Ultrasound Obstet Gynecol 2020; **55**: 482–488
Published online 6 March 2020 in Wiley Online Library (wileyonlinelibrary.com). **DOI:** 10.1002/uog.21925

Twin pregnancy with two live fetuses at 11–13 weeks: effect of one fetal death on pregnancy outcome

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KEYWORDS: dichorionic twins; endoscopic laser surgery; first-trimester screening; monochorionic twins; selective fetal growth restriction; single fetal death; twin pregnancy; twin-to-twin transfusion syndrome

CONTRIBUTION

What are the novel findings of this work?
First, in monochorionic (MC), compared to dichorionic (DC), twin pregnancies, there is a higher rate of death of both twins or death of one fetus and subsequent death of the cotwin within 3 days, but the rate of cotwin death at ≥ 3 days is not significantly different between MC and DC twin pregnancies. Second, the rate of early preterm birth in pregnancies with two live fetuses is higher in MC than in DC twins and the rate in pregnancies with single fetal death is higher than in those with two live fetuses. Third, in pregnancies with single fetal death and a live cotwin ≥ 3 days later, there is a significant inverse association between gestational age at death and interval to delivery.

What are the clinical implications of this work?
These findings should be useful in counseling parents as to the likely outcome of their pregnancy after single fetal death and in defining strategies for surveillance in the management of these types of twin pregnancy.

ABSTRACT

Objectives *First, to compare the incidence of single and double fetal death between monochorionic (MC) and dichorionic (DC) twin pregnancies with two live fetuses at 11–13 weeks' gestation and no major abnormalities. Second, to investigate the relationship between gestational age at single fetal death and interval to delivery of the cotwin. Third, to determine the rate of early preterm birth in DC and MC twin pregnancies with two live fetuses and those with single fetal death.*

Methods *This was a retrospective analysis of prospectively collected data on twin pregnancies undergoing routine ultrasound examination at 11–13 weeks' gestation between 2002 and 2019. The outcome measures, which were stratified by chorionicity, were: first, death of both fetuses at presentation or death of one fetus followed by delivery of a live or dead cotwin within the subsequent 3 days at < 34 weeks' gestation; second, in pregnancies with single fetal death at < 34 weeks' gestation and a live cotwin ≥ 3 days later, the subsequent risk of fetal death and gestational-age distribution at birth of the cotwin; and, third, the gestational-age distribution at birth in pregnancies with two live fetuses.*

Results *The main findings of this study of 4896 DC and 1329 MC twin pregnancies with two live fetuses at 11–13 weeks' gestation were: first, the rate of death of both twins or death of one fetus and delivery of the live or dead cotwin within 3 days was higher in MC than in DC twin pregnancies; second, the rate of single fetal death with a live cotwin ≥ 3 days later was higher in MC than in DC twin pregnancies, but the rate of subsequent cotwin death in MC twin pregnancies was not significantly different from that in DC twin pregnancies; third, in pregnancies with two live fetuses, the rate of early preterm birth was significantly higher in MC than in DC twin pregnancies; fourth, the rate of early preterm birth in pregnancies with single fetal death and a live cotwin ≥ 3 days later was not significantly different between MC and DC twin pregnancies but the rates were substantially higher than in those with two live fetuses; and, fifth, in both MC and DC pregnancies with single fetal death and a live cotwin ≥ 3 days later, there was a significant inverse association between gestational age at death and interval to delivery (mean interval of 19 weeks for death at 15 weeks and mean interval of 2.5 weeks for death at 30 weeks).*

Conclusions *First, in MC twin pregnancies, the risk of single or double fetal death is higher than in DC twins. Second, in both MC and DC twin pregnancies, the rate of*

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Accepted: 18 November 2019

early preterm birth is higher in those with one fetal death than in those with two live fetuses. Third, in both MC and DC twins with one fetal death, the interval to delivery is related inversely to gestational age at fetal death. These data should be useful in counseling parents as to the likely outcome of their pregnancy after single fetal death and in defining strategies for surveillance in the management of these types of twin pregnancy.

