Pattern of Twin Placentation in Ghana

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A 2-year study involving macroscopic examination of twin placentae was conducted at the Korle Bu Teaching Hospital in Accra, Ghana to determine the proportions of the various types of twin placentation, cord insertions and number of cord vessels and their relationships. Of 765 twin-pair placentae examined, 398 (52%, 95% confidence interval [CI] 48.4%–55.6%) had fused dichorionic, 247 (32.3%, 95% CI 29.0%–35.7%) had separate dichorionic, and 119 (15.6%, 95% CI 13.1%–18.4%) had monochorionic diamniotic placentae; only one (0.1%, 95% CI 0.0%–0.8%) had monochorionic monoamniotic placentation. Of 1529 cords whose insertion could be determined, 1285 (84%) had disc, 172 (11.2%) marginal and 72 (4.7%) velamentous insertions. Only 10 (0.65%) cords had two vessels (i.e., single umbilical artery). Abnormal cord insertions (marginal and velamentous) were significantly more likely to occur in monochorionic than in dichorionic placentation (odds ratio [OR] 3.56, 95% CI 2.62–4.84), and in two-vessel than in three-vessel cords (OR 5.79, 95% CI 1.44–24.5). The prevalence of two-vessel cord in monochorionic was not significantly different from that in dichorionic placentation (OR = 0.60, 95% CI 0.10–2.67). Zygosity could be determined in 53.3% of twins from placental examination and babies' sex-pair combinations. In conclusion the most common twin placentation in Ghana is fused dichorionic. Abnormal cord insertion is more common in monochorionic than dichorionic placentation. Monoamniotic twins and single umbilical artery are less common than have been reported in other centers. Modern methods of DNA analysis are needed to establish zygosity in almost half of twin pairs.

Twin pregnancies may have monochorionic diamniotic, monochorionic monoamniotic, fused dichorionic or separate dichorionic placentation. In general, a greater proportion of twins are dichorionic than monochorionic (Hanley et al., 2002; Malinowski, 2003; Minakami et al., 1999; Nylander, 1969; Victoria et al., 2001) although a greater proportion of monochorionic was reported in Japan over 20 years ago (Yoshida & Soma, 1984). Monochorionic twins have been reported, when compared to dichorionic, to have higher incidences of preterm birth, severe birthweight discordance, low birthweight, perinatal mortality of at least one twin and admission to the neonatal intensive care unit (Ferreira et al., 2005; Leduc et al., 2005; Machin, 2001; Minakami et al., 1999; Victoria et al., 2001).

The prevalence of abnormal umbilical cord insertion (UCI; velamentous or marginal) and of single umbilical artery are more common in twin than in singleton pregnancies (Benirschke, 1995), and in twins the prevalence of abnormal UCI is reported to be higher in monochorionic than in dichorionic placentation (Hanley et al., 2002). Both abnormal UCI and single umbilical artery are associated with increased risk of adverse pregnancy outcomes (Hanley et al., 2002; Victoria et al., 2001)

Where there is a single placental mass, macroscopic examination of the fetal surface and the septum separating the two cavities should be used to differentiate between monochorionic and dichorionic placentation (Benirschke & Kaufmann, 2000a).

Work has been done on twin placentation in Nigeria (Nylander, 1969) but no such work has been reported from Ghana, though both countries are closely linked in the West African subregion.

The aims of this study were to determine the proportions of the various types of twin placentation, of UCI and of the number of cord vessels, and the relationships of these to each other.

The study was conducted in the Korle Bu Teaching Hospital, the largest tertiary referral center in Ghana, situated in the capital city Accra, and which serves as the site for clinical training for the University of Ghana Medical School. The maternity unit of the hospital conducts between 11,000 and 12,000 deliveries a year and in a previous study the twin birth rate was found to be 35.5 per 1000 deliveries (Nkyekyer, 2002).

Materials and Methods

The study was conducted from January 2003 to December 2004. After every twin delivery the midwife involved identified the cord of the first twin by tying a piece of silk thread around it, placed the

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placenta(e) in a plastic bag and kept it in a designated place in the labor ward at room temperature. Either of the authors, depending on the day of the week, examined the placenta(e) and the cords within 12 hours of delivery. Twins were included only if at least one twin weighed 500 g.

