Obstetric causes for delivery of very-low-birth-weight babies at Tygerberg Hospital

E S Odendaal, D W Steyn, H J Odendaal

Objective. To determine the primary reasons for the delivery of very-low-birth-weight (VLBW) babies.

Design. Cross-sectional descriptive study.

Study period. 1 March 1997 - 31 August 1997.

Methods. Data were collected from all mothers who delivered babies weighing 500 - 1 499 g. The following primary causes were selected and clearly defined: spontaneous preterm labour, preterm prelabour rupture of membranes, hypertensive disease, antepartum haemorrhage, intrauterine death and congenital abnormalities. A total of 227 patients were admitted to the study. One patient was excluded from the study as the data in her file were inadequate. Of the remaining 226 patients, 210 had singleton pregnancies and 16 had twin pregnancies. In total 242 babies were delivered; however, 6 babies from the twin pregnancies were excluded from the analysis as they had a birth weight exceeding 1 499 g.

Results. Primary causes of delivery were hypertensive disease in 101 patients (44.7%), spontaneous preterm labour 65 (28.8%), preterm prelabour rupture of membranes 21 (9.3%), intrauterine death 17 (7.5%), antepartum haemorrhage 10 (4.4%), congenital abnormalities 3 (1.3%), and other 9 (4%). Of the hypertensive cases, 43 were delivered for fetal distress, 16 for fetal distress due to abruptio placentae, 20 for maternal reasons, 19 for intrauterine death and 3 for both fetal and maternal reasons.

Conclusion. Hypertension, preterm labour and prelabour rupture of membranes were the main causes of delivery of VLBW babies. Further research should address methods to reduce the number of these deliveries.

S Afr J Med 2003; **93:** 61-64.

Preterm delivery is the most important cause of perinatal mortality and morbidity in the developed world.[1] The prevalence of preterm delivery in First-World countries is 6 - 10%.[2] In developed countries very-low-birth-weight (VLBW) babies account for only 1 - 2.5% of all births.[3,4] However, more than half of prematurity-related deaths, morbidity and economic costs are due to VLBW neonates.[4]

The total perinatally related wastage at Tygerberg Hospital is 31.5 per 1 000 deliveries. Sixty per cent of these deaths are babies with a very low birth weight.[5] The mortality rate for severe respiratory distress syndrome is about 50%. The prevalence of other complications are periventricular haemorrhage (30%), patent ductus arteriosus (20%) and necrotising enterocolitis (5 - 10%).[3]

Although the mortality rate for VLBW babies has decreased over the past decades, there is still a high proportion of severely handicapped infants.[4] According to data from the National Institute of Child Health and Human Development (NICHD) neonatal networks, 90% of babies with a birth weight between 1 000 g and 1 500 g survived and only 20% had major handicaps. The survival rate was 77% for babies weighing 731 - 1 000 g, and the morbidity rate 35%. In the 501 - 750 g group, 39% survived, but 53% had major morbidity.[4]

VLBW babies are a group with heterogenic aetiologies and include neonates who are preterm, small for gestational age, or both.[3] Attempts to reduce the incidence of the delivery of very small babies can only succeed once the causes are identified. We conducted this study to determine the primary reasons for the delivery of VLBW babies at Tygerberg Hospital.

Patients and methods

A cross-sectional descriptive study was done at Tygerberg Hospital over a 6-month period. The decision that 6 months was sufficiently long was taken after reassessment of available departmental data sets which showed no seasonal variation in the occurrence of VLBW babies. Immediately after delivery, data were collected from files of mothers who delivered babies weighing between 500 g and 1 499 g. Data were charted on a data sheet which was then used for analysis. All live-born babies were also followed up for the first 7 days of the neonatal period.

The following primary causes were recorded and clearly defined.

