Original Article

Indication for Doppler evaluation in the management of intrauterine growth restriction of vascular origin in Sub-Saharan Africa

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ABSTRACT

Objective: To assess the contribution of Doppler in foetal monitoring and decision-making during delivery in case of in-utero vascular growth retardation.

Design: We conducted a retrospective cohort study from January 2015 to December 2017 in the Gynaecology and Obstetrics Department of the Yopougon University Hospital (Abidjan, Ivory Coast). It included 130 patients who gave birth in a setting of pre-eclampsia with intrauterine growth restriction (IUGR) from 28 weeks of amenorrhoea.

Results: The average age of patients was 31years. Nulliparous (33% of our patients) and pauciparous (41% of our patients) women were the group most affected. The mean gestational age at the first Doppler examination was 32 weeks of amenorrhoea. Doppler abnormalities were 65% in uterine Doppler and 90% in umbilical Doppler. The mean cerebrovascular ratio was reversed in 90% of the cases. Perinatal mortality was 22.3% (n = 29) with 21 foetal death in utero and 8 neonatal deaths. The time interval between absent end-diastolic or reverse flow velocity and in-utero foetal death was 3.8 days.

Conclusion: Foetal and umbilical Doppler ultrasound greatly modified the management of intrauterine growth retardation related to hypertension.

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INTRODUCTION

Intrauterine growth retardation (IUGR) of vascular origin remains one of the most complex problems in obstetrics. It occurs in 10% of pregnancies and hypertensive disorders of pregnancy (pre-eclampsia) greatly increase the risk in the foetus.[1] Doppler Velocimetry in obstetric is a widely used method for evaluating IUGR. Among a few parameters, the Doppler velocimetry of the umbilical artery provides important information on placental function. Thus, in case of placental dysfunction, the vascular resistance of the umbilical artery increases with a progressive decrease in the diastolic phase which can cancel or even reverse. This change exposes the foetus to a risk of hypoxaemia, acidosis causing severe morbidity and perinatal mortality.[2]

In developing countries, this perinatal mortality is certainly higher, however few studies have been conducted on the impact of obstetric Doppler on the prognosis of vascular IUGR.

It is to answer this research question that we conducted this study in an African environment, specifically in Ivory Coast, with the objective of studying the perinatal results of foetal IUGR with umbilical Doppler abnormalities.

METHODS

A retrospective cohort study was conducted between January 2015 and December 2017, in the

Keywords: *Ultrasonography, Doppler, pre-eclampsia, intrauterine growth restriction*

Gynaecology and Obstetrics Department of the University Hospital of Yopougon (Abidjan, Ivory Coast).

All women who gave birth in pre-eclampsia with IUGR at a time greater than or equal to 28 weeks of amenorrhoea (WA) were included in the study. The exclusion criteria were: multiple pregnancies; foetuses with malformations.

Pre-eclampsia was defined by the association HTA and proteinuria (> 0.3g / 24h) after 20th week of amenorrhea and disappearing before the 6th week of the postpartum on the basis of the recommendations of the French College of Gynaecologists and Obstetricians (CNGOF) and the French Society of perinatal medicine, the French Society of Neonatology and the French Society of Anesthesia and Resuscitation.[3]

IUGR was defined according to the recommendations from the CNGOF 2013[4]: a normal foetal morphology and foetal biometrics reduced according to the foetal weight estimation curve developed by the French College of Foetal Ultrasound (CFEF):

- ✓ An estimate of foetal weight less than or equal to the 10th percentile
- ✓ With Doppler abnormalities: elevation of the resistance index (IR) of the uterine arteries> 95th percentile and the presence of one or two Notches,
- ✓ And / or elevation of the umbilical Doppler resistance index> 95th percentile, or even zero diastole or reverse flow.

Echographic and doppler measurements

After the initial diagnosis of IUGR, all patients underwent serial foetal ultrasound evaluation throughout their pregnancy. Doppler velocimetry was performed by obstetricians with a SONOACE R5-type Samsung ultrasound scanner equipped with a 3.5MHz probe including TM, 2D, pulsed color-coded Doppler modes.

Waveforms of flow velocity were obtained from the uterine artery, umbilical artery and middle cerebral artery (MCA). The measurement at the level of the uterine artery was taken closest to its origin of the hypogastric artery. That at the level of the umbilical artery was performed on the free umbilical cord; and finally the average cerebral artery was localized and the spectrum analyzed at its mean third.

Resistance index (IR) values for the term were considered pathological if the IR values are greater than the 95th percentile for the umbilical artery, the IR values are greater than the 95th percentile, and/or the existence of Notch for the uterine artery and IR values below the 5th percentile for the middle cerebral artery (MCA). The index of resistance of the umbilical artery can highlight the existence of a decreased diastole, zero or even a reverse flow (Fig 1, 2, 3).

