

Mortality Rates in Low-Birth-Weight Infants Born after a Positive Contraction Stress Test

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SUMMARY

Perinatal mortality rates and the indications for contraction stress tests (CSTs) were studied in 46 patients with positive test results and who gave birth to infants weighing between 500 and 1 500 g. Severe pre-eclampsia and intra-uterine growth retardation were the indications for the CST in the large majority of patients. The perinatal mortality rate for infants weighing between 500 and 1 000 g was 76,9%, for infants between 1 001 and 1 250 g 38,5%, and only 25% when the infants weighed 1 251 - 1 500 g. After conservative treatment because of fetal immaturity only 1 of 7 infants was born alive, but after immediate delivery by caesarean section there was a high rate of fatal hyaline membrane disease in infants weighing less than 1 000 g. The real danger of intra-uterine death in the presence of a positive CST result indicates prompt delivery when the fetus has a reasonable chance of survival in the neonatal period.

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It is generally accepted that a positive stress test implies increased risk to the fetus, but there are differences of opinion as regards the management of the patient with a positive contraction stress test (CST). Some advocate immediate delivery.¹⁻⁴ Others, such as Freeman's group, approach the problem more conservatively, first determining the lecithin/sphingomyelin (L/S) ratio and only delivering when the ratio is over 2 or when the test is non-reactive and positive, or reactive and positive with a falling oestriol level. They therefore take into consideration late decelerations, baseline fetal heart rate (FHR) characteristics, the L/S ratio and oestriol levels before deciding on delivery in the problem case.⁵⁻⁷ Very few authors, however, advise on management in patients with positive stress tests earlier in pregnancy. Indeed, very few reports could be found in the literature in which an infant delivered after a positive stress test weighed less than 1 500 g.^{1,8,9} Since hypertension, mid-trimester pre-eclampsia and severe intra-uterine growth retardation are frequent indications for the performance of stress tests at Tygerberg Hospital, positive tests are encountered when the gestational age is less than 34 weeks, and occasionally in the patient with a small fetus and in whom the duration of pregnancy is uncertain. The difficult decision whether or not to deliver

the patient necessitated this study of the outcome in cases of positive contraction stress tests with a very small infant.

PATIENTS AND METHODS

Hewlett-Packard cardiotocographs were used for all antenatal fetal monitoring. At first the technique of Freeman¹⁰ was used, but later in the study acceleration patterns were accepted as indicative of fetal well-being and oxytocin was only used when accelerations or adequate spontaneous contractions were absent.¹¹ Repeated late decelerations, in the absence of overstimulation of the uterus or supine hypotension, were regarded as indications of a positive test. Immediately after a positive test result the cervix was assessed for induction. Caesarean section was performed when rupture of the membranes was impossible. After the first 42 positive stress tests¹² it was realized that most of the growth-retarded fetuses developed severe late decelerations of the FHR during labour. The management of patients with a definite diagnosis of severe growth retardation was therefore changed; caesarean section was substituted for induction of labour, even though the cervix might have been favourable for the latter.

Because of neonatal deaths due to severe hyaline membrane disease¹³ it was later decided to change to more conservative management which involved immediate amniocentesis under direct ultrasonic control. Amniotic fluid was sent off for a bubble test and L/S ratio estimation. When the bubble test was positive, steps were taken to deliver the patient. When the test was negative the result of the L/S ratio estimation, which was sometimes performed the next morning, was awaited; the patient was delivered if the ratio was 1,5 or higher. When the L/S ratio was less than 1,5 immediate delivery was not advised. Occasionally delivery was carried out in patients with a very low L/S ratio, but this was because of maternal indications such as fulminating pre-eclampsia. When amniotic fluid could not be obtained for L/S ratio determination the decision to deliver was taken on clinical grounds such as the duration of pregnancy and the estimated size of the fetus.

Immediately after delivery the infants were transferred to the paediatric special care unit, where they were carefully observed for hypoglycaemia or signs of respiratory distress. A Dubowitz score¹⁴ was obtained within 3 days after birth, usually as soon as the infant's clinical condition allowed this examination. After discharge from the special care nursery they were followed up for at least 28 days. The growth charts of Keet and Jaroszewicz¹⁵ were used to determine whether infants were small for dates. When both the duration of pregnancy according to the last menstrual period and the Dubowitz score were known, the latter was regarded as more accurate and

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was therefore used to determine growth retardation. When the Dubowitz score had not been ascertained, the duration of pregnancy according to the last menstrual period was used. Infants weighing 1 500 g or less were divided into different weight and gestational age groups and the perinatal mortality for each group was calculated.

