ROLE OF DOPPLER ULTRASOUND IN PREDICTION OF PERINATAL OUTCOME IN IUGR

Pradip Kumar Das[1], Santanu Das[2], Sampa Chakrabarti[3]

[1]Consultant, Department of Radiology, Medicare Images, Asansol.
[2]Associate Professor, Department of Radiology, R. G. Kar Medical College and Hospital, Kolkata, West Bengal.
[3]Consultant, Department of Gynaecologist and Obstetrician, ESI Hospital, Bandel, Hooghly, West Bengal.

ABSTRACT

BACKGROUND

Timely diagnosis of foetal compromise offers the best chance to reduce perinatal complications associated with IUGR. Intrauterine Growth Retardation (IUGR) is conveniently defined as foetal weight of less than 10th percentile for gestational age. IUGR is associated with many short-term complications like prematurity, necrotising enterocolitis, hypoxic ischaemic encephalopathy, intraventricular haemorrhage, etc. and long-term sequel like short stature and learning disabilities, etc. Perinatal mortality rates are 4-8 times higher for growth retarded infants and morbidity is present in 50% of surviving infants. It is therefore of utmost importance to recognise the condition as early as possible and intervene at a timely manner.

MATERIALS AND METHODS

In the present study, pregnancies of more than 24 weeks of gestational age with estimated foetal weight less than 10th percentile for gestational age were included. Doppler ultrasound on foetal MCA, UA and TA recorded the PI values obtained from each vessels and any End-Diastolic Flow (EDF) changes were obtained. Pregnancies were followed up and assessed the perinatal outcome in terms of gestational age at delivery, cesarean section for foetal distress, birth weight, admission to NICU and perinatal death.

RESULTS

The mean age of the mother was 26.02 years. On Doppler ultrasound study, 58% of the foetuses had some abnormality in the Doppler parameter. Cesarean section for foetal distress was significantly associated with REDF in TA ($p < 0.04$). On the other hand, absent or reversed EDF (AEDF/REDF) in UA was significantly associated with perinatal death ($p < 0.01$ for AEDF and $p < 0.001$ for REDF). AEDF in UA had the highest OR of 3.04 for cesarean section. AEDF in UA had the highest OR of 10.75 for perinatal death, whereas the RR for perinatal death was highest for REDF in UA (RR = 22.50).

CONCLUSION

Foetuses with AEDF/REDF in TA are at increased risk of cesarean section for foetal distress and admission to NICU. Foetuses with REDF in the UA have the highest risk of perinatal death.

KEYWORDS

Doppler Ultrasound, Perinatal Outcome, Intrauterine Growth Retardation.

HOW TO CITE THIS ARTICLE: Das PK, Das S, Chakrabarti S. Role of Doppler ultrasound in prediction of perinatal outcome in IUGR. J. Evid. Based Med. Healthc. 2017; 4(75), 4423-4426. DOI: 10.18410/jebmh/2017/881

BACKGROUND

Intrauterine Growth Retardation (IUGR) is conveniently defined as foetal weight of less than 10th percentile for gestational age. IUGR is associated with many short-term complications like prematurity, necrotising enterocolitis, hypoxic ischaemic encephalopathy, intraventricular haemorrhage,[1,2] etc. and long-term sequel like short stature and learning disabilities,[3,4] etc. Perinatal mortality rates are 4-8 times higher for growth retarded infants and morbidity is present in 50% of surviving infants.[5] It is therefore of utmost importance to recognise the condition as early as possible and intervene at a timely manner.

Foetal biometry, although a very good indicator of gestational age and foetal growth, can't detect foetal compromise and haemodynamic changes in the foetus. Traditional tests of foetal well-being including Amniotic Fluid Index (AFI), Biophysical Profile (BPP) and foetal Cardiotocography (CTG) valuable information about foetal status, however, it is now clear that abnormalities in findings using these modalities are relatively late in occurrence with foetal acidosis often being already present by the time of evaluation. Hence, in the present study, Doppler ultrasound was used to assess the foetal well-being as it can detect uteroplacental insufficiency and even acid-base status of the foetus before any other test can do so.

