EVALUATION OF FOETAL ABDOMINAL CIRCUMFERENCE IN PREGNANCIES AFFECTED BY GESTATIONAL DIABETES MELLITUS

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ABSTRACT

INTRODUCTION

India is widely known as the diabetic capital of the world. The current prevalence of diabetes represents only the tip of the iceberg of its real problem statement. Gestational diabetes mellitus has many maternal and foetal implications. Early screening, diagnosis and intervention can help prevent many of this complications thus reducing maternal and foetal morbidity. Ultrasonography is one of the easiest, most feasible, non-invasive and safest diagnostic tool which can be used to evaluate patients with gestational diabetes mellitus. The objective of the study was to evaluate foetal abdominal circumference measured sonographically between 28-34 weeks of gestation in patients with gestational diabetes and its association with perinatal outcome and also to study the association of glycaemic control with birth weight in patients with gestational diabetes mellitus.

METHODS

A single ultrasound examination was done between 28-34 weeks of gestation in 65 selected and well dated patients who satisfied the inclusion and exclusion criteria. The patients were classified into 2 groups with one group having foetal abdominal circumference ≤75th percentile and the other having foetal abdominal circumference >75th percentile. The patients were followed up till delivery and perinatal outcome and birth weight was noted.

RESULTS

Relevant statistical analysis was done to find out the association of foetal abdominal circumference with perinatal outcome. 73.9% of Large for gestational age infants had foetal abdominal circumference >75th percentile. 77.7% of neonates who had Apgar score <7 at 5 minutes after delivery had foetal abdominal circumference >75th percentile. All the neonates with hypoglycaemia and prematurity and 60% of neonates with hyperbilirubinemia and 85% of neonates with acute respiratory distress syndrome had foetal abdominal circumference >75th percentile. All the patients with poor glycaemic control had large for gestational age babies and 77.7% had foetal abdominal circumference >75th percentile.

CONCLUSION

This study showed that foetal abdominal circumference >75th percentile was associated with higher birth weight and poor perinatal outcome. It also concluded that poor maternal glycaemic control is associated with higher foetal abdominal circumference and birth weight and hence poor perinatal outcome.

KEYWORDS

Foetal abdominal circumference, Gestational diabetes mellitus, Perinatal morbidity.

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INTRODUCTION: Diabetes is a modern day epidemic which is affecting all walks of human life including the reproductive phases[1] with 18% prevalence of gestational diabetes mellitus worldwide.[2]

Gestational diabetes has many maternal and foetal implications. Maternal implications include unexplained stillbirth, preterm labour, increased risk of hypertension, preeclampsia, hydramnios, malpresentations, increased operative interference and maternal morbidity. Foetal implications include macrosomia, intrauterine growth retardation, birth injury, hypoglycaemia, respiratory distress syndrome, hyperbilirubinemia, polycythaemia, hypocalcaemia and hypomagnesemia. Early screening, diagnosis and intervention can help prevent many of this complications and thus reducing maternal and foetal morbidity.

Foetal hyperinsulinism plays a central role in the development of diabetic fetopathy and can be indirectly determined by measuring insulin levels in amniotic fluid. Despite the physiological rational behind using amniotic fluid insulin levels for detection of pregnancies at high risk of somatic and biochemical fetopathy, this approach has not been widely adopted as it requires an invasive approach. In recent years, studies have been performed to evaluate direct or indirect signs of foetal insulinization. One of these approach is ultrasound evaluation of intrauterine growth of

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insulin sensitive tissues. Foetal liver is the organ most affected by changes in insulin levels and nutritional status of the foetus, thus affecting the foetal abdominal circumference. Excess rate of foetal growth persists despite tight metabolic control. Moreover, low maternal glucose levels could expose the foetus to the risk of growth restriction. Using foetal ultrasound measurements of growth, in addition to maternal glycaemic control, helps in identifying foetuses at increased or decreased risk of accelerated somatic growth, thus helping in optimising foetal growth in utero.