RESULTS

Thirteen infants weighed between 500 and 1 000 g, 13 weighed between 1 001 and 1 250 g, and 20 weighed between 1 251 and 1 500 g.

500 - 1 000 g

Pre-eclampsia and suspected intra-uterine growth retardation were the indications for the antenatal fetal heart rate monitoring in the large majority of patients (Table I). The infants in this group weighed between 640 and 1 000 g at birth, with a mean of 844,6 g. Gestational ages ranged from 27 to 35 weeks (in 1 infant the gestational age was unknown). Amniocentesis was attempted in 4 patients, but was successful in only 1; in this case the L/S ratio was 1,8. Immediate delivery by caesarean section was carried out in 8 patients, but only 3 of these infants eventually survived. Five patients were not delivered immediately and in all the fetus died *in utero*. In 2 of these cases intra-uterine death occurred within 24 hours and in the others 1, 4 and 9 days after the positive test (Figs 1 and 2). Four of the 5 neonatal deaths were due to hyaline membrane disease and 1 to necrotizing enterocolitis. Two of the infants which survived developed hyaline membrane disease, but the remaining survivor did not experience any complications after birth.

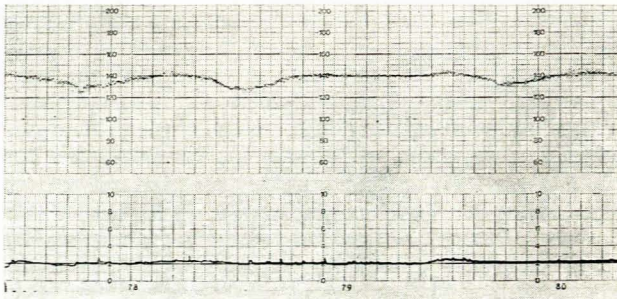


Fig. 1. Positive stress test at 33 weeks' gestation. Intra-uterine death occurred 4 days after the test; the fetus weighed 700 g.

1 001 - 1 250 g

The commonest maternal indication for the test was pre-eclampsia (Table II). Birth weights ranged from 1 005 to 1 230 g, with a mean of 1 123,5 g. There was 1 intra-uterine death, in a patient with a positive stress test at a gestational age of 30 weeks (Fig. 3). Amniocentesis was unsuccessful and the patient was treated conservatively. The fetus, which weighed 1 160 g, died *in utero* 1 day after the test. There were 4 neonatal deaths in this group. Two of the infants died of hyaline membrane disease

and 1 of a massive pulmonary haemorrhage. The 4th was severely asphyxiated at birth and died immediately afterwards. Fatal and non-fatal respiratory distress occurred in 7 of the infants.

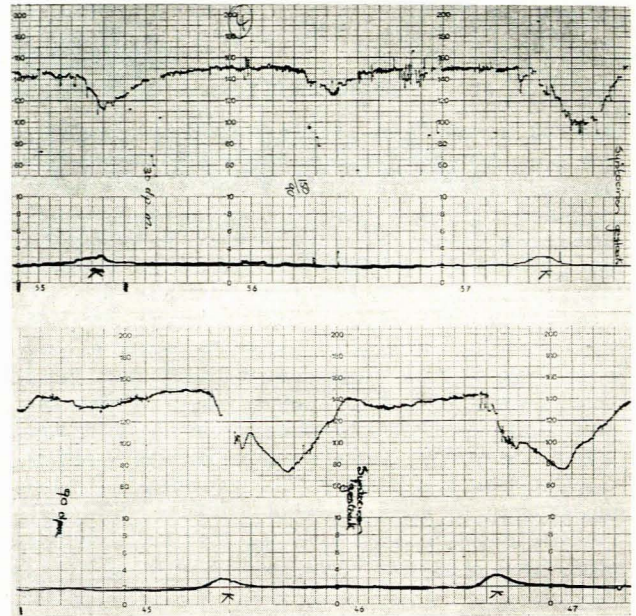


Fig. 2. Above — positive stress test at 33 weeks; below — test repeated 6 days later. Intra-uterine death occurred 3 days after the second test. The fetus weighed 920 g.