MATERIALS AND METHODS

A prospective study was conducted at the Department of Radiology, Institute of Postgraduate Medical Education and

Financial or Other, Competing Interest: None.
Submission 01-09-2017, Peer Review 06-09-2017,
Acceptance 12-09-2017, Published 16-09-2017.
Corresponding Author:
Dr. Santanu Das,
No. 485/32, Ajoy Nagar, Mukundapur,
(Uttar Basudha Housing Society), Kolkata - 700099.
E-mail: drsdaspg@gmail.com
DOI: 10.18410/jebmh/2017/881

Research (IPGME and R) and SSKM Hospital, Kolkata, between February 2008 and June 2009. Pregnant females referred from the Department of Gynaecology and Obstetrics after clinical suspicion of IUGR were included for the present study. 50 cases who fulfilled the above-mentioned criteria were assessed during the study period after obtaining their informed consent. Detailed history was obtained using a structured pretested questionnaire. It was followed by physical examination and relevant laboratory investigations.

Study parameters included Doppler indices like Pulsatility Index (PI) values of the Umbilical Artery (UA), the Middle Cerebral Artery (MCA) and the descending Thoracic Aorta (TA) of the foetus and the ratio of the PI values of MCA to UA (cerebroplacental ratio). Pregnancies were followed up by personal visit to ward, labour room and NICU and phone calls to the patients' families. Any adverse perinatal outcome was noted as described above.

RESULTS

The mean age of the mother was 26.02 years with a range of 18 to 40 years. 84% of the women were below 30 years of age. Majority of the women (52%) were multigravida. 16% of the women had some preexisting illness and 28% of the women had some significant past history.

Mean foetal gestational age during the time of Doppler ultrasound examination was 32.5 weeks. The estimated foetal weight was less than 10th percentile in all the cases. The mean estimated foetal weight was 1980 grams.

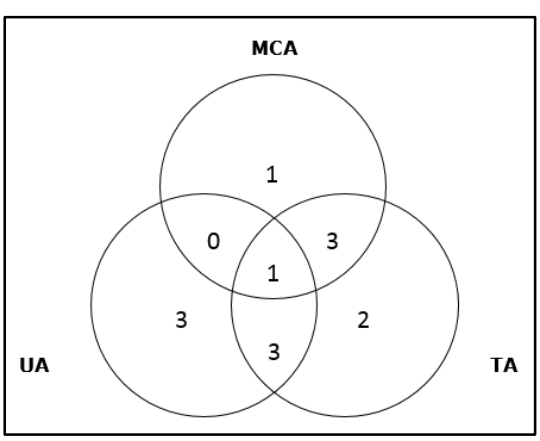
On Doppler ultrasound study, 58% of the foetuses had some abnormality in the Doppler parameter. We found abnormal PI values from MCA in 19 cases, UA in 17 cases and TA in 13 cases.

Umbilical Artery	
AEDF	6 (12)
REDF	1 (2)
Middle cerebral artery	
AEDF	3 (6)
REDF	2 (4)
Thoracic aorta	
AEDF	4 (8)
REDF	5 (10)
Distribution of changes	
AEDF in UA +TA	3 (6)
A/REDF in MCA + TA	3 (6)
A/REDF in MCA + UA +TA	1 (2)
Only UA	3 (6)
Only MCA	1 (2)
Only TA	2 (4)
Total	**13 (26)**

Table 1. Distribution of End-Diastolic Flow Changes among the Study Subjects

There were changes in the End-Diastolic Flow (EDF) in 13 (26%) cases in the form of either absent or reverse end-diastolic flow (AEDF or REDF). We observed changes in MCA, UA and TA in 4, 7 and 10 cases, respectively. In 7 cases, there was EDF changes in more than one vessel. These include changes in both MCA and TA in 3 cases and changes in both UA and TA in another 3 cases. One case showed changes in all the three vessels.

Table 2 showing the strength of association between the EDF changes for each vessel with adverse perinatal outcome. We observed that cesarean section for foetal distress was significantly associated with REDF in TA (p <0.04). On the other hand, absent or reversed EDF in UA was significantly associated with perinatal death (p <0.01 for AEDF and p <0.001 for REDF).