Use of ultrasonography for diagnosis of high risk patients of gestational diabetes is not only a great aid to the effective management of gestational diabetes mellitus patients but also is non cumbersome and can coincide with the routine antenatal visits. Positive correlation has been found between ultrasound measurement of foetal abdominal circumference and foetal hyperinsulinism.[3] Using foetal abdominal circumference measurements with a threshold >75th percentile for gestational age may be useful in identifying foetal hyperinsulinism and thus, the adverse perinatal outcomes associated with it.[4] Hence this study focuses on ultrasound evaluation of foetal abdominal circumference in pregnancies affected by gestational diabetes and its association with perinatal outcome.

AIMS AND OBJECTIVES:

1. To evaluate foetal abdominal circumference measured sonographically between 28-34 weeks of gestation in patients with gestational diabetes mellitus and its association with perinatal outcome.
2. To study the association of glycaemic control with birth weight in patients with gestational diabetes mellitus.

MATERIALS AND METHODS: This study was done in department of obstetrics and gynaecology in Indira Gandhi government medical college and hospital, Nagpur from dec 2013 to October 2015 in collaboration with department of Radiology. Total 65 subjects diagnosed as cases of gestational diabetes mellitus by 2 step method were selected as per inclusion and exclusion criteria described below after obtaining written informed consent.

Inclusion Criteria:

1. Gestational diabetes detected during screening done between 24–28 weeks of gestation.
2. Singleton pregnancy.
3. Reliable dates confirmed or established by an ultrasound scan performed no later than 22 weeks.

Exclusion Criteria:

1. Cases of diabetes mellitus diagnosed prior to pregnancy.
2. Patients with other associated conditions (Pregnancy Induced Hypertension, chronic hypertension, thyroid disorders, sickle cell disease, heart disease, tuberculosis, seizure disorder).

Detailed history was taken and clinical examination along with necessary investigations were done for all subjects. A single ultrasonographic scan was done between 28-34 weeks of gestation by a single qualified radiologist using PHILIPS HD 11 XE with convex abdominal probe 4-7 MHz and foetal abdominal circumference was measured as mentioned below.

Measurement of Foetal Abdominal Circumference: Foetal abdominal circumference was measured by placing the foetal spine horizontally across the screen with the stomach visible in the centre of the screen and then rotating the probe by 90° in such a way that stomach should be visualised in the left side of the abdomen and a 'J' shaped hypoechoic structure is seen in the midline (which represents the internal portion of the umbilical vein branching to the right portal vein).

For the section to be correct, the following conditions need to be fulfilled:

1. The section should be circular not oval.
2. The kidneys should not be visible in the section.
3. The cord insertion should not be visible.
4. The 'J' should not extend all of the way to the skin line anteriorly.

When the correct section was obtained by fulfilling the above conditions, foetal abdominal circumference was measured around the outside of the skin line.

According to the measurements of foetal abdominal circumference study subjects were classified into 2 groups as follows, those with.[5,6,7,8]

1. AC ≤ 75th percentile.
2. AC > 75th percentile.

Subjects were then managed and followed up as per the current hospital management protocols till delivery. The neonates were followed until 7 days of delivery and the neonatal outcome were evaluated as mentioned below.

A. Birth Weight[9]:

1. Small for gestational age (SGA)-<10th percentile for gestational age.
2. Appropriate for gestational age (AGA)-10th -90th percentile for gestational age.
3. Large for gestational age (LGA)- >90th percentile for gestational age.

B. Perinatal Morbidity:

1. Hypoglycaemia.
2. Hyperbilirubinemia.
3. Prematurity.
4. ARDS-acute respiratory distress syndrome.
5. Traumatic delivery.
6. Sepsis.
7. Congenital anomaly.
8. NICU Admission.