INTRODUCTION

In monochorionic (MC), compared to dichorionic (DC), twin pregnancy with two live fetuses at 11–13 weeks' gestation and no major abnormalities, there are higher subsequent rates of fetal loss at < 24 weeks' gestation, perinatal death at ≥ 24 weeks and early preterm birth[1]. Several previous studies have investigated the effect of death of one fetus on the subsequent outcome of the cotwin in relation to chorionicity. A systematic review of 16 studies on a combined total of 149 MC and 166 DC twin pregnancies with single fetal death reported that the risk of cotwin fetal death was 13.4% in MC and 3.0% in DC twins; in eight studies on a combined total of 67 MC and 49 DC twin pregnancies with single fetal death, the risk of preterm birth at < 34 weeks' gestation was 56.7% in MC and 55.1% in DC twins[2]. The authors suggested that these were the best estimates at the time but acknowledged the many limitations of their review, including heterogeneity between studies, inclusion of small case series with low event rates which were often zero, ascertainment bias because some articles reported data only for MC twins, and that the literature informing the review was from a long time period (1986–2009), which may be a potential confounder in results because, over the course of this period, neonatal survival rates in general will have improved[2]. A subsequent study of 2469 DC and 544 MC twin pregnancies with two live fetuses at 11–14 weeks' gestation, in which single death > 14 weeks occurred in 44 DC and 21 MC pregnancies, confirmed the association with increased risk of preterm birth, which was not significantly different between DC and MC pregnancies; the study also reported that the risk of preterm birth was higher when death occurred at ≥ 20 than at < 20 weeks' gestation[3].

The objectives of this study in 6225 twin pregnancies with two live fetuses at 11–13 weeks' gestation with no major abnormalities were, first, to compare the incidence of single and double fetal death between DC and MC twin pregnancies, second, to investigate the relationship between gestational age at single fetal death and interval to delivery of the cotwin, and, third, to determine the rate of early preterm birth in DC and MC twin pregnancies with two live fetuses and those with single fetal death.

METHODS

This was a retrospective analysis of prospectively collected data obtained from women undergoing routine ultrasound examination at 11–13 weeks' gestation at King's College Hospital or the Fetal Medicine Centre, London (January 2002 to February 2019), Medway Maritime Hospital, Gillingham (February 2007 to February 2019) or Southend University Hospital, Essex (March 2009 to February 2019), UK. The three participating hospitals are maternity units and offer routine ultrasound examination in all patients. The Fetal Medicine Centre is a private outpatient clinic of self-referred patients who deliver in many different hospitals. The inclusion criteria for this study were DC or MC twin pregnancy with two live fetuses at 11–13 weeks' gestation and known pregnancy outcome; we included MC pregnancies that were treated by endoscopic laser ablation of intertwin communicating placental vessels. We excluded pregnancies with chromosomal abnormality or major defect diagnosed prenatally or postnatally and those with twin reversed arterial perfusion (TRAP) sequence. At the 11–13-week scan, gestational age was determined by the crown–rump length of the larger twin and chorionicity was determined from the number of placentas and the presence or absence of the lambda sign at the intertwin membrane–placenta junction[4,5]. This study is based on data derived from a routine clinical service and did not require ethics committee approval. The same database used in this study was also used in our previous publications on the outcome of MC and DC twins, and the relationship of intertwin discordance in crown–rump length and increased nuchal translucency thickness with pregnancy outcome[1,6,7].