Criteria of judgment

The primary endpoint was perinatal mortality defined by in-utero foetal death or neonatal death occurring during neonatal hospitalization.

The secondary outcome measures were to evaluate perinatal morbidity defined by a poor Apgar score, a neonatal transfer.

Variables studied

For each pregnancy, maternal epidemiological characteristics were collected. Regarding the course of pregnancy, all patients were observed: gestational age at the time of diagnosis; the duration of hospitalization of the patients; the estimated foetal weight and Doppler parameters (the existence of a diastole, the existence of a reverse flow, the cerebro-placental ratio (CPR).

The details concerning the course of delivery were noted: the delivery route, the delay between the presence of Doppler anomaly and childbirth and complications related to delivery.

Finally, the neonatal characteristics such as term and birth weight, Apgar at 5 minutes, the need for neonatal resuscitation defined by the need for pediatrician management with resuscitation

methods such as cardiac massage, intubation, catheterization, respiratory distress with intubation or the need for even transient oxygenation and neonatal transfer have been collated.

Statistical analysis

Qualitative variables were described with percentages, and quantitative variables were described with means and standard deviation. For comparison, the percentages were compared with the $\chi 2$ method. A gross odds ratio (OR) was calculated with a 95% confidence interval. The EPI 7 software was used. The tests are performed with a significance level of $p < 0.05$.

RESULTS

We recorded 8,735 births during the study period and the diagnosis of preeclampsia with RCIU was retained in 520 patients. Of these 520 patients, 130 met the inclusion criteria and were included in the analysis. Patients with pre-eclampsia without IUGR (n = 323), multiple pregnancies (n = 62), foetal abnormalities (n = 5) were not included in our study. Of the 130 included patients, 117 eligible (90%) patients had ICDU with Doppler abnormality and 13 (10%) had normal Doppler (Figure 1).

Figure 1: flow chart of the study population

The study population consisted of 280 patients with pre-eclampsia with RCUI. Maternal and ultrasound characteristics are presented in Table 1.

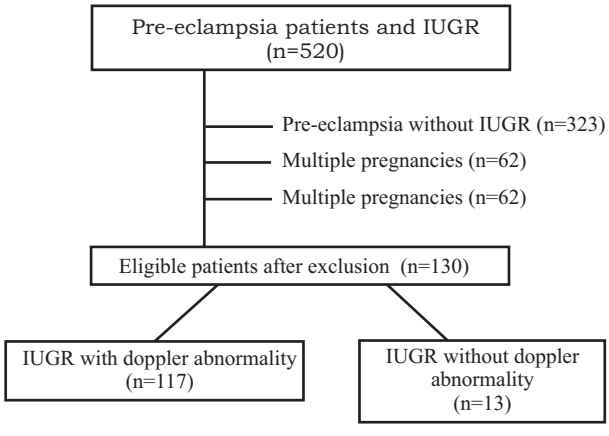

Table 1: Maternal and ultrasound characteristics of the study population (n=130)

	n = 130	Percentage
Maternal characteristics		
Maternal age (year) mean 32, S.D.6.3, rang (15,44)		
Parity		
Nullipara	43	33%
Primipara	53	41%
Gestational age at diagnosis (weeks of gestation)	32(+2)	
Gestational age at delivery (weeks of gestation)	33(+2)	
Diagnosis-to-delivery interval (days)	7(+4)	
Hospital (days)	9(+4)	
Ultrasound characteristics		
Estimated foetal weight(g)	1588(448)	
Doppler assessment		
uterine artery notching presence	85	65%
uterine artery notching absence	45	35%
normal umbilical artery velocity waveforms	13	10%
absent end-diastolic velocity	94	80%
reverse flow velocity	23	20%
normal cerebroplacental ratio (CPR)	13	10%
reverse cerebroplacental ratio (CPR)	117	90%

The study population consisted of 280 patients with pre-eclampsia with RCUI. Maternal and ultrasound characteristics are presented in Table 1

Table 2: Perinatal characteristics of the study population

	n=130	percentage
Delivery		
Spontaneous vaginal delivery	29	22%
Caeserean section	101	78%
Neonatal characteristics	21	16%
Perinatal death	48	37%
Apgar @ 5 min < 7	22	17%
Admission to Neonatal Intensive Care Unit	1690(+334)	
Birth weight		
Maternal complications	7	88%
Postpartum haemorrhage	1	12%
Wall Suppuration		

The vaginal delivery rate was 29/131 (22%), including 9 instrumental extractions (31%) for vaginal deliveries and 101/130 (78%) for caesareans.

Regarding, neonatal outcomes, the perinatal mortality rate was estimated at 22.3% (n = 29). We recorded 21 children born and 48 of 109 live children (45.3%), had an Apgar score of less than 7 in 5 minutes, but none at 10 minutes (Table 2). 22 children (20.18% of the 109 children born alive) were transferred to neonatology. Of these, 36.3% (n = 8) died while in hospital.

