

# Neonatal Complications and Conditions Associated with Asphyxia Neonatorum

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## SUMMARY

The complications and conditions associated with a group of asphyxiated infants born in the Groote Schuur Maternity Hospital during 1971-72 are described. The neonatal deaths were mainly in very low birth mass infants, most of whom died within 12 hours. The prevalence of convulsions, hypoglycaemia, respiratory distress syndrome and haematological complications is discussed. An increased incidence of infections and major congenital abnormalities was encountered.

*S. Afr. Med. J.*, 48, 2259 (1974).

Asphyxia neonatorum, characterised by failure on the part of the newborn infant to establish sustained respiration after complete delivery, is an acute emergency. Although much is known about the infant at this stage, its fate after resuscitation has not been well documented. The purpose of this article is to discuss the neonatal complications and conditions associated with asphyxia neonatorum, and to focus attention on the period after transfer from the delivery room.

## METHOD OF STUDY

A prospective study was carried out on all asphyxiated infants born in the Groote Schuur Maternity Hospital between 1 April 1971 and 31 March 1972. The criteria for inclusion in the study were a 1-minute Apgar score of 0-3, and/or the need for positive pressure ventilation within the first 10 minutes of life. Of a total of 3 176 liveborn infants, 206 were asphyxiated at birth, a frequency of 6.7%. After resuscitation most of the infants were transferred to the observation nursery where continuous surveillance was carried out by experienced nursing staff. Some infants, however, required intensive care from birth, while others were admitted to the intensive care unit when complications arose.

## RESULTS

### Neonatal Deaths

Of 206 asphyxiated infants 27 died in the neonatal period. Fig. 1 demonstrates that the majority of deaths

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Date received: 10 July 1974.

occurred in the group of less than 1 500 g birth mass (17 of the 25 asphyxiated infants in this mass category died). The time after birth that the infants died is shown in Fig. 2, and the causes of death are given in Table I. Postmortem examinations present a difficulty in Cape Coloured patients since permission is frequently refused for religious reasons. Although only 10 parents agreed to an autopsy, a satisfactory major cause of death was reached in most cases. Eleven of the infants who died from immaturity survived less than 12 hours. Two of the infants dying from asphyxia had postmortem examinations but no complicating cause was found.

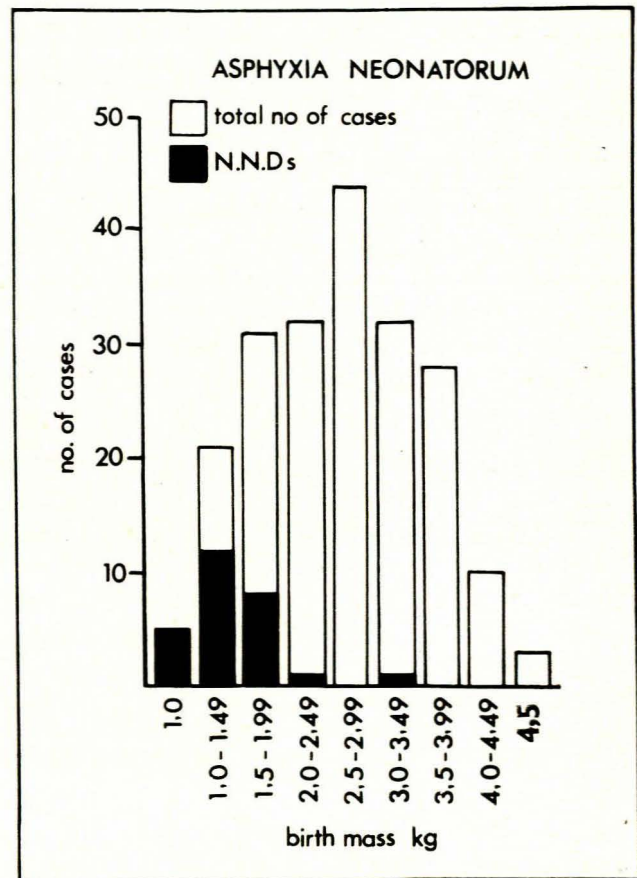


Fig. 1. Neonatal deaths in relation to birth mass.

