

FACTORS ASSOCIATED WITH NEONATAL DEATHS IN VERY LOW BIRTH WEIGHT INFANTS

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Summary

THE majority of neonatal deaths in normally formed newborns occur in V.L.B.W. infants. This study was performed to determine where efforts should be directed towards improving their management. The charts of 18 infants with birth weights 750-1,500 grams who died in the first month of life over a 2 year period at the Rotunda Hospital were reviewed. During this time there were 11,500 total births with 0.8% of births < 1.5 Kg. birth weight. Gestational age of the infants studied ranged from 24 to 30 weeks. Fifteen infants died less than 48 hours of age. Postmortems were performed on 16. Twelve infants were severely asphyxiated. Seven died from intraventricular haemorrhage; all who died after surviving greater than 44 hours developed I.V.H. Seven developed a pneumothorax, two of whom subsequently developed an I.V.H. Four infants died due to pneumonia. Six twins died; three due to twin to twin transfusion. Other important prenatal factors were antepartum haemorrhage (7), prolonged premature rupture of membranes (3), and mothers presenting "unbooked" (2).

Introduction

The majority of neonatal deaths in normally formed infants occur in infants weighing less than 1,500 grams at birth, very low birth weight infants (V.L.B.W.). The factors causing death in some infants are generally the same factors resulting in handicap in other infants. Optimal management of the underlying problems should result not only in improved mortality rates but also in a decreased incidence of handicap.

The survival rates of V.L.B.W. infants currently is not as good in many hospitals as those being reported from certain centres¹⁻⁷. Studies are required from hospitals not yet achieving optimal survival rates. The purpose of this study was to determine factors associated with neonatal death in V.L.B.W. infants, to determine the specific cause of death and to determine where efforts in improving management should be directed.

Patients and Methods

The charts of all the normally formed inborn infants, eighteen in number, with birth weights 750-1,500 grams, who died in the first month of life during a two year period, 1983-1984, at the Rotunda Lying-In Hospital were reviewed. Mothers' and infants' charts and autopsy reports were reviewed by an obstetrician (P. McK.) and paediatrician (T.C.).

Results

Eighteen infants who fulfilled the study criteria died, twelve males and six females. Birth weight ranged from 840 to 1,430 grams and gestational age from 24 to 30 weeks.

Maternal Factors

The eighteen deaths resulted from sixteen pregnancies. Maternal age ranged from 17-34 years. Six of the mothers were primigravid and one mother's only previous pregnancy had resulted in an early abortion. Eight mothers were single. Two of the mothers were unbooked and one mother was a maternal transfer from a county hospital because of premature rupture of the membranes. Twelve of the mothers had booked before twenty weeks gestation and seven of these before twelve weeks.

All of the deaths resulted from pregnancies identified as being at high risk (Table I). Six of the

TABLE I
Obstetric complications and factors in 18 V.L.B.W. deaths.

	No. neonatal deaths
Twins (4 pregnancies)	6
Antepartum haemorrhage	7
Addicted mother	2
R.O.M. > 24 hours	3
Intrauterine infection	2
Delivered < 4 hours after admission	6
Mode of delivery: S.V.D.	9
Caesarean section	6

neonatal deaths resulted from four twin pregnancies. Significant antepartum haemorrhage (A.P.H.) complicated seven pregnancies. Two mothers were addicted to heroin. Two mothers had a "poor obstetric history". Three had prolonged rupture of the membranes with clinical evidence of intrauterine infection prenatally in one of these and in an additional patient. One patient was hospitalized antenatally for nine weeks because of bleeding associated with a placenta praevia. Six mothers delivered within four hours of admission. Nine infants were born by spontaneous vaginal delivery and six by caesarean section — indications were A.P.H. and foetal distress (2); breech (2); foetal distress (1) and infection (1). There was one breech and one lift-out forceps delivery.

