Outcome of twin deliveries according to planned mode of delivery at Level II hospitals within the Metro West Cape Town Health District

by

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SCHAMA006

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DECLARATION OF STUDENT

I, Amaal Schroeder, hereby declare that the work on which this dissertation/thesis is based on my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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I am satisfied that this is the original work of Amaal Schroeder and that this dissertation should be submitted in partial fulfilment of the requirements for the degree, Master of Medicine (Obstetrics and Gynaecology) in the University of Cape Town.

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LIST OF TABLES

ABBREVIATIONS AND GLOSSARY OF TERMS

CD	Combined delivery - first twin delivered vaginally, second twin by caesarean section
Chorionicity	The numbers of zygotes involved in a multiple pregnancy
CS	Caesarean Section
DCDA	Dichorionic diamniotic
Diamniotic	Twin pregnancy with each fetus surrounded by its own amniotic sac.
Dichorionic	Twin pregnancy resulting from two zygotes and produces non-identical twins.
Early neonatal death	Death within the first 7 days of life
ECV	External cephalic version - the version of a breech presentation to a cephalic, by manipulation of the fetus externally through the abdomen.
EFW	Estimated fetal weight, by ultrasound
HIV	Human Immunodeficiency virus
Internal podalic version	The version of a cephalic presenting fetus to breech by the grasping on and pulling of the feet, with the clinician's hand inside the uterus.
IOL	Induction of labour
IUD	Intrauterine (fetal) demise
IVH	Intraventricular haemorrhage
Late neonatal death	Death after the first 7 days but within the first 28 days of life
MCDA	Monochorionic Diamniotic
MCMA	Monochorionic Monoamniotic
Monoamniotic	Twin pregnancy with two foetuses sharing one amniotic sac.
Monochorionic	Twin pregnancy resulting from one zygote and produces identical twins.
Neonatal Death	Death within the first 28 days of life
PCS	Planned caesarean section
PVD	Planned vaginal delivery
RCT	Randomised control trial
TBS	Twin Birth Study (Barrett et al)
TTTS	Twin-twin transfusion syndrome

1. ABSTRACT

Twin pregnancies are associated with greater fetal and neonatal morbidity and mortality compared to singleton pregnancies[3]. It has been shown in a large multicentre randomised control trial by Barrett et al, that this risk is not significantly changed by planned mode of delivery in a twin pregnancy with a cephalic presenting first twin[1].

This study was undertaken to assess the outcome of cephalic-presenting twin gestations according to planned mode of delivery in the local context of secondary level hospitals in the Metro West Cape Town Health District.

Methods

This was a retrospective cohort study of twin deliveries at Mowbray Maternity Hospital and New Somerset Hospital over a 12 month period, starting from 1 January 2013 until the 31 December 2013. Study subjects included all twin deliveries with a cephalic presenting first twin, gestational age > 28w and 0 days, with no contraindication to vaginal delivery.

The primary outcome was to document fetal and neonatal outcome according to the planned mode of delivery. Secondary outcomes included maternal outcomes and associations for combined delivery.

Result

A total of 124 cases were identified. 95 had a planned vaginal delivery, and 29 had a planned caesarean section. In the planned vaginal delivery group, 61.1% delivered vaginally and 38.9% delivered via caesarean section. Nine of these caesarean sections were combined deliveries. The planned caesarean section group had a caesarean section rate of 93.1%. Two cases delivered vaginally.

There was no statistical difference in the composite neonatal score between the two groups (21.1% and 29.3%, in the planned vaginal delivery and planned caesarean section groups respectively, p=0.092). There was also no significant differences in maternal outcomes between the two groups.

Conclusion

The results of this study are in keeping with the findings of the Twin Birth Study. It showed no statistically significant difference in neonatal and maternal outcomes of twin gestations, with a cephalic presenting first twin, with respect to planned mode of delivery. A trial of vaginal birth is therefore a feasible option in our setting.

2. INTRODUCTION AND LITERATURE REVIEW

Twin pregnancies comprise 2-3% of pregnancies worldwide[1], and in 2010 it was estimated by the Demographic and Health Surveys, that the twinning rate in South Africa was 12,6 per 1000 births. The highest twinning rates were found in Central Africa, where the rate was in excess of 18.1 per 1000 births[2] .

Twin pregnancies pose numerous risks to both the fetus and the mother. These risks present themselves antenatally, during delivery, as well as in the post-partum period. Some of the risks include growth restriction of either or both twins, twin-twin transfusion syndrome, intrauterine demise of a single twin - with neurological sequelae in the surviving twin, conjoined twins and preterm delivery[3]. Maternal risks include pregnancy-induced hypertension, post-partum haemorrhage and blood transfusion, preterm labour and preterm delivery and a higher likelihood of caesarean section[4]. As a result, the care of a twin gestation and its delivery conveys significant challenges to the health care provider. Awareness of these risks will determine antenatal care and surveillance, the timing of delivery and the mode of delivery. The management is more intensive when compared to singleton pregnancies, with respect to number of antenatal visits, hospital admissions and ultrasound surveillance.

Unique to multiple pregnancies is the issue of placentation and chorionicity. Accurate assessment of chorionicity is best performed by ultrasound examination before 14 weeks of gestation[5]. Monochorionic pregnancies are at higher risk and have unique complications[6]. These complications include conjoined twinning, twin-twin-transfusion-syndrome and twin reversed arterial perfusion sequence[7]. Determining chorionicity is important as it relates directly to the antenatal and intrapartum risks of the pregnancy. It will also determine the mode and timing of delivery, which is usually earlier for monochorionic pregnancies[8]. In our service, many patients book late in their pregnancies, precluding accurate determination of chorionicity.

Timing and mode of delivery

An integral part of the antenatal management of twin pregnancies is determining the timing and mode of delivery. In November 2013, the outcome of the Twin Birth Study (TBS), a large multicentre randomized control trial was published. This study took place over 8 years, across 106 centres in 25 different countries, and assessed the outcome of 2804 twin gestations. Di- and monochorionic diamniotic twin pregnancies, with a cephalic leading twin, between 32 weeks and 0 days and 38 weeks and 6 days, were randomised to caesarean section or vaginal delivery. The intrapartum care and delivery was attended to by a doctor assessed as competent in vaginal twin deliveries, and who had documented experience thereof. The participating centres had to be able to perform an emergency caesarean section within thirty minutes. The study showed no statistically significant difference in neonatal and maternal outcomes between planned vaginal and planned elective caesarean section for twin pregnancies with a cephalic presenting first twin[1].

The only other randomized control trial assessing the mode of delivery of twin pregnancies was published in 1987. This study was underpowered and therefore, the results were not statistically significant. The outcome of this study was similar to that of the Twin Birth Study[9]. Sixty twin gestations, of more than 35 weeks, were randomised to caesarean section or vaginal delivery. The pregnancies studied had a cephalic-presenting leading twin, and the second twin was non-cephalic. The outcome showed no significant difference in neonatal morbidity and mortality between the two groups, but did show an increase in maternal febrile morbidity in the planned caesarean group. The authors concluded that the outcome of the non-cephalic second twin is not affected by the mode of delivery.