1. Preterm labour — onset of labour before 37 completed weeks of gestation.

2. Preterm prelabour rupture of membranes (PPROM) — rupture of membranes before 37 completed weeks of gestation

Department of Obstetrics and Gynaecology, Tygerberg Hospital and University of Stellenbosch and Medical Research Council Unit for Perinatal Mortality, Tygerberg, W Cape

E S Odendaal, MB ChB, MMed (O & G)

D W Steyn, MB ChB, MMed (O & G), FCOG (SA), MD

H J Odendaal, MB ChB, MMed (O & G), FCOG (SA), MD, FRCOG

and at least 1 hour before the onset of contractions.

3. Hypertensive diseases were considered as primary cause when the delivery was attributed to the hypertensive condition or to the complications of its management. Hypertension was defined as a diastolic pressure of 90 mmHg, taken on two occasions at least 6 hours apart, or a single diastolic pressure of 110 mmHg. Pre-eclampsia was defined as hypertension in the presence of significant proteinuria, that is 2+ or more on urine Dipstix or > 300 mg in a 24-hour urine sample. When conditions such as abruptio placentae, fetal distress or intrauterine death occurred in patients with underlying hypertensive disease, the latter was considered to be the cause of delivery. The diagnosis of fetal distress, severe enough to warrant delivery, was made in the presence of fetal heart rate baseline variability of less than 5 beats per minute continuing for at least 60 minutes, or repeated late decelerations.

4. Antepartum haemorrhage included bleeding due to abruptio placentae, placenta praevia and antepartum haemorrhage of unknown origin. Patients with an underlying hypertensive condition were included in the hypertension group and excluded from the antepartum haemorrhage group.

5. Intrauterine deaths, stillbirths and late abortions of normally formed fetuses in whom the death was not due to hypertensive disease, antepartum haemorrhage, preterm labour or PPROM.

6. Congenital abnormalities.

7. Other causes included maternal illness and intrauterine growth restriction unrelated to a hypertensive disease.

In patients with preterm labour and PPROM an attempt was made to diagnose the causes or co-factors that could have led to the onset of labour.

Results

From 1 March to 31 August 1997, 2 589 mothers delivered babies at Tygerberg Hospital. During this period, 227 mothers (8.8%) delivered VLBW babies. One patient was excluded from the study as the data in her file were inadequate. Of the remaining 226 patients, 210 had singleton pregnancies and 16 had twin pregnancies. Six babies from the twin pregnancies were excluded from the analysis as the birth weight exceeded 1 499 g (Fig. 1).

Patient profile

One hundred and sixty patients (70.8%) were from the Cape metropolitan area, and 66 patients (29.2%) were referred from outside areas.

The mean age of our patients was 26.5 ± 6.3 years (range 14 - 42 years). The range of the gravidity was 1 - 8, and of the parity 0 - 5, with a mean of 2.6 and 1.3 respectively. Sixty-five patients (28.7%) were primigravidas. One hundred and eighty-six

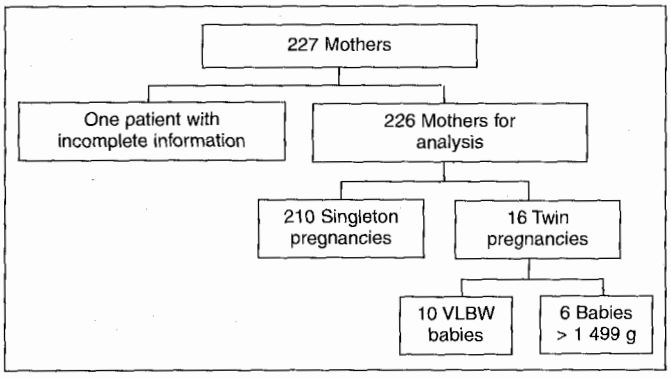

Fig. 1. Summary of the distribution of patients (VLBW = very low birth weight).

patients (81.6%) attended antenatal clinics. The median number of clinic visits was 4 (range 1 - 14). Twenty patients (8.8%) were diagnosed as having syphilis. In our study group 89 patients (39%) were married, 91 (40%) were smokers and 15 (7%) admitted that they abused alcohol during the pregnancy.