Neonatal Factors

Twelve of the infants who died were in poor condition at birth with low Apgar scores. Six infants were in a satisfactory condition at five minutes with apgar score > 7 . Intubation was performed in ten infants immediately at birth and four others were intubated during resuscitation, by age 5 minutes. One infant was considered pre-viable and not resuscitated. Several intubations were required in the first hour in five infants; this was because of technical difficulties in three infants, and in two others the endotracheal tube was relocated because of failure to respond to resuscitation.

Fourteen infants had a temperature greater than 36° on admission to the N.I.C.U.; one only had a temperature less than 35° . Four infants had a systolic blood pressure < 30 mm Hg. and four a blood pressure of 30-40 mm Hg. The haematocrit was less than 45 in five infants, two of whom were twins and in two there had been an A.P.H. One infant had a haematocrit of 80 due to twin-to-twin transfusion. The initial pH was less than 7 in three infants and greater than 7.3 in four. Thirteen infants were begun on a ventilator rate of 30-40; three infants in the later part of the study period were begun on a ventilator rate of 50-60. Two infants died in the first few minutes of life. Fifteen infants were sedated for ventilatory management, thirteen with omnopon and pancuronium.

Neonatal Deaths

Fifteen infants died less than forty-eight hours of age, of whom five died less than six hours (Table II). Seven infants died from intraventricular haemorrhage (I.V.H.). All infants who died after surviving more than forty-four hours developed an I.V.H. Seven infants developed a pneumothorax and two of these subsequently developed an I.V.H. Twin-to-twin transfusion was documented in three of the six twins who died. Hyaline membrane disease was evident on histology in ten infants and pneumonia occurred in four. Postmortems were performed on sixteen infants.

TABLE II

Postnatal factors most commonly associated with neonatal death in 18* V.L.B.W. infants.

Asphyxia (Apgar < 3 at 1 minute) (2 Hydrops; 4 Pneumonia; 6 R.D.S.) (3 developed intraventricular haemorrhage)	12
Intraventricular haemorrhage (All died > 44 hours developed I.V.H.)	7
Pneumothorax	7
Twins (Twin to twin transfusion 3)	6
R.D.S.	10
Pneumonia	4

* Postmortems performed on 16

Six of the seven infants had a massive I.V.H., involving the brain parenchyma, and in five of these this appeared to have been the main factor in the infants' ultimate demise. Only three of the twelve infants with asphyxia developed I.V.H.; this may be largely explained by the early death of most of these infants.

During the two year study period there were 11,500 total births with 0.8% of births < 1.5 Kg. birth weight. The overall neonatal survival of normal infants weighing 1,251 to 1,500 grams during the study period was 93% but only 47% for those weighing 750 to 1,000 grams. During the two year study period ten infants weighing 750 to 1,500 grams at birth died due to lethal congenital malformations.

TABLE III

Summary of priorities in management of very low birth weight infants.

Education of mothers to present in early labour.
Development of obstetric guidelines for acute management of A.P.H., twins and prolonged rupture of membranes.
Prevention of intrapartum asphyxia.
Skilled resuscitation team in delivery room (for each infant).
Recognition and management of complications of twin pregnancy.
Prevention and early diagnosis of pneumothorax.
Discussion on when (gestation and foetal size) to consider foetus potentially viable.

Discussion

The number of V.L.B.W. infant deaths in many hospitals still remains relatively high. Survival rates of up to 80% have been reported for infants weighing 750 grams to 1 Kg. at birth.

This study shows that A.P.H. and twin pregnancies remain the major obstetric problems responsible for deaths of premature infants. For the past several decades the management of these problems has been a major dilemma for obstetricians, and they remain the major problems affecting the group of infants at highest risk of dying.

There were almost no "low risk" mothers in the group. The occurrence of all these deaths in clearly identifiable high risk pregnancies emphasises the need to concentrate on such high risk pregnancies at the antenatal clinic. There is a need to reconsider the value of routine antenatal care for low risk mothers⁸ and to consider allocating more resources to mothers identified at high risk.