### Convulsions

Table II lists details of the 9 infants who had convulsions during the neonatal period. As far as documenting a

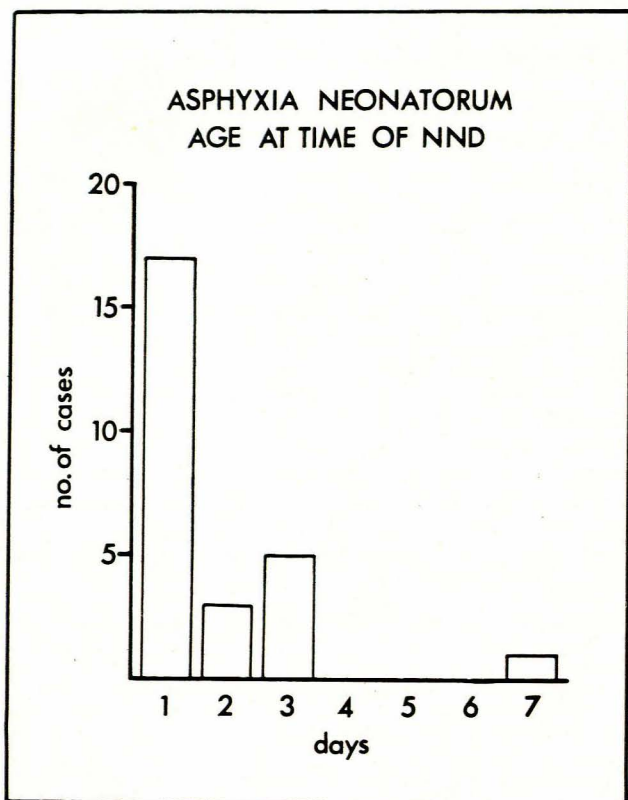


Fig. 2. Age at time of neonatal death.

TABLE I. MAIN CAUSES OF NEONATAL DEATHS

Cause	No.
Immaturity (under 1500 g birth mass)	12
Asphyxia	4
Respiratory failure	4
Major congenital abnormalities	3
Cerebral haemorrhage	2
Infection	2

TABLE II. INFANTS PRESENTING WITH CONVULSIONS

Birth mass (g)	Intra-uterine asphyxia	Apgar score		Onset (hours)	Dextrostix (745 mg/100 ml)	Serum calcium (mg/100 ml)	CSF
		1 min	5 min				
3 175	Yes	1	2	45	Yes	9,7	Normal
3 850	No	2	4	6	Yes	10,0	Bloody tap
3 175	No	3	8	8	Yes	—	—*
2 450	No	2	2	24	Yes	—	Xanthochromic
4 100	Yes	2	7	24	Yes	Given calcium empirically	Bloody tap
3 200	Yes	1	2	24	Yes	—	Normal
3 200	Yes	1	4	12	Yes	10,1	Normal
2 350	Yes	1	6	48	Yes	8,9	Bloody tap
3 600	Yes	1	3	24	Yes	7,0	Normal

\* Given Syntometrine in error.

cause other than perinatal hypoxia was concerned, one infant was given Syntometrine in error, another had a low serum calcium, and a third had xanthochromic cerebrospinal fluid. Three other infants had blood in their cerebrospinal fluid, though at the time it was felt that this was traumatic.

### Hypoglycaemia

All infants had serial Dextrostix estimations during the first 12 hours, and for a longer time if they were of low birth mass or remained clinically ill. Hypoglycaemia was diagnosed if a repeat Dextrostix reading was less than 45 mg/100 ml in a term infant or 25 mg/100 ml in a preterm infant. Table III lists details of such infants. Symptoms attributable directly to hypoglycaemia were infrequent, but 2 infants had apnoeic attacks which were probably on this basis. Treatment was successful in all cases, either by giving 10% dextrose water by intravenous infusion or, if they were already receiving this therapy, by increasing the rate of the infusion. The 2 infants with

