Artery-to-vein anastomoses in unequally shared placentas and their association with birthweight discordance (ATTACHED study)

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Introduction

The monochorionic placenta consists of three parts: two parts supplying each twin and a shared third part perfused by artery-to-vein (AV) anastomoses. Selective fetal growth discordance (sFGR) is primarily caused by unequal placental sharing. However, not all unequally shared placentas lead to sFGR.

In this study, we aim to investigate whether a more elaborate intertwin blood exchange and larger shared placental part benefits the twin with the smaller share if the placenta is unevenly divided.

Methods

Retrospective analysis of color-dyed unequally shared monochorionic placentas. Placentas from pregnancies delivered before 24 weeks, affected by remote fetal demise, lethal malformations, twin-twin transfusion syndrome or twin anemia-polycythemia sequence were excluded. The anastomoses were measured at the equator, and all non-anastomosing AV-diameters in the smaller share were also measured. The shared part was defined as the sum of all AV diameters. The AV-ratio represents the size of the shared part relative to the smaller individual part.

Univariable and multivariable linear regression was used to assess the relationship between the birthweight/placental territory (BW/PT) ratio and the artery-to-artery (AA) and vein-to-vein (VV) diameters, net AV flow, AV-ratio and placental cord insertion site. Additionally, we compared all variables based on the smaller twin's umbilical artery Doppler pattern in pregnancies with sFGR.

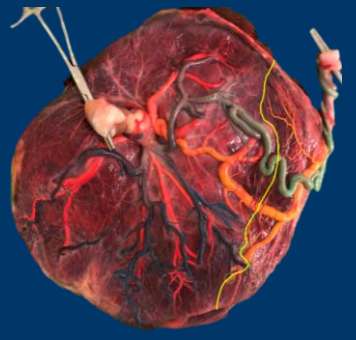
Results

353 placentas were examined. The median placental territory ratio was 2.01 (IQR 1.7 – 2.7). sFGR was present in half of the twin pairs. The majority (92%) had an artery-to-artery (AA) anastomosis and 27% had a vein-to-vein (VV) anastomosis.
The association between the BW/PT and placental anastomoses and size of the third shared part is depicted in Table 1. The comparison between the different types of sFGR can be viewed in Table 2.

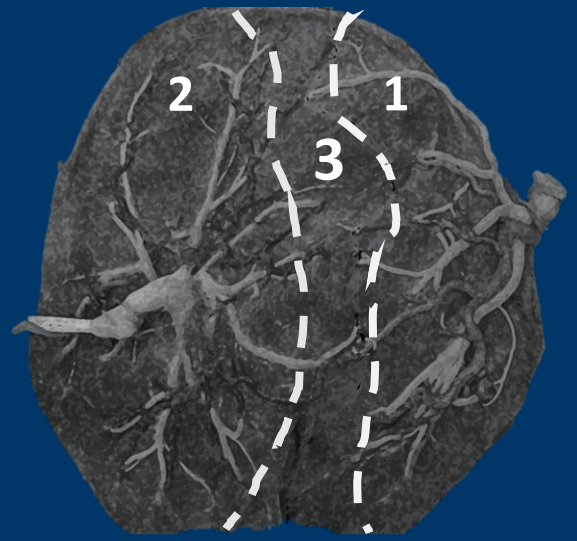
Conclusion

Placentas with a large shared third part are associated with a lower birthweight discordance than expected based on placental territory, regardless of the size of the AA and VV anastomoses. An elaborate intertwin blood exchange facilitated by shared AV anastomoses may benefit the twin with the smaller placental share.