C. Perinatal Mortality.

OBSERVATIONS AND RESULTS:

Age in years	Number	Percentage
≤20	0	0
21-25	21	32.31
26-30	20	30.77
31-35	22	33.85
>35	2	3.08
Total	**65**	**100**

Table 1: Distribution of study subjects as per age

Foetal abdominal circumference percentile	Small for gestational age		Appropriate for gestational age		Large for gestational age		Total
	No.	%	No.	%	No.	%	No.
≤75th percentile	7	77.77	7	21.21	6	26.08	20
>75th percentile	2	22.22	26	78.78	17	73.91	45
TOTAL	**9**	**100**	**33**	**100**	**23**	**100**	**65**

Table 2: Relation of foetal abdominal circumference percentile with birth weight

p-value: <0.00411 (S), Obtained using Chi Square test

Neonatal morbidity parameters	Foetal Abdominal Circumference Percentile						p Value
	≤75		>75		Total		
	No.	%	No.	%	No.	%	
Hypoglycaemia	0	0	10	100	10	15.38	0.041
Hyperbilirubinemia	6	40	9	60	15	23.07	0.89
Prematurity	0	0	3	100	3	4.61	0.188
Acute respiratory distress syndrome	2	25	6	75	8	12.30	0.815
Sepsis	1	33.33	2	77.77	3	4.61	0.99
Traumatic delivery	0	0	2	100	2	3.07	0.81
NICU admission	2	16.66	10	83.33	12	18.46	0.089
Congenital anomalies	1	100	0	0	1	1.53	-
None	11	37.93	18	62.06	29	44.61	-

Table 3: Relation of foetal abdominal circumference percentiles with neonatal morbidity parameters

Tests of Significance Used:

1. Fischer's exact test: hypoglycaemia, prematurity, acute respiratory distress syndrome, sepsis and traumatic delivery.
2. Chi-square test: hyperbilirubinemia.
3. Chi-square test with Yates' correction: NICU admissions.

Foetal Abdominal circumference percentiles	APGAR score at 5 minutes				Total	
	<7		≥7			
	No.	%	No.	%	No.	%
≤75	2	22.22	18	32.14	20	30.76
>75	7	77.77	38	67.85	45	69.23
Total	**9**	**100**	**56**	**100**	**65**	**100**

Table 4: Relation of foetal abdominal circumference percentiles with APGAR score at 5 minutes

p-value: 0.5236 (NS), Obtained using Fisher's exact test.

Foetal abdominal circumference percentiles	Glycaemic control			
	Good		Poor	
	No.	%	No.	%
≤75	15	30	5	33.33
>75	35	70	10	77.77
Total	**50**	**100**	**15**	**100**

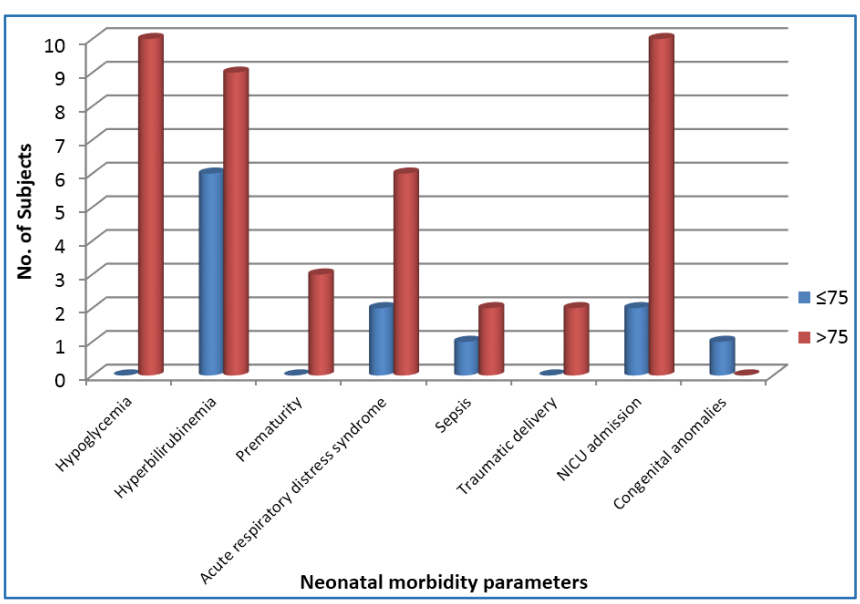
Table 5: Relation of foetal abdominal circumference percentiles with glycaemic control

p-value: 0.5725 (NS), Obtained using Chi-square with Yates' correction.

