

A Comparative Study on Maternal Renal Artery Sonographic Findings with Doppler in Women with Hypertensive Disorders of Pregnancy

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Abstract: Doppler study of maternal renal artery was conducted to evaluate maternal renal artery doppler changes in women with Hypertensive disorder of pregnancy and normotensive healthy pregnant women. This study was conducted on 140 pregnant women full-filing inclusion and exclusion criteria with informed consent. The study population divided into 2 groups: Group 1 (70 cases) - pregnant women with Hypertensive Disorders of Pregnancy, Group 2 (70 controls) - normotensive pregnant women underwent maternal right main renal artery sonography with doppler. Maternal renal artery Doppler indices calculated and values were compared in both groups. Results: Peak systolic velocity PSV, end-diastolic velocity EDV, systolic/diastolic ratio S/D ratio, pulsatility indices PI, resistivity indices RI of maternal right main renal artery were significantly higher in pregnant women with HDP compared to normotensive pregnant women ($p < 0.05$). Conclusion: Maternal renal artery doppler ultrasound is clinically relevant in the diagnosis and follow-up of renal complications in women with hypertensive disorder of pregnancy.

Keywords: Hypertensive disorder of pregnancy, doppler ultrasonography, maternal renal artery.

1. Introduction

Hypertensive disorders occur in 5-7% of all pregnancy (1). HDP is said to occur when systolic BP >140 mmHg and diastolic BP >90 mmHg on atleast 2 occasions 4 hrs apart. It encompasses gestational hypertension, preeclampsia, eclampsia (2). Preeclampsia is a syndrome with multi-organ involvement with maternal and perinatal adverse effects as a consequence of vasospasm, endothelial dysfunction and ischemia (2, 3). During normal pregnancy, marked physiological changes occur with increase in total blood volume and cardiac output with decrease in systemic vascular resistance (4). Blood flow velocity is directly related to peripheral vascular resistance and there are changes in downstream resistance of renal artery in HDP. HDP affects kidney both functionally and morphologically (4, 5). With advent of doppler ultrasonography, it is possible to evaluate renal function in relation to changes in renal circulation and to timely diagnose and to have an adequate follow up of maternal renal complications in HDP so that timely management can be done.

2. Material and Methods

- **Type of study**- Hospital based Comparative study.
- **Study design**- Cross-sectional study.
- **Place of study**- Department of Obstetrics and Gynaecology, SMS Medical College and associated hospitals, Jaipur.
- **Study duration**- June 2019-May 2020.
- **Study participants** - Hypertensive disorders of pregnancy and normotensive pregnant subjects.
- **Sample size:** 140 pregnant subjects with Group 1 (70 cases) - pregnant women with Hypertensive Disorders of Pregnancy, Group 2 (70 controls) - normotensive pregnant women.

Selection criteria

- **Inclusion Criteria:** Singleton pregnancies of >20 weeks of gestation with Hypertensive disorders (case group) and those with normotension (control group) willing to participate in the study (informed written consent).
- **Exclusion Criteria:** Chronic renal disease, Chronic hypertension predating pregnancy, Diabetes, Multiple gestation, urinary tract infection, Previous renal surgery.

3. Methodology

This is a hospital based comparative cross-sectional study conducted on pregnant women attending OPD in Department of Obstetrics & Gynaecology at SMS Medical College, Jaipur. All eligible women fulfilling inclusion criteria & exclusion criteria were explained about nature and purpose of the study. Verbal and written informed consent obtained from all participants. Their personal data and medical history taken, vitals- blood pressure recorded. Presenting complaints, drug history obtained. Laboratory results checked to detect the presence & degree of proteinuria, serum creatinine, urine analysis, complete blood count and results reviewed. Doppler ultrasound assessment was performed with - ultrasound scanner equipped with a curvilinear probe of frequency ranging from 3.5 to 5 MHz. The pregnant women were positioned in supine or lateral decubitus on examination couch. After appropriate exposure of the abdomen, acoustic gel was applied and both maternal kidneys scanned to rule out gross abnormalities in renal size, shape, echogenicity. Modified flank approach was employed to visualize the entire length of the renal artery. The probe was placed beneath the rib cage in sagittal plane with a Doppler angle of 60 degree or less, the pulsating right renal artery was insonated by placing the pulsed Doppler sample volume gate within it to obtain an angle-corrected velocity waveform measurement during a period of suspended respiration. The doppler sample volume was set at 3mm, and a 100Hz pass filter was used to reduce the noise from

the pulsating arterial wall. Pulse Repetition Frequency (PRF) of 2500 Hz was used.