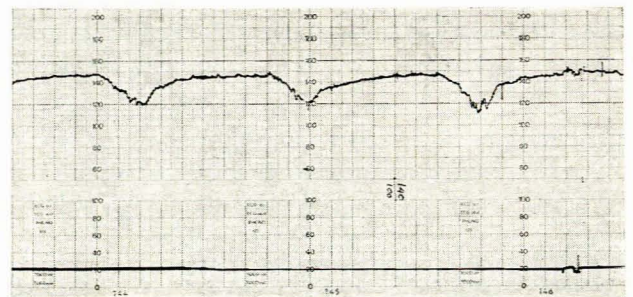


Fig. 3. Positive CST at 33 weeks. Amniocentesis was unsuccessful, and intra-uterine death occurred 1 day later. The fetus weighed 1 160 g.

1 251 - 1 500 g

Pre-eclampsia, suspected intra-uterine growth retardation and hypertension were the indications in 15, 3 and 2 patients respectively, and birth weights of these infants ranged between 1 290 and 1 500 g, with a mean of 1 397,3 g. No intra-uterine deaths occurred in this group, but there were 5 neonatal deaths, of which 1 was due to hyaline membrane disease and 3 were due to necrotizing enterocolitis, which occurred 10, 12 and 39 days after delivery. The 5th infant was severely asphyxiated at birth and died within 20 minutes. Non-fatal complications were hypoglycaemia in 2 patients and type II

TABLE I. DATA FOR INFANTS WEIGHING 500 - 1 000 g

Maternal diagnosis	Blood pressure (mmHg)	Proteinuria	Calculated gestational age (wks)	Dubowitz score (wks)	Amniocentesis	Treatment	IUD	Method of delivery	Birth weight (g)	Apgar score at 1, 5 and 10 min	Neonatal complications	Neonatal death
Pre-eclampsia, IUGR	210/110	++	35	—	Not done	Active	No	CS	874	6, 8, 10	HMD	Day 7
Pre-eclampsia	180/125	++	?	—	Not done	Active	No	CS	890	2, 9, 10	HMD	Day 2
Pre-eclampsia, IUGR	220/120	++++	33	—	Not done	Active	No	CS	825	5, 7, 7	HMD	Day 2
IUGR	125/85	Nil	32	32	Not done	Active	No	CS	780	5, 8, 10	—	No
Pre-eclampsia, IUGR	140/100	+++	29	29	Not done	Active	No	CS	710	2, 4, 7	NE	Day 18
Pre-eclampsia, IUGR	165/110	+++	31	31,5	Not done	Active	No	CS	850	1, 4, 5	—	No
Pre-eclampsia, Hypertension, IUGR	190/120 150/95	+++ Nil	30 31	28,5 31,5	Not done L/S ratio 1,8	Active Active	No No	CS CS	926 985	3, 6, 7 8, 9, 10	HMD —	Day 4 No
IUGR, pre-eclampsia	210/110	+++	27	—	Not done	Passive	After 1 day	Vaginal	640	—	—	—
Pre-eclampsia, IUGR	130/90	++	33	—	Unsuccessful	Passive	After 4 days	Vaginal	700	—	—	—
Pre-eclampsia, IUGR	130/85	+++	33	—	Unsuccessful	Passive	After 9 days	Vaginal	920	—	—	—
Pre-eclampsia	125/110	+++	30	—	Not done	Passive	After 1 day	Vaginal	1 000	—	—	—
Pre-eclampsia	160/110	++	31	—	Unsuccessful	Passive	After 1 day	Vaginal	880	—	—	—

IUD = intra-uterine deaths; HMD = hyaline membrane disease. CS = caesarean section; NE = necrotizing enterocolitis; IUGR = intra-uterine growth retardation.