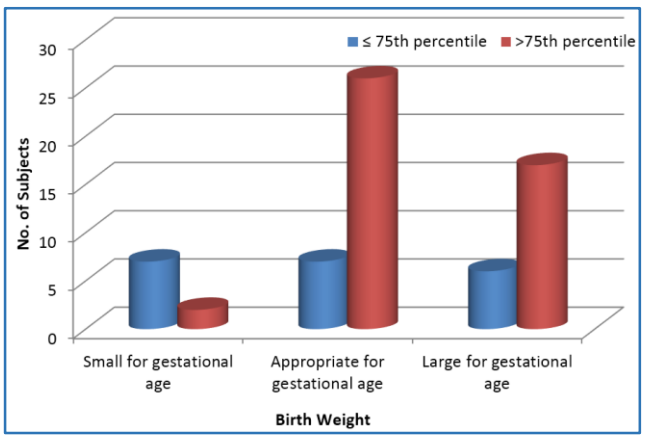
Birth weight	Glycaemic control			
	Good		Poor	
	No.	%	No.	%
Small for gestational age	9	18	0	-
Appropriate for gestational age	33	66	0	-
Large for gestational age	8	16	15	100
Total	**50**	**100**	**15**	**100**

Table 6: Relation of glycaemic control with birth weight

p-value:<0.001 (S), Obtained using Chi-square test.



Graph 1: Relation of foetal abdominal circumference percentiles with neonatal morbidity parameters



Graph 2: Relation of foetal abdominal circumference percentile with birth weight

Fig. 1

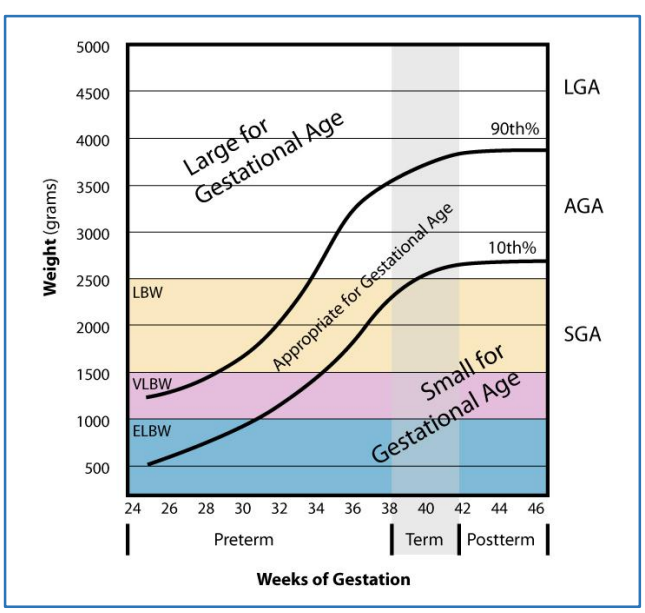


Fig. 2

DISCUSSION:

