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Original Research Article

Sonomorphology and Color Doppler Changes in Maternal Kidneys & Renal Artery in PIH

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Abstract: Preeclampsia complicates approximately 5% of all pregnancies. Pre-eclampsia affects the kidney both functionally and morphologically. Diastolic flow is directly related to peripheral vascular resistance. PIH causes significant down stream resistance changes in renal artery. It has been established that continuous vasospasm of proximal renal artery is implicated in the pathogenesis of PIH, while in normotensive patient increase in total circulating blood volume, and thus mildly reduced blood pressure. The objective is to evaluate renal sono morphological and renal Doppler changes (RI and PI) in PIH and normal pregnant patients. It is prospective study, non-randomized done in 15 months, taking 50 normotensive pregnant subjects and 50 PIH subjects with exclusive criteria of Patients with pre-existing renal disease, pre-existing HT, Diabetes mellitus and patients having active UTI. The PSV, EDV and acceleration time of right main renal artery were significantly higher in subjects with PIH. Resistive index was higher in patients with PIH. Based on the mean values of renal artery Resistivity, Pulsatility index and Accleration time ,a cut off value of 0.7 for RI,1.2 for PI and AT>100 milisec were taken to differentiate normal and abnormal values. Renal volume was increased in PIH subjects of our study groups. Our study suggests significant difference in the renal size and Doppler waveform in Normotensive pregnancy and in pregnant women with PIH.PI, AT and RI correlate very well with peripheral vascular resistance.
Keywords: Sonography, PIH, Renal artery Doppler, Renal volume, Preeclampsia, Resistive index, Pulsatility Index, Normotensive, Pregnancy

INTRODUCTION

Preeclampsia complicates approximately 5% of all pregnancies and thus it may be the most common glomerular disease in the world [1]. The development of preeclampsia is believed to be a two-stage process: The first, asymptomatic stage is marked by abnormal placentation, possibly related to ischemia. Placental elaboration of soluble factors that enter the maternal circulation follows, leading to endothelial dysfunction and the clinical syndrome(s). Preeclampsia is characterized by gestational hypertension, a phenomenon that has been attributed to an excess of vasoconstrictor over vasodilator influences in the systemic circulation [2-4]. Several preeclampsia risk factors including chronic hypertension, diabetes, and obesity are related to underlying maternal endothelial dysfunction. These women may be more susceptible to the adverse endothelial effects of anti angiogenic factors [5].

Pre-eclampsia affects the kidney both functionally and morphologically. Renal haemodynamics decrease and urinary protein excretion increases due to lesions affecting the glomerulus, where a combination of changes produces a characteristic appearance and permits differentiation of pre-eclamptic

nephropathy from other glomerular alterations associated with hypertension in pregnancy. In pre-eclampsia the glomerulus is diffusely enlarged and bloodless due to hypertrophy of the intracapillary cells, not due to proliferation. These alterations occur in the cytoplasmic organelles of endothelial cell and occasionally mesangial cells These reactive changes have been termed 'glomerular capillary endotheliosis [6].

A Syndrome of pregnancy induced hypertension is defined as hypertension with proteinuria and with or without edema [1]. PIH is said to occur, when the systolic BP is more than 140 mmHg and diastolic BP is more than 90 mmHg on at least two occasions and 6 hrs apart [7]. Pre-eclampsia is a major cause of maternal deaths world wide, with the advent of Color Doppler USG, it is possible to evaluate renal function in relation to changes in renal circulation "Diastolic flow is directly related to peripheral vascular resistance. PIH causes significant down stream resistance changes in renal artery. It has been established that continuous vasospasm of proximal renal artery is implicated in the pathogenesis of PIH [8-12]. Therefore we conducted a study to evaluated Doppler changes that occur in patients with PIH and with those in healthy pregnant patients.

Pregnancy produces marked physiologic changes throughout the body. Systemic hemodynamics are altered, with dramatic increases in total circulating blood volume, increased cardiac output, and reduced systemic resistance. The net result is a high-output state with a mildly reduced blood pressure [13].

AIMS AND OBJECTIVE

- To evaluate renal sono-morphological and renal Doppler changes in PIH and normal pregnant patients.
- To evaluate changes in resistivity index, Pulsatility Index and AT values of renal artery in PIH and normal pregnant women.
- To compare RI and PI of renal artery in normal pregnant women and women with PIH.

MATERIAL & METHODS

This is a prospective study, non-randomized, done in the Department of Radio-diagnosis from October 2015 to December 2016. The study was approved by the research & ethical committee of our institute. The study involved 50 normotensive pregnant subjects and 50 pregnant subjects with recently diagnosed PIH.

