circulation. We sought to evaluate changes in the pulmonary artery doppler following maternal hyperoxygenation in utero, during the third trimester of pregnancy.

STUDY DESIGN: Forty six women with a singleton gestation greater than or equal to 31 weeks gestational age were prospectively recruited to the study. A fetal echocardiogram was performed on all subjects to exclude congenital heart disease. Pulsatility index (PI), Resistance index (RI), Peak systolic (PSV) and end diastolic velocity (EDV), acceleration time (AT), and ejection time (ET) were taken within the proximal portion of the fetal main pulmonary artery (PA). AT:ET was used to assess pulmonary vascular resistance (PVR). Doppler measurements were taken at baseline and repeated immediately following maternal hyperoxygenation for 10 minutes (O2 100% v/v inhalational gas) at a rate of 12L/min via a partial non-rebreather mask. Doppler waveform measurements were also taken of the umbilical artery (UAD), middle cerebral artery (MCA) and the ductus arteriosus (DA).

RESULTS: The median gestational age was 35 [33 – 37] weeks. There was a decrease in fetal PA PI following maternal hyperoxygenation (from 2.37 [2.04 – 2.70] to 2.05 [1.69 – 2.41], p=0.001). The resistance index of the PA decreased from (0.86 [0.81- 0.91] to 0.78 [0.69-0.87]. There was an increase in PA AT (57 [42-71] to 66 [49 – 82] ms, leading to an increase in AT:ET following maternal hyperoxygenation (0.32 to 0.34], p=0.001) (Table 1). There were no significant changes in the resistance indices of the UAD and DA. There was a significant increase in MCA blood flow, but not in MCA resistance indices.

CONCLUSION: Maternal hyperoxygenation offers the opportunity to assess the reactivity of the pulmonary vasculature before birth. Our findings would indicate a reduction in fetal pulmonary vascular resistance with secondary increased fetal pulmonary blood flow. This was not achieved at the expense of ductal constriction. There was evidence of improved MCA peak systolic velocity parameters; this was likely due to the positive impact of improved pulmonary venous return on left ventricular preload. The hyperoxygenation test can inform us of functional rather than anatomical information in relation to the pulmonary arteries and this warrants further exploration in a larger cohort.

Table 1: Changes in Doppler indices at baseline and following Maternal hyperoxygenation

	Pre MH	Post MH	p-value
PA PI	2.37 [2.04 – 2.70]	2.05 [1.69 – 2.41]	<0.001
PA RI	0.86 [0.81- 0.91]	0.78 [0.69-0.87]	<0.001
PA PSV	66.4 [50.9-81.9]	62.3 [50.6-74.0]	0.142
PA EDV	9.5 [4.7-14.3]	14 [7.5-20.5]	<0.001
PA AT	56.6 [42-71]	65.5 [49 – 82]	<0.001
PA ET	181.2[145.2-217.2]	193.3 [158.3-228.3]	0.001
AT:ET	0.32 [0.23-0.40]	0.34 [0.27-0.41]	0.029
UAD PI	0.96 [0.71-1.21]	0.96 [0.76-1.16]	0.95
UAD RI	0.61 [0.52-0.70]	0.62 [0.54-0.69]	0.67
UAD PSV	39.8 [29.8-49.8]	41.6 [30.8-52.4]	0.28
UAD EDV	16.1 [10.5-21.7]	16.2 [11.2-21.2]	0.85
MCA PI	1.7 [1.1-2.3]	1.7 [1.2-2.2]	0.98
MCA RI	0.78 [0.69-0.87]	0.80 [0.67-0.93]	0.27
MCA PSV	33.3 [21.8-44.8]	40.5 [23.5-57.5]	0.005
MCA EDV	7.0 [3.7-10.3]	8.8 [3.2-14.4]	0.043
DA RI	0.87 [0.77-0.97]	0.88 [0.76-1.0]	0.74
DA PSV	50.3 [39.9-60.7]	50.4 [38.4-62.4]	0.62
DA EDV	7.3 [4.2-10.4]	7.6 [5.7-9.5]	0.81