During the study period, the general policy was to, first, manage all pregnancies on an outpatient basis, unless there was a specific pregnancy complication such as pre-eclampsia, second, in addition to the 11–13-week scan, to carry out ultrasound assessment every 4 weeks from 20 weeks' gestation until delivery in DC twins and every 1–2 weeks from 16 weeks' gestation until delivery in MC twins, and, third, to recommend delivery at around 37 weeks' gestation for DC twins, 36 weeks for MC diamniotic (DA) twins and at 32–33 weeks for MC monoamniotic (MA) twins, if there were no pregnancy complications necessitating earlier delivery. In both DC and MC twin pregnancies with single fetal death, the management was essentially expectant. The surviving MC twin was assessed initially for anemia, through measurement of fetal middle cerebral artery peak systolic velocity and need for fetal blood transfusion, and, in the subsequent weeks, for ultrasound and magnetic resonance imaging evidence of brain damage. Women with MCDA twin pregnancy and suspected twin–twin transfusion syndrome and/or selective fetal growth restriction were referred to the fetal medicine unit at King's College Hospital for endoscopic laser ablation of intertwin communicating placental vessels[8–10].

Data on pregnancy outcome were collected from computerized records of the delivery ward and neonatal unit or the patients' general practitioners or the women themselves, and all prenatal and postnatal findings were recorded in a fetal database. The outcome measures for

this study, which were stratified by chorionicity, were: first, death of both fetuses at diagnosis either by prenatal ultrasound or at delivery, or death of one fetus followed by delivery of a live or dead cotwin within the subsequent 3 days at < 34 weeks' gestation; second, in pregnancies with single fetal death at < 34 weeks' gestation and a live cotwin ≥ 3 days later, subsequent risk of fetal death and gestational-age distribution at birth of the cotwin; and, third, gestational-age distribution at birth in pregnancies with two live fetuses at < 34 weeks' gestation.

The rationales for selecting these outcome measures were: first, in most pregnancies with two fetal deaths, the diagnosis is made at a routine ultrasound scan or at birth and it is not possible to determine accurately the timing of death of each fetus; second, in pregnancies with diagnosis of single fetal death, there is a high risk of cotwin death within the subsequent few hours either because of spontaneous onset of labor or rupture of the membranes, or, in cases of MC twins, retrograde hemorrhage from the live to the dead fetus[11]; third, in pregnancies with single fetal death in which the cotwin is alive in the subsequent ≥ 3 days, the parents and their obstetricians wish to know what is the likely pregnancy outcome, including cotwin death and risk of preterm birth, as compared with pregnancies with two living fetuses; and, fourth, the upper gestational age cut-off of 34 rather than 37 weeks was used to define preterm birth because most MC twin pregnancies are delivered before the latter.

Statistical analysis

Data from categorical variables are presented as *n* (%) and from continuous variables as median and interquartile range. Comparisons in outcome measures between DC and MC twin pregnancies were carried out using Fisher's exact test for categorical variables and Mann–Whitney *U*-test for continuous variables. The risk of birth at < 34 weeks' gestation was assessed using Kaplan–Meier analysis, in which gestational age was the time scale and birth was the event, and the log-rank test was used to compare the difference in survival between DC and MC twin pregnancies with two live births at < 34 weeks or two fetuses alive at 34 weeks, and between DC and MC twin pregnancies with single fetal death at < 34 weeks. The statistical package SPSS for Windows version 24.0 (IBM Corp., Armonk, NY, USA) was used for data analyses.

RESULTS

Study population

The inclusion criteria were fulfilled by 6225 twin pregnancies with two live fetuses at 11–13 weeks' gestation, including 4896 (78.7%) DC, 1274 (20.4%) MCDA and 55 (0.9%) MCMA twin pregnancies. For further analysis, the MCDA and MCMA groups were combined into a MC group. The demographic characteristics of DC and MC twin pregnancies are shown in Table 1. In MC twins, compared to DC twins, median maternal age and weight were lower, there were more parous women and those of South and East Asian racial origin and more natural conceptions.

Pregnancy outcome was subdivided into three groups (Figure 1): first, two live births at < 34 weeks' gestation or both fetuses alive at 34 weeks (Group 1); second, single fetal death at < 34 weeks' gestation with the cotwin alive ≥ 3 days later (Group 2); and, third, both fetuses dead at diagnosis or one fetus dead and the live or dead cotwin born within 3 days at < 34 weeks' gestation (Group 3).