Avoidance of asphyxia is the most important consideration in management of the V.L.B.W. infant. Twelve of the infants were severely asphyxiated at birth, with apgar score < 3 at 5 minutes. The importance of maintaining cerebral perfusion

and oxygenation in the premature infant at high risk of intraventricular haemorrhage is well recognised^{9,10}. In this regard it is essential to avoid any compromise of these infants during labour and to deliver them in the best possible condition. Five of the six infants born by caesarean section were in poor condition at birth indicating the need to consider earlier intervention in some instances — providing specific guidelines is difficult as the infants did not have any uniform underlying problem.

One third of mothers delivered within a few hours of admission. Warning mothers about the importance of attendance with problems arising late in 2nd trimester or early in 3rd trimester could possibly lead to a better outcome in some instances.

Technical problems with resuscitation still occur. With properly supervised instruction the necessary skill should be readily acquired. It is obvious that personnel skilled in newborn resuscitation must be present at all V.L.B.W. deliveries. The incidence of hyaline membrane disease is decreased in infants who are in good condition and pink on admission to a neonatal intensive care unit¹¹. Early intubation and stabilization has been shown to be associated with improved survival¹².

Pneumothorax remains an important problem, as has been noted by several authors. Pneumothorax may interfere with venous drainage from the brain and has been shown to be associated with an increased risk of I.V.H.^{13,14}. Diagnosis can be difficult in tiny infants. A high index of clinical suspicion is required. The use of transillumination at the bedside is frequently helpful. With refinements in assisted ventilation including the appropriate use of paralysis¹⁵ and use of more rapid rates and shorter inspiratory times in these infants^{16,17,18}, the incidence of pneumothorax may decrease.

As the management of other problems improves a relatively greater number of neonatal deaths is accounted for by twin pregnancies. Twins are at greater risk of perinatal asphyxia because of the increased difficulty in monitoring both antenatally and intrapartum. Overall twins are responsible for about 20% of all births of less than 1,500 grams¹⁹. Twin-to-twin transfusion syndrome is a potential life threatening problem; 20% of twins are mono-chorionic and it is estimated that the transfusion syndrome occurs in about 15% of such twins²⁰. A substantial number may die in utero before viability is achieved due to severe placental shunting. Awareness of the occurrence of this syndrome and clinical examination for evidence of heart failure due to anaemia or complications of polycythaemia is required. The syndrome should be strongly suspected if there is a difference of 5 grams or more in haemoglobin value. Haematocrit or haemoglobin should be routinely measured immediately following birth in all monozygotic twin pregnancies.

Several large surveys have been performed in the United Kingdom to determine areas in which improved care is required in the perinatal period²¹⁻²³. Such studies have shown that in a significant number of cases there was an inappropriate response by medical and nursing staff to results of investigations or observations which indicated that all was not well; such errors occurred most commonly during monitoring of foetal growth antenatally or of foetal well-being during labour. An inappropriate level of care was also noted frequently in those studies. In the paediatric area problems were most frequently noted in the resuscitation of small infants, in ventilatory support of the low birth weight infant and in delayed diagnosis, especially of meningitis and hypoglycaemia. In this study, in retrospect, earlier and more aggressive obstetric intervention might have been considered in some instances. In this regard general agreement on when fetal salvage should reasonably be pursued aggressively in a given maternity unit is very desirable. Twin-to-twin transfusion could have been recognised earlier in one instance and diagnosis was possibly delayed also in some cases of pneumothorax. Inappropriate level of care was not felt to be a problem as the infants' management was closely supervised by consultant obstetricians and paediatricians, but this may occasionally be a problem in smaller poorly staffed units.

The importance of avoiding asphyxia cannot be over emphasised in the management of the V.L.B.W. This requires the involvement of experienced staff in the management of all aspects of V.L.B.W. infants including the delivery. A skilled resuscitation team in the delivery room for each infant is essential. While the management of V.L.B.W. infants is complicated the problems which result in deaths are limited in number. Reducing deaths to a minimum requires skilled and knowledgeable perinatal staff so that "avoidable factors" are minimised.

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