DOI: https://doi.org/10.53350/pjmhs211581931

ORIGINAL ARTICLE

Comparison of Head Circumference and Abdominal Circumference Ratio in Normotensive and patients with Pregnancy Induced Hypertensive Disorders after 28 weeks of gestation

IFFAT UN NISA[1], ANJUM TAZEEN[2], SABAR BUTT[3], MEHREEN FATIMA[4], SYED AMIR GILANI[5]
[1]Rehmat Surgical and Maternity Hospital, Chowk Ghuffar Park Mochi Wala Road Gojra, District Toba Tek Singh
[2]Assistant professor Department (UIRSMIT) FAHS, University of Lahore.
3Director Medical Imaging, Sabri, Sabri Surgical Hospital, Faisalabad
[4]Biostatician (UIRSMIT) FAHS, University of Lahore
[5]Dean FAHS, University of Lahore
Correspondence to Dr. Iffat un Nisa, Email: driffatunnisa@gmail.com , Tel. 0322-7718394

ABSTRACT

Background: Hypertensive disorders are an important medical problem of gestation. Hypertensive disorders of pregnancy (HDP) are a significant cause for maternal and fetal morbidity as well as mortality. Intrauterine growth retardation (IUGR) commonly describes the condition of fetus whose size or growth is subnormal. IUGR fetus is frequently described as symmetrical and asymmetrical IUGR in term of their body proportions. Asymmetric growth retardation is typically linked to uteroplacental inadequacy. Hypertension is one of the maternal causes of placental insufficiency.
Aim: To compare head circumference and abdominal circumference ratio in normotensive and patients with pregnancy induced hypertensive disorders after 28 weeks of gestation.
Methodology: A cross sectional analytical study was carried on 113 pregnant females in which 57 women were normotensive and 56 women were hypertensive. All individuals were scanned by two- dimensional ultrasound following 28 weeks of pregnancy to evaluate sonographic parameters HC and AC. The HC/AC ratio was estimated by dividing head circumference with abdominal circumference.
Results: Out of 57 normotensive patients 27 (36.48%) fetuses were diagnosed with IUGR having HC/AC ratio more than 1, while 30 had normal HC/AC ratio. In 56 hypertensive patients 47(63.51%) fetuses were diagnosed with IUGR having HC/AC ratio greater than 1, however 9(23.07%) fetuses had HC/AC ratio within normal range. So out of total 113 patients, 74 fetuses were found with IUGR while 39 fetuses had HC/AC ratio within normal ranges. Our study found that a cut off value of ≥ 1.0974 for HC/AC ratio could be used as diagnostic parameter in predicting IUGR.
Conclusion: HC/AC ratio is a useful parameter for the detection of IUGR.
Keywords: Head Circumference, Abdominal Circumference, Intra Uterine Growth Retardation

INTRODUCTION

Pregnancy induced hypertension is referred to as gestational hypertension or hypertensive disorders of pregnancy[1]. Hypertensive disorders of pregnancy are reported in 6-8% of pregnancies worldwide[1,2]. The frequency of hypertensive disorder was reported as high as 15% in one study from Pakistan.[2] The incidence of intra uterine growth restriction (IUGR) is estimated to be approximately 5% in the general obstetrics population.[3] The frequency of IUGR in patients with PIH was found to be 28%[3]. The most common definition of IUGR is that if the weight of the fetus is below the 10 percentile for its gestational age[4]. IUGR fetus is a frequently described as symmetrical and asymmetrical IUGR in terms of their body proportions. Symmetrically small fetuses are associated with factors that impair the intrauterine growth potential of fetus (i.e. chromosomal abnormalities, viral infection etc.), while asymmetric growth restriction is classically associated with uteroplacental insufficiency[3].