Fetal death

The rate of death of both twins or death of one fetus and delivery of live or dead cotwin within 3 days at < 34 weeks' gestation (Group 3) was higher in MC than in DC twin pregnancies (7.9% *vs* 2.2%; relative risk (RR), 3.615; 95% CI, 2.781–4.699). Similarly, the rate of single fetal death at < 34 weeks' gestation with the cotwin alive ≥ 3 days later (Group 2) was higher in MC than in DC twin pregnancies (3.5% *vs* 1.2%; RR, 2.992; 95% CI, 1.994–4.282). However, the rate of cotwin death at ≥ 3 days after the diagnosis of single fetal death in MC twin pregnancies (15.2%; 7/46) was not significantly different from that in DC twin pregnancies (10.3%; 6/58) ($P = 0.555$).

In Groups 2 and 3, most cotwin fetal deaths occurred in pregnancies at < 24 weeks' gestation (Group 2: 5/6 in DC twins and 5/7 in MC twins; Group 3: 89/91 in DC twins and 87/94 in MC twins), whereas all liveborn fetuses in both MC and DC twins from both groups were delivered at ≥ 24 weeks (Table 1).

Preterm birth

In pregnancies with two live fetuses (Group 1) the rate of preterm birth at < 30, < 32 and < 34 weeks' gestation was significantly higher in MC than in DC twin pregnancies (6.3% *vs* 3.8%, 13.6% *vs* 7.0% and 28.8% *vs* 14.8%, respectively); the rate of birth at < 28 weeks was not significantly different (3.0% *vs* 2.1%). The rates of early preterm birth in pregnancies with single fetal death and a live cotwin ≥ 3 days later (Group 2) was not significantly different between MC and DC twin pregnancies, but the rates were substantially higher than in Group 1 (Table 1). Kaplan–Meier analysis showed significantly earlier gestational age at delivery in MC than in DC twin pregnancies in Group 1 (log-rank test, $P < 0.0001$), but not in Group 2 (log-rank test, $P = 0.307$) (Figure 2).

In both DC and MC twin pregnancies in Group 2, there was significantly earlier gestational age at delivery than in the respective pregnancies in Group 1 (log-rank test, $P < 0.0001$ for both; Figure 2). For example, in DC twin pregnancies, the rate of delivery at < 28 weeks' gestation was 24.1% in Group 2 and 2.1% in Group 1 (RR, 11.307; 95% CI, 6.890–28.555); the respective values in MC twin pregnancies were 19.6% and 3.0% (RR, 6.585; 95% CI, 3.367–12.878). In DC twin pregnancies, the rate of delivery at < 32 weeks' gestation was 34.5% in Group 2

Table 1 Characteristics and outcome of study population of 6225 twin pregnancies with two live fetuses at 11–13 weeks, according to chorionicity