Figure: Maternal Right Main Renal artery Colour Doppler study showing doppler indices

The Peak Systolic Velocity PSV, End-Diastolic velocity EDV were measured at the apex of the highest systolic peak and at the end of diastole, respectively. The velocity waveform was analysed for Resistivity index RI of Pourcelot, Pulsatility index PI of Gosling et al., and Systolic/Diastolic ratio S/D ratio. These indices were calculated automatically by the ultrasound machine's software. Statistical analysis: Appropriate parametric test was used for linear variables and a nonparametric test was used for nominal variables depending upon data yield. P value < 0.05 was considered as significant, data was analysed using Medcalc 16.4 version statistical software.

4. Results

Maternal renal artery doppler indices	Normotensive pregnant women (n=70)		Women with HDP (n=70)		p-value
	Mean	SD	Mean	SD	
Peak systolic velocity (cm/s)	68.46	8.39	71.38	6.98	0.02
End-diastolic velocity (cm/s)	20.81	1.74	22.71	2.64	0.001
Resistivity index	0.68	0.05	0.76	0.06	0.001
Pulsatility index	0.98	0.17	1.21	0.03	0.001
Systolic/Diastolic ratio	2.86	0.72	3.14	0.28	0.001

Peak systolic velocity, End-diastolic velocity, Resistivity index, Pulsatility index, S/D ratio of maternal right main renal artery were significantly higher in pregnant women with HDP compared to normotensive pregnant women (p < 0.05).

5. Discussion

Several investigators have attempted to evaluate renal circulation by performing Doppler sonography in healthy pregnant women and women with HDP. However, the parameters analysed in these studies were restricted to the most common parameters of distal or downstream vascular resistance such as systolic/diastolic ratio, RI and PI. In this study, the right main renal artery had a statistically significant higher PSV, EDV, S/D ratio and PI and RI in women with HDP (p < 0.05). Similar findings to these were reported in 2015 by Ogunmoroti OA et al (5) conducted the study on Eighty (80) subjects with pregnancy-induced hypertension (PIH) and 160 controls (80 pregnant normotensive women and 80 healthy, non-pregnant women) underwent triplex renal sonography prospectively to determine their renal volumes and right renal artery Doppler indices. The peak systolic velocity, end diastolic velocity, pulsatility index, systolic/diastolic ratio and acceleration time were respectively significantly higher in the PIH group (68.67 cm/s, 21.55 cm/s, 1.23, 3.38, 123.2 ms) than the pregnant, normotensive group (65.19 cm/s, 20.27 cm/s, 0.88, 3.35, 61.14 ms) and healthy, non-pregnant group (52.06 cm/s, 18.27 cm/s, 0.84, 2.90, 68.48ms). Resistivity index was also increased in the PIH group, but this was not statistically significant. The study concluded that Renal Doppler ultrasound is clinically relevant in the diagnosis and follow-up of renal complications in patients with pregnancy-induced hypertension. Similarly, Sohn and Fendel (6) in Germany who studied 31 non-pregnant, 52 normotensive pregnant and 12 pregnant women with PIH. They found significant differences between the non-pregnant and normotensive pregnant subjects as well as between the non-pregnant and those with PIH. In addition to increase in renal

artery resistance, the hypertensive women had markedly different flow velocity waveform which manifested as prolongation of acceleration time and reduction of the Acceleration Index. Conversely, Lubomirova et al (7) did not find any differences in renal PI and velocities unlike in the indexed study which showed significant differences in these parameters. The systolic/diastolic ratio was significantly higher in the HDP group than the other study group. However, in the study done by Kuo et al (8), 12 pregnant women with preeclampsia demonstrated significantly lower S/D ratio of 2.07 as compared to a normotensive, pregnant women with S/D ratio of 2.41. However, Kuo's results are not consistent with the established concept of renal arterio-spasm as part of the pathophysiology of preeclampsia.

6. Conclusion

The above study suggested that there were significant differences in the maternal renal artery Doppler waveforms with Hypertensive Disorders in Pregnancy. The EDV, PI, RI very well correlate with Peripheral Vascular Resistance. Thus, concluding that Maternal Renal Doppler ultrasound are clinically relevant in the diagnosis of renal complications in patients with HDP and would be beneficial in follow up of renal sequelae to know the progression of disease process and timely management of the same.

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