The placenta(e) was (were) placed on a flat surface with the fetal surface upwards. The type of insertion of each cord was determined and if this was onto the surface of the placenta the distance from the insertion to the nearest free edge of the placenta was measured using a tape measure. Three types of cord insertion were defined for the purpose of this study: disc — insertion onto placental surface and more than 2 cm away from closest free edge; marginal — insertion along the free edge of the placenta or, if inserted onto the placental surface, 2 cm or less from closest free edge; velamentous — insertion onto membranes. The cut end of each cord was then examined at least 10 cm from its insertion to determine the number of vessels.

If there was a single placental mass the following features were looked for to determine the chorionicity. In the fused dichorionic placenta an elevated ridge of tissue on the fetal surface was identified between the two sacs (the ridge develops as the two placentae push against each other as they grow together and fuse), with the septum separating the two sacs arising from the ridge. Vessels did not cross the ridge from one side of the placenta to the other. No such ridge was identifiable in monochorionic placentation and vessels run from one side of the placenta to the other, anastomosing with vessels from the opposite side. Examination of the separating septum showed a thick and opaque structure in dichorionic as opposed to that of monochorionic placentae which was thin and translucent. The layers in the separating membrane were then peeled apart digitally to reveal the number of layers — four (two chorions and two amnions) in dichorionic and two (two amnions) in monochorionic placentae. Whereas the amnion could be peeled off the placental surface completely, the chorion could not.

For each twin birth, sex of the babies was noted after examination of the placenta. Each mother's age and parity were extracted from the notes.

Data analysis was performed using Epi-info 2000. Categorical variables were compared using χ^2 tests (differences were considered significant if $p < .05$); where appropriate, odds ratios (ORs) with 95% confidence intervals (CIs) were stated. Weinberg's differential rule was used to estimate the number of monozygotic (MZ) and dizygotic (DZ) twins in the sample.

Results

During the period of study there were 815 twin births. The mean maternal age was 28.4 (*SD* = 5.4) years and the mean parity 1.6 (*SD* = 1.8). Seven hundred and sixty-five (93.9%) twin births had their placenta(e) examined. The placentae of 50 (6.1%) twin births were inadvertently disposed of before they could be examined. Twins whose placenta(e) were examined were same-sex (477) and opposite-sex (288) pairs; among those whose placentae were not examined were 35 same-sex and 15 opposite-sex pairs. There was no significant difference in the proportions of same-sex and opposite-sex pairs between the twins whose placentae were examined and those whose were not (OR 1.41, 95% CI 0.73–2.75, $p = .28$).

Of the 765 placentae examined, 398 (52%, 95% CI 48.4%–55.6%) had fused dichorionic, 247 (32.3%, 95% CI 29.0%–35.7%) had separate dichorionic, and 119 (15.6%, 95% CI 13.1%–18.4%) had monochorionic diamniotic placentae; only one (0.1%, 95% CI 0.0%–0.8%) had monochorionic monoamniotic placentation. Thus 84.3% of twin placentae were dichorionic. In the case of the only monochorionic monoamniotic placentation, no second bag of membranes had to be ruptured before delivery of the second twin and there was no separating membrane identifiable on the placenta; each of the cords had three vessels with disc UCI, with the cord insertions 2 cm apart. This case was not used in any further analysis except for determining the proportion of twins whose zygosity could be determined by placental examination and twin sex-pair combinations.

In the fused dichorionic placenta group 231 (58%) twin sets were of the same sex while 167 (42%) were of opposite-sex combinations; the number of twins in the separate dichorionic placenta group were 126 (51%) and 121 (49%) respectively. There was no significant difference in dichorionic placentation in the proportions of same-sex and opposite-sex fetal pairs between fused and separate placentae (OR 1.33, 95% CI 0.95–1.85, $p = .08$).

In one case of separate dichorionic placentation one placenta had become mutilated after manual removal and the cord insertion could not be ascertained, although the number of vessels in the cord could be determined. Of the 1527 cord insertions there were 1195 (78.3%) disc, 260 (17.0%) marginal and 72 (4.7%) velamentous UCI. Abnormal UCI therefore constituted 21.7%. When the twin pair with one mutilated placenta was excluded there were 504 (66.1%) twin pairs with both cords normally inserted (disc/disc), 58 (7.6%) with both cords abnormally inserted (marginal/velamentous) and 201 (26.3%) with a combination of normal and abnormal insertions (marginal/disc or velamentous/disc).

