Short communication

Arterio-arterial vascular anastomoses in monochorionic placentas with and without twin–twin transfusion syndrome

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A B S T R A C T
We performed a matched case–control study to analyze the placental angioarchitecture, in particular the diameter of arterio-arterial (AA) anastomoses in monochorionic placentas from pregnancies with twin–twin transfusion syndrome (TTTS) compared to a control group of uncomplicated monochorionic placentas. Placental angioarchitecture was analyzed using colored dye injection. AA anastomoses were detected in 37% (14/38) of TTTS placentas versus 91% (209/228) in control placentas (p < 0.001). The median diameter of AA anastomoses in the group with and without TTTS was 1.9 mm and 2 mm, respectively (p = 0.711). In conclusion, our findings show that AA anastomosis occur less frequently in TTTS placentas, supporting the concept of the protective role of AA anastomoses in TTTS. However, the size of the AA anastomosis, when present, does not appear to influence the pathophysiology of the disease.

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1. Introduction

Twin–twin transfusion syndrome (TTTS) is a severe complication of 9% of monochorionic twin pregnancies [1]. It is caused by chronic imbalance in inter-twin blood flow through the placental vascular anastomoses and leads to oligohydramnios in the donor twin and polyhydramnios in the recipient twin [2,3]. Untreated TTTS is associated with high mortality and morbidity rates [2,3]. The pathogenesis of TTTS is not yet clearly understood. Previous studies have shown that arterio-arterial (AA) anastomoses are significantly less common in TTTS placentas [4,5]. AA anastomoses are therefore thought to have a protective effect against TTTS by creating an equilibrating shift and compensating for hemodynamic imbalances [5,6].

The objective of this study was to compare the diameter of AA anastomoses in monochorionic (MC) twin placentas with and without TTTS to determine if the size of the AA anastomosis could play a role in the pathophysiology of TTTS.

2. Methods

All TTTS placentas examined at our center between June 2002 and March 2012 were included in this study. For the purpose of this study we excluded placentas treated with fetoscopic laser coagulation.

Each MC placenta examined at our center is routinely injected with colored dye according to a previously described protocol [7]. After colored dye injection, placentas are photographed in a plain view, and digital pictures are saved for computer analysis. Data on placenta angioarchitecture, including the number and type of anastomoses, the percentage of placental territory and the type of umbilical cord insertion were prospectively entered in a dedicated database. The diameter of AA anastomoses was the primary outcome. This was measured with Image Tool for Windows version 3.0 (Image Tool, San Antonio, Texas, USA, http://ddsdx.uthscsa.edu/dig/itdesc.html).

Each TTTS placenta with an AA anastomosis was compared with three control placentas from uncomplicated MC twin pregnancies (with an AA anastomosis). The uncomplicated control MC pregnancies were identified from a dedicated database in which all monochorionic twins delivered at our hospital are registered and were the next twin pregnancy with a matched gestational age at birth (±1 week gestational age).

Diagnosis of TTTS was based on internationally accepted standardized antenatal ultrasound criteria [8] and staged according to the staging system from Quintero [9]. Results of continuous and categorical variables were analyzed using the Mann–Whitney U test and Fisher exact test. A p-value < 0.05 was considered to indicate statistical significance. All statistical data were analyzed using SPSS statistics version 17.0 (SPSS Inc., Chicago, IL, USA).

3. Results

A total of 41 TTTS placentas (not treated with laser) were examined at our center. Of these, three were excluded due to damage (n = 2) or contamination with formaldehyde (n = 1). Of the remaining 38 TTTS placentas, AA anastomoses were detected in 14 (37%) placentas. Quintero stage at diagnosis in the 14 included placentas was stage 1: n = 6 (43%), stage 2: n = 2, (14%); stage 3:
compensate for hemodynamic inter-twin imbalances. The low-resistance aspect of AA anastomoses may help equilibrate and prevent TTTS than in uncomplicated MC control placentas, 37% (16%, 6/38) of the placentas without TTTS. In accordance with several other studies showing the paucity of AA anastomoses in TTTS, the rate of AA anastomosis in TTTS placentas was significantly lower than in the control group of uncomplicated MC placentas (37% (14/38) versus 91% (209/228); p < 0.001). We were able to match each TTTS placenta with an AA anastomosis (n = 14) with 3 control MC placentas (n = 38), except for three cases. Two TTTS cases delivered at 17 weeks and 23 weeks gestation could only be matched with 2 control MC placentas and 1 TTTS case delivered at 20 weeks gestation could only be matched with 1 control MC placenta. Mean gestational age at delivery in the TTTS group and control group was 28.4 weeks (±5.7) and 29.1 weeks (±5.4), respectively (p = 0.549).

