International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Marhatta N et al. Int J Reprod Contracept Obstet Gynecol. 2017 Jun;6(6):2407-2412
www.ijrcog.org

pISSN 2320-1770 | eISSN 2320-1789

DOI: http://dx.doi.org/10.18203/2320-1770.ijrcog20172321

Original Research Article

Validity of clinical and sonographic diagnosis of IUGR: a comparative study

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Received: 17 March 2017
Accepted: 21 April 2017

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ABSTRACT

Background: IUGR refers to a condition in which a fetus is unable to grow to its genetically predetermined potential size. It is the major cause of perinatal morbidity and mortality in developing countries. The present study was conducted to compare the validity of clinical diagnosis against sonographic diagnosis of IUGR.
Methods: This study was conducted in the department of Obstetrics and Gynaecology, SMGS Hospital, Jammu from Octobar 2013 to September 2014. It included 247 women with singleton pregnancies with longitudinal lie. They underwent serial clinical assessment using SFH, AG and weight gain along with Ultrasound and Doppler of Umbilical & Middle cerebral artery. Birth weight of newborns was measured at delivery and was thereafter correlated with clinical and sonographic diagnosis; to access their validity.
Results: Sensitivity of SFH in detecting IUGR was 71.4% against 75.7% by Ultrasound and was highest with Doppler of 82.9%. Specificity was 43.6% by SFH, 64.3% by Ultrasound and 86.2% by Doppler. Doppler also had the highest NPV of 92.6% against 79.1% by SFH and 86.8% by Ultrasound. The combination of clinical and ultrasound diagnosis increased the sensitivity to 95.2% and NPV to 95.91%. However, the combination of clinical and Doppler assessments did not significantly change the outcome.
Conclusions: Doppler is the single best investigation available for diagnosing IUGR with a high specificity and NPV. However, importance of clinical diagnosis cannot be overlooked, especially in a developing country with limited resources like ours. In the absence of Doppler combined clinical and Ultrasound assessment should be considered.

Keywords: Clinical Diagnosis, Doppler, IUGR, Sonographic diagnosis, Ultrasound

INTRODUCTION

IUGR refers to a condition in which a fetus is unable to grow to its genetically predetermined potential size. It is the major cause of perinatal morbidity and mortality in developing countries.[1] Low birth weight is a major problem in India. Nearly 3 million low birth weight babies are born anually in India.[2,3] Of the various strategies that can be launched to combat this situation prevention of low birth weight by early diagnosis and its effective management is most important and desirable. The objective of study was to evaluate the validity of clinical diagnosis of IUGR in comparison with sonographic (USG and DOPPLER) diagnosis of IUGR.

METHODS

The study was conducted in the department of Obstetrics and Gynaecology, SMGS Hospital, Jammu over a period of 1 year (October 2013 to September 2014). It was a Longitudinal Follow Up Study. All the pregnant women with 20 weeks' period of gestation or beyond with singleton pregnancy in a longitudinal lie were included in this study; excluding those with polyhydramnios, fetal anomalies, mistaken dates and diabetes complicating

pregnancy. First Ten women attending the OPD were selected on once a week basis. These patients were followed till delivery on a 4-weekly basis (frequency was increased in suspected IUGR). Those patients who were either lost to follow up for more than 8 weeks or at delivery; were excluded from the final stastical evaluation.

The symphysio fundal height, abdominal girth and maternal weight measurements were taken at each antenatal visit as per the standard guidelines. All these parameters were recorded at each antenatal visit for each patient in their respective performa. The patients also underwent routine USG for abdominal circumference measurements and DOPPLER of uterine, Umbilical and Middle cerebal artery. The birth weights of newborns were taken at delivery and hence grouped as IUGR and normal weight based on normograms for this local population. IUGR was defined as birth weight less than 2500 grams.

The stastical analysis was finally done Software SPSS Version 21. Validity of the clinical and sonographic diagnosis of IUGR was evaluated using sensitivity, specificity, Positive predictive value, negative predictive value, positive likehood ratio and negative likehood ratio.

Out of a total of 247 cases, we lost three cases to follow up at birth, hence they were excluded from the statistical evaluation. Hence, 244 cases were used for Validity assessment.

RESULTS

The mean age in IUGR group was 25.7 with a SD of ±3.46 and in the group with normal birth weight, mean age was 26.34 with SD of ±4.26.

Table 1: Age distribution.

Age group (yrs)	Birth weight		T value	P value
	IUGR N (%)	Normal N (%)		
19-25	36 (51.42)	86 (49.42)	1.05	0.08 (not significant)
26-30	29 (41.42)	64 (36.78)		
31-35	3 (4.28)	22 (12.64)		
36-40	2 (2.85)	1 (1.42)		
>40	0 (0)	1 (1.42)		
Total	70	174		

In present study, 132 cases (54.09%) were from urban areas and 112 cases were from rural areas (45.90%). Our hospital is a Referral center for our rural population but the maximum population attending the OPD is from urban areas. Hence using SFH measurements; we could identify more cases in the GA between (29-32) weeks as growth restricted. The pattern was almost similar with the SFH pattern. This shows that weight gain is not a very good indicator of IUGR in this population studied.