The results of the above two studies are important as they confirm what many prior retrospective studies have also found[10,11,12,13]. What these studies had in common, was the active management of delivery of the second twin in a 'suitable obstetric-paediatric setting'[9]. The active management of the second twin included complete breech extraction, internal podalic version with breech extraction, and external cephalic version and vaginal delivery. These were performed by at least one obstetrician who was assisted by skilled doctors or midwives, adequate regional anaesthesia was provided, and there was full recourse to an emergency operating theatre. The Twin Birth Study demonstrated that this outcome was unchanged across various countries, and this may imply that it may be applicable in the public sector in South Africa as well.

Outcome of second twin

In twin deliveries, it is well known that the second twin is associated with a poorer outcome[14]. The commonly found associations include combined delivery, which is a caesarean delivery of the second twin following vaginal delivery of the first, and prolonged inter-twin delivery interval[15,16,17]. Factors associated with combined delivery include non-vertex presentation of second twin, fetal distress and cord prolapse[15, 18, 19, 20]. Weight discordance, with a smaller second twin, has also been found to correlate with a poorer outcome in the second twin, with an almost 4-fold increase in risk of perinatal death when the discordance is greater than twenty-five percent[21]. However, it has been shown that the active management of the delivery of the second twin, including the use of uterotonics and obstetric manoeuvres, improves the outcome of the second twin[7, 8, 9, 10].

Appropriate timing of delivery aims to produce the lowest risk to the fetuses, while ensuring a reduction in neonatal morbidity and mortality. It has been estimated that dichorionic pregnancies have a stillborn rate at 38 weeks equivalent to that of singleton pregnancies at 42 weeks[7]. It has also been found that the highest rates of morbidity for dichorionic and monochorionic pregnancies are in the 38th and 37th weeks of pregnancy respectively[22]. It is thus appropriate to deliver healthy diamniotic pregnancies, regardless of chorionicity, at 37 weeks. This has been found to be suitable for monochorionic pregnancies, and has also not been found to cause harm in dichorionic pregnancies[23,24]. Monoamniotic pregnancies are of significantly higher risk compared to diamniotic pregnancies and delivery is advised at an earlier gestation at 32 to 34 weeks[25], and usually in a tertiary setting.

Problem Statement

At present, there is no consensus regarding the mode of delivery of twin pregnancies in the Metro West Cape Town Heath District hospitals. The final decision regarding mode of delivery is made by the consultant on call and may either be in favour of caesarean section or a trial of labour. The labour wards at New Somerset Hospital (NSH) and Mowbray Maternity Hospital (MMH) are extremely busy with a high turnover of patients, and are managed by doctors of varying seniority and experience. These doctors may not be sufficiently experienced in twin deliveries, and at the time of delivery, there may be other emergency cases also requiring attention. If an emergency caesarean section is indicated, the labour ward surgical theatre may be occupied with other operative cases, and this may

result in a significant delay in delivery. Regional anaesthesia, in the form of epidurals, is also not freely available. This would be beneficial during labour as it would promote patient co-operation, allow easier fetal monitoring and aid in the active management of the delivery of the second twin.

The rationale behind conducting this research would be to assess the neonatal and maternal outcome of twin deliveries in the Metro West Cape Town Health District secondary level hospitals, namely, Mowbray Maternity Hospital and New Somerset Hospital. The Twin Birth Study has provided evidence to show that a trial of vaginal birth for an uncomplicated twin pregnancy, with a cephalic presenting first twin, is safe and appropriate. With the information gathered from this research, we would be able to establish whether a trial of vaginal birth for uncomplicated twin pregnancies, with a cephalic presenting first twin, is a reasonable option in a resource-limited setting.

3. RESEARCH PLAN

3.1 SPECIFIC AIMS AND OBJECTIVES

This study was conducted to assess the neonatal and maternal outcomes of twin deliveries according to the planned mode of delivery at New Somerset and Mowbray Maternity hospitals.

3.1.1 Primary Objective

To document neonatal outcome based on the planned mode of delivery of twin pregnancies, where the leading twin is cephalic and there is no contraindication to vaginal delivery.

3.1.2 Secondary Objectives

Three secondary objectives were identified and included, the assessment of maternal outcome based on planned mode of delivery, determining whether the findings of the Twin Birth Study can be extrapolated to our setting, and to identify risk factors for combined delivery.

3.2 RESEARCH DESIGN AND METHODS

3.2.1 Study Design

This was a retrospective cohort study. Data were obtained from medical records at Mowbray Maternity Hospital and New Somerset Hospital of twin deliveries over a 12 month period, starting from 1 January 2013 until the 31 December 2013.

3.2.2 Study subjects

The study included all twin deliveries at MMH and NSH during the determined time period, with a cephalic presenting first twin, gestational age > 28w and 0 days, and no contraindication to vaginal delivery.

The following exclusion criteria were applied: non-cephalic leading twin, monochorionic monoamniotic twin pregnancy, gestational age less than 28 weeks, fetal anomaly, delivery prior to arrival in the labour ward and stillbirth of a single twin before the onset of labour.

3.2.3 **Sample Size**

A power calculation was performed. The unexposed group was planned caesarean sections, and the exposed group included planned vaginal twin deliveries. We estimated that the ratio of unexposed to exposed group would be 2:1. It was estimated that the unexposed group would have a 3% chance of an adverse neonatal outcome compared to 15% in the exposed group.

A sample size of 216 was calculated. A planned caesarean section group of 144 and vaginal delivery group of 72 would be needed to establish significant differences between the two groups.

3.2.4 **Data Collection**

Data was collected from hospital records and labour ward records at Mowbray Maternity Hospital and New Somerset Hospital, and recorded on a data sheet (Addendum A). All twin deliveries were identified, and those who met the inclusion criteria were used. The folders were obtained from hospital records departments.

Fetal and neonatal data that were collected included: Apgar scores at 1 and 5 minutes, umbilical artery pH if available, admission to neonatal intensive care unit (ICU), neonatal death, intrapartum stillbirth, any neonatal complication, chorionicity and amnionicity, any antenatal complication (intrauterine growth restriction, growth discordance of greater than 20%, twin-twin transfusion syndrome, intrauterine death), estimated fetal weight by most recent ultrasound assessment of both twins and birth weight.

Maternal and pregnancy data that were collected included: age, gestational age, method of gestational age determination, gravidity and parity, HIV status, syphilis serology, blood group and rhesus serology, previous caesarean section, planned mode of delivery, actual mode of delivery, timing of caesarean section (pre-labour or intrapartum), type of anaesthetic, presentation at delivery, inter-twin delivery interval, and any maternal complication.

From the above, the neonatal and maternal composite scores were calculated. The composite scores were contributed to by any of the complications or events listed below.