Previous obstetric history of note

Forty-nine patients had a total number of 68 miscarriages in their previous pregnancies. In 42 patients, hypertensive diseases had complicated one or more of their previous pregnancies. Preterm labour or PPROM occurred in 10 patients in their previous pregnancies.

Antepartum course

Eighteen patients had urinary tract infection. In 11 patients, *Escherichia coli* was cultured. Vaginitis occurred in 56 patients. In 31 patients, chronic hypertension or pregnancy-induced hypertension was diagnosed and 22 patients subsequently developed superimposed pre-eclampsia. A total number of 103 patients had pre-eclampsia.

A Doppler resistance index of the umbilical artery was performed in 79 patients. Thirty patients had absent-end diastolic flow velocity.

Primary cause of delivery (Table I)

Hypertensive diseases and complications of hypertension and

Table I. Primary causes of delivery in 237 patients

Primary cause	No. of patients (%)
Hypertensive disease	101 (44.7)
Preterm labour	65 (28.8)
Preterm prelabour rupture of membranes	21 (9.3)
Intrauterine death	17 (7.5)
Antepartum haemorrhage	10 (4.4)
Congenital abnormalities	3 (1.3)
Other	9 (4)

pre-eclampsia were the primary cause of delivery in 101 patients (44.7%). Forty-six of these patients were referred from outside areas.

Of the hypertensive cases, 43 were delivered for fetal distress, 16 for fetal distress due to abruptio placentae, 20 for maternal reasons, 19 for intrauterine deaths and 3 for both fetal and maternal reasons. Maternal reasons included complications such as the HELLP (haemolysis, elevated liver enzymes and low platelet) syndrome, renal failure and pulmonary oedema. Intrauterine death complicated the pregnancy in 19 patients. Abruptio placentae caused 9 of the 19 intrauterine deaths. Eighty-one patients with hypertensive disease were delivered at 28 weeks' gestation or later.

Antepartum haemorrhage without underlying hypertensive disease occurred in 10 patients (4.4%). Of these patients, 6 had intrauterine deaths and 3 fetal distress due to abruptio placentae. Placenta praevia was diagnosed in 1 patient.

Intrauterine death, not related to any of the other primary causes for delivery, occurred in 17 patients (7.5%).

Congenital abnormalities were diagnosed in 3 patients (1.3%) (2 singleton and 1 twin pregnancy).

Maternal and fetal complications unrelated to hypertensive disease was the primary cause of delivery in 9 patients (4%).

Preterm labour occurred in 65 patients (28.8%) and **PPROM** in 21 patients (9.3%). The median time from onset of symptoms to admission was 7 hours (range 0 - 336 hours). This delay was mainly due to a lack of transport and long travelling distance. The mean cervical dilatation on admission was 5.7 ± 3 cm. In 31 patients the cervical dilatation was more than 6 cm on admission. In 37 patients (43%) infection was demonstrated at the time of preterm labour or PPROM — this included vaginitis (13), urinary tract infections (7), chorioamnionitis (8), pulmonary tuberculosis (2), congenital syphilis (6) and AIDS (1). In 12 patients an abruption was seen on the placenta at delivery. Cervical incompetence was diagnosed in 9 patients, multiple pregnancies in 9 patients and 2 patients had a placenta praevia.

Mode of delivery

Caesarean section was the mode of delivery in 90 patients (39.6%). In 74 patients the indication for caesarean section was fetal distress. One hundred and three patients (45.4%) had normal vertex deliveries and 33 (14.5%) breech deliveries.

Neonatal outcome

The mean gestational age at delivery was 23.44 ± 3.09 weeks (range 21 - 41 weeks). Of the 236 babies born, 189 (83.3%) were at a gestational age of 25 - 32 weeks. Fifteen babies were delivered after 32 weeks, 3 with congenital abnormalities. Five of these babies were born to mothers with severe hypertensive disease; 2 of these babies had absent-end diastolic flow velocity on umbilical artery Doppler studies. Thirty-two babies were born before 25 weeks' gestation.

