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Placental Characteristics of Monoamniotic Twin Pregnancies in Relation to Perinatal Outcome

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ABSTRACT

Objective: To study placental characteristics in relation to perinatal outcome in 55 pairs of monochorionic monoamniotic (MA) twins.

Methods: Between January 1998 and May 2008 55 pairs of MA twins were delivered in 4 tertiary care centers and analysed for mortality, birth weight discordancy and twin-to-twin transfusion syndrome (TTTS) in relation to type of anastomoses, type and distance between cord insertions and placental sharing. Five acardiac twins, 2 conjoined twins, 4 higher order multiples and one early termination of pregnancy were excluded, leaving 43 MA placentas for analysis. Of these 43, one placenta could not be analysed for placental vascular anastomoses due to severe maceration after single intra-uterine demise leaving 42 placentas for analysis of anastomoses.

Results: Arterio-arterial (AA), venovenous (VV) and arteriovenous (AV) anastomoses were detected in 98%, 43% and 91% of MA placentas, respectively. Velamentous cord insertion was found in 4% of cases. Small distance between both umbilical cord insertions (<5 cm) was present in 53% of MA placentas. Overall perinatal loss rate was 22% (19/86). We found no association between mortality and type of anastomoses, type and distance between cord insertions and placental sharing. The incidence of TTTS was low (2%) and occurred in the only pregnancy with absent AA-anastomoses.

Conclusion: Perinatal mortality in MA twins was not related to placental vascular anatomy. The almost ubiquitous presence of compensating AA-anastomoses in MA placentas appears to prevent occurrence of TTTS.

1. Introduction

Monoamniotic (MA) twinning is a rare obstetric event, which occurs in approximately 1% of all monozygotic twin gestations. The condition is characterized by a single amniotic cavity with a single placenta and two umbilical cord insertions which are most commonly close together. MA twins are associated with high antenatal and perinatal mortality rates. Compared to older literature, perinatal survival has improved substantially, from 30–70% [1–4] to 80–90% [5]. This high risk has partly been attributed to common complications in (monochorionic) twin pregnancies such as preterm delivery, low birth weight and twin–twin transfusion syndrome (TTTS), but the most important cause of death is entanglement and knotting of the umbilical cords, a complication specific to MA twins [6].

The incidence of TTTS is reported to be lower in monochorionic MA pregnancies (3–10%) [7–10] than in monochorionic diamniotic pregnancies (10–15%) [11,12]. The lower incidence of TTTS in MA twins is thought to be due to the almost universal presence of compensating arterio-arterial (AA) anastomoses in MA placentas [13].

The aim of our study was to investigate the placental angioarchitecture in a large series of MA placentas and study the

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association between placental characteristics and perinatal mortality and morbidity.

2. Materials and methods

Between January 1998 and May 2008 55 pairs of monochorionic MA twins were delivered in four different Dutch tertiary care centers, including the University Medical Center Utrecht, Leiden University Medical Center, Academic Medical Center Amsterdam and Radboud University Nijmegen Medical Center. The following anatomic variables were recorded for each placenta: number and type of anastomoses, type (central, paracentral, marginal or velamentous) and distance between cord insertions and the relative distribution of the placental territories.

Each umbilical cord was labeled at delivery to identify the twin from whom it originated. Monoamnionicity was determined on the basis of first-trimester ultrasound features of the absence of a dividing amniotic membrane with a single placenta and concordant gender and postpartum confirmed by examination of placentas and intertwin membranes.

Gestational age was calculated from the first day of the last menstrual period and confirmed by first-trimester ultrasound. Due to the rarity of these pregnancies, local antenatal management and surveillance of the MA twin pregnancies differed between the study centers. In general, all MA twin gestations were monitored by regular ultrasound assessment of growth, amniotic fluid volume, Doppler of the umbilical artery, and cord entanglement fortnightly. Subjects with either nonreassuring fetal findings or with maternal complications were submitted to frequent but at least twice weekly maternal–fetal evaluations that were performed during hospitalization or during visits at an outpatient clinic setting. In three centers, women were hospitalized between 30 and 32 weeks of gestation in order to monitor fetal heart rates twice a day. In all centers, elective caesarean section was offered around 32–34 weeks of gestation after steroid treatment or determination of lung maturity.

After delivery, placental injection studies were performed generally within three days after delivery (Fig. 1). Occasionally, placentas were stored for seven days at 4 °C; quality of these placentas was still good enough to evaluate vascular anastomoses and microscopy. The staff was instructed to store the placentas unfixed. Veins and arteries of both cords were cannulated successively with a 1–4 mm large umbilical catheter; sequence of injection of both placental shares is arbitrary. Veins and arteries were flushed with water with a 50 ml syringe to flush out the blood. Veins and arteries were cannulated again, a string was placed around the vessel and tightened around the canula to prevent backflow and leakage of dye out of the vessel, and the vessels were injected with different coloured dyes; the veins were injected first with a light coloured dye (yellow or orange) and subsequent the arteries were injected with black or blue. In case of a venovenous (VV)-anastomosis only one vein was canulated and in case of an AA-anastomosis only one artery was canulated. Since the venous or arterial system of the second twin will automatically fill in case of the presence of a VV-anastomosis or an AA-anastomosis, respectively, there is no need to cannulate the venous or arterial system of this twin. Size and number of anastomoses were documented. An AA-anastomosis was defined as a superficial connection between two arteries of both placental shares. A VV-anastomosis was defined as a superficial connection between two veins of both placental shares. An AV-anastomosis is a connection between an artery, which perfuses a cotyledon and subsequently drains via a vein towards the other twin; both vessels perforate the chorionic plate through the same foramen. The differentiation between the varying anastomoses was made by visual inspection (see Fig. 1). The placenta was weighed. After the injection study, the placenta was divided at the vascular equator. The percentage of placental territory was calculated by dividing the weight of each individual placental territory by total placental weight. Equal placental sharing was defined as 40–60% of placental weight attributed to each twin. Unequal placental sharing was defined as one twin receiving blood from >60% of the placenta [14]. Umbilical cord insertions were described as (para)central, marginal or velamentous. (Para)central UCI is defined as an insertion into the disc of the placenta, ≥1 cm away from the placental border. Marginal UCI is defined as an insertion within 1 cm of the disc edge and velamentous insertion is an insertion directly into the membranes. The distance between both umbilical cord insertions was measured.