Table 2: Demographic distribution.

Demography	Birth weight		Chi Sq.	P value
	IUGR N (%)	Normal N (%)		
Rural	34 (48.57)	78 (44.82)	0.282	0.596 (Not Significant)

Table 3: SFH pattern at different gestatioal ages.

Weeks	Total cases	Normal SFH	Reduced SFH
20-24	127	123	4
25-28	212	175	37
29-32	232	172	60
33-36	232	185	47

The sensitivity of diagnosis of IUGR using clinical evaluation in our study was found to be 71.4%, specificity 43.6%, NPV 33.7% and PPV was 79.1%. Positive likelihood hood ratio=1.2682 (CI=1.26-1.27), negative likelihood ratio=0.65414. (CI=0.64-0.66). p value (0.029).

Table 4: Abdominal girth pattern at different gestational ages.

Weeks	Total cases	Normal age	Reduced age
20-24	127	127	0
25-28	212	182	34
29-32	232	165	67
33-36	232	185	47

The sensitivity of diagnosis of IUGR using ultrasonically determined fetal AC in our study was 75.7%, specificty of 64.3%, PPV 46% and NPV of 86.8%. Positive likelihood ratio =2.12(CI=2.10-2.14) and negative likelihood ratio =0.3773 (CI=0.37-0.38) p value (0.001).

Table 5: Maternal weight gain pattern.

Weight gain	Total cases	Percentage
<6 kg	241	97.57
≥6 kg	6	2.43

The sensitivity of diagnosis of IUGR using DOPPLER WAS 82.9%, specificity 86.2%, PPV 70.7%, NPV 92.6%. Positive likelihood ratio=6.007 (CI=5.93-6.08) and negative likelihood ratio=0.198 (0.195-0.202) p value (0.001).

DISCUSSION

Intra uterine growth restriction (IUGR) is a condition that changes names and definitions but unchangingly contributes to perinatal mortality and morbidity. It's the major cause of perinatal morbidity and mortality in developing countries and it's a major problem in our country as well.[1] Nearly 3 million low birth weight babies are born annually in India.[2,3]

Hence, being one of the major public health problems in developing country like ours, its Prevention by early diagnosis and its effective management is important and desirable. In present study patients were in the range of 19-41 years of age, maximum patients were in the age group of 19-25 years (Table 1) present study is consistent with study of Acharya D et al.[4]

Sociodemographic conditions also play an important role in causing IUGR. In this study 132 cases (54.09%) were from urban areas and 112 cases were from rural areas (45.90%) (Table 2). Present findings are similar to those of Helcowitz et al.[5] However, Kinare AS et al in their study found fetal size to be smaller in rural Indian population than in urban Indian population.[6]

In present study, we tried to evaluate growth of fetus using serial SFH measurements Rate of growth of SFH >2 cm per week was considered normal. The sensitivity of diagnosis of IUGR using SFH measurement in our study was found to be 71%, specificity 43%, NPV 33%, PPV of 79% (Table 3, 7). Cnattingus S et al, in their study have shown that SFH measurment has a sensitivity of 100 %, specificity of 92% and a NPV of 100%.[7] Pillay P et al, found that the sensitivity of the Gravidogram was 74.1%, specificity was 95.9%, PPV was 78.4% and NPV was 94.8%.[8] Mc Dermott et al, estimated the average sensitivity of detecting IUGR using SFH to be 65% with a false positive rate of 50%.[9] Jenson et al showed that SFH identified only 40 % cases of IUGR.[10]

In present study using abdominal girth as a parameter to diagnose IUGR; the pattern was found almost similar to the SFH pattern. Maximum number of cases picked up as IUGR using this parameter was between the GA of 29-32 weeks (Table 4). Hamudu NA et al in their study concluded that SFH and abdominal girth could predict Birth weight more closely than gestational age.[11] Strauss RS et al in their study concluded that maternal weight gain in pregnancy positively influences fetal growth and birth weight.[12] However, serial maternal weight gain did not prove a very good indicator of IUGR in present study population (Table 5).

Table 6: Birth weight distribution.

Birth weight (gm)	Total cases (244)	Percent
IUGR (<2500)	70	28.68
Normal (≥2500)	174	71.31

Sonographic evaluation of IUGR involves fetal body measurements; which are in turn used to calculate the EFW. In present study, authors used AC as the major indicator of GA and predictor of IUGR A lag of 3 weeks or more between the expected GA of the fetus using LMP and USG documented GA using AC was taken as the key criteria to diagnose IUGR by USG.