The American College of Obstetricians and Gynecologist (ACOG) proposed a classification in 1972, which was reaffirmed in 1990 by the national high blood pressure education working group. These hypertensive disorders were classified as preeclampsia and eclampsia, transient hypertension of pregnancy, chronic hypertension and preeclampsia superimposed on chronic hypertension[5]. The majority of cases of mild PIH develop beyond 37 weeks of gestation and in these cases pregnancy outcomes are comparable to those of normotensive pregnancies[1-5]. Preeclampsia is a major cause of maternal mortality and morbidity[6]. According to conducted studies in Pakistan it ranges among the top three most common causes of maternal death. Pregnancy induced hypertension (PIH) is classified as mild or severe. Mild PIH is defined as new onset hypertension (systolic blood pressure ≥140mmHg and/or diastolic blood pressure ≥90mmHg occurring after twenty weeks of gestation[1-7]. Severe PIH defined as sustained elevated blood pressure ≥160mmHg systolic and ≥110mmHg diastolic[1-7]. Preeclampsia is usually diagnosed in the presence of hypertension associated with proteinuria[6,7]. Preeclampsia is a disorder that affects pregnancy and the health of the mother and fetus[8]. The placenta forms the interface between fetal and maternal circulation. Multiple manifestation of placental insufficiency is the diagnostic approach to the fetuses with suspected intrauterine growth restriction[9]. Low birth weight is defined as singleton live birth infant weighing less than

Received on 13-03-2021
Accepted on 17-07-2021

2500g regardless of his or her gestational age. There was significant association of PIH with low birth weight[10].

An equation for estimating fetal weight based upon sonographic measurement of abdominal circumference (AC) and head circumference (HC) was first proposed in 1975 by Cambell and Wilkin[11]. Fetal abdomen circumference is measured routinely to determine the fetal weight along with other biometric parameters to rule out intra uterine growth restriction.[12] The HC/AC ratio can be used as a Quick and Easy Reference Key (QERK) for the detection of IUGR. HC/AC ratio between 35-37 weeks of gestation is approximately 1[13]. HC/AC ratio changes during pregnancy. The HC is always greater than AC in the second trimester of pregnancy. Ratio is 1:1 between 32-35 weeks of gestation and in normal pregnancies abdominal circumference increases after 36 weeks gestation. Reduced abdominal circumference due to decreased glycogen storage in liver is the first sign of asymmetric growth retardation. If the HC/AC ratio remains more than 1 in last trimester of pregnancy it indicates asymmetric IUGR[14].

Pregnancy induced hypertension (PIH) that may lead to preeclampsia is common in our country in the obstetric population. Ultrasound is a convenient non invasive and inexpensive modality to detect the effect of PIH on fetus in the third trimester.

The basic purpose of this study is to facilitate early and accurate identification of intra uterine growth restriction (IUGR), by monitoring the HC/AC ratio due to pregnancy induced hypertension and preeclampsia.

MATERIALS AND METHODS

Cross sectional analytical study of pregnant women who underwent scanning after 28 weeks of gestation during November 2018 to July 2019 was performed at Sabri Surgical hospital Amin Pur Bangla Faisalabad, Sabri Color Doppler Diagnostic Ultrasound Centre, Ghulam Muhammadabad Faisalabad and Rehmat Surgical and Maternity hospital Chowk Ghaffar park Gojra. 113 pregnant women with a single live fetus, who started pregnancy with normal blood pressure; with exact knowledge of their last menstrual date or an early first trimester dating scan participated in this research study. Patients with any other chronic disease such as diabetes, renal or heart disease and any gross structural abnormality in the fetus were excluded.

A standard third trimester obstetric ultrasound was conducted according to AIUM parameters. Head circumference was measured on axial plane traversing thalami and cavum septum pellucidum with transducer vertical to central axis of head. The calvaria and cerebral hemispheres appeared symmetric and cerebellar hemisphere was not visible in this plane. The ellipse was drawn with calipers in the region of outer borders of calvarium. Abdominal circumference was measured in an axial plane having fetus stomach bubble as well as portal sinus. The kidneys, heart and umbilical vein insertion in abdominal wall were not seen. The calipers were on the surface of skin. Head circumference and abdominal circumference ratio in normotensive patients and patients with pregnancy induced hypertensive disorders were compared.