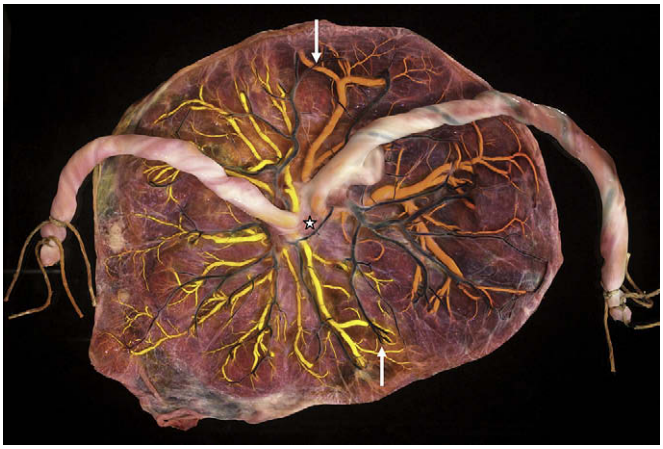

Fig. 1. MA placenta with central cord insertions and a small intercord distance after dye injection (arteries are black and veins are orange or yellow). Several AV-anastomoses (white arrow; upper arrow an AV territory from left to right, lower arrow a territory from right to left) and 1 AA-anastomosis can be seen (white star).

Stillbirth was defined as an intra-uterine demise of a fetus with a birth weight of >500 g and/or ≥20 weeks of gestation. Early neonatal mortality was defined as the death of an infant during the first 7 days of life and late neonatal death when the infant died between 8 and 28 days after birth. Total perinatal mortality was defined as intra-uterine death or early or late neonatal death of one or both infants. The diagnosis of TTTS was based on prenatal ultrasound findings [15]. However, since the polyhydramnios–oligohydramnios sequence cannot be detected in MA pregnancies, diagnosis of TTTS was based on the identification of other clinical manifestations of TTTS, such as polyhydramnios, discordance in bladder size and abnormal Doppler flow patterns in either twin. Birth weight discordance was calculated by dividing the difference in birth weight between both infants by the birth weight of the larger twin. Severe birth weight discordancy was defined as a birth weight difference of ≥20% of the larger twin's weight.

Statistical analysis was performed with the SPSS statistical package 12.0. Differences between categorical variables were analysed by Chi-square tests. Logistic regression was used to evaluate the relation between perinatal outcome (mortality and birth weight differences) and the various placental characteristics. *P*-values < 0.05 (two-sided) were considered to indicate statistical significant differences.

3. Results

In the study period, 55 MA twin pairs were delivered in the study centers. We excluded five acardiac twin pregnancies, 2 pregnancies with conjoined twins, 4 higher order multiples and one pregnancy with an early termination on social indication (mental disability), leaving 43 MA placentas for analysis. In one placenta, placental vascular anastomoses could not be analysed due to severe maceration after single intra-uterine demise. This placenta was included in all other analyses. Table 1 shows the characteristics of the study population. Median gestational age at delivery was 33^{+0} weeks (range: 16^{+0}–38^{+6} weeks). Birth weight of six twin pairs was severely discordant (≥20%). Four pregnancies were complicated with death of one of the infants and in seven pregnancies both infants died. Overall perinatal loss rate was 22% (19/86).

Vascular anastomoses were present in all MA placentas (100%). In nearly all placentas (98%) AA-anastomoses were found. There was only one placenta without AA-anastomoses. The majority of the placentas had AV-anastomoses (91%), either with blood flow in both directions (66%) or in one direction (34%). VV-anastomoses were found in 18 placentas (43%). Further details on placental angioarchitecture in MA placentas are shown in Table 2. Most cord insertions were (para)-central (76%), 20% of the umbilical cords were inserted marginally, and the incidence of a velamentous cord insertion was 4% ($n = 3$). Median intercord distance was 4 cm (range: 0–20 cm).

Table 3 shows that the relation between placental angioarchitecture and perinatal mortality. We found no clear relationship between mortality and type of anastomoses, type and distance

Table 1
Characteristics of MA twin pregnancies (study population).

No. of pregnancies	43
Gestational age at delivery (median, range)	33^{+0} (16^{+0}–38^{+6})
Birth weight (g), mean ± SD	1702 ± 577
Birth weight discordancy (%), median and range	8 (0.5–83)
Pregnancies with discordancy, *n* (%)[a]	6 (14)
Pregnancies affected by TTTS, *n* (%)	1 (2)
Perinatal loss rate (per infant), *n* (%)	19 (22)
Pregnancies complicated by single death, *n* (%)	5 (12)
Pregnancies complicated by double death, *n* (%)	7 (17)

[a] Discordancy is defined as ≥20% of the larger twin's birth weight.