Table 7: Validity of clinical diagnosis comparing with final birth weight.

Clinical diagnosis	Birth weight		Total	Senstivity	Specificity	Positive predictive value	Negative predictive value
	IUGR	Normal					
IUGR	50	98	148	0.714	0.436	0.337	0.791
Normal	20	76	96	CI=	CI=	CI=	CI=
Total	70	174	244	(0.710-0.717)	(0.434-0.439)	(0.335-O.340)	(0.789-0.794)

Table 8: Validity of ultrasound diagnosis of IUGR.

USG Diagnosis	Birth Weight		Total	P-value	Sensitivity	Specificity	Positive predictive value	Negative predictive value
	IUGR	Normal						
IUGR	53	62	115					
Normal	17	112	129	0.001**	0.757	0.643	0.460	0.868
Total	70	174	244					
					CI= (0.75-0.76)	CI= (0.641-0.645)	CI= (0.457-0.463)	CI= (0.866-0.870)

The sensitivity of diagnosis of IUGR using ultrasonically determined fetal AC in our study was 75.7%, specificity of 64.3%, PPV 46.08% and NPV of 86.8% (Table 8). Present study is comparable to the study conducted by Pillay P et al who in their study found that detection of IUGR by USG had a sensitivity of 85.2%, specificity of 96.6% and PPV of 83.6% and NPV of 97%.[8] Present study was contrary to that of Baschat and Weiner.[13] In their study, they showed that low abdominal circumference percentile had the highest sensitivity (98.1%) for diagnosing IUGR. Pearce et al showed that the sensitivity of the AC measurements (83%) was slightly better than that of SFH measurements (76%) but this difference was not statistically significant.[14]

Table 9: Validity of doppler diagnosis of IUGR.

Doppler Diagnosis	Birth weight		Total	P-value	Sensitivity	Specificity	Positive predictive value	Negative predictive value
	IUGR	Normal						
IUGR	58	24	82	0.001**	0.829	0.862	0.707	0.926
Normal	12	150	162					
Total	70	174	244					
					CI= 0.82-0.83	CI= 0.860-0.863	CI= 0.704-0.710	CI= 0.924-O.927

The sensitivity of diagnosis of IUGR using Doppler was 82.9%, specificity 86.2%, PPV 70.7% and NPV 92.6% (Table 9). Singh S et al in their study showed that UA RI was 84.6% sensitive and 82.9% specific in diagnosing IUGR even at 30 weeks.[15] Uterine Artery PI had also good sensitivity, specificity of 79% and 76.9% respectively.

In present study, it was found that a total of 70 cases weighed <2500 grams and 174 cases had birth weight =>2500 gms (Table 6). Current study reveals, that sensitivity of Doppler, USG and clinical diagnosis is almost equal (71.4%, 75.7%, 82.9% respectively). However, Doppler is the most specific of all the three and also has the highest NPV (Table 10).

Table 10: Evaluation of results of clinical and sonographic diagnosis of IUGR.

Test	Sensitivity	Specificity	PPV	NPV
Clinical diagnosis	71.4	43.6	33.7	79.1
Ultrasound	75.7	64.3	46.08	86.8
Doppler	82.9	86.2	70.7	92.6

Table 11: Validity of clinical diagnosis and ultrasound (in combination).

Clinical diagnosis and ultrasound (combined)	Birth Weight		Total	Sensitivity	Specificity	Positive predictive value	Negative predictive value
	IUGR	Normal					
IUGR	40	30	70	95.23%	61.03%	57.14%	95.91%
Normal	2	47	49				
Total	42	77	119				
				CI= 0.950-0.954	CI= 0.60-0.61	CI= 0.567-0.575	CI= 0.95-0.96

Table 12: Validity of clinical diagnosis and doppler (in combination).

Clinical diagnosis and doppler (combined)	Birth Weight		Total	Sensitivity	Specificity	Positive predictive value	Negative predictive value
	IUGR	Normal					
IUGR	53	13	66	0.854	0.841	0.803	0.884
Normal	9	69	78				
Total	62	82	144				
				CI= 0.852-0.857	CI= 0.838-0.843	CI= 0.799-0.806	CI= 0.882-0.886

In present study, authors tried to evaluate the usefulness of combination of clinical diagnosis with ultrasound and Doppler; we found that the sensitivity of combined clinical diagnosis and ultrasound was 95.23%, specificity was 61.03%, PPV was 57.14% and NPV was 95.91%.