Variable	*Dichorionic (n = 4896)*	*Monochorionic (n = 1329)*	P
Pregnancy characteristic			
Maternal age (years)	34.1 (30.4–37.4)	32.1 (28.1–36.0)	< 0.0001
GA (weeks)	12.9 (12.5–13.3)	12.9 (12.5–13.3)	0.617
Maternal weight (kg)	67.6 (60.4–77.6)	66.0 (59.0–76.3)	0.0004
Maternal height (cm)	165 (161–170)	165 (160–169)	0.062
Racial origin			
White	4053 (82.8)	1067 (80.3)	0.035
Black	513 (10.5)	135 (10.2)	0.761
South Asian	188 (3.8)	81 (6.1)	0.0006
East Asian	61 (1.2)	29 (2.2)	0.019
Mixed	81 (1.7)	17 (1.3)	0.385
Smoker	296 (6.0)	101 (7.6)	0.043
Parity			
Nulliparous	2638 (53.9)	612 (46.0)	< 0.0001
Parous	2258 (46.1)	717 (54.0)	< 0.0001
Method of conception			
Natural	2575 (52.6)	1185 (89.2)	< 0.0001
In-vitro fertilization	2047 (41.8)	129 (9.7)	< 0.0001
Ovulation-induction drugs	274 (5.6)	15 (1.1)	< 0.0001
Outcome			
Two live births at < 34 weeks or two fetuses alive at 34 weeks	4731 (96.6)	1178 (88.6)	< 0.0001
GA at delivery			
< 28 weeks	101/4731 (2.1)	35/1178 (3.0)	0.1024
< 30 weeks	182/4731 (3.8)	74/1178 (6.3)	0.0004
< 32 weeks	330/4731 (7.0)	160/1178 (13.6)	< 0.0001
< 34 weeks	701/4731 (14.8)	339/1178 (28.8)	< 0.0001
One fetus dead at < 34 weeks and cotwin alive ≥ 3 days later	58 (1.2)	46 (3.5)	< 0.0001
GA at delivery of cotwin			
< 28 weeks	14/58 (24.1)	9/46 (19.6)	0.640
< 30 weeks	15/58 (25.9)	12/46 (26.1)	1.000
< 32 weeks	20/58 (34.5)	16/46 (34.8)	1.000
< 34 weeks	23/58 (39.7)	24/46 (52.2)	0.237
Fetal death of cotwin	6/58 (10.3)	7/46 (15.2)	0.555
≥ 24 weeks	1/6 (16.7)	2/7 (28.6)	1.000
Live birth of cotwin	52/58 (89.7)	39/46 (84.8)	0.555
≥ 24 weeks	52/52 (100)	39/39 (100)	1.000
One fetus dead at < 34 weeks and cotwin delivered < 3 days later	107 (2.2)	105 (7.9)	< 0.0001
Fetal death of cotwin	91/107 (85.0)	94/105 (89.5)	0.411
≥ 24 weeks	2/91 (2.2)	7/94 (7.4)	0.169
Live birth of cotwin	16/107 (15.0)	11/105 (10.5)	0.411
≥ 24 weeks	16/16 (100)	11/11 (100)	1.000

Data are given as median (interquartile range), *n* (%) or *n*/*N* (%). GA, gestational age.

and 7.0% in Group 1 (RR, 4.944; 95% CI, 3.416–7.155); the respective values in MC twin pregnancies were 34.8% and 13.6% (RR, 2.561; 95% CI, 1.681–3.902).

Endoscopic laser surgery in MC twins

Endoscopic laser ablation of intertwin communicating placental vessels was carried out in 127 (9.6%) MC twin pregnancies at a median gestational age of 18 (range, 16–27) weeks; there were two live births in 79 (62.2%) cases, one live birth in 25 (19.7%) cases and no survivors in 23 (18.1%) cases. When the cases with endoscopic laser surgery were excluded, the rate of death of both twins or death of one fetus and delivery of the live or dead cotwin within 3 days at < 34 weeks' gestation remained higher in MC than in DC twin pregnancies (6.8% *vs* 2.2%; $P < 0.0001$). The rate of preterm birth at < 28, < 30, < 32 and < 34 weeks' gestation in the 79 cases with two live births was 13.9%, 30.4%, 54.4% and 75.9%, respectively. When the cases with endoscopic surgery were excluded, the rate of preterm birth at < 32 and < 34 weeks' gestation remained significantly higher in MC than in DC twin pregnancies (10.6% *vs* 7.0% and 25.4% *vs* 14.8%, respectively).

Interval between single fetal death and delivery of cotwin

In pregnancies with single fetal death and a live cotwin ≥ 3 days later (Group 2), there was a significant inverse association between gestational age at death and interval to delivery ($r = -0.685$ for DC and $r = -0.661$ for MC