MH, maternal hyperoxygenation; PA, pulmonary artery; PI, pulsatility index; RI, resistance index; PSV, peak systolic velocity; EDV, end-diastolic velocity; AT, acceleration time; ET, ejection time; UAD, umbilical artery Doppler; MCA, middle cerebral artery; DA, ductus arteriosus

419 Prediction of fetal hemoglobin after multiple intrauterine transfusions

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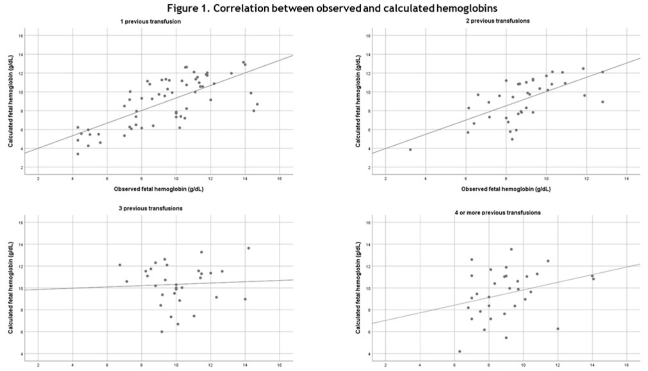
OBJECTIVE: A mathematical formula has been developed to estimate fetal hemoglobin based on the middle cerebral artery peak systolic velocity (MCA-PSV). A preliminary study reported strong correlation between estimated and observed fetal hemoglobin prior to the first intrauterine transfusion. The goal of this study was to assess the accuracy of this model in the prediction of fetal hemoglobin after multiple fetal transfusions.

STUDY DESIGN: This was a retrospective study of data from 162 cordocentesis procedures performed for fetal red-cell alloimmunization in patients with a history of 1 (N=60), 2 (N=39), 3 (N=31) or greater than 3 (N=32) intrauterine transfusions. Doppler velocimetry of the MCA-PSV was performed prior to cordocentesis. Expected hemoglobin values for gestational age were calculated using previously described formulas. Predicted hemoglobin multiples of the median (MoM) were calculated as 0.6835 + 1.2794*MCA-PSV MoM − 1.2885*MCA-PSV MoM^2 + 0.2861*MCA-PSV MoM^3. Median hemoglobin for gestational age was calculated as $e^{2.84-(8.55/GA)}$. The product of the predicted hemoglobin MoM and median hemoglobin was used to calculate expected hemoglobin. Observed fetal hemoglobin was measured at time of cordocentesis. Patients were subdivided based on the number of previous transfusions. Linear regression analyses were used to assess the correlations between observed and calculated pretransfusion fetal hemoglobin levels.

RESULTS: The median gestational age was 27.0 (IQR 23.3, 31.8), 28.0 (24.0, 31.3), 29.0 (27.0, 33.0), and 31.9 (29.2, 33.8) weeks for patients with history of 1, 2, 3, or more than 3 previous transfusions, respectively. The median observed hemoglobin for each respective group was 9.7 (IQR 7.5, 11.2), 8.7 (8.0, 10.0), 10.0 (9.1, 11.4), and 9.0 (7.6, 10.0) g/dL. Scatterplots showing regression lines between calculated and measured fetal hemoglobin are shown in Figure 1. There were significant correlations after 1 ($r^2 = 0.51$; $P < .001$) and 2 ($r^2 = 0.41$; $P < .001$) previous transfusions. There was no correlation after 3 ($r^2 = 0.003$; $P = .77$) or greater than 3 transfusions ($r^2 = 0.09$; $P = .10$).

CONCLUSION: Calculated fetal hemoglobin is well correlated with observed fetal hemoglobin after 1 or 2 previous intrauterine transfusions. The ability to calculate fetal hemoglobin with MCA-PSV is diminished after 3 or more intrauterine transfusions.