TABLE III. INFANTS WITH BIOCHEMICAL HYPOGLYCAEMIA

Gestational age (weeks)	Birth mass (g)	Apgar score		Symptoms
		1 min	5 min	
35	2 450	1	5	—
32	1 250	1	4	—
37	2 850	3	4	—
38	2 650	2	8	—
33	1 912	3	9	—
38	2 180	1	4	—
40	4 050	2	2	—
36	1 518	1	6	+
35	1 021	1	3	+
32	1 600	9	4	—
35	1 843	2	7	—
35	2 495	4	6	—
36	3 513	2	4	—
36	1 700	3	8	—

hypoglycaemic symptoms were started on 50% intravenous dextrose water. No infant required steroids. Three neonatal deaths occurred, one from extreme immaturity, another from multiple congenital abnormalities and the third from intracranial haemorrhage. Only 1 baby had gross neurological deficit at follow-up, and because this patient's hypoglycaemia was mild, transient, and responded rapidly to therapy, the neurological damage probably resulted from the severe perinatal hypoxia.

### Respiratory Distress Syndrome

Table IV lists the different causes in this series. In each case the diagnosis was made on clinical grounds and confirmed radiologically. Meconium aspiration occurred in 7 cases out of 43 with meconium-stained liquor. Two of these developed pneumothoraces. In 2 other cases pneumothorax did not follow meconium aspiration. Hyaline membrane disease occurred in 21,4% of the preterm infants (excluding those who were small for gestational age). The 2 patients with postintubation stridor had only mild, transient distress.

TABLE IV. RESPIRATORY DISTRESS SYNDROME

	No.
Hyaline membrane disease ... ..	14
Neonatal disseminated atelectasis ... ..	4
Meconium aspiration syndrome ... ..	7
Pneumothorax (2 with meconium aspiration) ... ..	4
Pneumonia ... ..	6
Cerebral depression ... ..	2
Postintubation stridor ... ..	2

### Haematological Abnormalities and Neonatal Jaundice

Polycythaemia was diagnosed if the haematocrit on a specimen of hyperaemic heelprick blood was over 70. Less than 45 on a similar specimen during the first week of life was regarded as anaemia. Three infants were

polycythaemic and 7 were anaemic. Of the latter, haemolysis accounted for 4 and haemorrhage for the other 3. Two infants showed a haemorrhagic tendency. One of these was severely asphyxiated at birth, bled severely from all infusion sites, and, despite fresh blood and fresh frozen plasma, died at 30 hours. Necropsy revealed a haemorrhagic liver, adrenals and kidneys, as well as a subarachnoid haemorrhage. Clotting studies were carried out on the other patient, but disseminated intravascular coagulation was not demonstrated. *Listeria monocytogenes* was grown on blood and cerebrospinal fluid culture. Fresh blood was transfused and the clotting status returned to normal.

Total serum bilirubin was estimated in all infants who were clinically jaundiced. In 30 babies the bilirubin level was over 10 mg/100 ml. Blood group incompatibility was present in 3 of these and no cause was apparent in the rest.

### Infection

Details of patients judged to have been infected are given in Table V. Eleven of the 13 were of low birth mass and 10 were preterm infants. In all but 3 there was evidence of either maternal infection, prolonged rupture of the membranes (more than 24 hours) or both. The diagnosis was clinical, with X-ray confirmation in pneumonia, and cerebrospinal fluid tests in meningitis. Although blood, cerebrospinal fluid and urine cultures were carried out on all infants, organisms were grown in only 4 cases, and syphilis was confirmed at necropsy in 1 case. The infection contributed significantly to the outcome in the 3 infants who died.

### Congenital Abnormalities

Five infants had major congenital abnormalities, as listed in Table VI.