Inclusion Criteria

The patients with clinical diagnosis of pre-eclampsia were evaluated for renal involvement. The pre-eclampsia was diagnosed in a pregnant women using two cardinal features of the disease i.e. normotensive and non-proteinuria 20 weeks pregnant women shows increase blood pressure more than 140/90 mm Hg with proteinuria more than 300 mg/24 hrs.

Exclusion Criteria

Patients with pre-existing renal disease, pre-existing HT, Diabetes mellitus and patients having active UTI.

Color Doppler ultrasound was done by Siemens' Acuson X 300 machine equipped using convex probe of frequency ranging from 3-5 MHz in appropriate position to the patients after taking informed consent. Both kidneys were scanned to rule out gross renal abnormalities. Renal volume was calculated by taking length, width and antero-posterior diameter. RV-LxTxAPx0.523- ellipsoid volume. Color Doppler and pulse Doppler of Renal artery examinations were performed in lateral decubitus position, although both renal arteries were scanned, but parameters of right renal artery were included in our study. Peak systolic velocity (PSV) was measured as highest systolic peak and end diastolic velocity as end of the diastole. Acceleration time is defined as beginning of systole to the highest systolic peak of the pulse waveform. The velocity pulse waveform was assessed for RI (Resistivity Index) of pourcelot [14], pulsatillity index of gosling *et al* [15] & S/D ratio [16]. Resistance index (RI) was calculated using formula- RI = Peak systolic velocity – Peak diastolic velocity/ Peak systolic velocity. 2. Pulsatility index (PI) will be calculated using formula. PI= Peak systolic velocity – End diastolic velocity / Mean velocity

Statistical Methods

All data was analysed and statistical significance was determined by x2 test and value of $p<0.05$ is considered significant.

RESULTS

Table :1 Distribution of PIH in different age group

Age in year	**Normotensive (x-50)**	**Women with PIH (x-50)**	**Total No of pt.**
≤20	06	07	13
21-34	26	22	48
≥35	16	23	39

This table suggests that PIH is more prevalent as age increases

Table :2 Pulse Doppler pattern in PIH patients

Doppler Indices of RA	**Mean PSV** (cm /sec)	**Mean EDV(** cm /sec)	**Mean RI**	**Mean AT (**milisec)
Women with PIH	69.1	18.2	0.70 ± 0.28	123 ± 34
Normotensive	62.5	22.2	0.65 ± 0.64	60 ± 8

This table suggests that in PIH subjects, there is increase in PSV, RI and mean AT

Table :3 Distribution of PIH in different gestation weeks

Weeks of gestation	**Normotensive (n -50)**	**Women with PIH (n -50)**
20- 32 Weeks	4	5
32-36 Weeks	21	22
≥ 36 Weeks	22	18
Post Partum	3	5

This table suggests that PIH is more prevalent in 32 to 36 weeks of gestations.

Table :4 Relation of systolic and diastolic blood pressure in PIH patients

Hypertension in PIH	**No. (n -50)**	**%**
Systolic BP -		
140-160 mmHg	36/50	72%
≥ 160 mmHg	14/50	28%
Diastolic BP -		
90-110	32/50	64%
≥ 110	18/50	36%

Table :5 Relation between Renal volume and PIH

Renal volume	**Normo tensive (n -50)**	**Women with PIH (n -50)**
<120 cm^3	42	15
>120 cm^3	8	35

This table indicates that there is increase in renal volume in PIH subjects.

Table :6 Relation between mean acceleration time of renal artery and PIH patients

Mean Acc	**Normotensive (n -50)**	**Women with PIH (n -50)**
<100 cm^3	44	12
>100 cm^3	6	38

There is increase in Mean acceleration time in PIH subjects

Table :7 Significance of RI of renal artery in control group and PIH patients

GA in weeks	Mean±SD		P Value	significance
	Normotensive	Preeclampsia		
20- 32 Weeks	0.64±0.03	0.75±0.03	< 0.001	HS
32-36 Weeks	0.61±0.03	0.79±0.05	< 0.001	HS
≥ 36 Weeks	0.57±0.04	0.76±0.03	< 0.001	HS

This table reveals significant difference in RI of renal artery in normotensive pregnant women and PIH patients as the P-value is less than 0.001(significant)

Table :8 Correlation of RI of renal artery with PIH patients

RI	**Normotensive (n -50)**	**Women with PIH (n -50)**
<0.7	45	10
>0.7	5	40

There is increase in resistive index in PIH subjects.