The perinatal outcome for all age groups was: intrauterine deaths 89 (37.7%), early neonatal death 29 (12.3%) and alive on day seven 118 (50%). Morbidity or mortality was caused by respiratory distress syndrome in 94 babies (63.9%).

The most important causes of delivery before 28 weeks' gestation were preterm labour in 35 patients (47.9%) and hypertensive diseases in 20 patients (27.4%). After 28 weeks' gestation these percentages were reversed. Hypertensive diseases were the cause of delivery in 81 patients (52.9%) and preterm labour in 30 patients (19.6%).

Discussion

Sixty per cent of perinatally related wastage at Tygerberg Hospital occurs in VLBW babies.[5] It is clearly a clinical and research priority. However, there may be various underlying causes leading to the birth of VLBW babies. While the logical approach to preventing an unfavourable outcome in any condition would be an attempt to prevent the disease, a great deal may also be achieved by approaching those complications which contribute most significantly to the unfavourable outcome which is to be prevented.

Previous studies have emphasised the role of preterm labour and PPROM in the incidence of preterm or VLBW babies.[6-8] In this study, complications of hypertensive disease mandated delivery in 101 patients (44.7%). This figure may be falsely high, because there may have been patients, for example, with preterm labour, PPROM and intrauterine deaths who delivered before referral to Tygerberg Hospital. Even after considering this possibility, this study once again emphasises the importance of hypertension and pre-eclampsia in our population.

While there seems to be general agreement that low birth weight is associated with poorer outcome, there are a paucity of data regarding the underlying causes. In a study by Dobbelaere *et al.*,[6] the primary reasons for the delivery of 550 low-birth-weight babies, also over a 6-month period, were spontaneous preterm labour (28%), hypertensive diseases (19%) and PPROM (18%). However, from their report it is clear that the exact birth weight as well as the presence of multiple pregnancy influenced the ratio between spontaneous preterm labour and hypertensive diseases. Among the 466 singleton pregnancies, 230 babies (49.4%) weighed less than 2 000 g. The primary obstetric cause of the delivery was preterm labour in 57 (24.8%) and hypertensive disease in 55 (23.9%) of these cases. In contrast, 72 (30.9%) of the 233 singletons weighing more than 2 000 g were delivered due to spontaneous preterm labour, while hypertension was the underlying cause in only 32 cases (13.7%). Spontaneous preterm labour resulted in the birth of 19 of the 55 babies from twin pregnancies (34.5%) weighing

less than 2 000 g, in comparison with only 4 (7.3%) due to hypertension. The respective statistics for babies larger than 2 000 g were 45.7% and 13.3%. It seems from their data that there may be a trend towards a higher ratio of hypertensive disease with decreasing birth weight.

It is clear that our approach to the prevention of small-for-gestational-age babies will differ from units where the underlying causes are different. Much work has been done towards improving perinatal outcome in pregnancies complicated by maternal hypertension. We have shown repeatedly that gestational age at birth is the most important factor determining perinatal outcome.[9,10] It is also well known that expectant management of carefully selected patients with early onset pre-eclampsia results in a decline in the perinatal mortality rate.[9] Meticulous control of maternal blood pressure and frequent monitoring of the fetal heart rate pattern with cardiotocography for early diagnosis of abruptio placentae are essential when adapting this approach. A Doppler resistance index of the umbilical artery can identify those babies with intrauterine growth restriction at risk of fetal distress and intrauterine death.[11]

Studies of interventions to prevent the development of pre-eclampsia in patients considered to be at high risk have generally been disappointing. However, there have been some promising messages as well. While the role of low-dose aspirin in preventing pre-eclampsia is clearly limited, it may be of value in women at high risk of early onset pre-eclampsia.[12] Perhaps earlier and more aggressive treatment of early onset hypertension with or without proteinuria may reduce the incidence of complications. In our study, 22 patients developed superimposed pre-eclampsia after the initial diagnosis of chronic hypertension or pregnancy-induced hypertension was made. In 14 mothers the babies had absent-end diastolic flow and were growth restricted.

