CLINICAL AND ULTRASONOGRAPHIC PREDICTORS OF FOETAL MACROSOMIA

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ABSTRACT

BACKGROUND

Foetal macrosomia is defined as foetal growth above the 90th percentile for a given gestational age or as foetal weight >4000 gms. In India, a baby weighing more than 3.25 kg would be greater than the 90th percentile and therefore by definition has macrosomia. Foetal macrosomia is associated with increased risk of maternal and foetal complications.

The aim of the study is to study the predictive power of clinical parameters and ultrasound foetal measurements in macrosomia.

MATERIALS AND METHODS

A case-control study was conducted in the Department of Obstetrics and Gynaecology at the Institute of Maternal and Child Health, Government Medical College, Kozhikode, during the period March 2014-April 2015. A comparison between a group of women delivering liveborn babies between 37-40 weeks weighing more than 4 kg and another group with similar inclusion criteria with less than 4 kg is done. 110 cases constituted the macrosomic group and 440 cases constituted the non-macrosomic group. Singleton pregnancy with regular cycles, known LMP and obstetric ultrasonography before 20 weeks to confirm the gestational age more than 37 weeks and less than 40 weeks were taken as the criteria for inclusion into the study. Obstetric ultrasonography must have been performed 2 weeks before delivery. Multiple gestation, stillbirth, gross or chromosomal abnormalities, small for gestational age, oligohydramnios and pregnancy in advanced labour were excluded from the study. Detailed clinical history is taken. Foetal ultrasound parameters measured are Biparietal Diameter (BPD), Head Circumference (HC), Abdominal Circumference (AC), Femur Length (FL), Femur Length/Abdominal Circumference (FL/AC), Intrauterine Ponderal Index (IUPI) and Estimated Foetal Weight (EFW). Data are expressed in its frequency and percentage. To elucidate the association and comparisons, chi-square test was employed. Risk of each parameter was assessed using binary logistic regression analysis and odds ratio was found out. For statistical evaluation, a two-tailed probability value less than 0.05 was considered significant.

RESULTS

87% of the study population were less than 30 years. More than half were multigravida. Among them, 24.5% had macrosomic babies while among the primigravida only 14% had macrosomic babies. About 30% had gestational diabetes mellitus. Previous history of macrosomic foetus was present in 18.44%. Among 110 macrosomic babies, 74 mothers of those babies had BMI more than 25. In ultrasonography, 45 babies had BPD more than 96 mm (90th percentile), 40 had HC more than 354 mm (90th percentile), 92 had AC more than 346 mm (90th percentile) and 85 had FL more than 74 mm (90th percentile). Estimated foetal weight was more than 4000 grams in 86 patients.

CONCLUSION

Foetal macrosomia is more common among multigravida. There is significant association between the incidence of macrosomia and gestational diabetes mellitus. Previous macrosomic birth and high body mass index have influence over macrosomia. Biparietal diameter and head circumference are poor predictors of macrosomia. Estimated foetal weight is the best individual ultrasound parameter in predicting macrosomia followed by abdominal circumference.

KEYWORDS

Ultrasound, Foetal Weight Estimation, Foetal Macrosomia.

HOW TO CITE THIS ARTICLE: Kalam S, Sam KM, Suriya K. Clinical and ultrasonographic predictors of foetal macrosomia. J. Evid. Based Med. Healthc. 2017; 4(8), 440-444. DOI: 10.18410/jebmh/2017/84

BACKGROUND

Foetal macrosomia is defined as foetal growth above the 90th percentile for a given gestational age or as foetal weight >4000 gms.[1] This definition is based on the average birth weight at each gestational age and is country specific. In India, a baby weighing more than 3.25 kg would be greater than the 90th percentile and therefore by definition has macrosomia.[2] Foetal macrosomia is associated with increased risk of maternal and foetal complications. Women who gave birth to macrosomic foetuses are more likely to be predisposed to caesarean section, instrumental delivery, prolonged labour, perineal and uterine laceration. At delivery, foetus is more likely to suffer from shoulder dystocia, traumatic injury and birth asphyxia.

Financial or Other, Competing Interest: None.
Submission 10-01-2017, Peer Review 15-01-2017,
Acceptance 24-01-2017, Published 26-01-2017.
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DOI: 10.18410/jebmh/2017/84

AIM

To study the predictive power of clinical parameters and sonographic foetal measurements in macrosomia.

