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Original Research Article

Association between before and during early pregnancy hypertension with the gestational diabetes mellitus prevalence: a prospective observational study

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ABSTRACT

Background: Type 2 diabetes mellitus and hypertension are both components of the metabolic syndrome and commonly occur together in individuals. It has been found that blood pressure (BP) predicted the development of incident type 2 diabetes independent of body mass index (BMI) and other known risk factors.

Methods: All the women with preeclampsia from 30 weeks onwards were enrolled in the study. The umbilical artery (UA) systolic-diastolic (S/D) ratio >2 standard deviation (SD) or UA-pulsatility index (PI) and UA-resistive index (RI) >2SD were taken as abnormal. The middle cerebral artery (MCA) was visualised and cerebroumbilical PI ratio calculated. MCA-RI<2SD was taken as abnormal.

Results: The prevalence of GDM in this study was found 13.4 (%). Prevalence of GDM was found to be almost two-fold higher in hypertensive and pre hypertensive patients as compared to normotensive patients (p- 0.009) emphasizing upon the fact that diabetes and hypertension may be connected by the common pathogenic pathways of insulin resistance and endothelial dysfunction.

Conclusions: The results of this study are quite indicative of this fact that patients with older age >30 (years) and with history of hypertension and prehypertension should be strictly screened for GDM as GDM was found twice more common in pre-hypertensive and hypertensive group and GDM prevalence markedly increased as the age advanced.

Keywords: Gestational diabetes mellitus, Hypertension, Metabolic syndrome, Pre hypertension

INTRODUCTION

Type 2 diabetes mellitus and hypertension are both components of the metabolic syndrome and commonly occur together in individuals. It has been found that blood pressure (BP) predicted the development of incident type 2 diabetes independent of body mass index (BMI) and other known risk factors.¹ Paradoxically, under normal physiologic conditions, insulin is a vasodilator with secondary effects on sodium reabsorption in the kidney.²

Hypertensive disorders represent one of the most common complications of pregnancy, which affects 5-10% of pregnancies in the United States each year.³⁻⁹ During normal pregnancy there is physiological drop in blood pressure in the late first and early second trimester which then increases to pre-pregnancy levels or higher beginning in the third trimester.^{3,5} Gestational hypertension (GHTN) is defined as the development of hypertension (HTN) after 20 weeks gestation with a return to normal levels by 12 weeks postpartum.^{6,7}

Type 2 diabetes mellitus is a heterogeneous group of disorders characterized by variable degree of insulin resistance, impaired insulin secretion and increased glucose production as result of complex interaction of genetic and environmental factors.¹⁰ GDM is defined as any degree of glucose intolerance with onset or first recognition during pregnancy, typically sets in at about 24-28 weeks of gestation.¹¹ The most common maternal complications of diabetes in pregnancy are, polyhydramnios, urinary and genital tract infection, risk of premature birth, operative and caesarean delivery, risk of GDM in future pregnancy and future possibility of type 2 diabetes mellitus. The most common neonatal complications include hypoglycemia, hypocalcemia, polycythemia, jaundice requiring phototherapy, trauma (shoulder dystocia) and respiratory distress syndrome.¹² The prevalence of GDM is variable worldwide, depending on the population, race and the diagnostic criteria used.

Despite a close relationship between hypertension and type 2 diabetes, little information exists on the relationship of BP levels with the subsequent development of type 2 diabetes.^{13,14} Data in women are more limited even as they are subjected to higher risk because of gestational hypertension.¹³ Finding an independent association between blood pressure or its progression and new-onset diabetes may be important, as it could imply close surveillance of blood glucose levels in pregnant females with increasing blood pressure levels. This study, was therefore, designed to evaluate the relationship between high blood pressure before or during early pregnancy and GDM.

The aim of this study was to assess the relationship between before and during early pregnancy hypertension with gestational diabetes mellitus.

The main objectives of this study were to estimate the prevalence of prehypertension and hypertension before or during early pregnancy and to assess and compare the risk of GDM prevalence among normotensive, prehypertensive and hypertensive women.

METHODS

This prospective observational study was conducted in the Postgraduate department of medicine, Government Medical College, Srinagar. The study included pregnant women attending OPD of the Government Lal Ded Hospital, an associated hospital of GMC Srinagar, from April 2015 to October 2016.

Ethical clearance was not required for the study as it was an observational study. A total of 500 patients were enrolled in our study. The study included history and relevant physical examination with blood pressure recording before and during early pregnancy. Oral glucose tolerance test (OGTT) was done between 24-28 weeks of pregnancy, meeting the following criteria.

Inclusion criteria

Pregnant women who were attending OPD of obstetrics and gynecology, government medical college, Srinagar, with singleton live intrauterine fetus with USG documented gestational age of <20 weeks.

Exclusion criteria

Pregnant ladies with documented diabetes mellitus or previous history of GDM or with twin or multiple pregnancy and pregnant ladies with underlying chronic diseases like chronic kidney disease, chronic liver disease etc.

