cord and subsequently uteroplacental vessels<sup>3</sup>. Renal dysfunction during pregnancy is associated with a substantial decrement in RBF<sup>4</sup>. A non invasive method of serially assessing renal vasculature during pregnancy may be useful in predicting or quantifying renal deterioration and assessing response to treatment. Therefore, we use Doppler indices. Rationale underlying all 3 indices – systolic diastolic ratio, Resistivity index and Pulsatility Index.

### Objectives:-

1. To establish normal range of resistivity index [RI] and Pulsatility Index [PI] values of renal artery In normal pregnant women
2. To compare RI and PI of renal artery in normal pregnant women and women with PIH.

### Material and method

The present study was conducted from April 2015 to December 2015 in the department of obstetrics and Gynaecology, SMS Medical College, Jaipur amongst the patients attending the antenatal clinic and Indoor at Mahila Chikitsalaya, Jaipur after proper selection through the

### Inclusion criteria.

1. Maternal age 18-35 years.
2. Gestational age 24-39 week.
3. Singleton pregnancy

### Exclusion Criteria

1. Known renal disease
2. Essential hypertension.
3. Multifetal pregnancy.

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50 patients in total was evaluated divided in two groups:

**Control:**

(30) Normotensive pregnant female

**Test group:**

**(20) Females with PIH.**

+Colour Doppler studies for each subject was done three times during pregnancy (initially at 24-31 weeks, then at 32-36 weeks and 37-39 week). All subjects were evaluated with duplex Doppler scanner with a 3.5 MHZ curvilinear transducer. We calculated resistivity (RI) and Pulsatility Index (PI) and then compared these indices between Normotensive pregnant women and women with PIH. A p value of <0.05 was considered to be statistically significant.

**Table - 1: Mean values of Maternal renal artery RI in various Gestational age :-**

GA ( In week)	Mean $\pm$ SD		P- value	Significance
	Control	Case		
24-31	0.63 $\pm$ 0.04	0.74 $\pm$ 0.02	<0.001	HS
32-36	0.61 $\pm$ 0.05	0.76 $\pm$ 0.03	<0.001	HS
37-39	0.59 $\pm$ 0.06	0.74 $\pm$ 0.06	<0.001	HS

This table shows there is significant difference in renal artery RI in control group i.e. normotensive pregnant women and study group i.e.pregnant women with PIH.This difference is significant as the P-value is less than 0.001.

**Table -2: Mean values of Maternal renal artery PI in various Gestational age :-**

GA ( In week)	Mean $\pm$ SD		P- value	Significance
	Control	Case		
24-31	1.07 $\pm$ 0.20	1.38 $\pm$ 0.20	<0.001	HS
32-36	1.05 $\pm$ 0.18	1.43 $\pm$ 0.17	<0.001	HS
37-39	1.06 $\pm$ 0.27	1.40 $\pm$ 0.24	<0.001	HS

This table shows at gestational age of 24-31 week 100% PIH cases has RI values  $\geq$  0.70 at 32-36 week gestational age 100% PIH cases has RI values  $\geq$  0.70. At 37-39 wk gestational age only 15% PIH cases has RI values less than 0.70 and 85% PIH cases has RI values more than 0.70. We selected a cut off value of 0.70 of maternal renal artery RI because this cut off value can successfully identify the pregnant women with PIH.

**Table-4: Distribution of PI value in Normotensive pregnant women and women with PIH.**

GA RI	24-31		32-36		37-39	
	Control	Case	Control	Case	Control	Case
< 0.70	25 (83.33%)	0 (0.00%)	30 (100.00%)	0 (0.00%)	29 (96.67%)	3 (15.00%)
$\geq$ 0.70	5 (16.67%)	20 (100.00%)	0 (0.00%)	20 (100.00%)	1 (3.33%)	17 (85.00%)
Total	30 (100.00%)	20 (100.00%)	30 (100.00%)	20 (100.00%)	30 (100.00%)	20 (100.00%)

This table shows at gestational age of 24-31 wk 60% PIH cases has PI values more than 1.2 At gestational age of 32-36 wk. 80% PIH cases has PI value more than 1.2. At gestational age of 37-39 wk 80% PIH cases has PI values > 1.2.

We selected a cut off value of 1.2 of maternal renal artery PI as maximum percentage of PIH cases in our study have maternal renal artery PI more than 1.2

**Table-4: Distribution of PI value in Normotensive pregnant women and women with PIH.**

GA RI	24-31		32-36		37-39	
	Control	Case	Control	Case	Control	Case
< 1.2	20 (66.7%)	8 (40.00%)	19 (63.3%)	4 (20.00%)	23 (76.7%)	4 (20.00%)
$\geq$ 1.2	10 (33.3%)	12 (60.00%)	11 (36.7%)	16 (80.%)	7 (23.3%)	16 (80.00%)
Total	30 (100.00%)	20 (100.00%)	30 (100.00%)	20 (100.00%)	30 (100.00%)	20 (100.00%)

This table shows at gestational age of 24-31 wk 60% PIH cases has PI values more than 1.2 At gestational age of 32-36 wk. 80% PIH cases has PI value more than 1.2. At gestational age of 37-39 wk 80% PIH cases has PI values > 1.2.