Neonatal factors included early and late neonatal death, 5-minute Apgar score of less than 7, neonatal ICU admission, intubation and ventilation, hypoxaemic ischaemic encephalopathy (HIE), including seizures, and depressed level of consciousness, birth trauma (long bone fractures, brachial plexus palsy, facial nerve palsy and other), respiratory distress (hyaline membrane disease, transient tachypnoea of the neonate, bronchopulmonary dysplasia), septicaemia, necrotising enterocolitis, meningitis and intraventricular haemorrhage.

Maternal factors included maternal death, post-partum haemorrhage (≥1000ml), and blood transfusion, dilatation and curettage or evacuation of uterus, anogenital injury (third or fourth degree perineal lacerations, vulval or vaginal haematoma requiring evacuation and drainage in theatre), exploratory laparotomy (with or without hysterectomy), wound sepsis or dehiscence, prolonged hospital stay post-delivery, or readmission, puerperal sepsis, venous thromboembolism and intra-operative injury of bladder, ureter or bowel.

3.2.5 **Data handling**

All data remained anonymous. A study number was assigned to each mother-infant pair for the purposes of being able to verify data, or retrieve uncaptured data. These numbers were known to the primary investigator only.
Data was entered into a Microsoft® Excel spreadsheet on a private password-protected computer. The data included the study number only.

3.2.6 **Data analysis**

The data were divided into descriptive, continuous and categorical variables. To check the distribution of the continuous parametric variables between the groups, a t-test was used. For continuous non-parametric variables, a Wilkoxin rank test was used. In the case of categorical variables, data was tested using the Chi-

squared test, and the Friedman test was used when categories had fewer than 5 events.

Interpretation of results required the use of p-values and confidence intervals, where applicable, to assess statistical significance. A p-value of <0.05 was regarded as statistically significant.

3.3 ETHICS

Ethical approval for the study was obtained from the Human Research Committee of the University of Cape Town, and is attached (Addendum B). The ethics approval number is **HREC/REF 244/2015**.

Permission to collect data was obtained from the relevant authorities at Mowbray Maternity Hospital and New Somerset Hospital, and the Public Health Research Committee of the Department of Health of the Western Cape Government.

4. RESULTS

Cases for this study were identified from birth records in the labour wards and operative theatres at New Somerset and Mowbray Maternity Hospitals. In total, 124 cases met the inclusion criteria. Complete sets of maternal and neonatal folders were found for 112 cases. 11 maternal folders were not found and information was then obtained from the corresponding neonatal folders.

One neonatal folder was not obtained, which belonged to a second twin in the Planned Vaginal Delivery group. This particular neonate was known to have a 5 minute Apgar score of less than 7 from the maternal record and the labour ward register and is thus included in the total number for the neonatal composite calculation. The available data were used for analysis.

The data were analysed according to planned mode of delivery based on an intention to treat analysis. There were 95 cases in the planned vaginal delivery group, and 29 cases in the planned caesarean section group.

4.1 MATERNAL CHARACTERISTICS

The maternal demographic characteristics are presented in Table 1. The mean age of participants was 27.8 (±5.6) years, with no difference between the planned vaginal delivery (PVD) and planned caesarean section (PCS) groups, and over half of participants were between 20 and 29 years of age. About 40% were between 30 and 39 years of age, and less than 10% were younger than 20 years of age.

Most participants were parous, with at least one previous delivery, and 14 (11.3%) had one previous caesarean section delivery. No participants in the planned vaginal delivery group had a previous caesarean section. There was a prevalence of 48.3% of participants in the planned caesarean section group who had a previous caesarean section delivery. The association of a previous caesarean section and a subsequent planned caesarean section was statistically significant ($p < 0.0001$). This is an important but not surprising finding.

The overall HIV prevalence was 21%. The planned vaginal delivery group had a higher prevalence of 23.2% and the planned caesarean section group had a prevalence of 13.8%. This difference was not found to be statistically significant (p=0.278). There were 3 cases of syphilis present in the study population, and they were all in the planned vaginal delivery group. All received treatment antenatally. There was no difference in the median booking haemoglobin levels across the two groups. Both groups had a median haemoglobin of 11g/dL.

Table 1 - Maternal Characteristics

		PVD n=95	**PCS n=29**	**p-value**	**Total = 124**
Age, mean in years (±SD)		27.5 (±5.6)	28.7(±5.4)	0.327	27.8 (±5.6)
Percentage distribution	<20y	8.4	3.4		7.3
	20-29y	53.7	55.2		54
	30-39y	36.8	41.4		37.9
Gravidity, median (IQR)		2(1-3)	2(2-3)	0.605	2(1.5-3)
Parity, median (IQR)		1(0-2)	1(1-2)	0.331	1(0-2)
Previous CS, n (%)		0	14 (48.3)	<0.0001	14 (11.3)
HIV status, n (%)		22 (23.2)	4 (13.8)	0.278	26 (21.0)
Syphilis status, n (%)		3 (3.2)	0	1.000	3 (2.4)
Booking Hb, median (IQR)		11(10.2-11.9)	11 (10.2-11.9)	0.955	11 (10.2-11.9)

(**CS** caesarean section**, Hb** haemoglobin in g/dL**, IQR** interquartile range)

4.2 PREGNANCY AND FETAL CHARACTERISTICS

The median gestational age at delivery was 36 weeks across the entire study population. There was a difference of one week between the two groups, 36 weeks for the planned vaginal delivery group and 37 weeks for the planned caesarean section group. This difference was not statistically significant (p=0.593). The earliest delivery occurred at 29 weeks in the planned vaginal delivery group, and at 30 weeks in the planned caesarean section group. No deliveries were observed beyond 40 weeks in either group. See Table 2.

About two thirds of all pregnancies were dichorionic diamniotic (DCDA), with a slightly higher percentage in the planned vaginal delivery group (63.2%) than the planned caesarean section group (58.6%). Twenty percent of pregnancies were monochorionic

diamniotic (MCDA), and this was consistent between the two groups. There were 22 (17.7%) pregnancies with undetermined chorionicity, but all were diamniotic. These associations were not statistically significant (p=0.876). There were no monochorionic monoamniotic (MCMA) pregnancies as this formed part of the exclusion criteria.

The most recent estimated fetal weight by ultrasound between the two groups were similar with a mean of 2261.1g and 2297.5g for the leading twin, and 2153.4g and 2343g for the second twin, in the planned vaginal delivery and planned caesarean section groups respectively.

Over half of all pregnancies had cephalic-cephalic presentations at time of delivery. In the planned vaginal delivery group, 55.8% had a cephalic-cephalic presentation at the time of delivery, while the planned caesarean section group had a lower rate of 41.4%. The rest of the presentations were cephalic-other, which included mostly cephalic-breech and cephalic-transverse presentations. The difference was not statistically significant (p=0.174).