However, the combination of clinical diagnosis and Doppler had sensitivity equal to 85.4%, specificity was 84.1%, PPV was 80.3% and NPV was 88.4% (Table 11, 12). Pillay P et al in their comparative study of Gravidogram and USG in diagnosing IUGR found that when both these modalities were used together, it reduced the sensitivity to 31.4% but increased the specificity to 98.8%, PPV to 92.5% and NPV to 98%.[8]

Pearce JM et al in their comparative study of SFH and USG also concluded that screening from both the tests

improved the sensitivity to 93%, reduced specificity to 67% and had a PPV of 32%.[14]

The study reflected following facts:

- Mean age for IUGR in our study was 25.7±3.46and for Normal birth weight group was 26.34±4.26. But Correlation of IUGR with age was not found to be statistically significant (p=0.08).
- There was no significant correlation between demography and IUGR (p=0.59)
- 148 patients (59.91%) had SFH which was not corresponding to the expected values at a particular gestational age and majority of these were diagnosed clinically between (29-32) weeks period of gestation.
- Abdominal girth (AG) showed almost a similar pattern as SFH; with maximum cases diagnosed as IUGR using AG being 59.91%.
- Only 2.42% cases had a weight gain ≥6 kgs form GA of 20-36 weeks, depicting that maternal weight gain is not a very good parameter to assess fetal growth in our population.
- The sensitivity of diagnosis of IUGR using clinical evaluation in our study was found to be 71.4%, specificity 43.6%, NPV 33.7% and PPV was 79.1%. Positive likelihood hood ratio=1.2682 (CI=1.26-1.27), negative likelihood ratio=0.65414. (CI=0.64-0.66). The correlation of SFH with IUGR was significant (p=0.02).
- The sensitivity of diagnosis of IUGR using ultrasonically determined fetal AC in our study was 75.7%, specificity of 64.3%, PPV 46% and NPV of 86.8%. Positive likelihood ratio=2.12 (CI=2.10-2.14) and negative likelihood ratio= 0.3773 (CI=0.37-0.38). The correlation of USG (AC) with IUGR was highly significant (p=0.001).
- The sensitivity of diagnosis of IUGR using Doppler was 82.9%, specificity 86.2%, PPV 70.7%, NPV 92.6%. Positive likelihood ratio=6.007 (CI=5.93-6.08) and negative likelihood ratio= 0.198 (0.195-0.202). The correlation of Doppler with IUGR was highly significant (p=0.001).
- A total 0f 70 cases (28.69%) weighed <2500 grams and 174 cases had birth weight ≥2500 gms.
- There is positive correlation between Clinical and Sonographic diagnosis of IUGR.
- Doppler is the most specific in diagnosing IUGR with maximum negative predictive value.
- The combination of clinical diagnosis and ultrasound improved sensitivity of diagnosis of IUGR to 95.2%, PPV to 57.14% and NPV to 95.91%.
- However, the combining clinical diagnosis with Doppler does not seem to significantly improve diagnosis of IUGR, compared to Doppler evaluation alone. Hence if Doppler is available it's the single best diagnostic technique for IUGR, however, importance of clinical diagnosis cannot be overlooked.

CONCLUSION

Present study thus conclude that Doppler is the single best investigation available for diagnosing IUGR with a high specificity and NPV. Moreover, it has a very significant correlation with perinatal outcome thus can help us in decision making and hence avoiding iatrogenic prematurity due to false positive diagnosis of IUGR. In short its confirmatory, but in present study, authors made an attempt to evaluate utility of clinical diagnosis for screening IUGR since we are a developing nation with limited resources at reach of common people.

Authors found that clinical assessment has an appreciably good sensitivity and PPV; almost the same as ultrasound and slightly comparable to Doppler as well. Thus, it has all the characteristics of a good screening test as it is simple, free of cost, does not need any expertise, and there is no problem associated with its availability. Even paramedical staff especially ANMs can be trained for the routine use of clinical assessment.

On the contrary Doppler is still not available at peripheral levels. In such a case, clinical diagnosis even though not very specific; is a good screening tool for IUGR. However, if sonographic equipments are available, a combination of clinical diagnosis with ultrasound will improve the detection rates and make a better diagnosis of IUGR. Doppler if available is the best single investigation and in its absence clinical and ultrasound combined diagnosis can prove valuable.

In a developing country like India where health institutions with sophisticated technology (Doppler in particular) are inaccessible to majority of women and moreover our female population seem to be reluctant for even routine antenatal visits, in such a situation routine screening for growth restriction using regular Ultrasound and Doppler is not a very impressive tool. Hence although Doppler is the best investigation available for diagnosis of IUGR, it can't replace clinical evaluation.

It's true that advances in the technology, introduction of colour Doppler, development of neonatal intensive care have proved to be a boon for Growth restricted fetuses, but prevention is always better than cure. Thus, our efforts should be directed at improving growth of fetus in utero, to prevent further complications and that too with cost effective measures.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Marhatta N, Kaul I. Validity of clinical and sonographic diagnosis of IUGR: a comparative study. Int J Reprod Contracept Obstet Gynecol 2017;6:2407-12.