Preterm labour and PPROM complicated the pregnancies in 28.8% and 9.3% of patients respectively in our study. Even if the labour was theoretically preventable, suppression of labour was only attempted in 23 patients (37.4%) with preterm labour or PPROM. The main reasons for non-suppression of labour were ruptured membranes with the risk of chorioamnionitis and cervical dilatation of more than 8 cm on admission. Infection was demonstrated in 43% of patients with preterm labour or PPROM.

Screening methods for the earlier detection of lower genital and urinary tract infections must be implemented at antenatal clinics. Patients with a previous history of preterm labour or PPROM are especially at risk. Hulsey *et al.*[13] reported that preterm labour recurred in 24.6% of patients with previous preterm labour.

Abruptio placentae was diagnosed in 46 patients (20.4%). Twenty-five patients had hypertension or pre-eclampsia. In 9 patients the abruption was unrelated to an underlying hypertensive disorder. Abruptio placentae was a causal or cofactor in 12 patients with preterm labour or PPROM. The high incidence of abruptio placentae necessitates further research into the pathophysiology of this problem.

VLBW babies are a group with heterogenic aetiologies, but with one common parameter — increased mortality and morbidity. Interventional strategies must be planned on the basis of the primary obstetric reason for delivery, not only to increase the survival, but also to decrease the morbidity due to handicaps.

Hypertension, preterm labour and preterm rupture of membranes were the primary causes for delivery of 82.8% of VLBW babies. Research on how to reduce these factors is urgently needed.

References

1. Danielian PJ, Hall MH. The epidemiology of prematurity. *Curr Obstet Gynecol* 1996; **6:** 133-136.
2. Pitman MC, Steer PJ. Prematurity: Assessment of uterine activity. *Curr Obstet Gynecol* 1996; **6:** 137-142.
3. Halliday HL. Management of the very low birthweight neonate. *Curr Obstet Gynecol* 1992; **2:** 207-211.
4. Novy MJ, McGregor JA, Iams JD. New perspectives on the prevention of extreme prematurity. *Clin Obstet Gynecol* 1995; **38:** 790-808.
5. Prins CA, Theron GB, Steyn DW, Geerts LTGM, De Jong G. Total perinatally related wastage at Tygerberg Hospital — a comparison between 1986 and 1993. *S Afr Med J* 1997; **87:** 808-814.
6. Dobbelaere A, Pattinson RC, Makin JD, Quintelier J. The potential for preventing the delivery and perinatal mortality of low-birth-weight babies in a black urban population. *S Afr Med J* 1996; **86:** 536-539.
7. Berkowitz GS, Lapinski RH. Relative and attributable risk estimates for preterm birth. *Prenat Neonat Med* 1998; **3:** 53-55.
8. Tucker JM, Goldenberg RL, Davis RO, Copper RL, Winkler CL, Hauth JC. Etiologies of preterm birth in an indigent population: Is prevention a logical expectant? *Obstet Gynecol* 1991; **77:** 343-347.
9. Odendaal HJ, Steyn DW, Norman K, et al. Improved perinatal mortality rates in 1 001 patients with severe pre-eclampsia. *S Afr Med J* 1995; **85:** 1071-1076.
10. Hall DR, Odendaal HJ, Kirsten GF, Smith J, Grove D. Expectant management of early onset, severe pre-eclampsia: Perinatal outcome. *Br J Obstet Gynaecol* 2000; **107:** 1258-1264.
11. Hay WW. Etiologies of preterm birth: Intra-uterine growth restriction. *Prenat Neonat Med* 1998; **3:** 121-124.
12. Louden KA, Kilby MD. Low-dose aspirin: The rationale for preventing pre-eclampsia and intra-uterine growth retardation: A role after CLASP? In: Bonnar J, ed. *Recent Advances in Obstetrics and Gynaecology* No 19. Edinburgh: Churchill Livingstone, 1995: 15-33.
13. Hulsey TC, Alexander GR, Van Dorsten P. 'Cause' of preterm birth in first and second deliveries. *Prenat Neonat Med* 1998; **3:** 134-137.

Accepted 18 August 2002.