STUDENT PAPER

Massive pulmonary haemorrhage as a cause of death in the neonate — a retrospective review

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Objectives. To examine massive pulmonary haemorrhage as an independent factor and as a co-factor in neonatal mortality by analysing the associated factors, with the purpose of identifying predisposing characteristics.

Design. A retrospective study reviewing 32 neonates who died of pulmonary haemorrhage. Data were extracted from the 2001 King Edward VIII Hospital (KEH) neonatal death records. Relevant obstetric and neonatal variables were used in the data analysis.

Setting. KEH, a tertiary care institute, provides secondary and tertiary services and functions as a referral centre for surrounding clinics and hospitals.

Results. Pulmonary haemorrhage occurred in 32 of 260 neonatal fatalities (12.3%). All cases of pulmonary haemorrhage fell into the low-birth-weight category (< 2 500 g), and 26 of the infants (81.25%) died during the early neonatal period. A gestational age of 28 - 32 weeks was recorded in 27 cases (87%) and 19 (60%) showed adequate growth for gestational age. Three infants had pulmonary haemorrhage as a primary cause of death. In the remaining 29, pulmonary haemorrhage was secondary to a variety of causes. Obstetric information revealed that 29 mothers (93.5%) experienced obstetric complications, viz. pre-eclampsia/eclampsia syndrome 21 (64.5%), abruptio placentae 5 (16.1%) and previous pregnancy losses 9 (29%). Seven babies were ventilated and 2 were diagnosed with patent ductus arteriosus.

Conclusion. The study revealed more well-grown babies than expected. Complications of pregnancy hypertension, abruptio placentae and previous pregnancy losses were more frequently associated with pulmonary haemorrhage in these neonates. The majority of babies suffering pulmonary haemorrhage were not associated with intensive care management.

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Perinatal and maternal mortalities are essential audits for any health care institute providing obstetric and neonatal services. Such services are an integral part of overall health care and therefore measures should be taken to ensure that they are of the highest possible standard. Clinical audit aims to improve the quality of health care through an ongoing critical examination of activities, compared with an agreed standard, leading to the identification and utilisation of opportunities for bringing practice closer to that standard.[1] The low birth weight (LBW) rate provides a useful measure of maternal and child health, socio-economic status and the general standard of living of a community.[2] LBW infants are divided into those born prematurely and those who are underweight for gestational age. A LBW is synonymous with a higher incidence of morbidity and mortality.

Pulmonary haemorrhage should not be overlooked as a factor contributing to neonatal mortality. Associated with a high mortality rate and usually presenting within the first week of life, pulmonary haemorrhage is defined pathologically as the presence of extravasated erythrocytes in the pulmonary alveoli, septa or both. Clinically, it is depicted by bloodstained frothy secretions, exuding or aspirated from the trachea.[3] Rapid deterioration of ventilatory function, progressive hypoxia and hypercarbia with associated respiratory acidosis are noted in affected infants.[4]

Important precipitating events include those that might increase the filtration pressure and so injure the capillary endothelium of the lung. Pulmonary haemorrhage may therefore be considered the extreme form of high-permeability pulmonary oedema resulting from increased hydrostatic pressure and vascular permeability.[5,6]

Perinatal disorders account for 56% of infant deaths in South Africa.[2] At King Edward VIII Hospital (KEH) common causes

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of death among neonates in order of frequency include hyaline membrane disease, infection, asphyxia, pneumonia, pulmonary haemorrhage, interventricular haemorrhage and congenital abnormalities (M Adhikari — personal communication).[7] Neonatal and obstetric factors, as well as the interaction of both, are important predictors of perinatal mortality.[7]

The aim of this study was to examine pulmonary haemorrhage as an independent factor and as a co-factor in neonatal mortality, and to analyse the associated factors with the purpose of identifying characteristics that contributed or predisposed to the fatal outcome of pulmonary haemorrhage.

Methods

A retrospective study was carried out at KEH to investigate pulmonary haemorrhage as a cause of death in the neonate. The hospital, a tertiary care institute in Durban, provides services at both secondary and tertiary level to socio-economically disadvantaged members of the community, and functions as a referral centre for surrounding primary health care clinics and regional hospitals serving a population of 9.5 million.

Neonatal death records for the year 2001 were obtained from the Department of Paediatrics and Child Health at the University of KwaZulu-Natal, Durban. These contained details regarding antepartum and intrapartum care as well as neonatal interventions recorded after each death. This information was captured on the EpiInfo version 6 database.