TABLE II. DATA FOR INFANTS WEIGHING 1 001 - 1 250 g

Maternal diagnosis	Blood pressure (mmHg)	Proteinuria	Gestational age (wks)	Dubowitz score (wks)	Amniocentesis	Treatment	IUD	Method of delivery	Birth weight (g)	Apgar score at 1, 5 and 10 min	Neonatal complications	Neonatal death
Pre-eclampsia	160/110	++	?	—	—	Active	No	CS	1 110	8, 9, 9	No	No
IUGR	110/60	+	?	—	—	Active	No	Vaginal	1 020	9, 10, 10	No	No
Pre-eclampsia, IUGR	180/120	+++	29	31	—	Active	No	CS	1 040	10, 10, 10	Type II RDS	No
IUGR	130/90	—	34	32	—	Active	No	CS	1 220	6, 8, 8	Hypoglycaemia	No
Pre-eclampsia	220/120	++++	25	—	—	Active	No	CS	1 100	1, 0, 0	Severe asphyxia	Yes
Pre-eclampsia, IUGR	180/110	+++	32	32,5	—	Active	No	CS	1 150	3, 10, 10	Grade I HMD	No
Pre-eclampsia	210/110	+++	28	30	—	Active	No	CS	1 180	1, 2, 9	HMD	Day 2
Pre-eclampsia	150/100	++	32	34	—	Active	No	CS	1 030	7, 9, 10	Grade II HMD	No
Pre-eclampsia	180/120	+++	28	31	—	Active	No	CS	1 230	1, 3, 6	Pulmonary haemorrhage	Day 3
Pre-eclampsia, IUGR	160/110	++	41	—	L/S ratio 0,8	Active	No	CS	1 005	4, 8, 9	Grade IV HMD	Day 3
Pre-eclampsia	170/110	++	?	32	L/S ratio 2,2	Active	No	CS	1 190	9, 10, 10	Hypoglycaemia	No
Pre-eclampsia	170/130	+++	33	33,5	Meconium	Active	No	CS	1 170	0, 1, 3	RDS	No
Pre-eclampsia	140/90	++	30	—	Unsuccessful	Passive	After 1 day	Vaginal	1 160	—	—	—

IUD = intra-uterine deaths; HMD = hyaline membrane disease. CS = caesarean section; NE = necrotizing enterocolitis; IUGR = intra-uterine growth retardation; RDS = respiratory distress syndrome.

TABLE III. PERINATAL DEATHS IN DIFFERENT WEIGHT GROUPS

Birth weight (g)	Total	IUD	NND		No. surviving	PND (%)
			0 - 28 days	NND after 28 days		
500 - 1 000	13	5	5	0	3	76,9
1 001 - 1 250	13	1	4	0	8	38,5
1 251 - 1 500	20	0	4	1	15	25,0
Total	46	6	13	1	26	43,5

IUD = intra-uterine deaths; NND = neonatal deaths; PND = perinatal death rate.

TABLE IV. PERINATAL DEATHS AND CALCULATED GESTATIONAL AGE

Gestational age (wks)	Total	IUD	NND		No. surviving	PND (%)
			0 - 28 days	NND after 28 days		
26 - 27	2	1	1	0	0	100
28 - 29	4	0	4	0	0	100
30 - 31	8	3	3	1	2	75
32 - 33	9	2	1	0	6	33
34 - 35	15	0	2	0	13	13
36 - 37	3	0	0	0	3	0
38 - 39	0	0	0	0	0	—
40 - 41	1	0	1	0	0	100
Total	42	6	12	1	24	45

IUD = intra-uterine deaths; NND = neonatal deaths; PND = perinatal death rate.

respiratory distress syndrome in 1. Only 3 out of 20 infants therefore developed respiratory distress after birth. All patients in this group were treated actively and there were no intra-uterine deaths.

Perinatal Mortality in Different Weight Groups

Only 3 of the 13 neonates who weighed 1 000 g or less survived, giving a perinatal death rate of 76,9% (Table III). For those weighing between 1 001 and 1 250 g the rate was 38,5%. Five of the 20 infants who weighed 1 251 - 1 500 g died (25% perinatal death rate). Strictly speaking, the death of the infant 39 days after birth should not be recorded as a perinatal death, but because necrotizing enterocolitis is a complication of preterm delivery this case was also included.

Perinatal Deaths and Duration of Pregnancy

For infants delivered at between 26 and 29 weeks' gestation the perinatal death rate was 100%. It improved to 75% for those with gestational ages of 30 - 31 weeks, and when the duration of pregnancy had reached 32 - 33 weeks the rate fell to 33%, falling further to 13% when the gestational age had reached 34 - 35 weeks (Table IV).

According to the Dubowitz score, 3 infants, all of whom died, were delivered at 28 - 29 weeks. Five infants were delivered at 30 - 31 weeks; of these only 1 died in the neonatal period. Seven infants, only 1 of whom died, were delivered at 32 - 33 weeks, and 10 were delivered

after 33 weeks, with no neonatal deaths in this group (Table V). In 44 infants either the calculated gestational age or the Dubowitz score was known and they could therefore be assessed for growth retardation; only 27% were not growth-retarded.