Most of the pregnant patients, who developed PIH fall in 21-34 years of age, however more than 35 years old also contributed significantly to PIH (50%). In our study there was statistically significant difference between the ages of women in these groups. The PSV, EDV and acceleration time of right main renal artery were significantly higher in subjects with PIH. Resistive index was higher in patients with PIH. Based on the mean values of renal artery Resistivity, Pulsatility index and Accleration time ,a cut off value of 0.7 for RI,1.2 for PI and AT>100 milisec were taken to differentiate normal and abnormal values. Renal volume was increased in PIH subjects of our study groups, right renal volumes were 120 ± 25cm^3 in the PIH, while in normo tensive pregnant women were 105.2 ± 23 cm^3.

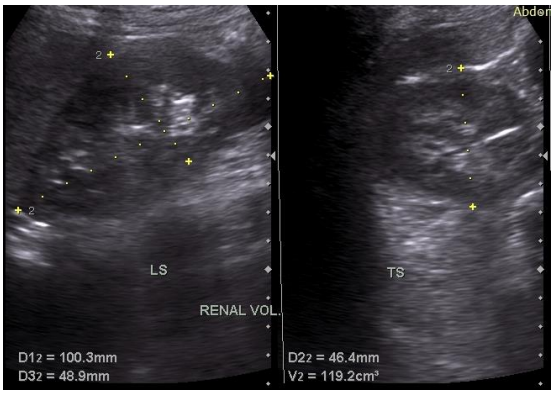

Fig-1: Increase in maternal renal volume in PIH patient

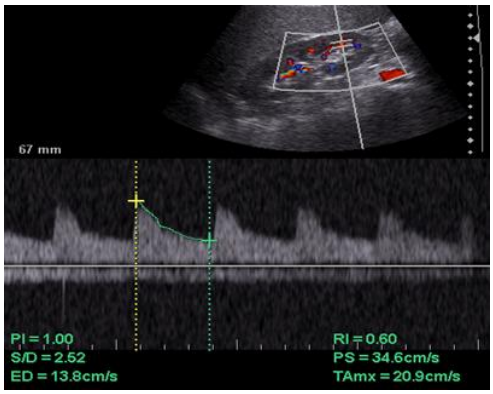

Fig-2: Normal RI and PI of maternal renal artery in normo tensive patient

Fig-3: Raised RI and PI of maternal renal artery in preeclampsia patient

DISCUSSION

Pre-eclampsia is a pregnancy specific vascular endothelial disorder with varying degrees of involvement of multiple organs, out of which kidney bears the main brunt being a highly vascular organ.

Abnormal cytotrophoblast invasion of spiral arterioles secondary to reduced ischemia, which is considered to activate maternal vascular endothelium consequently, there is increased formation of endothelin, thromboxane and enhanced sensitivity to angiotensin II and reduced formation of endothelin vasodilators such as nitroxide & prostacyclin. As a result chain of hemodynamic disorders including elevation of peripheral resistance and reduction in renal blood flow are triggered [17]. Pre-eclampsia is primarily regarded as a disease of first pregnancy. In our study (27/50) 54% of patient were primigravida and 46% were multigravida showed high resistance flow in renal artery. Miyake *et al* [18] reported his 52% patient as primipara this observation was similar to our study.

The mean age of our study having PIH patient was 26.2 ± 5, which is similar to that observed in several other studies. The age of patients ≥ 35 showed high degree of PIH in comparision to young age, similar age distribution was noted by Roberts CL *et al* [4].

In this study renal volume was found to be significantly higher in subjects with PIH than subjects with normotensive pregnancy' similar findings was documented in the study by lubomirova *et al* [19], who mentioned a reasonable increase in right renal volume in the PIH patients as compared to the normotensive pregnant patients.

The systolic and diastolic blood pressures of the two groups revealed statistically significant difference of High BP in PIH patients is due to increased peripheral vascular resistance, whereas in normo tensive pregnant patient BP decreases, because of increased plasma volume, which leads to systemic vasodilatation and hence decreased in BP. Doppler is an important parameter to evaluate renal circulation in pregnant patients, these Doppler parameters are most commonly used in clinical practice to analyze downstream vascular resistance, RI, & S/D ratio. In our study right renal artery revealed high, PSV & S/D ratio with low EDV. Shon & fender [9] also reported the same findings.