MATERIALS AND METHODS

A case-control study was conducted in the Department of Obstetrics and Gynaecology at the Institute of Maternal and Child health, Government Medical College, Kozhikode, during the period March 2014-April 2015. A comparison between a group of women delivering liveborn babies between 37-40 weeks weighing more than 4 kg and another group with similar inclusion criteria with less than 4 kg is done. 110 cases constituted the macrosomic group and 440 cases constituted the non-macrosomic group. Singleton pregnancy with regular cycles, known LMP and obstetric ultrasonography before 20 weeks to confirm the gestational age more than 37 weeks and less than 40 weeks were taken as the criteria for inclusion into the study. Obstetric ultrasonography is performed 2 weeks before delivery. Multiple gestation, stillbirth, gross or chromosomal abnormalities, small for gestational age, oligohydramnios and pregnancy in advanced labour were excluded from the study. Detailed clinical history is taken. Foetal ultrasound parameters measured are Biparietal Diameter (BPD), Head Circumference (HC), Abdominal Circumference (AC), Femur Length (FL), Femur Length/Abdominal Circumference (FL/AC), Intrauterine Ponderal index (IUPI) and Estimated Foetal Weight (EFW). Study tools utilised were Siemens ACUSON X300 USG machine and 3-5 MHz secular probe. The data collected were analysed in SPSS version 10. Data are expressed in its frequency and percentage. To elucidate the association and comparisons, chi-square test was employed. Risk of each parameter was assessed using binary logistic regression analysis and odds ratio was found out. For statistical evaluation, a two-tailed probability value less than 0.05 was considered significant.

RESULTS

A total of 80% (440/550) were Appropriate for Gestational Age (AGA) and 20% were Large for Gestational Age (LGA). Age group included 18-46 years. 87% of the study population were less than 30 years as seen in Figure 1. More than half (56%) were multigravida, which is depicted in Figure 2. Among them, 24.5% (76/309) had macrosomic babies while among primigravidas only 14% (34/241) had macrosomic babies as shown in Figure 3. About 30% (166/550) had gestational diabetes mellitus as seen in Figure 4. Previous history of macrosomic foetus was present in 18.44% (57/309), which is shown in Figure 5. Among 110 macrosomic babies, 74 mothers of those babies had BMI more than 25.

Among 110 macrosomic babies, 45 had BPD more than 96 mm (90th percentile), 40 had HC more than 354 mm (90th percentile), 92 had AC more than 346 mm (90th percentile) and 85 had FL more than 74 mm (90th percentile).