Table2 - Pregnancy and fetal characteristics

		PVD (95)	PCS (29)	p-value	Total (124)
GA, median (IQR) in weeks		36 (34-38)	37 (34-38)	0.593	36 (34-38)
Chorionicity, n (%)	DCDA (%)	60 (63.2)	17 (58.6)	0.876	77 (62.1)
	MCDA (%)	19 (20.0)	6 (20.7)		25 (20.2)
	Unknown	16 (16.8)	6 (20.7)		22 (17.7)
EFW, mean (±SD) in grams	1st twin (±1SD)	2161.1 (±491.4)	2297.5 (±524)	0.417	2197
	2nd twin (±1SD)	2153.4 (±471)	2343 (±597.4)	0.076	2204
Presentation, n (%)	CC	53 (55.8)	12 (41.4)	0.174	65 (52.4)
	CO	42 (44.2)	17 (58.6)		59 (47.6)

(**CC** cephalic-cephalic, **CO** cephalic-other, **EFW** estimated fetal weight, **GA** gestational age)

4.3 LABOUR AND DELIVERY CHARACTERISTICS

Of the 95 cases in the planned vaginal delivery group, 58 (61.1%) proceeded to vaginal delivery of both twins, 28 (29.5%) were delivered via caesarean section, and 9 (9.5%) resulted in a combined delivery, where the first twin was delivered vaginally and the second via caesarean section. The indications for caesarean section were fetal distress (37.8%), failure to progress (32.4%), retained twin (13.5%) and failed induction of labour (5.4%). Five caesarean sections were performed prior to the onset of labour in this group, and were done for the reasons of fetal distress and failed induction of labour. These 5 cases were analysed as planned vaginal deliveries. See Table 3.

In the planned caesarean section group, 27 (93.1%) delivered via caesarean section. Seven patients went into labour prior to planned elective caesarean section, and two of these delivered vaginally. The differences in the modes of delivery in the two groups showed statistical significance ($p<0.0001$).

Spinal anaesthesia was the most common form of anaesthetic. In the planned vaginal delivery group, spinal anaesthesia was used for a third of caesarean sections, 4% had general anaesthesia, and 2.1% had spinal anaesthesia that needed conversion to general anaesthesia. The planned caesarean section group had almost 90% of caesarean sections done under spinal anaesthesia, only one case had general anaesthesia, and no cases required conversion from spinal to general anaesthesia. This difference was statistically significant ($p=<0.0001$).

The inter-twin delivery intervals were markedly different between the two groups. The median delivery interval in planned vaginal delivery group was 10 minutes, with an interquartile range of 1-207 minutes. In the planned caesarean section group, the median delivery interval was 2 minutes, with an interquartile range of 1-5 minutes. This difference was statistically significant ($p=<0.0001$).

There was no difference in birthweight between the two groups. The mean birthweight for the first-born twins were 2318.1g (±526.2) and 2352.5g (±524.1) in the planned vaginal delivery and planned caesarean section groups respectively, and 2251.6g (±507.5) and 2264.2g (±513.9) for the second twins.

Table 3 - Labour and delivery Characteristics

		PVD (95)	PCS (29)	p-value	Total
Actual MOD, n (%)	VD	58 (61.1)	2 (6.9)	**<0.0001**	60 (48.4)
	CS	28 (29.5)	27 (93.1)		55 (44.4)
	CD	9 (9.5)	0		9 (7.3)
Timing of CS, n (%)	Prelabour	5 (5.3)	21 (72.4)	**<0.0001**	26 (21.0)
	Intrapartum	32 (33.7)	6 (20.7)		38 (30.7)
Anaesthetic, n (%)	Spinal	30 (31.6)	26 (89.7)	**<0.0001**	56 (45.2)
	GA	4 (4.2)	1 (3,5)		5 (4.0)
	Sp/GA	2 (2.1)	0		2 (1.6)
	None	58 (61.1)	2 (6.9)		60 (48.4)
Delivery interval, median (IQR) minutes		10 (1-207)	2 (1-5)	**<0.0001**	5.5 (1-207)
BW1 (g), mean (±SD)		2318.1 (±526.2)	2352.5 (±524.1)		2318.1 (±526.2)
BW2 (g), mean (±SD)		2251.6 (±507.5)	2264.2 (±513.9)		2251.6 (±507.5)

(**BW1** birth weight of first twin, **BW2** birth weight of second twin, **CD** combined delivery, **CS** caesarean section, **GA** general anaesthetic, **Sp/GA** spinal anaesthesia converted to general anaesthesia, **MOD** mode of delivery, **VD** vaginal delivery)

4.4 NEONATAL OUTCOME

190 infants were delivered in the planned vaginal delivery group and 58 in the planned caesarean section group. The composite neonatal score calculated for neonatal complications in the two groups were 67 (35.2%) and 18 (32.8%) respectively. The difference was not statistically significant (p=0.955). When sepsis was excluded, these numbers decreased to 40 (21.1%) and 17 (29.3%). This relative increase in neonatal complications in the planned caesarean section group compared to the planned vaginal delivery group did not show statistical significance (p=0.092. This may have clinical significance as the diagnosis of sepsis in the planned vaginal delivery group was mostly a presumptive diagnosis, and not always confirmed as the aetiology of preterm birth. It is also known that twin gestation itself is an important risk factor for preterm birth even in the absence of sepsis. (See Table 4).

The two most serious complications, death and hypoxic ischaemic encephalopathy (HIE), occurred in the planned vaginal delivery group only. There was one intrapartum death (p=0.580), and three neonates were confirmed to have hypoxic ischaemic

encephalopathy (p=0.336). The correlation was not statistically significant, but their occurrence in the planned vaginal delivery group only may influence the decision regarding mode of delivery.

There were no statistically significant differences in the following outcomes between the planned vaginal delivery and the planned caesarean section groups: Low 5-minute Apgar score of less than 7 (4.2 vs 3.4%), ICU admissions (13.7 vs 13.8%), respiratory distress syndrome, including transient tachypnoea (2.6 vs 6.9%) and intraventricular haemorrhage (0.5 vs 0%).

The two neonatal complications that displayed statistical difference between the two groups were sepsis and assisted ventilation and intubation longer than 24 hours. The former showed a high rate of sepsis in the planned vaginal delivery group (14.8 vs 3.4%, p=0.026). For the latter, there were no cases in the planned vaginal delivery group but two cases (3.4%) in the planned caesarean section group (p=0.010) required assisted ventilation.

There were no incidences of birth trauma in either group.

On further assessment of the data, in the group of neonates that contributed to the neonatal composite score, it was found that there were many cases of undiagnosed growth discordance.

In the planned vaginal delivery group, 7 twin gestations (10.4%) had growth discordance of >20% at birth, and of these, only one could be identified antenatally on ultrasound estimated fetal weight. The other 6 cases had no significant discordance antenatally on estimated fetal weight, but at birth one set of twins had weight discordance as great as 43,2% (birth weights of 3240g for the first twin and 1840g for the second). Antenatally, the difference in ultrasound estimated fetal weight for this pair was 17.4%.