Regarding maternal morbidity, (the results are presented in Table 2), there were 7 cases of postpartum haemorrhage (88%), which occurred during caesarean section, with uterine atony requiring oxytocic infusion and 600 micrograms of misoprostol rectally.

Table 3: comparison of perinatal data between IUGR with and without Doppler abnormality

	IUGR with Abnormalities Doppler	R without UG Abnormalities Doppler	p
Perinatal death	**20**	**9**	**0,000002**
Apgar @ 5 < 7 min	**35**	**13**	**0,0003**
Admission to Neonatal Intensive Care Unit	**16**	**6**	**0,0001**

We analyzed the variables that can influence the neonatal prognosis: IUU with Doppler anomaly versus RCUI without Doppler anomaly (Table 3).

The relative risk of perinatal death in case of umbilical doppler abnormality (zero diastole, reverse flow) is 3.48 with a 95% confidence interval (CI) (2.19, 5.52). The risk of an APGAR score <7 in 5 min in RCIU foetuses with pathological umbilical doppler is 1.86 with 95% CI (1.35; 2.57). The relative risk of hospitalization in neonatology was significantly higher in the RCIU group with Doppler abnormality: RR = 3.14 95% CI at (2.04, 4.82).

DISCUSSION

In our study, the relative risk of perinatal death in the case of umbilical artery Doppler abnormality is 3.48 95% CI (2.19, 5.52). This increase in risk is statistically significant at the alpha threshold of 5%. This implies the interest of the close monitoring of hypertensive patients with IUGR by the different parameters of Doppler velocimetry. In particular the index of resistance of the foetal umbilical artery having proved their effectiveness in the evaluation of the haemodynamic flow of the foetal umbilical artery.[5,6] In developing countries, particularly Côte d'Ivoire, some public hospitals do not have monitors for foetal heart rate (FHR) recording in these foetuses at risk of acidosis; hence the use of umbilical Doppler, because of its accessibility, for optimal surveillance of patients hospitalized for hypertension with IUGR. These complicated pregnancies with hypertension and/or IUGR present numerous ischaemic placental lesions: isolated infarction and villous necrosis with deposits of fibrinoid substances. These lesions reduce the flow rate in the intervillous chamber and the foeto-maternal exchanges, at the origin of this situation of hypoxia.[7]

Our study has several limitations that deserve to be considered. The data used in this study were mainly recorded from birthing records and observation records, which could lead to missing information. In addition, our country does not have growth curves adapted to the foetuses of our regions, we used the curves of the French College of Foetal Sonography (CFEF) screening in the general population for the biometrics and estimation of the foetal weight.[8] Our study has been limited to the Gynaecology and Obstetrics Department of the Yopougon University Hospital (Abidjan, Ivory Coast) and the staff is reduced, resulting in a lack of power. The data collected cannot ideally be extrapolated to all health services in our country.

However, they will provide a solid base of work since the results will better prepare for future studies

at the national level. The study presents some strengths that are important to mention. Congenital malformations identified as prenatal antennas were excluded, and their management differs from the small for gestational age (SGA) of vascular origin assumed to avoid selection biases. In addition, we also excluded twin pregnancies because the method of dating and management differs from that of monofoetal pregnancies. The 10th percentile screening threshold was used to select IUGR as recommended by the CNGOF guidelines.[4]

Several studies have evaluated the contribution of Doppler in foetal monitoring and decision making for vascular IUGR.[9,10,11] They all suggest that the use of umbilical artery Doppler velocimetry in high-risk pregnancies reduces the risk of perinatal mortality.

In the study by Lees *et al.*, they found a perinatal death rate of 8% through the use of umbilical Doppler in fetuses with IUGR.[11] This rate is much lower than ours due to the weakness of our technical platform as soon as the birth decision is made. The median time from diagnosis of abnormal Doppler to delivery is 7 days in our study, whereas in the Lees *et al* series, it was 13 days for women without hypertension, 8 days for women with gestational hypertension, 4 days for preeclampsia and 3 days for HELLP syndrome.

Caesarean section was the most common delivery route in our series, with an estimated rate of 78% confirming several data from the literature.[12,13,14] Indeed, the increased fragility of the fetus RCIU exposes it during spontaneous work or induces at increased risk of asphyxia, and the mother for whom caesarean section is associated with increased morbidity. This situation is responsible for an increase in neonatal transfer rates. In this study, this transfer rate was significantly elevated in the IUSRs with Doppler anomaly (16 versus 6, p = 0.0001).

CONCLUSION

IUGR is a major public health problem because of its consequences and its high rate of perinatal morbidity and mortality. Extraction of the foetus "at the right time" is the only current therapeutic option. The timing of the extraction is extremely delicate. In the current state of knowledge, Foetal Doppler clearly clarifies what to do in these situations. Its use thus makes it possible to identify the foetuses with high risk of adverse outcome.

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