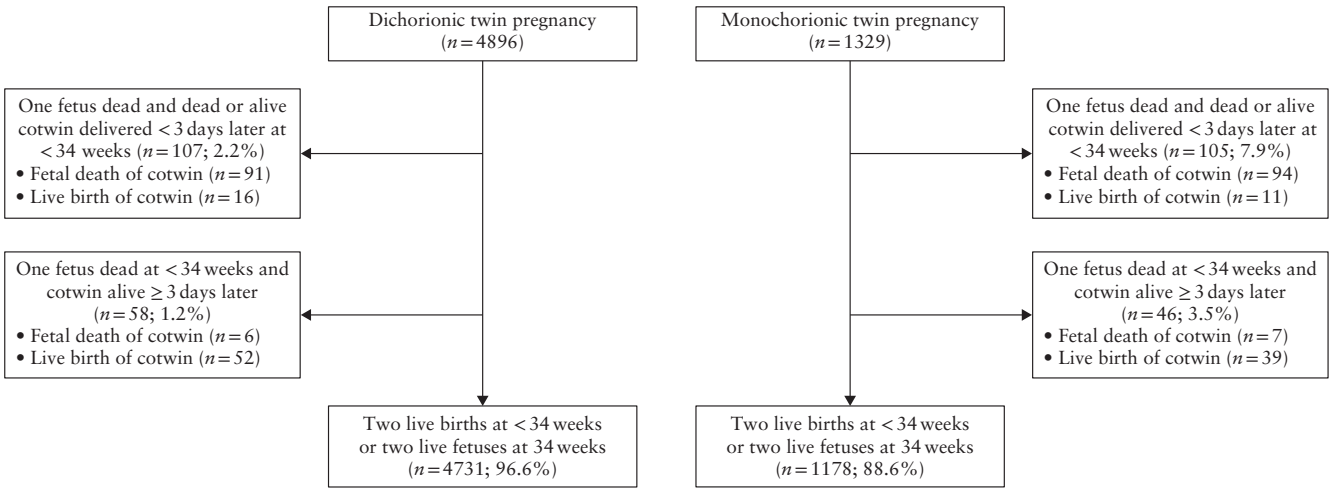

Figure 1 Flowchart showing outcome of 6225 twin pregnancies with two live fetuses at 11–13 weeks, according to chorionicity.

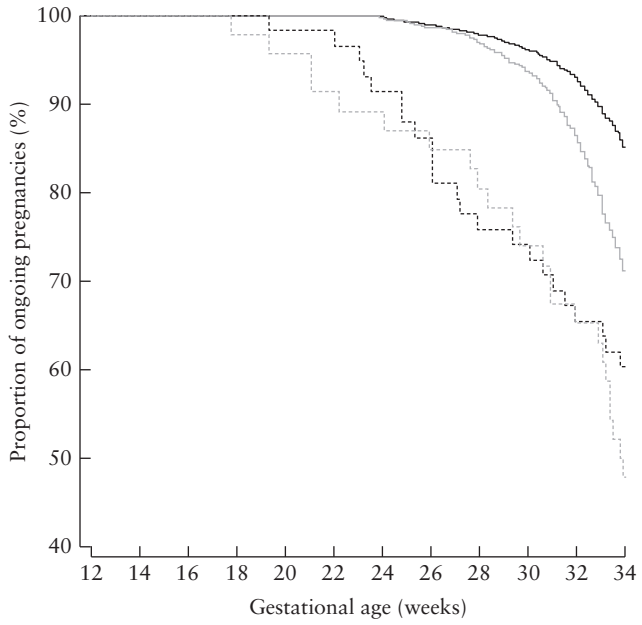

Figure 2 Kaplan–Meier survival analysis of dichorionic (black lines) and monochorionic (gray lines) twin pregnancies from 12 to 34 weeks' gestation. Solid lines are pregnancies with two live fetuses and dashed lines are those with single fetal death and live cotwin ≥ 3 days later.