In the planned caesarean section group 2 of the 18 neonates that formed part of the composite score for that group had significant growth discordance (of greater than 20%). One of these twin pairs were undiagnosed antenatally. The growth discordance

at birth was 20.7%. The other was diagnosed antenatally with an ultrasound estimated fetal weight discordance of 29.8%, went into spontaneous labour but developed fetal distress and had a caesarean section as initially planned. The growth discordance of this pair at birth was 31.6%. In this study it was found that the association of growth discordance with an adverse neonatal event was not statistically significant (p=0.839). See Table 5.

Table 4 - Neonatal outcome

Characteristic	Planned NVD (n=190)	Planned CS (n=58)	p-value	Total (n=248)
Neonatal complications, n (%)	67 (35.2)	18 (31.0)	0.955	85 (34.3)
Neonatal complications excluding sepsis, n (%)	40 (21.1)	17 (29.3)	0.092	57 (23.0)
1st Twin: $Apgar_5$ <7, n (%)	3/95 (3.2)	1/29 (3.5)	1.000	4 (3.2)
2nd Twin: $Apgar_5$ <7, n (%)	5/95 (5.3)	1/29 (3.5)	1.000	6 (4.8)
$Apgar_5$ < 7 @ 5 mins, n (%)	8 (4.2)	2 (3.4)	0.796	10 (4.0)
Death, n (%)	1 (0.5)	0	0.580	1 (0.4)
Birth trauma	0	0	-	0
ICU Admissions, n (%)	26 (13.7)	8 (13.8)	0.983	34 (13.7)
Respiratory distress, n (%)	5 (2.6)	4 (6.9)	0.129	9 (3.6)
HIE, n (%)	3 (1.58)	0	0.336	3 (1.2)
Assisted vent / ETT >24 hours, n (%)	0	2 (3.4)	**0.010**	2 (0.8)
Neonatal sepsis, n (%)	27 (14.8)	2 (3.4)	**0.026**	29 (11.7)
IVH, n (%)	1 (0.5)	0	0.580	1 (0.4)

(**$Apgar_5$** 5 minute Apgar score, **ETT>24** intubation and ventilation > 24 hours, **HIE** hypoxic-ischaemic encephalopathy, **IVH** intraventricular haemorrhage)

Table 5 - Growth Discordance

Discordance >20%	**Adverse neonatal outcome**		
	None n=64 (%)	In one twin	In both twins
Absent	57 (89.1)	22	13
Present	7 (10.9)	4	2

p = 0.839

4.5 MATERNAL OUTCOME

There were 14 (14.7%) maternal complications in the planned vaginal delivery group and 4 (13.8%) in the planned caesarean section group. There were no maternal deaths in this study. See table 6.

There were no statistically significant differences in any of the following maternal complications between the planned vaginal delivery and planned caesarean section groups: postpartum haemorrhage > 1000ml (9.5 vs 10.3%, p=0.890), blood transfusion (8.4 vs 6.9%, p=0.792), sepsis (2.1 vs 3.4%, p=0.680), uterine evacuation (1.1 vs 0%, p=0.579) and total abdominal hysterectomy (1.1 vs 0%, p=0.579).

The median hospital stay was 1 day longer in the planned caesarean section group, and showed statistical significance (p<0.001).

Table 6 - Maternal Outcome

Characteristic	Planned NVD (n=95)	Planned CS (n=29)	p-value	Total (n=124)
Maternal death, n (%)	0	0	-	0
PPH > 1000ml, n (%)	9 (9.5)	3 (10.3)	0.890	12 (9.7)
Blood transfusion, n (%)	8 (8.4)	2 (6.9)	0.792	10 (8.1)
Sepsis, n (%)	2 (2.1)	1 (3.4)	0.680	3 (2.4)
Uterine evacuation, n (%)	1 (1.1)	0	0.579	1 (0.8)
TAH, n (%)	1 (1.1)	0	0.579	1 (0.8)
Admission (days), median (IQR)	2 (1-3)	3 (3-4)	<0.001	3 (1-3)

(**PPH** post-partum haemorrhage, **TAH** total abdominal haemorrhage)

4.6 MODEL THAT PREDICTS THE NEONATAL OUTCOME FROM THE COMPOSITE SCORE

The mode of delivery did not result in any statistically significant difference in fetal or maternal outcome. The major factor predicting mode of delivery was previous caesarean section. From Table 7 below, we can see that the factors that affect neonatal outcome are EFW, maternal parity and HIV status.

From the multivariate analysis, we observe the following:

1. For every 100g increase in the EFW, there is a 27% decrease in the relative odds of a recorded neonatal outcome holding other variables constant (p<0.0001).
2. With every pregnancy experienced by the mother, there is a 32% decrease in the relative odds of a recorded neonatal outcome holding other variables constant (p 0.024-0.075).
3. The odds of recording a neonatal outcome in those whose mothers are HIV positive are 2.21 times the odds of those with HIV negative mothers holding other variable constant (p 0.909 – 0.200).

Table 7 - Model that best predicts the neonatal outcomes from composite score

	Univariate analysis		Multivariate analysis	
Characteristic	OR (95% CI)	p-value	OR (95% CI)	p-value
EFW/100 (max)	0.75 (0.67 – 0.84)	<0.0001	0.73 (0.65 – 0.83)	<0.0001
Parity	0.83 (0.60 – 1.16)	0.024	0.68 (0.44 – 1.04)	0.075
HIV status	1.05 (0.44 – 2.51)	0.909	2.21 (0.66 – 7.48)	0.200

4.7 RISKS AND ASSOCIATIONS FOR A COMBINED DELIVERY

All of the cases that resulted in a combined delivery were from the planned vaginal delivery group. The two cases that delivered vaginally in the planned caesarean section group did not have any adverse outcome. For the participants with a combined delivery the mean maternal age was 29 (±5.5) years with a mean parity of 1.4 (±0.9) and mean gestational age of 34.4 (±3.4) weeks. Compared to the study population, the maternal age was about one year older, and the gestational age was one week less. (see Table 8).

Two women had HIV infection (22.2%). The incidence was similar to that of the study population. One tested for positive for syphilis, and received treatment.

With respect to chorionicity, seven were DCDA, one was MCDA and one was of undetermined chorionicity. The mean estimated fetal weight by ultrasound scan, was 2053.5 (±458.4) grams for the first twin, and 2065 (±493.8) grams for second twin.

The presentation of the twins were cephalic-cephalic (n=3) and cephalic-breech (n=6). The indications for caesarean delivery after vaginal delivery of the first twin were retained twin (n=5), fetal distress (n=2), and two were of unclear indication, which may have included transverse lie, cord prolapse or compound presentation of the second twin. The median inter-delivery interval was 82 minutes (IQR 65-83). Four cases were performed under spinal anaesthesia (44.5%), three required general anaesthetic (33.3%) and two required conversion from spinal to general anaesthesia (22.2%).