TABLE V. PERINATAL DEATHS AND THE DUBOWITZ SCORE

Gestational age (wks)	Total	Neonatal deaths	
		No.	%
28 - 29	3	3	100
30 - 31	5	1	20
32 - 33	7	1	14
34 - 35	9	0	0
36 - 37	1	0	0
Total	25	5	20

One patient not included in the previous tables needs special mention. She was admitted in preterm labour at 26 weeks' gestation. Repeated late decelerations were seen when the FHR was monitored. Amniocentesis revealed an L/S ratio of 1,1. Glucocorticoids were administered and the test was repeated the following day. This time and on the following day the test result was suspected of showing abnormality, but it then became negative. Spontaneous labour occurred 30 days later and a normal infant, weighing 2 460 g, was delivered. This was the only case in which the infant survived after conservative therapy.

Since no infant in the conservatively treated group weighed more than 1 250 g, active and conservative treatment were compared only in infants weighing 500-1 250 g. In the group treated actively (20 patients) there were no intra-uterine deaths, but 9 infants (45%) died in the neonatal period. Of the 7 patients treated conservatively 6 fetuses (86%) died *in utero*.

All the fetuses which had died *in utero* were delivered vaginally. Of the remaining 40 patients only 3 were delivered vaginally and the rest by caesarean section.

DISCUSSION

In any decision regarding delivery of a very small or preterm fetus after a positive stress test several factors should be taken into consideration. Some of the most important are the fetal pulmonary maturity and gestational age, the reliability of the stress test, the degree of growth retardation, the available neonatal care facilities, and finally the clinical condition of the mother.

Demonstrating pulmonary maturity in very small fetuses is rather difficult when fetal growth has been severely retarded, since this is associated with oligohydramnios. Amniocentesis was successful in only 1 out of 4 cases in which the fetus weighed 1 000 g or less, although it was carried out under ultrasonic control. It should be performed, however, since the L/S ratio of 1,8 obtained in this specific case prompted delivery and the infant survived. Failure to obtain amniotic fluid would probably have indicated a conservative approach, which might have resulted in death of the fetus. Determination of the L/S ratio also saved another infant's life, since in one case an initially positive test result returned to normal after a few days; without an L/S ratio the immaturity of the lungs would not have been appreciated and delivery might have been undertaken. In the earlier active part of the study knowledge of the L/S ratios could have prevented some of the caesarean sections, which were often followed by neonatal hyaline membrane disease and neonatal death. Although it is usually recommended that the L/S ratio should be more than 2, this study dealt with an extremely high-risk group in which an L/S ratio of 1,5 was acceptable for delivery.

The reliability of the stress test should always be kept in mind. Garite *et al.*¹⁶ warned that the relatively high false-positive rate of up to 48% could cause unnecessary deliveries. Of the 7 fetuses in this study who were not delivered after a positive test only 1 was born alive; all the others died within 0-9 days. When the fetus is not delivered after a positive stress test, therefore, the chance of intra-uterine death is 86%. If the one patient with the false-positive test result is excluded, all infants not delivered after a positive stress test died *in utero*. If the patients treated conservatively after 32 weeks had been treated more actively some of the intra-uterine deaths might have been prevented.

It is interesting to note that the perinatal mortality rate was much lower in infants whose gestational ages were assessed by the Dubowitz method. Although intra-uterine deaths and some neonatal deaths are not included in Table V, one wonders whether the gestational

age is not underestimated in low-birth-weight and growth-retarded infants. The mother's condition should also be considered at all times. Although very few deliveries were carried out primarily because of maternal indications, a large percentage of patients had severe pre-eclampsia and many of them probably had underlying hypertension. Had they been treated more conservatively, more intra-uterine deaths might have occurred or maternal indications could have necessitated delivery. One patient was found to have an L/S ratio of 0,8, but because of fulminating pre-eclampsia a caesarean section was carried out. Had the pre-eclampsia not been so severe, this patient would have been treated conservatively.

The chance of intra-uterine death after conservative therapy in the patient with a positive CST result is high, but the likelihood of neonatal death in the infant delivered before 32 weeks is also high. From 32 weeks a much larger proportion of newborn infants survive and there should be a good reason not to resort to immediate delivery. Molteno *et al.*¹⁷ studied infants of low birth weight in a similar population group and also found a reduced neonatal mortality rate once 32 weeks had been reached. Since the chances of survival and normal development in infants with birth weights of 1 500 g or less have improved considerably in the last 10 years,¹⁸ these infants should not be regarded as too small to be delivered.

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