Records of infants with pulmonary haemorrhage were extracted from the above database and reviewed in order to identify the most relevant variables. Maternal information selected included age, antenatal care, mode of delivery, previous pregnancies, complications, and drugs administered. Neonatal data comprised lifespan, birth weight, gestational age, growth, gender, resuscitation, birth trauma, respiratory distress, infection and cause of death in addition to pulmonary haemorrhage.

Individual patient data were entered into a spreadsheet using Microsoft Excel 2000 and cross checked for any errors or omissions. This facilitated the process of re-entering the patient data into a questionnaire compiled in EpiInfo. Thus a mini database was created allowing information from each case to be analysed.

Annual perinatal statistics from the Departments of Obstetrics and Paediatrics have shown that 17 - 18% of women admitted suffer pregnancy-induced hypertension (PIH) or eclampsia, and about 5 - 6% suffer abruptio placentae. The perinatal mortality rate varies from 40 to 50, the early neonatal mortality rate from 25 to 28, and the LBW rate from 18 - 20% each year. Growth restriction is diagnosed in up to 45% of babies admitted to the neonatal unit. Seven to 9% of mothers (total deliveries) suffer previous pregnancy losses.

Definitions used in the study

Early neonatal death (ENND): death of a live-born baby, weighing 500 g or more at birth, during the first 7 days of completed life.

Late neonatal death (LNND): death of a live-born baby between the 8th and 28th days of life.

Low birth weight (LBW): a baby with a birth weight of less than 2 500 g.

Very low birth weight (VLBW): a baby with a birth weight of between 1 000 and 1 499 g, inclusive.

Extremely low birth weight (ELBW): a baby with a birth weight of less than 1 000 g.

Perinatal death: death of a fetus with a birth weight above 500 g if measured, or a gestational age of at least 22 completed weeks, or a body length of at least 25 cm or more, including all macerated, fresh stillbirths and neonatal deaths within 1 week of delivery.[8]

Antenatal (or antepartum) care (ANC): health care of the pregnant woman and her fetus from conception to the onset of labour.

Intrapartum care: health care of the pregnant woman and her fetus during labour.

Postnatal (or postpartum) care: health care of the mother and infant during the first month after birth.

Results

Out of a total of 260 neonatal fatalities, 32 (12.3%) had pulmonary haemorrhage listed as a cause of death. Of the 32 mothers, 31 experienced obstetric complications (Table I). Thirteen mothers had eclampsia, and 8 had pre-eclampsia. Five mothers had abruptio placentae, 2 of whom had associated pre-eclampsia. Of 2 mothers with multiple pregnancy, 1 had eclampsia and the other pre-eclampsia. A malpresentation was stated to be present in 1 of the cases of intra-uterine infection/premature rupture of membranes (IUI/PROM).

All neonates fell into the LBW category. Table II summarises the proportion of ELBW, VLBW and LBW neonates with significant variables drawn from the database. Twenty-six infants (81.25%) with pulmonary haemorrhage died during the early neonatal period, 25 between 0 and 4 days. A gestational age of 28 - 32 weeks was recorded in 27 cases.

Birth trauma occurred in 13 cases; 10 asphyxia, 2 intraventricular haemorrhage (IVH) and 1 soft tissue injury. Six neonates had no evidence of infection, 4 had confirmed septicaemia with Gram-negative infective agents and 22 had suspected sepsis. Seven babies were ventilated (4 had hyaline membrane disease, 2 had pneumonia and 1 was diagnosed

Table I. Characteristics of mothers whose neonates died due to pulmonary haemorrhage compared with those whose infants died of causes other than pulmonary haemorrhage

Characteristic	Pulmonary haemorrhage	No pulmonary haemorrhage	*p*-value
Age (years)	*N* = 30	*N* = 228	
18 - 35	28	178	0.68
> 35	2	22	0.34
ANC	*N* = 31	*N* = 228	
Yes	25	179	0.96
No	6	49	0.96
Mode of delivery	*N* = 31	*N* = 200	
Normal	3	78	0.002
Caesarean	26	111	0.005
Vaginal breech	2	11	0.54
Previous pregnancy losses	*N* = 31	*N* = 62	
Abortions	5	39	0.0005
Still births	2	9	0.61
Neonatal death	2	14	0.09
Complications	*N* = 31	*N* = 137	
Eclampsia/PIH	21	64	0.05
Abruptio placentae	5	22	0.58
Other*	8		

*Overlapping complications — multiple pregnancy, prolonged rupture of membranes, malpresentation and intra-uterine growth retardation.
ANC = antenatal care; PIH = pregnancy-induced hypertension.

