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Original Article

Relevance of routine Doppler sampling at the two umbilical arteries in the follow-up of dichorionic twin pregnancies with intrauterine growth-restricted fetuses

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ABSTRACT

Objective. – The aim of this study is to assess if the presence of bilateral absent or reverse end-diastolic velocity (AREDV) indicates a poorer prognosis than unilateral AREDV in dichorionic-diamniotic twin pregnancies complicated by intrauterine growth restriction.
Methods. – A prospective observational study of 36 dichorionic-diamniotic twin pregnancies complicated by intrauterine growth restriction. One hundred and fifty seven ultrasound (US) examinations were performed. The pulsatility indexes (PI) of the two umbilical arteries (UA–perivesical site), the middle cerebral artery (MCA) and the ductus venosus (DV) were recorded. The fetal hemodynamic status was represented by the existence of a bilateral positive end-diastolic velocity (PEDV), a unilateral AREDV or a bilateral AREDV in the umbilical arteries.
Results. – Bilateral PEDV, unilateral AREDV and bilateral AREDV represented respectively 66.0%, 10.6% and 23.4% of the US examinations. Intervals between Doppler examinations and delivery were significantly longer ($P < 0.005$) in the bilateral PEDV group (26.5 days ± 19.7) than in the unilateral AREDV group (11.8 days ± 11.7) and in the bilateral AREDV group (11.0 days ± 8.6). MCA-PI, DV-PI, IFI and early neonatal outcomes did not differ between the unilateral and bilateral AREDV groups.
Conclusion. – The routine measurement of the Doppler indices of the two umbilical arteries seems to be no more relevant than unilateral measurement in fetuses of dichorionic-diamniotic twin pregnancies complicated by intrauterine growth restriction.

Introduction

Dichorionic twin pregnancies are known to have a higher morbidity-mortality rate than singleton ones, often because of prematurity [1]. But this is also the result of an increased risk of intrauterine growth restriction (IUGR). In the past twenty years, improved management of IUGR has helped reduce stillbirth and neonatal death rates [2]. The antenatal care of twin pregnancies is based on repeated ultrasound (US) examinations, including biometric assessment and Doppler samplings [3]. Doppler velocimetry of the umbilical artery (UA) is linked to placental vascular resistance and reflects perfusion to the fetus. Its assessment is a valuable contribution to the management of IUGR. A meta-analysis of 10,000 women suggested that the use of Doppler US in singleton high-risk pregnancies reduced the risk of perinatal death and obstetric intervention, whereas there is no evidence that the routine Doppler sampling of the UA is beneficial in dichorionic twin pregnancies [4]. Few teams have worked on velocimetric differences between the two UAs. There appears to be a more than 20% difference between the 2 UAs in the systolic-diastolic (S/D) ratio in more than one quarter of pregnancies [5]. Janeczek et al. reported a higher S/D ratio and pulsatility index (PI) in the left UA than in the right UA in about one third of cases of IUGR [6]. More recently, we showed that sampling of the two UAs at the perivesical site in IUGR singleton fetuses can detect a bilateral absent or reverse end-diastolic velocity (AREDV), which could indicate a more severe hemodynamic compromise of the placental circulation than a unilateral AREDV [7]. The aim of this study was

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to assess whether bilateral absent or reverse end-diastolic velocity in UAs, like in the singleton pregnancies, indicates a poorer prognosis than unilateral AREDV in dichorionic twin pregnancies complicated by IUGR.

Methods

Study subjects

Between January 2010 and June 2011, 36 women with dichorionic-diamniotic twin pregnancy complicated by IUGR of vascular origin were prospectively assessed. All fetuses were delivered in two Maternal-Fetal Medicine Departments: Maternité Port-Royal (Université Paris-Descartes, Paris, France) and Hôpital Antoine-Béclère (Université Paris Sud, Clamart, France). IUGR was prenatally defined as a fetal weight estimated by US below the 10th percentile after checking the accurate dating of the pregnancy [8]. IUGR was taken to be of vascular origin in view of its association with abnormal UA Doppler parameters. Exclusion criteria were congenital malformations, chromosomal abnormalities, and medical abortions.

Study endpoint

The primary study endpoint was the time between US examination and fetal extraction for 3 groups of patients: Doppler examinations were sorted with respect to their degree of placental compromise (PEDV, unilateral AREDV or bilateral AREDV).