RESULTS

One hundred and thirteen patients were included in this study, of which, 57 were normotensive and 56 had pregnancy induced hypertension. The mean and the standard deviation of ages of the normotensive cases was 25.5088 ±1.70213 years with a range from 22.00 to 29.00 years while the mean and the standard deviation of hypertensive cases was 26.2321±1.76832 years with the range from 23 to 30 years. (Table-1, Graph-1)

The mean and standard deviation of HC in 57 Normotensive patients was 302.5±22.63026 mm and it ranged from 229.5 to 343.9mm. The mean and standard deviation of AC was 287.6 9±26.45703mm and it ranged from 236.1 to 340.7mm. In hypertensive patients, the mean and standard deviation of HC was 299.1 ± 22.3 mm with minimum value of 251.7 mm and maximum value of 338.9 mm. In these patients, the mean value of the AC was 308.1±306.6 mm and it ranged between 184.5 and 254.8mm (Table-2).

IUGR: Intrauterine Growth Retardation: Out of 113 total patients 74 fetuses were found to have HC/AC ratio of more than 1 while 39 fetuses had HC/AC ratio within normal range. Out of 57 normotensive patients, 27 (36.48%) fetuses showed HC/AC ratio of more than 1, while 30 had a normal HC/AC ratio. In hypertensive patients 47 (63.51%) fetuses exhibited HC/AC ratio greater than 1, and 9 (23.07%) fetuses had HC/AC ratio within normal range (Table-3).

In normotensive patients, mean and standard deviation of HC/AC ratio of IUGR fetuses was 1.09 ± 0.02 and in normal fetuses it was 1.00 ± 0.01. In hypertensive patients, the mean and standard deviation of HC/AC ratio of IUGR fetuses was 1.12 ± 0.07 and that of normal fetuses was 0.98 ± 0.03 (Table-4).

In normotensive patients, mean and standard deviation of HC/AC ratio of IUGR fetuses was 1.09 ± 0.02 and that of hypertensive patients was 1.12 ± 0.07 (Table-5).

Independent T- test shows no statistically significant difference between HC/AC ratio of normotensive (with IUGR) and hypertensive with IUGR (p≤0.05) (Table 6).

In normotensive patients, mean and standard deviation of HC/AC ratio of all fetuses (with and without IUGR) was 1.09 ± 0.02 and that of hypertensive patients was 1.12 ± 0.07 (Table-7). Independent T-test shows significant difference between HC/AC ratio of normotensive and hypertensive with/ without IUGR (p=0.0000) (Table 8)

Graph 1

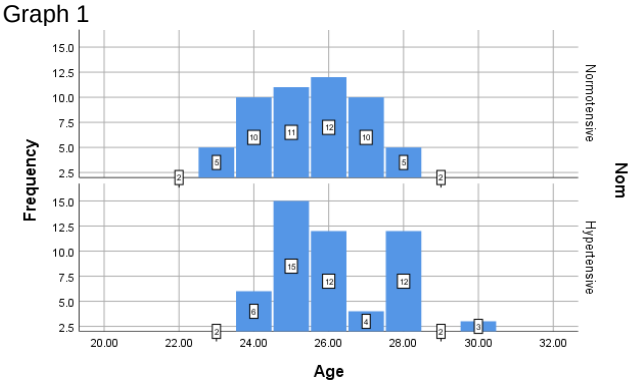

Table1: Mean, standard deviation and range of age of subjects in years

	Mean	N	Std. Deviation	Min.	Max.
Normotensive	25.5088	57	1.70213	22	29
Hypertensive	26.2321	56	1.76832	23	30
Total	25.8673	113	1.76526	22	30

Table 1: Mean value of Head Circumference (HC) and Abdominal Circumference (AC) in the different groups

		HC	AC
Normo-tensive	Mean	302.4579	287.6281
	N	57	57
	Std. Deviation	22.63026	26.45703
	Minimum	229.50	236.10
	Maximum	343.90	340.70
Hyper tensive	Mean	299.0946	308.1179
	N	56	56
	Std. Deviation	22.31033	306.62220
	Minimum	251.70	184.50
	Maximum	338.90	254.830
Total	Mean	300.7912	297.7823
	N	113	113
	Std. Deviation	22.43543	215.92828
	Minimum	229.50	184.50
	Maximum	343.90	254.830