Procedure

Following parameters were noted: relevant clinical history. Self-reported information on socio-demographics and associated risk factor profile as a part of interview questionnaire. Relevant physical and gynecological examination as mentioned in proforma. A pre pregnancy BP was taken as a blood pressure documented closest to the LMP of current pregnancy but not more than 5 years. Blood pressure was measured with a standardized protocol. Each participant was allowed a rest of at least 5 minutes before the first measurement. Up to 3 sequential brachial Blood pressures were measured with a standardized protocol. The systolic and diastolic blood pressure recordings were taken by using appropriate cuff size. The averages of all the available measurements for systolic and diastolic blood pressure were used.

The pregnant women were classified into three groups with respect to the blood pressure recording according to JNC 7 criteria: normotensive (SBP<120 mmHg and DBP<80 mmHg); pre hypertensive (SBP 120-139 mmHg and DBP 80-89 mmHg); hypertensive (SBP>140 mmHg and DBP>90).¹⁵

All the selected patients were followed up between 24-28 weeks of gestation determined from LMP and correlated with USG documentation. Between 24-28 weeks, all patients were subjected to OGTT according to ADA 2015 criteria.¹⁶ A diagnosis of GDM was made when any one of below glucose level was documented: fasting: 92 mg/dl and above; 1 hour: 180 mg/dl and above; 2 hour: 153 mg/dl and above.

Ethics

The study was approved by the institutional ethics committee.

Statistical analysis

The recorded data was compiled and entered in a spreadsheet (Microsoft Excel) and then exported to data editor of SPSS version 20.0 (SPSS Inc., Chicago, Illinois, USA). Continuous variables were expressed as mean±SD

and categorical variables were summarized as percentages. Chi-square test or Fisher's exact test, whichever appropriate, was used for comparison of categorical variables. Student's independent t-test was employed for comparison of continuous variables. Graphically the data was presented by bar and pie diagrams. A p value of less than 0.05 was considered statistically significant. All p values were two tailed.

RESULTS

The mean age of our patients was 32.1±4.58. Most of the patients (42.6%) were in the age group of 30-32 years (Table 1).

Table 1: Age distribution of studied population.

Age (in years)	No. of patients	Percentage
<25	61	12.2
25-29	89	17.8
30-34	213	42.6
≥35	137	27.4
Total	500	100
Mean±SD =32.1±4.58		

42.4% of patients were primigravida. The prevalence of patients who had given birth previously to one baby and two or more than two babies were comparable, 29.8 and 27.8% respectively (Table 2).

Table 2: Parity distribution of studied population.

Parity	No. of patients	Percentage
0	212	42.4
1	149	29.8
≥2	139	27.8
Total	500	100

Majority of the patients in our study belonged to overweight and obese group, 47.6% and 28.8% respectively (Table 3).

Table 3: Distribution of studied population as per BMI.

BMI	No. of patients	Percentage
<20	16	3.2
20-24.9	102	20.4
25-29.9	238	47.6
≥30	144	28.8
Total	500	100
Mean±SD =27.1±2.18		

One third of the patients were prehypertensive, and 19.2% of the patients belonged to hypertensive group (Table 4).

The association between BMI and prevalence of hypertension and prehypertension is quite evident in this

table. Patients with BMI>25 having greater than two times prevalence of prehypertension and greater than three times prevalence of hypertension (Table 5).

Table 4: Stage of blood pressure in studied population.

Stage of hypertension	No. of patients	Percentage
Normotension	258	51.6
Prehypertension	146	29.2
Hypertension	96	19.2
Total	500	100

Table 5: Association of blood pressure with BMI.

Stage of hypertension	BMI (<25)		BMI (≥25)	
	N	%	N	%
Normotension	91	77.1	167	43.7
Prehypertension	17	14.4	129	33.8
Hypertension	10	8.5	86	22.5
Total	118	100	382	100
Chi-square = 40.32; P value<0.001				

Table 6: Prevalence of GDM in studied population.

GDM	No. of patients	Prevalence
Present	67	13.4
Absent	433	86.6
Total	500	100

The prevalence of GDM in our study was found to be 13.4% (67 out of 500) (Table 6).

Table 7: Prevalence of GDM in studied population as per age.

Age (years)	GDM present	GDM absent	Prevalence	P value
<25	3	58	4.9	<0.001*
25-29	7	82	7.9	
30-34	25	188	11.7	
≥35	32	105	23.4	
Total	67	433	13.4	

*Statistically significant difference (p value <0.05).

Table 8: Prevalence of GDM in studied population as per parity.

Parity	GDM present	GDM absent	Prevalence	P value
0	27	186	12.7	0.921
1	21	128	14.1	
≥2	19	120	13.7	
Total	67	434	13.4	

*Statistically Significant Difference (p value <0.05).

Table 9: Prevalence of GDM in studied population as per BMI.

BMI	GDM present	GDM absent	Prevalence	P value
<25	9	109	7.6	0.031*
25-29.9	31	207	13.0	
≥30	27	117	18.8	
Total	67	433	13.4	

*Statistically significant difference (p value <0.05).