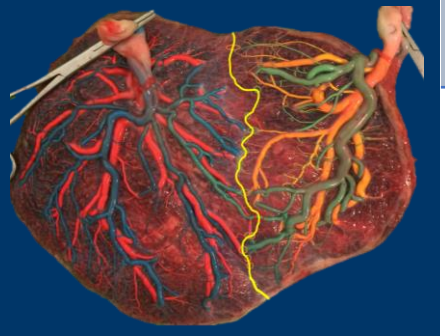
A large and elaborate intertwin blood exchange through shared AV-anastomoses benefits the twin on the smaller placental share in unequally divided monochorionic placentas



Placenta with a relatively large shared territory (high AV ratio (1.85) and low BW/PT ratio (0.49)



1: individual AV-anastomoses of the small placental share
2: individual AV-anastomoses of the large placental share
3: shared AV-anastomoses; the shared 'third' placental part



Placenta with a relatively small shared territory (low AV ratio (0.23) and high BW/PT ratio (0.99)

Tables and figures

Table 1. Univariable and multivariable linear regression of the association between BW/PT ratio and the placental anastomoses and AV-ratio in the total cohort unequally shared placentas (n = 353).

Characteristics	Univariable linear regression		Multivariable linear regression	
	β-coefficient (95% CI)	p-value	β-coefficient (95% CI)	p-value
Total AA diameter	-0.035 (-0.044 – -0.027)	<.001	-0.02 (-0.03 – -0.01)	<.001
Total VV diameter	-0.019 (-0.027 – -0.012)	<.001	-0.01 (-0.02 – -0.003)	.007
AV-ratio	-0.149 (-0.187 – -0.111)	<.001	-0.11 (-0.15 – -0.07)	<.001
Net AV transfusion	-0.001 (-0.004 – 0.002)	.547	-	-

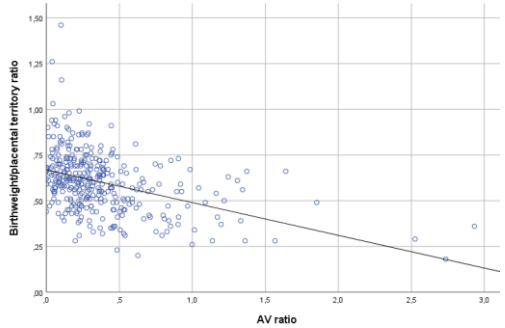


Figure 1. Correlation between birthweight/placental territory ratio and the AV-ratio

Table 2. Placental characteristics of the sFGR cohort (n = 177*), divided per umbilical artery Doppler flow pattern.

Characteristics	Type I (n = 76)	Type II (n = 17)	Type III (n = 66)	p-value
GA at birth (weeks)	34.1 (32.6 – 36.0)	31.1 (28.6 – 31.8)	31.7 (29.6 – 32.6)	<.001
BW discordance (%)	29.2 (25.0 – 35.1)	37.0 (30.6 – 46.1)	31.6 (26.1 – 38.4)	.007
BW ratio	1.41 (1.33 – 1.54)	1.59 (1.44 – 1.85)	1.46 (1.35 – 1.62)	.008
PT ratio	2.11 (1.79 – 2.64)	2.26 (2.04 – 3.18)	3.00 (2.49 – 3.69)	<.001
BW/PT ratio	0.67 (0.57 – 0.79)	0.67 (0.46 – 0.89)	0.50 (0.39 – 0.60)	<.001
Total AA diameter	2.51 (1.35 – 3.57)	2.05 (1.28 – 2.84)	3.28 (2.38 – 5.16)	<.001
Total VV diameter	0.00 (0.00 – 0.00)	0.00 (0.00 – 0.00)	0.00 (0.00 – 3.97)	.068
AV-ratio	0.226 (0.119 – 0.348)	0.293 (0.178 – 0.532)	0.494 (0.305 – 0.842)	<.001

Data are presented as median (interquartile range) or number (percentage). * sFGR classification was unknown in eighteen twin pairs. GA, gestational age; BW, birthweight; PT, placental territory; AA, artery-to-artery; VV, vein-to-vein; AV, artery-to-vein, sFGR: selective fetal growth restriction

Definitions

- Unequally shared placenta: placental territory (PT) ratio ≥ 1.5
- Selective fetal growth restriction (sFGR): a ≥ 20% birthweight difference

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