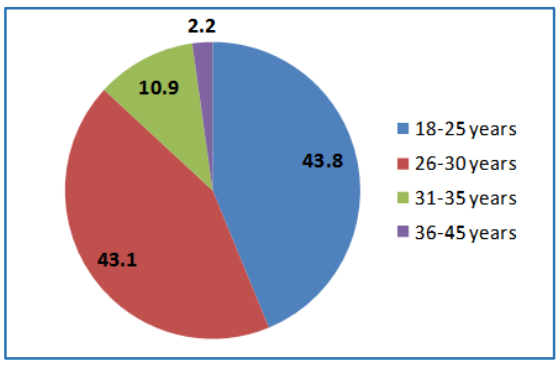

Figure 1. Age Distribution

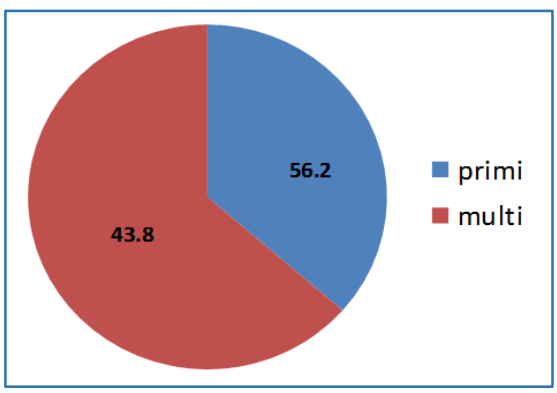

Figure 2. Gravidity

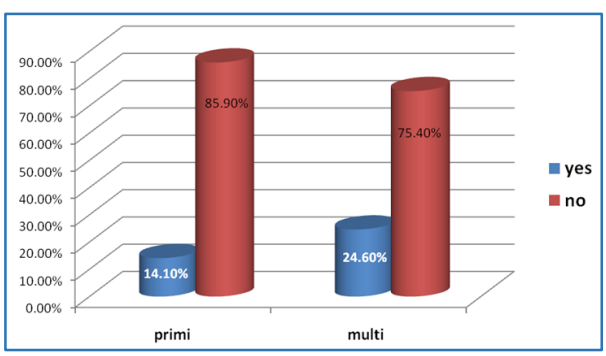

Figure 3. Frequency of Macrosomia in Primigravida and Multigravida

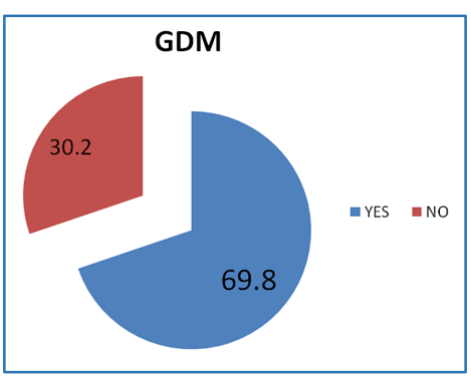

Figure 4. History of Gestational Diabetes Mellitus

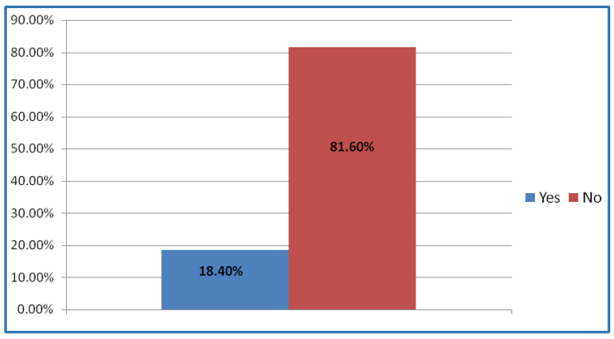

Figure 5. History of Previous Macrosomic Birth in Multigravida

Gravidity (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
Primi	34	14.1	207	85.9
Multi	76	24.6	233	75.4
	110		440	
	Chi-square value - 9.308; p value - 0.002; OR - 0.5; 95% CI (0.32-0.78)			

Table 1. Association Between Gravidity and Macrosomia

GDM (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
Yes	64	38.6	102	61.4
No	46	12	338	88
	110		440	
Chi-square value - 51.1; p value - <0.000001; OR - 4.6; 95% CI (2.9-7.15)				

Table 2. Association Between GDM and Macrosomia

Previous Macrosomic Birth (n=309)	Macrosomia			
	Yes		No	
	n	%	n	%
Yes	26	45.61	31	54.39
No	50	19.8	202	80.2
	76		233	
Chi square value - 16.6; p value <0.00012822; OR - 3.38; 95% CI (1.8-6.2)				

Table 3. Association Between Previous Macrosomia and Macrosomia in Current Pregnancy

BMI (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
>25	74	28.5	185	71.5
<25	36	12.37	255	87.63
	110		440	
Chi-square value - 21.47; p value - <0.00000223; OR-2.8333				

Table 4. Association Between BMI and Macrosomia

Biparietal Diameter (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
>90th percentile	45	41	64	59
</= 90th percentile	65	14.8	376	85.2
	110		440	
Chi-square value - 36.8; p value - <0.00000001; OR - 4.06; 95% CI (2.5-6.46)				

Table 5. Association Between BPD and Macrosomia

Head Circumference (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
>90th percentile	40	42	45	58
</= 90th percentile	70	15	395	85
	110		440	
Chi-square value – 44; p value - <0.00000001; OR - 5.01; 95% CI (3.05-8.23)				

Table 6. Association Between HC and Macrosomia

Abdominal Circumference (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
>90th percentile	92	71.8	36	28.2
</= 90th percentile	18	4.2	404	95.82
	110		440	
Chi-square value – 280; OR - 57.35; 95% CI (31.1-105.5)				

Table 7. Association Between AC and Macrosomia

Femur Length (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
>90th percentile	85	48.5	90	51.5
</= 90th percentile	25	6.66	350	93.34
	110		440	
Chi-square value - 130; p value - <0.00000001; OR - 13.1; 95% CI (7.9-21.8)				

Table 8. Association Between FL and Macrosomia

FL/AC (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
>90th percentile	32	86.4	5	13.6
</= 90th percentile	78	15.2	435	84.8
	110		440	
Chi-square value - 109; p value - <0.00000001; OR - 35.6; 95% CI (13.4-94.4)				

Table 9. Association Between FL/AC and Macrosomia

Intrauterine Ponderal Index (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
>90th percentile	52	34.6	98	65.4
</= 90th percentile	58	14.5	342	85.5
	110		440	
Chi square value - 27.7; p value - 0.00000058; OR - 3.12; 95% CI (2-4.84)				

Table 10. Association Between IUPI and Macrosomia

Estimated Foetal Weight (n=550)	Macrosomia			
	Yes		No	
	n	%	n	%
>90th percentile	86	98.8	1	1.2
</= 90th percentile	24	5.2	439	94.8
	110		440	
Chi-square value - 395; p value - <0.00000001; OR - 1573; 95% CI (12.9-28.17)				