The prevalence of GDM increases proportionately as the age advances with highest prevalence in age group of greater than 35 years (23.4%) and least in age group of less than 25 years (4.9%) (Table 7).

The prevalence of GDM was independent of parity. As the prevalence was quite comparable (Table 8).

The association between BMI and GDM is quite evident in this table. Patients with BMI>30 have more than two times prevalence of GDM and those with BMI 25-29.9 have almost two times prevalence of GDM, than normal weight patients (Table 9).

The prevalence of GDM increases from 8.9% to 18.8% as the stage of blood pressure advanced. The prevalence of GDM in hypertensive and pre hypertensive patients was more than two times as compared to normotensives (Table 10).

Table 10: Prevalence of GDM as per blood pressure category in studied population.

Stage of hypertension	GDM present	GDM absent	Prevalence	P value
Normotension	23	235	8.9	0.009*
Prehypertension	26	120	17.8	
Hypertension	18	78	18.8	
Total	67	433	13.4	

*Statistically significant difference (p value <0.05)

DISCUSSION

Type 2 diabetes mellitus is a major modifiable risk factor for premature morbidity and mortality with an estimated prevalence of 8.5%.¹⁷ Though hypertension and diabetes are both off-shoots of a metabolic syndrome, the occurrence of one may precede the other. World Health Organization (WHO) estimates recent prevalence of GDM between 10 and 25%.¹⁷ The reported prevalence of GDM from Indian studies have shown variable results with prevalence ranging from 7% to 14%.^{18,19} The prevalence of GDM in the present study was found to be 13.4%.

In the present study, blood pressure readings of the patients were taken before the twentieth gestational week. Among the studied patients, 19.2% belonged to hypertensive group and 29.2% were pre hypertensive. The prevalence of prehypertension was in accordance with the global data.²⁰ While as that of hypertension was lesser in our study as compared to the global prevalence of hypertension, probably because of the relatively younger age of the study population.²⁰

Prevalence of GDM was found to be almost two-fold higher in hypertensive and pre hypertensive patients as compared to normotensive patients (p- 0.009) emphasizing upon the fact that diabetes and hypertension may be connected by the common pathogenic pathways of insulin resistance and endothelial dysfunction.²¹

Increase in age had a significant impact on prevalence of GDM, with women of age more than 35 years having a

GDM prevalence of 23.4% which was almost 5 fold higher than in women with age of less than 25 years (4.9 %), which is in line with the results of study conducted by Vibeke Anna et al.²² The significant effect of age on prevalence of GDM has got reflected even in ADA and ACOG guidelines, which recommend routine screening of patients more than 25 years of age for GDM.^{23,24}

Similar to results obtained based on stratification of hypertension, increase in BMI was found to have major effect on the prevalence of GDM. Increase in BMI not only had a significant impact on the prevalence of GDM but was a major significant factor in determining the prevalence of hypertension, emphasizing the fact that insulin resistance caused by obesity may be the harbinger of future diabetes and hypertension. The prevalence of hypertension increased almost three-fold (8.3% versus 22.5%) while comparing the patients of BMI<25 kg/m² to BMI>25 kg/m², similar trend was noted with the prevalence of pre hypertension, which is in concordance with the results of study conducted by Brown et al.²⁵

While comparing the prevalence of GDM in various groups, prevalence was significantly higher in over weight and obese group (p value- 0.031). The prevalence of GDM in overweight group was almost two times higher than in normal group (13.0% versus 7.6%) and in obese group, prevalence increased furthermore (18.8%), which is in line with the study conducted by Chu et al.²⁶

The numerous maternal and fetal complications associated with GDM has compelled for a consensus among

clinicians including American Diabetes Association (ADA) and World Health Organization (WHO) to screen pregnant females with risk factors for GDM. The early screening for GDM allows the clinicians not only to recognize but also to modify the risk factors associated with GDM, so that the course of the disease can be modified and complications thus prevented.

Besides the non-modifiable risk factors of age, the modifiable risk factors associated with GDM were obesity, pre hypertension and hypertension. The significant association between hypertension and prehypertension in early weeks of gestation and subsequent prevalence of GDM in our study can be translated into the fact that pregnant females, who are hypertensive or prehypertensive in early weeks of gestation should not only be strictly screened for GDM but be educated about risk factor modification so that the future chances of development of GDM can be prevented.

There are some limitations of the study. The sample size was still smaller for the study of this condition, we need more studies of this kind to add to our knowledge.

CONCLUSION

Prevalence of GDM in our study of 500 patients was well within the range of global prevalence of GDM (13.4%). The results of our study are quite indicative of this fact that patients with older age (>30 years) and with history of hypertension and prehypertension should be strictly screened for GDM as GDM was found twice more common in prehypertensive and hypertensive group and GDM prevalence markedly increased as the age advanced. Lifestyle modification for weight reduction still forms the cornerstone for prevention of future development of diabetes mellitus as reflected from the results of our study where obesity had a marked influence on prevalence of GDM (3-fold increase). Early screening and subsequent management of GDM in the above-mentioned high-risk groups can prove fruitful in preventing onset of future diabetes and diabetes related maternal and fetal complications.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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