TABLE V. NEONATAL INFECTIONS

Gestational age (weeks)	Maternal infection	Prolonged rupture of membranes	Onset (days)	Diagnosis	Organism	Outcome
35	—	—	6	Gastro-enteritis	—	Recovered
38	—	—	12	Conjunctivitis	<i>Staphylococcus</i>	Recovered
32	+	—	1	Pneumonia	—	Died
38	—	+	3	Pneumonia	—	Recovered
41	+	—	2	Meningitis	—	Recovered
34	+	+	1	Meningitis, pneumonia	<i>Listeria monocytogenes</i>	Recovered
33	—	+	14	Meningitis	<i>E. coli</i>	Recovered
31	—	+	10	Meningitis	<i>E. coli</i>	Recovered
28	+	—	1	Congenital syphilis	<i>T. pallidum</i>	Died
32	—	+	5	Pneumonia	—	Recovered
36	—	+	1	Pneumonia	—	Recovered
32	—	—	5	Pneumonia	—	Recovered
32	—	+	3	? Septicaemia	—	Died

TABLE VI. MAJOR CONGENITAL ABNORMALITIES

	No.
Meningomyelocele ... ..	2
Oesophageal fistula and imperforate anus ... ..	1
Oesophageal atresia ... ..	1
Multiple congenital abnormalities ... ..	1

## DISCUSSION

Immaturity accounted for most of the neonatal deaths, which in this group usually occurred within the first 12 hours of life. The remainder were fairly evenly distributed among the other major causes of death in the newborn period.

The reported incidence of convulsions in the first 10 days of life varies from 0,2% to 1,4%.<sup>2,3</sup> The frequency in this series for asphyxiated infants suggests a fourfold increase above the figure for total live births. Convulsions occurred predominantly in mature infants, often after severe intra-uterine asphyxia, and were associated with a low 5-minute Apgar score. One infant was given Syntometrine in error, a situation known to cause fits in the newborn.<sup>4</sup> There was 1 case of hypocalcaemia.

The 7% incidence of hypoglycaemia agrees with that for high-risk newborns reported by Guthrie *et al.*<sup>5</sup> There was a wide scatter regarding maturity, with 5 infants small-for-gestational-age, and 1 the infant of a diabetic mother. Symptoms were infrequent and the response to the standard method of treatment was good.

The respiratory distress syndrome was a common complication in this series. Hyaline membrane disease was slightly more frequent in asphyxiated infants,<sup>6</sup> with a mortality of 3 out of 16. There were, in addition, 4 cases diagnosed as neonatal disseminated atelectasis. Out of 43 infants born after meconium staining of the liquor amnii, 7 developed the meconium aspiration syndrome. The 4 cases of pneumothorax with 2 fatalities emphasise the danger of this condition, especially in the presence of meconium aspiration. Pneumonia was a frequent complication of asphyxia neonatorum in this series.

Of the 7 cases of anaemia, 4 were the result of haemolytic disease. The others might be considered to have

followed a complication of asphyxia neonatorum. Polycythaemia was not unduly common in this series. Two infants developed a generalised haemorrhagic tendency. This situation has been reported in *Listeria* infections, both with and without disseminated intravascular coagulation (DIC).<sup>7</sup> The case reported here did not have DIC.

Of the 30 infants with a total serum bilirubin greater than 10 mg/100 ml, 3 were due to blood group incompatibility. The remaining 27 included 16 preterm and 16 low birth mass infants. This gives an incidence of 19% and 18% for these groups, which is far lower than figures for low birth mass infants reported by Lucey in 1960.<sup>8</sup> Intravenous infusions and early feeding probably account for the reduced incidence. Phototherapy proved effective in all those with unexplained jaundice, since no infant in this group required an exchange transfusion.

Neonatal infections, especially pneumonia and meningitis, were common complications in this series. Infections generally occurred predominantly in low birth mass and preterm infants. Maternal infection or prolonged rupture of membranes was often associated.

The incidence of major abnormalities in Britain, stillbirths included, is about 15/1000 births.<sup>9</sup> Infants with major abnormalities would appear to be prone to asphyxia neonatorum. Of the 5 such infants in this series, 3 died.

In conclusion, the neonatal deaths at 131/1000 were mainly in very low birth mass infants, most of whom died within 12 hours. The morbidity accounted for by the conditions described above underlines the importance of special care required in birth-asphyxiated infants during the first few days of life.

We wish to thank the South African Medical Research Council for financial assistance.

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