Twelve (66.7%) of the eighteen neonates delivered had one or more complications. Four of the first born twins had neonatal complications, which included neonatal ICU admission for respiratory distress, low birth weight and sepsis. Eight of the nine second-born twins had neonatal complications. These included neonatal ICU admission for respiratory distress, sepsis, hypoxic ischaemic encephalopathy, and low 5-minute Apgar score. There were no neonates in this group that required intubation and ventilation for longer than 24 hours.

Maternal complications included one post-partum hysterectomy for haemorrhage. The median length of admission following delivery was 3 days (IQR 3-3.5).

Table 8 - Risks and associations for a combined delivery

Characteristic	Distribution	Study population (n=124)
Maternal age, mean (±SD)	29 (±5.5)	27.8 (±5.6)
Parity, mean (±SD)	1.4 (±0.9)	1
Gestation, mean (±SD)	34.4 (±3.4)	36
HIV positive, n (%)	2 (22.2)	26 (21.0)
Syphilis positive, n (%)	1 (11.1)	3 (2.4)
Hb, mean (±SD)	11.7 (±2.2)	11
Chorionicity, n (%)		
DCDA	7 (77.8)	77 (62.1)
MCDA	1 (11.1)	25 (20.2)
Unknown	1 (11.1)	22 (17.7)
Previous CS, n (%)	0	14 (11.3)
EFW1 (g), mean (±SD)	2053.5 (±458.4)	2197
EFW2 (g), mean (±SD)	2065 (±493.8)	2204
Indication for CS, n (%)		
Fetal distress	2 (22.2)	
Retained twin	5 (55.6)	
Other (indication not clear)	2 (22.2)	
Presentation, n (%)		
Cephalic-cephalic	3 (33.3)	65 (52.4)
Cephalic-breech	6 (66.7)	59 (47.6)
BW1 (g), mean (±SD)	2089.4 (±691.7)	2318.1 (±526.2)
BW2 (g), mean (±SD)	2202.2 (±566.9)	2251.6 (±507.5)
Twin a: Apgar$_5$ <7, n (%)	0	4 (3.2)
Twin b: Apgar$_5$ <7, n (%)	2 (22.2)	6 (4.8)
Twin b: Cord gas, mean (±SD)	7.18 (±0.1)	
Inter-twin delivery interval, median (IQR)	82 (65-83)	5.5 (1-207)
Anaesthetic, n (%)		
Spinal	4 (44.5)	56 (45.2)
General anaesthetic	3 (33.3)	5 (4.0)
Sp/GA	2 (22.2)	2 (1.6)
ICU Admissions (twin 1), mean (±SD)	1.7 (±2.7)	
ICU Admissions (twin 2), mean (±SD)	1.6 (±1.7)	
Neonatal complications (twin 1), n (%)	4 (44.4)	39 (31.5)
Neonatal complications (twin 2), n (%)	8 (88.9)	46 (37.1)
Maternal TAH, n (%)	1 (11.1)	1 (0.8)
Admission (days), median (IQR)	3 (3-3.5)	3 (1-3)

(**BW1 and 2** birth weight of first and second twins, **CS** caesarean section, **EFW1 and 2** Estimated fetal weight of first and second twins by ultrasound, **Hb** haemoglobin in g/dL, **Sp/GA** conversion from spinal to general anaesthetic, **TAH** total abdominal hysterectomy)

5. DISCUSSION

The Twin Birth Study, a multicentre randomized control trial, showed that neonatal and maternal outcomes were not significantly affected by mode of delivery in twin gestations with a cephalic presenting leading twin, in the absence of any contra-indication to vaginal delivery[1]. Our study, despite being retrospective and small in number, reflects the same outcome. The composite score of neonatal complications between a group of twin gestations having a planned vaginal delivery and a group having a planned caesarean section, showed no statistically significant difference (33.2% and 32.88% respectively, p=0.955). Likewise a lack of statistically significant difference in maternal outcome between the two groups was also demonstrated.

In our study, there was no statistical difference in neonatal outcome based on the composite neonatal scores between the planned vaginal delivery and planned caesarean section groups (35.2% and 32.9% respectively, p=0.955) according to mode of delivery. In the planned vaginal delivery group there was a higher rate of neonatal sepsis than the planned caesarean section group (14.2% and 3.4%, p=0.026). Most cases were presumed sepsis as a cause for preterm labour, thus adjusting the composite score to exclude sepsis as a complication, the difference in neonatal composite scores still did not reach statistical significance (18.9% and 29.3%, p=0.092).

There was no significant difference in the following neonatal outcomes, 5 minute Apgar score < 7, ICU admission, respiratory distress syndrome, and intraventricular haemorrhage. The complications of HIE and intrapartum death also did not reach statistical significance, but only occurred in the planned vaginal delivery group. This may carry clinical significance as the more serious complications occurred in the planned vaginal delivery group.

Planned caesarean section was associated with a higher risk of respiratory morbidity. The incidence of respiratory distress syndrome was not significantly different between the two groups, but the incidence of intubation and assisted ventilation greater than 24 hours was higher in the planned caesarean section group and reached statistical significance (p=0.010).

With respect to neonatal outcome, placentation and chorionicity affects that of twin pregnancies, and also determines timing of delivery[5, 6, 7, 8]. Between the PVD and the PCS groups, there was a statistically insignificant difference between the number of DCDA pregnancies, MCDA pregnancies and pregnancies of undetermined chorionicity, at the time of delivery in each of the two groups.

According to Burgess et al, the ideal time for delivery of DCDA and MCDA twin gestations are 38 and 37 weeks respectively[22]. In the two study groups, the median gestational age at delivery was 36 weeks (IQR 34-38) in the planned vaginal delivery group and 37 weeks (IQR 34-38) in the planned caesarean section group. This difference was not significant (p=0.593). However, this differs from what is expected as awaiting spontaneous labour in the planned vaginal delivery group should result in a later gestational age at delivery than that of the planned caesarean section group. The main reason for preterm deliveries in both the planned vaginal delivery and planned caesarean section groups was spontaneous preterm labour, which was presumed to be due to underlying sepsis.

Growth discordance, with a smaller second twin, of greater than twenty-five percent, is associated with a 4-fold increase in the risk of perinatal death of the second twin according to Luo et al[21]. In the PCS group there were only two elective caesarean sections planned for the indication of growth discordance, and of these two, only one of them were accurately diagnosed on antenatal ultrasound. The other had a growth discrepancy of 17%, which is an acceptable difference.

Of the neonates that contributed to the composite score, there were several cases of undiagnosed growth discordance. In the planned vaginal delivery group, 7 twin gestations (10.4%) had growth discordance of >20% at birth. One of these sets of twins had a weight discordance as high as 43.2% (birth weights of 3240g for the first twin and 1840g for the second), but the difference in the ultrasound estimated fetal weight for this pair was only 17.4%.

In the planned caesarean section group, two of the eighteen neonates that contributed to the composite score had growth discordance of 20.7% and 31.6%. One was not detected antenatally, but the latter was diagnosed antenatally, with an ultrasound estimated fetal weight discordance of 29.8% and was for planned caesarean section. Spontaneous labour ensued, but resulted in a caesarean section for fetal distress.