There was no significant difference in the prevalence of abnormal cord insertions (marginal and velamentous) between first and second twins. However, abnormal UCI was more than three-and-a-half times more likely to occur in monochorionic as it was to occur in dichorionic placentation (Table 1). In dichorionic placentation, fused placentae had 113 abnormal and 683 normal UCI whilst the figures for separate placentae were 51 and 442 respectively. There was no significant difference in the prevalence of abnormal UCI between fused

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Table 1

Type of Cord Insertion, Twin Birth Order and Type of Placentation

Twin birth order	Type of cord insertion		
	Marginal/ velamentous	Disc	*p* value OR (95% CI)
Twin 1	144	620	
Twin 2	174	589	*p* = .057 OR 1.27 (0.99–1.64)
Total	318	1209	
Type of placentation			
Monochorionic diamniotic	100	138	
Dichorionic	218	1071	*p* < .00001 OR 3.56 (2.62–4.84)
Total	318	1209	

Note: CI = confidence interval; OR = odds ratio

and separate dichorionic placentae ($\chi^2 = 4.07$, $p = .054$; OR 1.43, 95% CI 0.99–2.07).

The significantly higher prevalence of abnormal UCI in monochorionic placentation is due, when twin-pairs are compared, to significantly lower proportions of both UCIs being normal and significantly higher proportions of one or both UCIs being abnormal in the monochorionic group (Table 2).

Ten of the cords had single umbilical artery (i.e., two-vessel cords), giving a prevalence rate of 0.65%. Only one twin pair was concordant for single umbilical artery; the remaining eight had co-twins with two umbilical arteries. There was no significant difference in the prevalence of single umbilical artery between the various types of placentation, although that may be due to the small number (Table 3). When monochorionic placentae were compared with total dichorionic placentae there was no significant difference in the prevalence of two-vessel cords (OR 0.60, 95% CI 0.10–2.67, $p = .52$; Fisher's exact test). However, in spite of the small number, twins with two-vessel cords were almost six times more likely to have an abnormal cord insertion than those with three-vessel cords (Table 4).

Table 3

Type of Placentation and Number of Cord Vessels

Type of placentation	Number of babies with two vessels in cord	Number of babies with three vessels in cord	Total
Monochorionic diamniotic	1	237	238
Fused dichorionic	4	490	494
Separate dichorionic	5	791	796
Total	10	1518	1528

Note: $p = .82$

Applying the Weinberg rule to the 765 cases whose placentae were examined (477 same-sex and 288 opposite-sex pairs) one can calculate the number of DZ and MZ pairs as follows: 576 DZ (288 × 2), 189 MZ (477 – 288). For comparison, on the basis that two thirds of MZ twins are known to be monochorionic and one third dichorionic (Bomsel-Helmreich & Al Mufti, 2004) the number of MZ twins can alternatively be calculated to be 180 (120 + 60). There is no significant difference between the number of MZ twins obtained using the Weinberg rule and that obtained using the known proportions of the different types of placentation in MZ twins.

Monochorionic twins are MZ while opposite-sex twins are DZ. In this study 120 twins were monochorionic and 288 dichorionic twins were opposite-sex pairs. Thus of the 765 twin pairs studied it was only in 408 (53.3%) that the zygosity could be determined in the labor ward after delivery (i.e., from placental examination and babies' sex combination).

Discussion

The proportion of dichorionic placentae is 84.3% in this study, higher than the 66% to 80.1% reported in various parts of the United States, Europe and Asia (Baghdadi et al., 2003; Ferreira et al., 2005; Hanley et al., 2002; Loos et al., 2001; Malinowski, 2003;

Table 2

Types of Placentation and Combination of Cord Insertions

Twin-pair combination of cord insertions	Number with type of placentation *n* (% of placentation group)			
	Monochorionic diamniotic	Fused dichorionic	Separate dichorionic	*p* value
Both normal	42 (35.3)	274 (68.8)	188 (76.4)	< .0001
Both abnormal	23 (19.3)	24 (6.0)	11 (4.5)	.009
Mixed	54 (45.4)	100 (25.2)	47 (19.1)	< .0001
Total	119 (100)	398 (100)	246* (100)	