HC: Head Circumference; AC: Abdominal Circumference

Table 3: Cross Tabulation between Normotensive and Hypertensive patients

		Diagnosis		Total
		IUGR	Normal	
Normo tensive	Count	27	30	57
	% within Diagnosis	36.48%	76.9%	50.4%
Hyper tensive	Count	47	9	56
	% within Diagnosis	63.51%	23.07%	49.6%
Total	Count	74	39	113
	% within Diagnosis	100.0%	100.0%	100.0%

Table 2: Mean and standard deviation of HC/AC ratio in Normotensive and Hypertensive patients

	Diagnosis	N	Mean	STD
Normotensive	IUGR	27	1.0974	.02413
	Normal	30	1.0037	.01925
	Total	57	2.1011	.04338
Hypertensive	IUGR	47	1.1262	.07481
	Normal	9	.9889	.03333
	Total	56	2.1151	.10814
Total	IUGR	74	2.2236	.09894
	Normal	39	1.0000	.05258
	Total	113	3.2236	

Table 5: Mean and standard deviation of HC/AC Ratio of IUGR fetuses in Normotensive and Hypertensive patients

Summary Data				
	N	Mean	STD	Std. Error Mean
Normotensive (with IUGR)	27.000	1.097	.024	.005
Hypertensive (with IUGR)	47.000	1.126	.172	.025

Table 6: Comparison of HC/AC Ratio in Normotensive and Hypertensive groups (with IUGR)

Independent Samples Test					
	Mean Difference	Std. Error Difference	t	Df	Sig. (2-tailed)
Equal variances assumed	-.029	.033	-.865	72.000	.390
Equal variances not assumed	-.029	.025	-1.131	49.117	.264
Hartley test for equal variance: F = 50.591, Sig. = 0.0000					

Table 7: Mean and standard deviation of HC/AC ratio in Normotensive and Hypertensive (with and without IUGR)

Summary Data				
	N	Mean	STD	Std. Error Mean
Normotensive (with and without IUGR)	57.000	1.054	.050	.007
Hypertensive (with and without IUGR)	56.000	1.123	.091	.012

Table 8: Comparison of HC/AC Ratio in Normotensive and Hypertensive groups (with and without IUGR)

Independent Samples Test					
	Mean Difference	Std. Error Difference	T	Df	Sig. (2-tailed)
Equal variances assumed	-.069	.014	-4.968	111.000	.000
Equal variances not assumed	-.069	.014	-4.945	85.119	.000
Hartley test for equal variance: F = 3.311, Sig. = 0.0000					

DISCUSSION

In my study, Out of 113 total patients 74 fetuses were found with IUGR while 39 fetuses were having HC/AC ratio within normal ranges. In 56 hypertensive patients 47(63.51%) fetuses were diagnosed with IUGR. Dilmen G *et al*, studied measurements of 320 pregnant women. The HC/AC ratio in ten IUGR fetuses was greater than 95th percentile for the diagnosis of IUGR fetuses[14]. Campbell and Thomas formulated an HC/AC nomogram from around 500 normal fetuses and analyzed 31 fetuses at danger of uteroplacental deficiency. The 70% of fetuses having HC/AC ratio of more than 95th percentiles were termed as asymmetric[15]. In another study 46% cases were found having raised HC/AC ratio[16]. A study was proposed including forty-three pregnancies, out of which twenty-six (60.5%) fetuses exhibited asymmetric growth (HC/AC ratio >95th percentile)[17].

In our study we collected data from 113 patients. Out of these, 74 fetuses were observed with an increased HC/AC ratio of more than 1. A study involving 103 SGA fetuses also found the mean HC/AC ratio to be increased[18]. In another study HC/AC with a cut off value more than 1.04 was found to have a moderate diagnostic value in prediction of IUGR[19]. Another study also found that mean value of HC/AC ratio in the case group is greater than control group[20].