Figure 1. Correlation between observed and calculated hemoglobins



420 Differences in impedance to blood flow in the umbilical arteries determine infant survival in TTTS

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OBJECTIVE: Unequal placental sharing is associated with inter-twin size discordance, twin-to-twin transfusion syndrome (TTTS) and reduced infant survival in monochorionic twin pregnancies. This study explores if inter-twin differences in impedance to blood flow (IDIBF) in the umbilical arteries influences infant survival in TTTS.

STUDY DESIGN: All women who underwent laser ablation of placental anastomoses for the management of TTTS between January 2012 and May 2018 at a single institution were included. Laser surgery was performed in all cases with Quintero stages II or greater and in women with Quintero stage I with either symptomatic polyhydramnios, cervix shortening or preterm labor. IDIBF in the umbilical arteries was estimated by substracting the pulsatility index (PI) of the umbilical artery of the donor twin from that of the recipient twin, prior to surgery. Outcomes included dual infant survival or survival of at least one fetus at delivery and at 30 days of age. Logistic regression analyses were perfomed to determine the relationship of IDIBF in the umbilical arteries with the study outcomes, while controling for gestational age (GA) at surgery, GA at delivery, Quintero stage, cervical length prior to surgery, inter-twin size discordance ≥25% and/or EFW<10 percentile for GA, advanced maternal age (≥35 years old), maternal obesity (BMI>35), and number of placental anastomoses.

RESULTS: A total of 230 consecutive TTTS cases met study the inclusion criteria. TTTS Quintero stages I, II, III and IV were present in 10%, 31.3%, 50.9% and 7.8% of all cases, respectively. Inter-twin size discordance ≥25% and/or EFW<10 percentile for gestational age was present in 72.4% of cases. Two live births or at least one live birth was present in 68.3% and 88.3% of cases, respectively. Two infants or al least one infant was alive by 30 days in 70.8% and 96.4% of cases, respectively. 27% (n=62) were lost to follow-up by 30 days or have not reached this age yet. Logistic regression analysis demonstrated that IDIBF in the umbilical arteries is an independent factor for the survival of one (p=0.004) or both infants (p<0.001) at birth as well as for the survival of both infants at 30 days of age (p=0.01). In contrast, neither Quintero staging nor inter-twin size discordance were associated with these outcomes (see Table).

CONCLUSION: Differences in impedance to blood flow in the umbilical arteries may influence infant survival in TTTS cases following laser ablation of placental anastomoses.

Table 1. Logistic regression analysis to evaluate differences in impedance to blood flow in the umbilical arteries as a determinant of infant survival in TTTS cases

Variable	At least one live born neonate		Two live born neonates		Two infants alive at 30 days	
	aOR	95% CI	aOR	95% CI	aOR	95% CI
IDIBF in UA	0.03*	0.003-0.34	0.07*	0.02-0.28	0.14*	0.03-0.63
GA at surgery (weeks)	1.21	0.71-2.05	1.04	0.83-1.29	1.01	0.80-1.26
GA at delivery (weeks)	1.86*	1.33-2.59	1.25*	1.11-1.40	1.27*	1.1-1.47
Quintero stage	0.50	0.12-2.04	0.66	0.35-1.21	0.68	0.37-1.25
CL prior surgery	0.21*	0.06-0.72	0.57*	0.33-0.98	1.11	0.64-1.91
EFW size discordance ≥25% and/or EFW < 10th percentile	0.29	0.03-3.24	0.59	0.20-1.78	1.16	0.39-3.44
AMA	3.34	0.35-32.19	1.96	0.72-5.36	0.77	0.27-.2.18
Maternal obesity	8.85	0.86-91.26	1.77	0.54-5.84	0.92	0.23-3.60
Number of placental anastomoses	1.22	0.89-1.66	0.96	0.83-1.10	0.98	0.85-1.11

*Inter-twin differences in impedance to blood flow (IDIBF) in the umbilical arteries, gestational age (GA), cervical length (CL), advanced maternal age (AMA≥35 years old), maternal obesity (BMI>35). *P<0.05.*