Number of Changes in the EDF in Each Vessel was Examined. Total Number of Cases with Changes in EDF was 13

		CS (29)	**NICU (20)**	**PD (5)**
MCA	Normal (45)* AEDF (3)	24/41 (58%) 3/3 (100%)	17/41 (41%) 1/3 (33%)	5/45 (11%) 0
	p value	p <0.15	p <0.78	p <0.54
	REDF (2)	2/2 (100%)	2/2 (100%)	0
	p value	p <0.24	p <0.1	p <0.62
UA	Normal (43) AEDF (6)	25/44 (57%) 4/5 (80%)	18/44 (41%) 2/5 (40%)	2/45 (4%) 2/6 (33%)
	p value	p <0.32	p <0.96	p <0.01

	REDF (1)	0	0	1/1 (100%)
	p value	p <0.26	p <0.41	p <0.0001
TA	Normal (40) AEDF (4)	20/38 (53%) 4/4 (100%)	15/38 (39%) 2/4 (50%)	3/40 (7%) 1/4 (25%)
	p value	p <0.07	p <0.67	p <0.22
	REDF (6)	5/5 (100%)	3/5 (60%)	1/6 (17%)
	p value	p <0.04	p <0.37	p <0.45

Table 2. Strength of Association

		CS	NICU	PD
MCA	AEDF	OR = Undefined, RR = 1.71	OR = 0.71, RR = 0.80	
	REDF	OR = Undefined, RR = 1.71	OR = Undefined, RR = 2.41	
UA	AEDF	OR = 3.04, RR = 1.41	OR = 0.96, RR = 0.98	OR = 10.75, RR = 7.50
	REDF			OR = Undefined, RR = 22.50
TA	AEDF	OR = Undefined, RR = 1.90	OR = 1.53, RR = 1.27	OR = 4.11, RR = 3.33
	REDF	OR = Undefined, RR = 1.90	OR = 2.30, RR = 1.52	OR = 2.47, RR = 2.22

Table 3. Degree of Association between EDF and Perinatal Outcome

AEDF in UA had the highest OR 3.04 for cesarean section. REDF in TA had the highest OR 2.30 for admission to NICU. AEDF in UA had the highest OR 10.75 for perinatal death.

Gestational Age at Delivery (Weeks)	**34.80 ± 2.28**
Birth weight	2271.43 ± 370.22*
BW <2500 g (No. of cases)	34 (68)
Normal delivery	17 (34)
CS for foetal distress	29 (58)
Admission to NICU	20 (40)
Only CS	12 (24)
Only admission to NICU	3 (6)
CS + NICU	17 (34)
IUFD	4 (8)
Perinatal death	1 (2)

Table 4. Distribution of Perinatal Outcome Among the Study Subjects

DISCUSSION

We observed that cesarean section for foetal distress was significantly associated with REDF in TA (p <0.04). On the other hand, absent or reversed EDF in UA was significantly associated with perinatal death (p <0.01 for AEDF and p <0.001 for REDF). AEDF in UA had the highest OR of 3.04 for cesarean section, whereas the relative risk of cesarean section was highest for AEDF/REDF in TA (RR = 1.90). REDF in TA had the highest OR of 2.30 for admission to NICU, whereas the RR for admission to NICU was highest for REDF in MCA (RR = 2.41). AEDF in UA had the highest OR of 10.75 for perinatal death, whereas the RR for perinatal death was highest for REDF in UA (RR = 22.50). This value was highest among all the parameters examined in our study.

These findings suggest that AEDF/REDF in TA has high risk of cesarean section and admission to NICU. Our findings agree with many investigators who found AEDF/REDF in TA to be a good predictor of neonatal morbidity and mortality. Hackett GA et al[6] studied the perinatal outcomes in 29 foetuses showing AEDF in thoracic aorta and found a higher incidence of perinatal death, necrotising enterocolitis and haemorrhage in the AEDF group than the control. Marsal K et al[7] also observed that the absence of EDF in thoracic aorta is the best predictor of foetal well-being. In foetuses with AEDF, the incidence of adverse perinatal outcome is significantly higher than in foetuses with normal aortic flow. Similar results were obtained in studies by Eronen M et al[8] and Arabin B et al.[9]

Foetuses with AEDF in TA have 3.33 times more risk of perinatal death, whereas foetuses with REDF in TA have 2.22 times more risk of perinatal death. Eronen M et al[8] in their study of 65 pregnant women with PIH observed that the presence of AEDF/REDF was associated with a mortality rate of 30%. In a study of 35 foetuses with severe IUGR, Illyes M et al[10] observed death of all 5 cases, which showed REDF in the thoracic aorta. Ertan et al[11] found an increased incidence of neonatal morbidity and mortality in the REDF group than the AEDF group. This was not supported in our study probably because the number of perinatal deaths was very low (1 case each) in our study, although the risk of NICU admission was higher in REDF group than AEDF group.