Ultrasound and Doppler measurements

Two prenatal Doppler ultrasound examinations were performed every week in both centers by only one experienced operator (F.P.) using an Aloka ProSound Alpha 10 ultrasound (Hitachi Medical Corporation©, Tokyo, Japan) equipped with a 5 MHz linear curved-array transducer. All spectral Doppler measurements were performed automatically from five or more consecutive waveforms, with the angle of insonation as close to 0° as possible, in the absence of fetal movements and, if required, with voluntary maternal suspended breathing. The color flow mapping function was superimposed and the pulsed Doppler sample volume placed on the region of interest. The mechanical and thermal indices were maintained below 1. We measured Doppler waveforms from the UA, MCA, DV and the aortic isthmus. PI was automatically calculated with peak systolic (PSV), end-diastolic (ED) and time-averaged mean (TAMX) velocities (PI = [PSV-EDV]/TAMX) by the equipment software. UA-PI was systematically recorded bilaterally from the perivesical portion (less than 1 cm proximal to the abdominal insertion) and from a free-floating loop of the umbilical cord. MCA-PI was measured in a transverse section of the fetal head, as its proximal portion arising from the circle of Willis. DV-PI was measured in a mid-sagittal or transverse section of the fetal abdomen, positioning the Doppler gate at its isthmic portion. The cerebroplacental ratio (CPR) was calculated as the ratio of the MCA-PI to the mean perivesical UA-PI. The greater UA-PI value of the pair was designated UA-PI_{max} and the smaller, UA-PI_{min}. The percentage difference between UA-PI_{max} and UA-PI_{min} (DUA-PI) was calculated for each pair of observations for each subject: DUA-PI = [(UA-PI_{max} − UA-PI_{min})/UA-PI_{min}] × 100. Aortic isthmus Doppler waveforms were measured in a sagittal view of the fetal thorax with clear visualization of the aortic arch, placing the gate a few millimeters beyond the origin of the left subclavian artery. The aortic isthmus blood flow index (IFI) was obtained by dividing the sum of the systolic (VTIS) and diastolic (VTID) Doppler blood flow velocity integrals by the systolic blood flow integral (IFI = [VTIS + VTID]/VTIS) [9].

All women were given standard care according to local guidelines. Decisions regarding fetal extraction were taken by a staff obstetrician. The sonographer was independent of the obstetrical teams and did not participate in these decisions.

Statistical analysis

The nonparametric Mann-Whitney test and Pearson Chi squared test were used to compare quantitative and qualitative data, respectively, and $P < 0.05$ was considered as significant. Statview 5.0 software, SAS Institute, was used for statistical analysis. Using published normal values, the UA-PI, MCA-PI, CPR, IFI, DV-PI and *z*-scores for gestational age (GA) were calculated, which allowed correction for the expected change in cerebral blood flow that occurs across gestation [9–13].

Results

Forty IUGR fetuses from 36 dichorionic twin pregnancies were included. The median age of included women was 32 years old (SD 6.1) (Table 1) Most of them were Caucasian (67%) and nulliparous (61%). The pregnancies were largely obtained using assisted reproductive technology (68%). Six pregnancies were complicated by preeclampsia (17%). Eighty one percent of deliveries were performed by cesarean section (67% emergency). Thirty-six percent of deliveries were performed because of fetal growth arrest and 19% because of abnormal fetal heart rate. No delivery was performed because of a single Doppler hemodynamic alteration.

One hundred and forty-one US examinations were performed between 25 and 37 weeks of gestation (Fig. 1). Concerning the two UAs, we noted 66% (93/141) of bilateral PEDV, 10.6% (15/141) of unilateral AREDV and 23.4% (33/141) of bilateral AREDV. The intervals between the first worst abnormal UA spectrum and birth were assessed: intervals were significantly longer ($P < 0.01$) in the bilateral PEDV group (38.1 days ± 19.9) than in the unilateral AREDV group (10.1 days ± 14.6) and in the bilateral AREDV group (13.2 days ± 5.9) (Table 2). There was no difference between the bilateral and unilateral AREDV groups. Furthermore, in the bilateral PEDV group, the MCA-PI z-scores were significantly higher (−0.81 ± 0.87) than in the unilateral AREDV group (−1.48 ± 0.86, $P < 0.01$) and in the bilateral AREDV group (1.53 ± 1.05, $P < 0.0001$). In the same way, in the bilateral PEDV group, the CPR *z*-scores significantly higher (−1.38 ± 1.37) than in the unilateral AREDV group (−2.73 ± 0.48, $P < 0.01$) and in the bilateral AREDV group (−2.76 ± 0.81, $P < 0.0001$). The IFI z-scores were significantly higher in the bilateral PEDV group (0.20 ± 1.70) than in the unilateral AREDV group (−3.13 ± 3.03, $P < 0.0001$) and the bilateral AREDV group (−3.50 ± 3.33, $P < 0.0001$). There were no significant differences between the 3 groups concerning the DV-PI. The overall mean UA-PI_{max} was 1.75 ± 0.63 and the overall mean UA-PI_{min} was 1.56 ± 0.57. The difference of 0.19 was statistically significant ($P < 0.0001$). The mean percentage difference (DUA-PI) was 16.5% ± 13.9.

A longitudinal hemodynamic analysis of placental vascular resistance was performed (Fig. 2). All umbilical Doppler examinations were sorted with respect to their degree of placental compromise (PEDV, unilateral AREDV or bilateral AREDV) according to the time between US examination and extraction (week). Of the 40 IUGR twin fetuses, ten with a bilateral PEDV waveform did not have a modified UA Doppler waveform. Six fetuses presented classic deterioration of UA Doppler waveform (from a bilateral PEDV to a unilateral and/or a bilateral AREDV). We observed an atypical progression of the UA Doppler waveform for five fetuses (from a bilateral AREDV to a unilateral AREDV and/or a bilateral