Out of 113 total patients, 39 fetuses were having HC/AC ratio within normal range that is equal to 1. Seventy four patient's fetuses were diagnosed with IUGR having HC/AC ratio greater than 1 in the third trimester. Özek *et al,* (1991) proposed that HC/AC ratio changes during pregnancy. If the HC/AC ratio remains more than 1 in last trimester of pregnancy it shows asymmetric IUGR[21]. An increase in HC/AC ratio associated with reduced birth weight was documented in a prospective cross sectional study of 41 females. In this study the HC/AC ratio was able to identify 88% of the SGA babies[22].

In our study comparison of HC/AC ratio in normotensive and hypertensive patients with IUGR shows significant difference between these two groups ($p \leq 0.05$). Siveska & Jasovick (2015) performed a prospective study consisting of 300 normotensive pregnant (termed as control) and 100 preeclampic females. This study showed an increase in the ratio of HC/AC in the fetus of hypertensive gestations especially in case of severe preeclampsia. Asymmetric IUGR developed in the last trimester of pregnancy. At 36 weeks ($p > 0.05$), at 38 weeks ($p < 0.05$), at 40 weeks ($p > 0.05$).[23] Jasovic-Savisca & Jasovic (2008) performed a study on 67 preeclamptic patients and 129 normotensive pregnancies. At 36 weeks 21.31% had asymmetric IUGR ($p<0.01$), at 38 weeks 25.29% had IUGR ($p<0.01$) and at 40 weeks 31.82% of

Hypertensive pregnancies had IUGR (p<0.01). They concluded that asymmetric IUGR is the major complication of hypertensive pregnancies[24].

In our study out of 56 hypertensive patients 47(63.51%) fetuses were diagnosed with IUGR having HC/AC ratio greater than 1. In another study of 107 pregnancies, 62(58%) had an elevated ratio of HC/AC (more than 95 percentile) that was 10 folds higher than the expected proportions (p<.001) in severe preeclampsia[25].

CONCLUSION

Fetal intrauterine growth retardation is commonly seen in pregnancy induced hypertensive patients and asymmetric growth retardation is more frequently seen as compared to symmetric growth retardation. Fetal HC/AC ratio is an accurate parameter for detection of intrauterine growth retardation.

Recommendations: It is a cross sectional study in which we collected the data on the single visit and we could not follow the patient to keep the record of growth retardation. There should be longitudinal studies to follow the growth pattern in the subsequent visits.

LIMITATIONS

- It is a cross sectional study in which we collected the data on the single visit and we could not follow the patient to keep the record of growth retardation. .
- Sometimes it is difficult to assess the head circumference in late third trimester if the fetal head descends deep into the maternal pelvis.