In addition to these findings, acceleration time (AT) of interlobar arteries is one of the haemodynamic parameter of significant upstream stenosis. Increased AT suggest severe stenosis or continous vasospasm in the proximal arteries such as main renal artery and segmental artery, implicated in the pathogenesis of PIH [20]. Given the immense health impact of preeclampsia due to its high worldwide prevalence, progress in this field has the potential to greatly improve global women's health in a relatively short period of time and women with PIH.

CONCLUSION

Sonomorphology and Renal Doppler ultrasound is clinically relevant in the diagnosis and follow-up of renal complications in patients with pregnancy-induced hypertension. Our study suggested that there is a significant difference in the renal size and Doppler waveform in normotensive pregnancy and in pregnant women with PIH, PI, AT and RI correlate very well with peripheral vascular resistance.

REFERENCES

1. Jun Z, Jonathan Z, Maureen C, Gertrud B. Epidemiology of pregnancy induced hypertension. Epidemiol Rev. 1997;19:218–32.
2. Brown MA. The physiology of pre-eclampsiaClin Exp Pharmacol Physiol. 1995;22 : 781-796
3. Noris M, Benegni A, Remuzzi G. The role of vasoactive molecules of endothelial origin in the pathophysiology of normal pregnancy and pre-eclampsia. Curr Opin Nephrol Hypertens. 1996; 5 : 347-352.
4. Roberts JM, Redman CWG. Preeclampsia: More than pregnancy induced hypertension. Lancet. 1994; 341 : 1447-1451.
5. Ogino. An electron microscopic study of the glomerular alterations of pure preeclampsia Nip Jin Gak Shi. 1999;41 : 413-429.
6. Renal pathology in pre-eclampsia Baillière's Clinical Obstetrics and Gynaecology Lillian W. Gaber. Author links open the author workspace. Benjamin H. Spargo. Author links open the author workspace. Marshall D. Lindheimer. Author links open the author workspace. 1994; 8(2):443-468.
7. Program NH. Report of the national high blood pressure education program working group on high blood pressure in pregnancy. American journal of obstetrics and gynecology. 2000 Jul 31;183(1):s1-22.
8. Boemi G, Bruno MT, La Ferreira G, Butera L, Pulvirenti G, Lanzone A. Maternal renal and interlobar arteries waveform evaluation with color Doppler ultrasound in Pregnancy induced hypertension. Fetal Diagn Ther. 1996;11:132–6.
9. Sohn C, Fendel H. Renal arterial and uterine circulation in normal and toxemic pregnancies. Z Geburtshife Perinatal. 1988;192:43–8.
10. Gudmundson S, Marshal K. Doppler ultrasound examination of the renal artery in healthy women, normotensive pregnant women, and in pre eclampsia. Ultrasound Obstet Gynecol. 1991;1:2258–60.
11. Kuo DM, Chiu TH, Hisieh TT. Maternal renal artery Doppler flow velocity waveform in pre-eclampsia. A preliminary report. J Reprod Med. 1993;38:189–92.
12. Kublicas M, Lunel NO, Nisll H, Westergren M. Maternal and renal artery blood flow velocimetry in normal and hypertensive pregnancies. Acta Obstet Gynecol Scand. 1996;75:715–9.
13. N.S. Assali, W.J. Dignam, K. Dasgupta Renal function in human pregnancy J Lab Clin Med. 1959; 54: 394-408.
14. Pourcelot L. Indication of Doppler's ultrasonography in the study of peripheral vessel. Rev Pract. 1975;25:4671–80.
15. Gosling RG, King DH. Arterial assessment by Doppler shift ultrasound. Proc R Soc Med. 1974;67:447–9.
16. Stuart B, Drumm J, Fitzgerald DE, Duignan NM. Fetal blood velocity waveform in normal pregnancy. Br J Obstet Gynecol. 1980;87:780–5.
17. Mac Gillivray I. Pre eclampsia: The hypertensive disease of pregnancy. London: WB Sanders.1983; 44(5): 227–88.
18. Miyake H, Nakai A, Koshino T, Araki T. Doppler velocimetry of maternal renal circulation is altered in pregnancy-induced hypertension. J Clin Ultrasound. 2001;29:449–55.
19. Lubomirova M, Andreev E, Bogov B, Djerassi R, Kiperova B, Nikolov A. A. Diagnostic value of the conventional and Doppler ultrasound in pregnancy complicated with pre eclampsia. Hippokratia. 2006;10:133–7.
20. Nakai, Asakura, Koshino T. Pulsed doppler US finding of renal interlobar arteries in PIH. 1999; 213(2):423-8.