Table II. Frequency of neonatal variables by birth weight

		Life span (*N* = 32)		Sex (*N* = 28)		Geowth (*N* = 30)			Gestational age (wks) (N = 31)		
		ENND	LNND	Male	Female	AGA	SGA	LGA	< 27	28 - 32	33 - 36
Birth weight (kg)											
0.751 - 0.999	4	3	1	0	3	3	1	0	2	2	0
1 - 1.25	19	16	3	11	8	11	7	0	0	20	0
1.26 - 1.49	4	4	0	1	2	3	1	0	0	4	0
1.5 - 1.99	4	2	2	2	1	1	2	1	0	1	2
Total	31	25	6	14	14	18	11	1	2	27	2

ENND = early neonatal death; LNND = late neonatal death; AGA = appropriate for gestational age; SGA = small for gestational age; LGA = large for gestational age.

with transient tachypnoea of the newborn). The records of the babies who survived in 2001 showed that only 2 babies with pneumonia who were ventilated suffered a pulmonary haemorrhage that could not be regarded as massive pulmonary haemorrhage.

Three infants had pulmonary haemorrhage listed as the primary and sole cause of death. In the remaining 29 fatalities, pulmonary haemorrhage was secondary to the causes listed in Table III. Pulmonary haemorrhage was isolated on the table only when it was an exclusive secondary cause.

Discussion

Pulmonary haemorrhage is frequently a fatal event in LBW neonates, occurring most often during the first 4 days of life. A significant cause of perinatal mortality, it accounted for 12.3% of neonatal deaths at KEH in the year 2001. Bhandari *et al.*[8] showed an incidence of 1.4%, with the mean age of occurrence being 3.1 days. Ninety per cent of neonatal deaths at KEH occur in babies weighing less the 2 500 g. All the infants in the study who died of pulmonary haemorrhage fell into this LBW category. Despite being underweight, the majority of babies (60%) showed adequate growth for gestational age. Generally pulmonary haemorrhage is associated with growth retardation.[3] Comparative studies in the developed setting demonstrate that pulmonary haemorrhage affects mainly VLBW and ELBW infants.[6,9]

Pulmonary haemorrhage was commonly found as a co-factor in neonatal mortality (90.6%), indicating that it predominantly affects sick neonates. The commonest underlying diagnoses made before the pulmonary haemorrhage occurred were

Table III. Primary and secondary causes of death

Primary cause / Secondary causes	N
Pulmonary haemorrhage	3
Suspected sepsis	10
Pulmonary haemorrhage	6
Pneumonia	2
Septicaemia	1
IVH	1
Septicaemia	3
Pulmonary haemorrhage	2
NEC	1
Pneumonia	3
Pulmonary haemorrhage	2
Septicaemia and syphilis	1
Intraventricular haemorrhage	1
HMD	1
Hyaline membrane disease	6
Pulmonary haemorrhage	3
Suspected sepsis	3
Asphyxia	6
Pulmonary haemorrhage	6

IVH = intraventricular haemorrhage; NEC = necrotising enterocolitis; HMD = hyaline membrane disease.

suspected sepsis, hyaline membrane disease and asphyxia. Pulmonary haemorrhage is therefore one component of a cascade of events that ultimately culminate in the death of the neonate.

All infants included in the study by Bhandari *et al.*[8] were on mechanical ventilation before or during the episode of pulmonary haemorrhage. Seven of the babies were ventilated and only 2 had clinically documented patent ductus arteriosus. The majority of babies in our study weighed less than 1 250 g and were under 32 weeks' gestation. Because of severe resource constraints many of these babies may not be offered ventilation. From the experience in the unit, many babies suffer a sudden deterioration with massive pulmonary haemorrhage which may be quite unexpected.

Unpublished data from KEH (2001) showed previous pregnancy losses to be 7% of total deliveries; however the mothers in this study demonstrated a much higher loss. Neonatal pulmonary haemorrhage was also likely to occur in mothers with pre-eclampsia/eclampsia syndrome and abruptio placentae. This suggests that these maternal complications could predispose to the neonate developing pulmonary haemorrhage, or that there is the likelihood of this group of neonates being more ill if they have high-risk mothers. Bhandari *et al.*[8] described no statistical significance between neonates with pulmonary haemorrhage and their controls with regard to pre-eclampsia, presentation, mode of delivery, 1-minute Apgar, race, sex, or sepsis.

A limitation of the study was that it focused only on physical characteristics of the mother and her baby and did not take into account the impact of treatment. Existing literature has connected pulmonary haemorrhage with various modalities of treatment. Pulmonary haemorrhage is also a well-known complication of surfactant therapy[9] which the majority of babies in this study did not receive.

Conclusion

In conclusion, this retrospective analysis of massive pulmonary haemorrhage in an under-resourced setting revealed more well-grown babies than expected, high pregnancy hypertension complications, abruptio placentae and previous pregnancy losses. Seven cases were associated with intensive care management.

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