Conflict of interest: Nil

REFERENCES

1. Ribowsky J, Henderson C. Pregnancy Induced-Hypertension.Clinician Reviews. 2012; (5):28-32
2. Hossain N, Shah N, Khan N, Lata S, Khan NH. Maternal and Perinatal outcome of Hypertensive Disorders of Pregnancy at a Tertiary care Hospital. Journal of Dow University of Health Sciences. 2015;5(1):12-16
3. Zafar H, Naz M, Fatima U, Irshad I. Frequency of IUGR in pregnancy induced hypertension. J Univ Med Dent Coll. 2012;3(2):8-13
4. Doubilet PM, Benson CB. Sonographic evaluation of intrauterine growth retardation. AJR. American Journal of Roentgenology. 1995;164(3):709-17
5. Al-Ghamdi SM, Al-Harbi AS, Khalil A, El-Yahyia AR. Hypertensive disorders of pregnancy: prevalence, classification and adverse outcomes in Northwestern Saudi Arabia. Annals of Saudi Medicine. 1999;19(6):557-60
6. Sibai B, Dekker G, Kupferminc M. Pre-eclampsia. The Lancet. 2005 ;365(9461):785-99
7. Sibai BM. Diagnosis and management of gestational hypertension and preeclampsia. Obstetrics & Gynecology. 2003;102(1):181-92
8. Gammill HS, Roberts JM. Emerging concepts in preeclampsia investigation. Front Biosci. 2007;12:2403-11
9. Baschat AA. Pathophysiology of fetal growth restriction: implications for diagnosis and surveillance. Obstetrical & Gynecological Survey. 2004;59(8):617-27
10. Rahman LA, Hairi NN, Salleh N. Association between pregnancy induced hypertension and low birth weight; a population based case-control study. Asia Pacific Journal of Public Health. 2008;20(2):152-58
11. Dacaj R, Izetbegovic S, Stojkanovic G. Hepato-Cephalic Index as a Predictor of Intrauterine Growth Restriction. Acta Informatica Medica. 2016;24(1):12-15
12. Hadlock FP, Deter RL, Harrist RB, Park SK. Fetal abdominal circumference as a predictor of menstrual age. American Journal of Roentgenology. 1982;139(2):367-70
13. Hasan M, Jawad S. Quick and Easy Reference Keys in Obstetric Sonography. Journal of Medical Ultrasound. 2008;16(1):79-85
14. Dilmen G, Toppare MF, Turhan NÖ, Öztürk M, Işik S. Transverse cerebellar diameter and transverse cerebellar diameter/abdominal circumference index for assessing fetal growth. Fetal diagnosis and therapy. 1996;11(1):50-6.
15. Campbell S, Thoms A. Ultrasound measurement of the fetal head to abdomen circumference ratio in the assessment of growth retardation. BJOG: An International Journal of Obstetrics & Gynaecology. 1977 Mar; 84(3):165-74.
16. Rajpoot N, Dodwa S, Sinha D, Yadav G. Early Diagnosis of Intrauterine growth retardation by using Ultrasonography Foetal Biometric Parameters. International Journal of Health and Clinical Research. 2020 Dec 31;3(12 (S)):293-5.
17. Proctor LK, Rushworth V, Shah PS, Keunen J, Windrim R, Ryan G, Kingdom J. Incorporation of femur length leads to underestimation of fetal weight in asymmetric preterm growth restriction. Ultrasound in Obstetrics and Gynecology: The Official Journal of the International Society of Ultrasound in Obstetrics and Gynecology. 2010 Apr; 35(4):442-8.
18. Snijders RJ, De Courcy-Wheeler RH, Nicolaides KH. Intrauterine growth retardation and fetal transverse cerebellar diameter. Prenatal diagnosis. 1994 Dec;14(12):1101-5.
19. Mohammed RM, Ismail MT, Hussein AM, Allam HA. Assessment of Accuracy of Three Ultrasound Methods for Prediction of Intrauterine Growth Restriction. The Egyptian Journal of Hospital Medicine. 2018 Apr 1;71(2):2505-11.
20. Nimmagadda H, Kapoor P, Ladwal MR. Evaluation of the Diagnostic Criteria of Ultrasonographic Parameters In The Prediction of Intrauterine Growth Restriction. World Journal of Research and Review. 2017;5(3).
21. Özek E, Tuncer M. Intrauterine growth retardation. Marmara Medical Journal. 1991;4(2)78-82
22. Quinton A, Cook C, Peek M. The prediction of the small for gestational age fetus with the head circumference to abdominal circumference (HC/AC) ratio: a new look at an old measurement. Sonography. 2015;2(2):27-31
23. Jasovic Siveska E, Jasovic V. Fetal Growth and Body Proportion during Pre-Eclamptic Pregnancy. Obstetrics & Gynecology International Journal. 2015;2:91-8.
24. Jasovic-Siveska EI, Jasovic VI. Real-time ultrasound in the detection of intrauterine growth retardation in preeclampsia. Bratisl Lek Listy. 2008;109(9):405-11
25. Riyami NA, Walker MG, Proctor LK, Yinon Y, Windrim RC, Kingdom JC. Utility of head/abdomen circumference ratio in the evaluation of severe early-onset intrauterine growth restriction. Journal of Obstetrics and Gynaecology Canada. 2011;33(7):715-19.