In our study, AEDF or REDF in the UA was significantly associated with perinatal death. In fact, foetuses with REDF had 22.50 times more risk of perinatal death than foetuses with normal flow. Pattinson et at[12] found that 52% of foetuses with AEDF in UA died and the liveborn had significantly higher morbidity than the normal group. Similar results were obtained in studies by Yildirim G et al[13] and Battaglia C et al.[14]

CONCLUSION

Foetuses with AEDF/REDF in TA are at increased risk of cesarean section for foetal distress and admission to NICU. Foetuses with REDF in the UA have the highest risk of perinatal death.

REFERENCES

[1] Bernstein IM, Horbar JD, Badger GJ, et al. Morbidity and mortality among very-low-birth-weight neonates with intrauterine growth restriction. The Vermont Oxford Network. Am J Obstet Gynecol 2000;182(1 Pt 1):198-206.

[2] Kramer MS, Olivier M, McLean FH, et al. Impact of intrauterine growth retardation and body

proportionality on foetal and neonatal outcome. Pediatrics 1990;86(5):707.
[3] Karlberg J, Albertsson-Wikland K. Growth in full-term small-for gestational-age infants: from birth to final height. Pediatr Res 1995;38(5):733-739.
[4] McCarton CM, Wallace IF, Divon M, et al. Cognitive and neurologic development of the premature, small for gestational age infant through age 6: comparison by birth weight and gestational age. Pediatrics 1996;98(6 Pt 1):1167-1178.
[5] Callen PW. Ultrasonography in obstetrics and gynecology. 5th edn. Philadelphia: Saunders 2008.
[6] Hackett GA, Campbell S, Gamsu H, et al. Doppler studies in the growth retarded foetus and prediction of neonatal necrotising enterocolitis, haemorrhage, and neonatal morbidity. Br Med J (Clin Res Ed) 1987;294(6563):13-16.
[7] Marsál K, Laurin J, Lindblad A, et al. Blood flow in the foetal descending aorta. Semin Perinatol 1987;11(4):322-334.
[8] Eronen M, Kari A, Pesonen E, et al. Value of absent or retrograde end-diastolic flow in foetal aorta and umbilical artery as a predictor of perinatal outcome in pregnancy-induced hypertension. Acta Paediatr 1993;82(11):919-924.
[9] Arabin B, Siebert M, Jimenez E, et al. Obstetrical characteristics of a loss of end-diastolic velocities in the foetal aorta and/or umbilical artery using Doppler ultrasound. Gynecol Obstet Invest 1988;25(3):173-180.
[10] Illyés M, Gáti I. Reverse flow in the human foetal descending aorta as a sign of severe foetal asphyxia preceding intrauterine death. J Clin Ultrasound 1988;16(6):403-407.
[11] Ertan AK, He JP, Tanriverdi HA, et al. Comparison of perinatal outcome in foetuses with reverse of absent end-diastolic flow in the umbilical artery and/or descending aorta. J Perinat Med 2003;31(4):307-312.
[12] Pattinson RC, Odendaal HJ, Kirsten G. The relationship between absent end-diastolic velocities of the umbilical artery and perinatal mortality and morbidity. Early Hum Dev 1993;33(1):61-69.
[13] Yildirim G, Turhan E, Aslan H, et al. Perinatal and neonatal outcomes of growth restricted foetuses with positive end diastolic and absent or reversed umbilical artery Doppler waveforms. Saudi Med J 2008;29(3):403-408.
[14] Battaglia C, Artini PG, Galli PA, et al. Absent or reversed end-diastolic flow in umbilical artery and severe intrauterine growth retardation. An ominous association. Acta Obstet Gynecol Scand 1993;72(3):167-171.