Undiagnosed growth discordance is a potential confounding factor, but it was found that the association of growth discordance and an adverse neonatal event was not statistically significant in this study (p=0.839).

Undiagnosed growth discordance, despite ultrasound estimates of fetal weight, may arise from the technical difficulty of performing an ultrasound for twin gestations. This may lead to decreased accuracy of estimated fetal weight. It also highlights the need for skills training of ultrasonographers or the need for a dedicated ultrasound service for twin pregnancies.

Other factors affecting adverse outcome in the second twin include prolonged inter-twin delivery interval and a combined delivery[15, 16, 17.]

There was a significant difference in the median inter-twin delivery interval in the planned vaginal delivery and planned caesarean section groups, 10 minutes and 2 minutes respectively. The inter-quartile range in the planned vaginal delivery group was 1-207 minutes.

In our study, the combined delivery rate was 9.5% and all cases occurred in the planned vaginal delivery group. The demographic of patients was similar to that of the whole study population. The mean gestational age at birth was 34.4 weeks, about one week less than the planned vaginal delivery group and two weeks less than the planned caesarean section group.

There was also a higher proportion of non-cephalic second twins in this group. Of the 9 pregnancies that proceeded to a combined delivery, 3 had cephalic-cephalic presentations, and 6 had cephalic-breech presentations. The median twin inter-delivery time was 82 minutes (IQR 65-83 minutes) and was much higher with combined delivery compared to the planned vaginal delivery and planned caesarean section groups (10 minutes and 2 minutes respectively).

The indication for combined delivery was mostly for retained twin and fetal compromise of the second twin. It was also more likely that the caesarean section was done under general anaesthesia, and that if spinal anaesthesia was done, there was a higher chance of conversion to general anaesthesia.

With combined delivery, there was a higher rate of neonatal complications in the second twin compared to first (88.9% and 44.4% respectively) and when compared to the entire study population (88.9% and 37% respectively). The only maternal post-partum total abdominal hysterectomy followed a combined delivery.

The numbers were too small to detect statistical significance, but combined delivery was associated with planned vaginal delivery, non-cephalic presenting second twin, and lower gestational age at delivery, prolonged inter-twin delivery interval, higher risk of general anaesthesia and conversion of spinal to general anaesthesia, higher rate of morbidity in the second twin and an increased risk for maternal morbidity.

The risk of combined delivery and its consequences should also be taken into account when counselling patients about mode of delivery especially if the second twin is non-cephalic.

From the multivariate analysis, the factors that were associated with an adverse neonatal outcome included estimated fetal weight, maternal parity and HIV infection.

For every 100g increase in the EFW, a 27% decrease in the relative odds of a recorded neonatal outcome was shown, holding other variables constant ($p<0.0001$). It can therefore be assumed that increased gestational age at birth would lead to a decreased risk of an adverse neonatal event.

It was also shown that with every pregnancy experienced by the mother, there was a 32% decrease in the relative odds of a recorded neonatal outcome holding other variables constant (p 0.024-0.075). There was no difference in gravidity and parity between the two groups in this study.

The odds of recording a neonatal outcome in those whose mothers are HIV positive were 2.21 times the odds of those with HIV negative mothers holding other variable constant (p 0.909 – 0.200). In this study there was no significant difference between the rate of HIV infection between the planned vaginal delivery and planned caesarean section groups (23.2% and 13.8% respectively, $p=0.278$).

Thus, greater birthweight and later gestational age is predictive of better neonatal outcomes and a maternal positive HIV status increases the risk of an adverse neonatal outcome.

Our study found little variation in maternal age, gravidity and parity between the two groups. The mean maternal age was 27.8 years, and the median gravidity and parity were 2 and 1 respectively. No participants in the planned vaginal delivery group had a previous caesarean section, but the planned caesarean section group had a previous caesarean section rate approaching 50%. The previous caesarean section rate was the only variable statistically associated with planning a vaginal or caesarean section delivery. It is therefore assumed that no other variable was in the causal pathway mediating the association between a planned caesarean section and the different neonatal and maternal outcomes.

Of the 124 cases identified, 95 were planned vaginal deliveries and 29 were planned caesarean sections. This differs from our initial assumption when calculating the required sample size. From the initial calculation, the assumption was made that twin pregnancies were twice as likely to be delivered via caesarean section as vaginal delivery. However, after cases that had contra-indications to vaginal delivery were excluded, there was a greater amount of planned vaginal deliveries than caesarean sections. It appears that it is more likely that cephalic presenting twin gestations have planned vaginal deliveries than planned caesarean sections at MMH and NSH. For our sample size estimation we predicted that the risk of an adverse neonatal outcome in the exposed group (planned vaginal delivery) would be 15% and in the unexposed group (planned caesarean section) would be 3%. In our study, the rates of an adverse neonatal outcomes were 35.2% and 31% respectively. This would mean that if future research is undertaken, preferably a randomised control trial, the sample size for each group should be the same.

In the planned vaginal delivery group, 62.1% delivered vaginally, 29.5% delivered by caesarean section and 9.5% by combined delivery. In the planned caesarean section group, 93.1% delivered by caesarean section, and 6.9% delivered vaginally. The difference in mode of delivery reached statistical significance ($p<0.0001$).

There seemed to be a correlation between presentation of the second twin and planned mode of delivery, and that a planned caesarean section was more likely if the second twin was non-cephalic. In the planned vaginal delivery group 55.8% were cephalic-cephalic,

compared to 41.4% in the planned caesarean section group. However, the difference was not significant (p=0.174).

The mode of anaesthesia showed statistically significant difference between planned vaginal delivery and planned caesarean section (p<0.0001). It was found that with planned vaginal delivery, there was a higher likelihood that the resultant emergency caesarean section would be done under general anaesthesia (10.8%), and also a higher risk of spinal anaesthesia requiring conversion to general anaesthesia (8.1%). With planned caesarean section, the rate of general anaesthesia was 3.1% and there were no cases requiring conversion of spinal to general anaesthesia.

The Twin Birth Study showed that there is no significant difference in maternal mortality and morbidity in twin gestations with a cephalic leading twin according to planned mode of delivery[1]. In our study, there was no statistically significant differences in maternal outcome between planned vaginal delivery and planned caesarean delivery. There were no maternal deaths in either group. There was no significant difference in the planned vaginal delivery and planned caesarean section groups between PPH > 1000ml (9.5% and 10.3% respectively, p=0.890), blood transfusion (8.4% and 6.9% respectively, p=0.792), post-partum sepsis (2.1% and 3.4% respectively, p=0.680), uterine evacuation (1.1% and 0 respectively, p=0.579) and total abdominal hysterectomy (1.1% and 0 respectively, p=0.579). The median length of admission post-delivery was 3 days in the planned caesarean section group, which was 1 day longer than the planned vaginal delivery group (p<0.001).