We selected a cut off value of 1.2 of maternal renal artery PI as maximum percentage of PIH cases in our study have maternal renal artery PI more than 1.2

**Table -5: Distribution of PI at various Gestational age in study group.**

PI Value	GA (in week)		
	24-31	32-36	37-39
1.00-1.20	8 (40.00)	3 (15.00)	7 (35.00)
1.30-1.50	8 (40.00)	12 (60.00)	8 (40.00)
1.60-1.80	4 (20.00)	5 (25.00)	5 (25.00)
Total	20 (100.00)	20 (100.00)	20 (100.00)

This table shows that maximum percentage of PIH cases fall in Range of PI 1.30 – 1.50 in all 3 gestational age groups.

**Table -6: Distribution of RI at various Gestational age in study group**

RI Value	GA (in weeks)		
	24-31	32-36	37-39
0.50- 0.69	0 (0.0)	0 (0.00)	3 (15.00)
0.70- 0.79	18 (90.00)	18 (90.00)	9 (45.00)
0.80- 0.99	0 (0.0)	2 (25.00)	8 (40.00)
1.00	2 (10.00)	0 (0.00)	0 ((0.00)
Total	20 (100.00)	20 (100.00)	20 (100.00)

shows that at all gestational age maximum no. of PIH cases fall in Range of 0.70-0.79.

**Table -7: Distribution of Maternal renal artery RI in control group**

RI Value	GA (in weeks)		
	24-31	32-36	37-39
0.50-0.69	25 (83.33)	30 (100)	29 (93.67)
0.70-0.79	5 (16.67)	0	1 (3.33)
0.80-0.89	0	0	0
Total	30	30	30

Thus maximum no. Of patients fall in Range of 0.50 -0.69 at all gestational age.

**Table -8: Distribution of Maternal renal artery PI in control group**

PI Value	GA (in weeks)		
	24-31	32-36	37-39
0.4-0.6	3 (10)	3 (10)	1 (3.33)
0.7-0.9	3 (10)	6 (20)	8 (26.67)
1-1.20	24 (80)	21 (70)	19 (63.33)
1.3-1.50	0	0	0
1.6 +	0	0	2 (6.67)
Total	30	30	30

Figures in parenthesis shows percentage. Thus at all gestational ages maximum no. of normotensive pregnant female fall in Range of 1-1.20.

Hypertensive disorders complicating pregnancy are associated with substantial morbidity and mortality. The current study is a prospective randomized study of maternal renal artery resistivity and Pulsatility Index in normal pregnant women and women with PIH. Mean values of Maternal renal artery Doppler indices in our study of 30 control cases are RI (mean  $\pm$  SD) equal to  $0.61 \pm 0.05$  & PI (mean  $\pm$  SD)  $1.06 \pm 0.27$ . Based on these mean values of RI and PI ratio a cut off value of 0.7 for RI and 1.2 for PI ratio was taken to differentiate between normal and abnormal values. In study group 100% PIH cases had RI values  $>0.7$ , 80% PIH cases had PI values  $>1.2$ . Normal range of renal artery RI in control group in our study was 0.50-0.69 & of PI was 1-1.20. Range of renal artery Doppler indices in which maximum no. Of PIH cases fall were RI 0.70 -0.79 and PI 1.30 -1.50

Study done by Sohan C, Fendel[5] Hetal(1988) showed that renal vascular changes detected by Doppler sonography may represent an early sign of PIH. Our study also confirmed this and it would make sense to include Doppler sonography of renal vessels in routine diagnostic procedure.

Boemi[6] and Sohn(1996) et al claimed that the Doppler indices of the renal arteries in a woman with PIH are different from a healthy pregnant women; this finding is suggestive of increased downstream vascular resistance.

Peterson, Jensen[7] et al (1995) used PI and RI as pulsed wave Doppler measurement of downstream renal artery resistance. Both the PI&RI were significantly higher in the PIH group than in control group. Thus RI&PI seems to be closely related to parameters of renal hemodynamics in hypertensive patients. Results of this study matches with our study, further emphasizing the role of increased vascular resistance in the etiopathogenesis of PIH.

#### Conclusion:-

There is difference between the renal artery Doppler waveform in normotensive pregnant women and in women with PIH. This difference is significant. Doppler study of maternal renal artery is a noninvasive method and most important achievements of modern obstetrics. PI&RI have been found to correlate with Renal vascular resistance.

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