The median diameter of AA anastomoses in the group with and without TTTS was 1.9 mm (range: 0.3–4.2) and 2.0 mm (range: 0.7–4.6), respectively (p = 0.711). The diameter of the AA anastomoses was < 1 mm in 4 of the TTTS placentas (29%, 4/14) and in 6 (16%) of the placentas without TTTS (p = 0.428). Further details on the placental characteristics in both groups are shown in Table 1. An example of an injected TTTS placenta with an AA anastomosis is shown in Fig. 1.

4. Discussion

This study shows that AA anastomoses occur less frequently in TTTS placentas than in uncomplicated MC control placentas, 37% (14/38) versus 91% (209/228) (p < 0.001). These findings are in accordance with several other studies showing the paucity of AA anastomoses in TTTS. Our findings support therefore the concept of protective role of AA anastomosis against the development of TTTS. Several studies have shown that the bidirectional and low-resistance aspect of AA anastomoses may help equilibrate and compensate for hemodynamic inter-twin imbalances.

However, our results show that when an AA anastomosis is present, its size is not significantly different than AA anastomoses in control MC placentas, suggesting that the size of the AA anastomosis has no major role in the development of TTTS. The similar AA anastomosis diameter in the TTTS group and control group is in contrast to our recent findings of placentas with and without twin anemia-polycythemia sequence (TAPS). In TAPS, the diameter of AA anastomoses (when present) is significantly smaller compared to the AA diameter in a control group of uncomplicated MC placentas. The small size of the AA anastomosis may thus play a role in the development of TAPS by inhibiting adequate compensatory mechanisms.

Although both TTTS and TAPS result from unbalanced feto–fetal transfusion, the two forms differ significantly in terms of pathogenesis and placental angioarchitecture. We previously hypothesized that TAPS may primarily result from slow inter-twin blood transfusion, whereas TTTS is probably a more complex disease resulting from imbalanced inter-twin blood transfusion in combination with imbalanced hormonal regulation.

Our results should be interpreted with care due to the retrospective nature of the study and a possible selection bias. Although all cases fulfilled the criteria for TTTS, there was an over-representation of stage 1 cases (6/14), probably due to the fact that most TTTS cases diagnosed at our center with higher Quintero stages (>1) are treated primarily with laser surgery. Since it is not possible to measure the diameter of AA anastomoses in placentas treated with laser surgery, we had to exclude these cases. Additional studies on the AA diameter in another TTTS cohort should therefore be repeated, and performed in a country where laser treatment is not routinely available.

In conclusion, our findings show that AA anastomoses occur less frequently in TTTS placentas, supporting the concept of the protective role of AA anastomoses in TTTS. However, the size of the AA anastomosis, when present, does not appear to influence the pathophysiology of the disease.

Disclosure

All authors report no conflict of interest.

References


Table 1

<table>
<thead>
<tr>
<th>Placental characteristics in MC placentas with and without TTTS.</th>
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<tbody>
<tr>
<td><strong>MC placentas with TTTS</strong> (n = 14)</td>
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</tr>
<tr>
<td>Number of anastomoses per placenta</td>
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<tr>
<td>VV anastomoses present (%)</td>
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<tr>
<td>AV anastomoses present (%)</td>
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<tr>
<td>Diameter of AA anastomosis (mm)</td>
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<td>Placental share discordance (%)</td>
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<tr>
<td>Unequal placental sharing &gt;20% – n (%)</td>
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<tr>
<td>Velamentous cord insertion – n (%)</td>
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<td>Marginal cord insertion – n (%)</td>
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<td>Velamentous or marginal cord insertion – n (%)</td>
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* Value given as median (range).

*Refers to the type of cord insertion per fetus.