Despite no statistical difference in maternal outcome, there may be clinical significance that the only post-partum hysterectomy occurred in the planned vaginal delivery group. The rate of sepsis may also be underrepresented from the data collected at Mowbray Maternity Hospital, as post-partum sepsis often manifests two to three days or more after delivery or may only be apparent following discharge from hospital. In these instances, these patients will not be readmitted to Mowbray Maternity Hospital, but will referred and seen directly at the tertiary referral hospital, Groote Schuur hospital. The information will therefore not be available in the Mowbray Maternity Hospital file.

The strengths of this study was that data were available in hospital records, both in patient folders and in the labour ward and theatre delivery books, and there was no need to recruit patients and take individual consent to conduct the study.

The limitations of this study is that it was retrospective and was therefore affected by poor record keeping, both in patient files and in labour ward and theatre registers. Availability of data depended on location and retrieval of patient folders. At one of the hospital sites the filing system of folders was not optimal, and resulted in missing folders. This highlighted the importance of accurate documentation in patient files and the need for systems that allow easy retrieval of patient records. An alternative would be an electronic delivery database.

The results of this study are in keeping with the findings of the Twin Birth Study with respect to neonatal and maternal outcomes in twin gestations with a cephalic presenting first twin and the planned mode of delivery.

The more serious complications occurred in the planned vaginal group. These complications included intrapartum death, hypoxic ischaemic encephalopathy of the fetus or neonate, and post-partum hysterectomy of the mother. It should be noted that a planned vaginal delivery with a non-cephalic second twin is associated with the risk of a combined delivery. This places the neonate and mother at higher risk of perinatal morbidity. A planned caesarean section was associated with more severe respiratory morbidity and in this study the risk of intubation and ventilation was higher in this group.
This study may reflect a different outcome if the composite scoring for adverse neonatal outcome was weighted. Thus, the more serious complications would have a greater impact on the composite score. This is a potential limitation.

It is therefore important to counsel patients thoroughly regarding the risks of twin delivery so that an informed decision can be made and patient autonomy respected. Although the composite scores of neonatal and maternal morbidity show no statistical significance, it has to be taken into consideration that the more severe complications, neonatal and maternal, occurred with planned vaginal delivery.

A method of improving these outcomes is to perform more vaginal twin deliveries in the obstetric theatre. This will result in a doctor, midwife and anaesthetist being present in

theatre and any complications can then be promptly acted on. This will shorten inter-twin delivery interval and contribute to improved outcome, it will also ensure that in the event of any obstetric emergency there will be sufficient staff on hand.

Staff, including doctors and midwives, should be trained to conduct twin deliveries. Active management of the second twin should be taught, which will also contribute to a decrease in the inter-twin delivery interval[9]. This could be done in the form of clinical drills. In addition, the most skilled midwives and doctors should be the ones conducting or overseeing a vaginal twin delivery.

A problem encountered in our study was a high number of undiagnosed growth discordance in study subjects. It is known that significant growth discordance with a smaller second twin is associated with a higher risk of an adverse outcome in the second twin[21]. It is important to ensure that skilled ultrasonographers scan twin pregnancies. In the public sector, the obstetric ultrasound service is often overburdened and care should be taken that only necessary ultrasound scans get done. Patients sent for ultrasound scans should be triaged by the senior doctor in the antenatal clinic. This will help to ensure that patients, especially those with twin gestations, can receive extra care during their ultrasound examinations.

Patients should be educated and encouraged to commence their antenatal care early, prior to 14 weeks, so that an early ultrasound can be done to determine gestational age and chorionicity if a twin pregnancy is diagnosed.

In conclusion, as a preliminary study, the outcome of our study parallels that of the Twin Birth Study. The Twin Birth Study is therefore relevant to our public sector setting at Mowbray Maternity and New Somerset Hospitals. With adequate patient counselling and skilled intrapartum care, a vaginal delivery of a twin gestation with a cephalic presenting leading twin is a feasible option in our setting. It also is acceptable that a planned caesarean section be undertaken if the patient desires it.
However, for a more accurate assessment of our obstetric service with respect to twin pregnancies and deliveries, a randomised control trial should be conducted.

Addendum A: Data Collection Sheet

Patient folder number	
Twin A	
Twin B	
Study number	
date of delivery	
age	
gravidity	
parity	
gestation	
gestagemode 1=dates 2=eus 3=lus 4=sfh	
hiv 1=neg 2=pos	
syphilis 1=pos 2=neg	
bloodgrp 1=A 2=B 3=O 4=AB	
rhesus 1=pos 2=neg	
bookhb g/dl	
chorionicity 1=dcda 2=mcda 3= mcma 4=unknown	
prevcs 1=no 2=yes	
EFW A grams	
EFW B in grams	
planmode 1=nvd 2=csection	
actualmode 1=nvd 2=csection 3=combined	
timecs 1=prelab 2=lab 3=na	
indication cs	
presentation 1=cc 2=cbr 3=ctv 4=co 5=brc 6=brbr 7=bro	
apgar1a	
apgar5a	
apgar10a	

apgar1b	
apgar5b	
apgar10b	
cordgasa pH 99 for unknown	
cordgasb pH 99 for unknown	
birthwta	
birthwtb	
timeofdela	
timeofdelb	
intertwdeltime	
anaes 1=spinal 2=ga 3=epidural	
outcomea 1=alive 2=sb 3=ennd 4=lnnd	
outcomeb 1=alive 2=sb 3=ennd 4=lnnd	
nicua days	
nicub days	
nnt compl a 1=hmd 2=ttn 3=hie 4=sepsis 5=other	
nnt compl b 1=hmd 2=ttn 3=hie 4=sepsis 5=other	
mat compl 1=none 2=pph>1000 3=sepsis 4=hpt 5=evac 6=other	
lengthadm post del days	
pph>1000 1=yes 2=no	
bldtf 1=yes 2=no	

Addendum B

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

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Observatory 7925
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Website: www.health.uct.ac.za/fhs/research/humanethics/forms

20 April 2015

HREC/REF: 244/2015

Dr G Petro
Obstetrics & Gynaecology
H-45
OMB

Dear Dr Petro

Project Title: OUTCOME OF TWIN DELIVERIES AT LEVEL II HOSPITALS WITHIN THE METROWEST CAPE TOWN HEALTH DISTRICT (Dr A Schroeder)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above mentioned study.

Approval is granted for one year until the 28 April 2016.

Please only include retrospective data up till April 20th, 2015.

Please submit a progress form, using the standardised Annual Report Form, if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

We acknowledge that the following student:-Dr Amaal Schroeder is also involved in this project.

Please note that the on-going ethical conduct of the study remains the responsibility of the principal investigator.

Please quote the HREC REF in all your correspondence.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, HSF HUMAN ETHICS

Hrec/ref:244/2015

Federal Wide Assurance Number: FWA00001637.

Institutional Review Board (IRB) number: IRB00001938

This serves to confirm that the University of Cape Town Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Convention on Harmonisation Good Clinical Practice (ICH GCP) and Declaration of Helsinki guidelines.

The Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Hrec/ref:244/2015

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