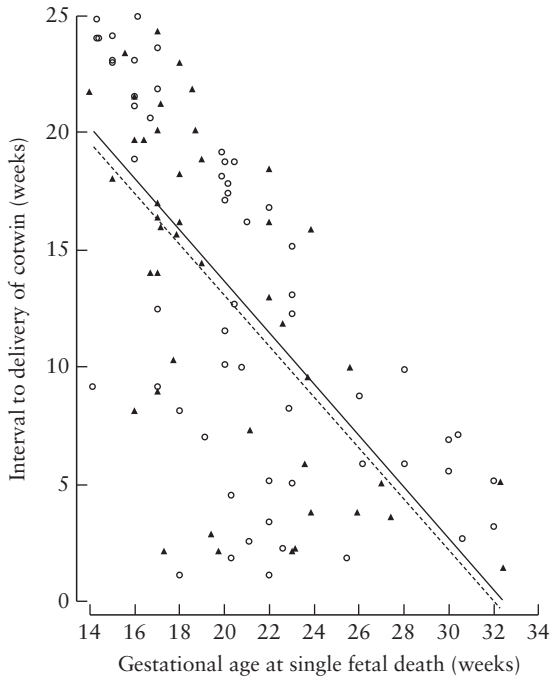

Figure 3 Relationship between gestational age at single fetal death and interval to delivery of cotwin in dichorionic (○, ——) ($r = -0.685$) and monochorionic (▲, ------) ($r = -0.661$) twin pregnancies.

twins; $P < 0.0001$ for both; Figure 3). For example, after single fetal death at 15, 20 and 30 weeks' gestation, the mean interval to delivery of the cotwin was 19, 13 and 2.5 weeks, respectively.

DISCUSSION

Main findings

The main findings of this study of 4896 DC and 1329 MC twin pregnancies with two live fetuses at 11–13 weeks' gestation and no major abnormalities were: first, the rate of death of both twins or death of one fetus and delivery of the live or dead cotwin within 3 days was higher in MC than in DC twin pregnancies; second, the rate of single fetal death with a live cotwin ≥ 3 days later was higher in MC than in DC twin pregnancies, but the rate of subsequent cotwin death in MC twin pregnancies was not significantly different from that in DC twin pregnancies; third, in pregnancies with two live fetuses at 34 weeks, the rate of early preterm birth was significantly higher in MC than in DC twin pregnancies; fourth, the rates of early preterm birth in pregnancies with single fetal death and a live cotwin ≥ 3 days later was not significantly different between MC and DC twin pregnancies but the rates were substantially higher than in those with two live fetuses; and, fifth, in both MC and DC pregnancies with single

fetal death and a live cotwin ≥ 3 days later, there was a significant inverse association between gestational age at death and interval to delivery of the cotwin (mean interval of 19 weeks for death at 15 weeks and mean interval of 2.5 weeks for death at 30 weeks).

In this study, we examined the rate and consequences of single and double fetal death from the first trimester onwards. We included cases that required endoscopic laser surgery because their exclusion would have underestimated the risk of adverse outcome in MC twins, but even if these cases are excluded, the risk of cotwin death within 3 days and risk of early preterm birth in pregnancies with two live births remains higher in MC than in DC twins.

Comparison with findings from previous studies

We found that, although in MC, compared to DC, twin pregnancies after the 11–13-week scan, there is a higher rate of death of both twins or death of one fetus and subsequent death of the cotwin within 3 days, the rate of cotwin death at ≥ 3 days was not significantly different between MC and DC twin pregnancies. Previous small and heterogeneous studies on the outcome of twin pregnancy with single fetal death reported contradictory results. A systematic review of 16 such studies on a combined total of 149 MC and 166 DC twin pregnancies with single fetal death reported that the rate of subsequent death of the cotwin was higher in MC than in DC twins (13.4% *vs* 3.0%)[2]. However, the heterogeneous nature of the included studies raises questions as to the validity of these observations. For example, some studies included cotwin deaths occurring within a few hours after the single fetal death[12], whereas, in others, the death occurred several days later[13]. In a more recent systematic review by the same group, on a combined total of 197 MC and 244 DC twin pregnancies with single fetal death, the rate of subsequent death of the cotwin was higher in MC than in DC twins (22.3% *vs* 14.0%)[14].