Note: *Excludes twin pair with one placenta mutilated

Both normal: disc/disc

Both abnormal: marginal/velamentous

Mixed: disc/marginal, disc/velamentous

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Table 4

Number of Cord Vessels and Type of Cord Insertion

Number of vessels in cord	Number with type of cord insertion		Total
	Marginal/velamentous	Disc	
Two	6	4	10
Three	312	1205	1519
Total	318	1209	1527

Note: Odds ratio = 5.79 (95% confidence interval 1.44–24.5), $p = .0076$ (Fisher's exact test)

Minakami et al., 1999). A much higher figure of 94.8% was reported from Ibadan, Nigeria (Nylander, 1969). These differences may be related to the differences in the rates of DZ twinning in the studied populations. Fused dichorionic placentation being the most common was also reported from Ibadan (Nylander, 1969) and St Louis, Missouri, United States (Victoria et al., 2001), although in Poland separate dichorionic placentation was the most common (Malinowski, 2003). The monochorionic monoamniotic placentation prevalence of 0.1% in this study is far lower than the 1.1% and 1.3% reported in other studies (Hanley et al., 2002; Victoria et al., 2001); it is significant to note, however, that a similarly low prevalence of 0.2% was reported from Ibadan (Nylander, 1969). It may be suggested that in the West African subregion, late division into MZ twins (between 8 to 12 days from fertilization) is perhaps not as common as in other parts of the world; on the other hand it is also possible that monoamniotic twins in the subregion are less likely to survive late into pregnancy to be identified.

The proportion of abnormal UCI in this study of 21.7% is lower than the 31.2% reported from New Jersey, United States (Hanley et al., 2002), although it is consistent with the 20.1% in Poland (Malinowski, 2003); in particular, the velamentous UCI prevalence of 4.7% is much lower than the 13% to 21% reported in the literature (Hanley et al., 2002).

The significantly greater prevalence of abnormal umbilical cord insertions in monochorionic compared to dichorionic placentation concurs with what has been reported from other centers (Hanley et al., 2002; Loos et al., 2001; Malinowski, 2003). In view of the reported greater incidence of adverse pregnancy outcomes in monochorionic compared to dichorionic twins it will be useful to determine, within the Ghanaian environment, the role abnormal UCI plays in adverse pregnancy outcomes within the two placentation groups.

The single umbilical artery prevalence rate of 0.65% is low when compared to about 3% to 4% reported for twins (Benirschke & Kaufmann, 2000b). Single umbilical artery and abnormal cord insertion each on its own is associated with adverse pregnancy outcomes. A combination of the two therefore portends a much more unfavorable prognosis. It is possible antenatally to diagnose both of them by ultrasonography: abnormal cord insertion by color doppler ultrasonography (Sepulveda et al., 2003) and single umbilical artery by conventional ultrasound (Pierce et al., 2001). It may be suggested that where in twin pregnancy a single umbilical artery is detected, every effort must be made to exclude abnormal cord insertion, in addition to excluding congenital anomalies. Such information may inform appropriate obstetric management.

The concordance between the number of MZ twins calculated using Weinberg's rule and that determined using the known proportions of monochorionic and dichorionic MZ twins suggests that the rule may be applicable to the Ghanaian population. It may be mentioned that although Weinberg's rule has been found to be consistent with direct zygosity determination in some populations (Vlietinck et al., 1988), the validity of its generalized application has been questioned (James, 1992).

The fact that only 53.3% of twins could have their zygosity established in the labor ward by the simple measures of placental examination and observation of babies' sex-pair combination points to the need to provide modern methods of DNA analysis to establish zygosity (Becker et al., 1997), especially since knowing the zygosity may have important future health implications (Machin, 2001).

In conclusion, the most common twin placentation in Korle Bu Teaching Hospital is fused dichorionic, followed by separate dichorionic and then monochorionic diamniotic. Abnormal cord insertion is significantly more common in monochorionic than in dichorionic placentation and more common in two-vessel than in three-vessel cords. Monochorionic monoamniotic placentation and single umbilical artery are much less prevalent than have been reported from other parts of the world and modern methods of DNA analysis will be needed to determine zygosity for almost half of twin pairs.

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