Table 11. Association Between EFW and Macrosomia

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
BPD >=96 mm	41	85	41	85.2
HC >=354 mm	36	89	47	84
AC >=346 mm	84	91	71.8	95.7
FL >=74 mm	77.27	79.5	48.57	93.33
FL/AC 0.205	29	98	86.4	84.79
IUPI 0.0009	47	77	34	85.5
EFW >4000 gm	78	99	98	94

Table 12. Sensitivity, Specificity, PPV and NPV of USG Parameters

	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
BPD >=96 mm	45	91	43	91
HC >=354 mm	37	90	37	90
AC >=346 mm	72	90	53	95
FL >=74 mm	51	86	36	92
FL/AC 0.205	50	87	38	92
IUPI 0.0009	37	85	27	89
EFW >4000 gm	65	99	90	95

Table 13. Sensitivity, Specificity, PPV and NPV of USG Parameters by Rosati et al

DISCUSSION

Maternal age is not found to be significantly higher in the macrosomic group because age group included in this study is not so diverse. Majority of them belonged to 18-25 years. In studies by Karim et al[3] and Meshari et al,[4] maternal age over 35 years was associated with foetal macrosomia. Frequency of macrosomia is found to more in multigravida and with gestational diabetes mellitus. Multiparity and gestational diabetes mellitus were significantly associated with macrosomia in studies by Karim et al and Meshari et al also. There is significant association between macrosomia and previous macrosomic birth. In a study by Okun et al,[5] the risk of foetal macrosomia is increased 9 fold in those with previous history of macrosomia. There is positive correlation between BMI and foetal macrosomia.

Table 12 shows the sensitivity, specificity, positive predictive value and negative predictive value of the different foetal ultrasound parameters (with the cutoff value) in predicting macrosomia. Study by Rosati et al[6] on the sensitivity, specificity, positive predictive value and negative predictive value of the different foetal ultrasound parameters in predicting macrosomia (Table 13) show results comparable with the present study. In the present study, BPD has specificity of 91% and the negative predictive value is 85.2% while the sensitivity is only 46%. Similarly, HC has sensitivity of only 36%, but the specificity is 89% and negative predictive value is 84%. AC was found to have sensitivity of 84%, specificity of 91% and negative predictive value of 95.7%. The single measurement, which strongly correlates with birth weight is foetal AC. Campbell and Wilkin[7] emphasised the importance of ultrasound AC measurements in determining the foetal size. Miller et al[8] using receiver operator characteristic curves showed that estimated foetal weight followed by AC is superior to BPD and FL in the identification of foetal macrosomia. Study by Hadlock et al[9] on FL/AC in the prediction of macrosomia has shown a sensitivity of 63% and positive predictive value of 68%. Benson et al[10] analysed FL/AC and found that the positive predictive value is 36-43% only and concluded that it is not useful in predicting macrosomia. The negative predictive value of FL/AC in the present study was found to be 92%. Intrauterine ponderal index is found to have sensitivity of 47% only while the negative predictive value is 85.5% comparable to study by Rosati et al. On analysing EFW as an individual parameter taking 4000 grams as the cutoff among 110 macrosomic babies, 86 had EFW more than 4000 grams. So, the sensitivity is 78% and positive predictive value is 98%. Specificity is found to be 99% and negative predictive value is 94%. Sulaiman et al[11] studied the accuracy of sonographic foetal estimation in the prediction of foetal macrosomia and found it to have sensitivity of 74.5%, specificity of 85.7%, positive predictive value of 89% and negative predictive value of 69%. O'Reilly and Divon[12] evaluated under receiver operator characteristic curves the sonographic estimated foetal weight as a predictor of foetal macrosomia in prolonged pregnancies and found that the sensitivity is 85%, specificity is 72%, positive predictive value is 49% and negative predictive value is 94%. This wide variation in the validity of the test maybe due to different sonographic scanner machines used and different sonographers and also there are certain technical limitations of ultrasonography like maternal obesity, anterior placentation and amount of liquor.

CONCLUSION

Foetal macrosomia is more common among multigravida. There is significant association between the incidence of macrosomia and gestational diabetes mellitus. Previous

macrosomic birth and high body mass index have influence over macrosomia. Biparietal diameter and head circumference are poor predictors of macrosomia. Estimated foetal weight is the best individual ultrasound parameter in predicting macrosomia followed by abdominal circumference. Though, the sensitivity is less than abdominal circumference, the positive predictive value of estimated foetal weight is higher than abdominal circumference.

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