We found that the rate of early preterm birth in pregnancies with two live fetuses is non-significantly higher in MC than in DC twins and the rate in pregnancies with single fetal death is higher than in those with two live fetuses, but there is no significant difference between MC and DC twins in the rate of preterm birth among pregnancies with single fetal death. These results are consistent with those of Hillman *et al.*[2] in a systematic review of eight studies on a combined total of 67 MC and 49 DC twin pregnancies with single fetal death, and those of D'Antonio *et al.*[3] in a study of 44 DC and 21 MC twin pregnancies with single fetal death which reported that the rate of preterm birth at < 34 weeks' gestation was higher in pregnancies with single fetal death than in those with two live fetuses, but was not significantly different between DC and MC twins with single fetal death.

We found that, in pregnancies with single fetal death and a live cotwin ≥ 3 days later, there is a significant inverse association between gestational age at death and interval to delivery of the cotwin. This is consistent with the hypothesis that the interval to delivery may be associated with the amount of dead fetoplacental products. Thus, in triplet pregnancies undergoing embryo reduction, the risk of subsequent miscarriage is greater if there is reduction of two rather than one fetus[15], in multifetal pregnancies reduced to twins, the risk of miscarriage increases with increasing number of starting fetuses[16], in twin pregnancies discordant for fetal abnormality, the risk of miscarriage and preterm birth is lower when selective termination is performed at < 16 than at ≥ 16 weeks' gestation[17], and, in twin pregnancies with TRAP sequence, there is an inverse correlation between gestational age at treatment and gestational age at birth[18]. We also reported that, in singleton pregnancies with spontaneous rupture of the membranes at 12–36 weeks' gestation that were managed expectantly, if there was fetal bacteremia, the median interval to delivery was 2 (range, 1–5) days, whereas, in pregnancies without intrauterine infection, the interval was 41 (range, 1–161) days and there was an inverse correlation between gestational age at amniorrhexis and delivery interval[19].

Implications for clinical practice

The data from this study should be useful in counseling parents as to the likely outcome of their pregnancy after single fetal death. At 11–13 weeks, after diagnosis of twins and determination of chorionicity, we should be aware that the chance of subsequent double or single fetal death is about 3% in DC and 11% in MC twin pregnancies. After diagnosis of single fetal death at < 24 weeks' gestation, there is a high risk of subsequent death of the cotwin or miscarriage of the whole pregnancy within the subsequent 3 days and this risk is similar in DC and MC twins. Should the cotwin be alive at ≥ 3 days, there is a high chance that it will be liveborn but with a high chance that the birth will be very premature; this chance is similar in DC and MC twins and is related inversely to gestational age at fetal death.

Strengths and limitations

The main strength of our study is the large population of DC and MC pregnancies with no major abnormalities and two live fetuses at 11–13 weeks' gestation which provided sufficient numbers of the various adverse outcome measures for valid conclusions to be drawn concerning differences between these two types of twin pregnancy.

Limitations of the study include: first, the retrospective nature with inherent risk of bias; second, lack of data on neonatal morbidity and long-term neurodevelopmental outcome; third, lack of data on whether preterm birth was spontaneous or iatrogenic; fourth, in pregnancies presenting with two fetal deaths or miscarriage, we assumed that the interval between the two deaths was within 3 days of each other but we cannot be certain that this was indeed the case; and, fifth, for many of the

pregnancies delivering in hospitals other than the three in which the routine first-trimester scan was carried out, pregnancy outcome was essentially obtained from the patients themselves, but, in most with complications, we obtained data from their hospitals and, for the others with normal outcome, it is reasonable to assume that the basic outcome measures for this study (survival and gestational age at delivery) are likely to be correct.

Conclusions

First, in MC twin pregnancies, the risk of single or double fetal death is higher than in DC twins. Second, in both MC and DC twin pregnancies, the rate of early preterm birth is higher in those with one fetal death than in those with two live fetuses. Third, in both MC and DC twins with one fetal death, the interval to delivery is related inversely to gestational age at fetal death. These data should be useful in counseling parents as to the likely outcome of their pregnancy after single fetal death and in defining strategies for surveillance in the management of these types of twin pregnancy.

ACKNOWLEDGMENT

This study was supported by grants from The Fetal Medicine Foundation (Charity No: 1037116).

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