1. Maximum number of subjects were in the age group of 31-35 years. The mean age in the present study was 28.55 years. Prevalence of gestational diabetes mellitus was more in higher age groups.
2. Among the LGA infants 17(73.9%) had foetal AC >75th percentile, while 6(26%) had foetal AC ≤75th percentile. Among the SGA infants, 7(77.77%) belonged to the group with foetal AC ≤75th percentile, while 2(22.22%) had foetal AC >75th percentile. In a study done by Siri L Kjos et al[5] at Los Angeles, all LGA infants had foetal AC >70th percentile, while all SGA infants had foetal AC between 30th to 50th percentiles. In a study done by Maria Teresa Pereira et al[3] in Portugal, 23% of LGA infants had foetal AC >50th percentile, while 25% SGA infants had foetal AC <50th percentile. In a study done by Bonomo et al[7] in Italy, 75% of small for gestational age babies had foetal AC <75th percentile, while 71.4% of large for gestational age babies had foetal AC ≥75th percentile.
3. 15.38% infants had hypoglycaemia, 23.07% had hyperbilirubinemia, 4.6% were premature, 8% had ARDS, 3% had sepsis, 2% had traumatic delivery and 12% required NICU admission. There was only one mortality in an infant who had congenital anomaly. All the infants with hypoglycaemia and prematurity had foetal AC >75th percentile. Among infants with hyperbilirubinemia, 60% of infants had foetal AC >75th percentile, while 40% had foetal AC <75th percentile. Among infants with Acute respiratory distress syndrome, 85% had foetal AC >75th percentile, while 25% had foetal AC <75th percentile. Among infants with sepsis, 66.66% of infants had foetal AC >75th percentile, while 33.33% had foetal AC <75th percentile. Among infants requiring NICU admission, 83.3% of infants had foetal AC >75th percentile, while 16.7% had foetal AC <75th percentile. Trauma during delivery was seen in 2 infants that belonged to the group with foetal AC >75th percentile. In a study done by Maria Teresa Pereira et al[3] in Portugal, increased perinatal morbidity was found in infants with foetal abdominal circumference >50th percentile. 29% of infants with neonatal morbidities had foetal AC≥50th percentile which is similar to the results of the present study.
4. Among 9 subjects who had APGAR score <7 at 5 minutes after delivery, 2(22.22%) neonates had foetal AC ≤75th percentile and 7(77.77%) had foetal AC >75th percentile. Among 56 study subjects who had APGAR score ≥7 at 5 minutes after delivery, 18(32.14%) neonates had foetal AC ≤75th percentile and 38(67.85%) had foetal AC >75th percentile. In studies done by Maria Teresa Pereira et al[3] in Portugal and by Siri L Kjos et al[5] at Los Angeles, positive correlation was found between higher AC percentile and poorer perinatal outcome.

5. Among 15 study subjects with poor glycaemic control, 10(77.77%) had foetal AC >75th percentile while 5(33.33%) had foetal AC ≤75th percentile. Among 50 study subjects with good glycaemic control, 35(70%) had foetal AC >75th percentile while 15(30%) had foetal AC ≤75th percentile. In a study done by Bonomo et al[7] in Italy, among patients with foetal AC ≤75th percentile, 3.05% had poor glycaemic control and 15.7% had good glycaemic control, while patients with foetal AC >75th percentile, 2.6% had poor glycaemic control and 58.5% had good glycaemic control.
6. All the patients with poor glycaemic control had large for gestational age babies. While amongst those with good glycaemic control, 9(18%) had small for gestational age babies, 33(66%) had appropriate for gestational age babies and 8(16%) had large for gestational age babies. Similarly, in a study done by S Gopinath et al in Pondicherry, India, fluctuating glycaemic control correlated well with foetal abdominal circumference and foetal birth weight.

CONCLUSIONS: The present study infers that foetuses with higher AC percentiles (>75th percentile) tend to have accelerated somatic growth in utero and are born as large for gestational age babies with poorer perinatal outcome. It also concludes that poor maternal glycaemic control produces a tendency towards higher foetal abdominal circumference and birth weight. The findings of the study are statistically significant. However, a potential limitation of the study is its humble sample size.

But as the results of the study are significant statistically, we can safely conclude that foetal abdominal circumference measured sonographically between 28-34 weeks of gestation can detect pregnancies at high risk for diabetic fetopathy and poor perinatal outcome and can be used to optimise therapy in patients with gestational diabetes mellitus. However, larger randomised controlled trials are required to establish the use of ultrasound measurement of foetal abdominal circumference as a potential tool in managing pregnancies with gestational diabetes mellitus and improving perinatal outcome.

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