



# Epidemiological, Diagnostic and Evolutionary Profile of Perinatal Asphyxia in Pikine National Hospital (Dakar/Senegal)

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## ABSTRACT

**Introduction:** Perinatal asphyxia is the 3<sup>rd</sup> leading cause of neonatal mortality worldwide and a major public health problem. The aim of our study was to investigate the epidemiological, clinical, therapeutic and prognostic aspects of perinatal asphyxia at the Pikine National Hospital.

**Materials and methods:** This was a retrospective, descriptive study, carried out from 1<sup>st</sup> January 2022 to 31<sup>st</sup> December 2022.

**Results:** The hospital frequency was 12.74%. The most common maternal age group was between 16 and 25 years old. Most mothers were housewives (44.44%) and primiparous (54%). The majority of mothers (57.43%) had presented pathologies during pregnancy which were dominated by prelabor rupture of membranes, dystocia and anemia. Half of the mothers (55.45%) had given birth vaginally. All newborns had not cried at birth and the majority (80%) had received resuscitation. All newborns had an Apgar score of less than 7 at the 5<sup>th</sup> min. Hypoxic-ischemic encephalopathy was found in 70.30% of cases. Most of the newborns (51.49%) had received neuroprotection in the form of such as magnesium sulphate and passive hypothermia. The mortality rate was 37.62%. The mean age at death was 4 days of life.

**Conclusion:** The presence of qualified personnel staff and the availability of adequate technical equipment at each birth remains necessary to reduce neonatal morbidity and mortality related to perinatal asphyxia.

**Keywords:** Perinatal asphyxia; Encephalopathy; Pikine National Hospital Center (CHNP); Obstetric care; Neonatal pathology

## INTRODUCTION

Perinatal asphyxia is defined by the World Health Organization (WHO) as the inability to establish and maintain respiration at birth [1]. It is a major public health priority because it is the 2<sup>nd</sup> leading cause of neonatal morbidity and mortality worldwide, particularly in countries with limited resources [2,3]. The incidence of perinatal asphyxia varies and depends on the quality of obstetric care and the ability to make an accurate

diagnosis. The management of perinatal asphyxia and its complications (hypoxic ischemic encephalopathy and multivisceral failure) is often problematic in developing countries, as resuscitation and therapeutic hypothermia facilities are often lacking. In Senegal, scientific data on perinatal asphyxia is limited in most of our health facilities. With a view to taking stock of this neonatal pathology, the main aim of this study was to examine the epidemiological, clinical, therapeutic and prognostic aspects of perinatal asphyxia at the Pikine National Hospital Center (CHNP).

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## MATERIALS AND METHODS

### Study setting

The study took place in the pediatrics and gynecology-obstetrics department of the CHNP, a level 3 public hospital located in the suburbs of Dakar (suburban area). It has a maternity unit with a newborn baby corner, staffed around the clock by qualified providers (pediatricians, gynecologists, midwives). It is also a referral facility that receives and admits all newborn babies transferred or coming from home.

### Type, period and study population

This was a retrospective, descriptive and analytical study, conducted from 1<sup>st</sup> January 2022 to 31 December 2022, of children admitted with perinatal asphyxia.

### Inclusion criteria

All newborn aged zero (0) to 28 days who presented birth asphyxia during the study period were included.

### Non-inclusion criteria

Newborns with severe congenital malformations and neurological disorders secondary to other aetiologies were not included.

### Data collected and parameters studied

Data were collected on a pre-established survey form after consultation of hospital records, the health record and the liaison form for referred children. The parameters studied were epidemiological (age, sex, geographical origin), diagnostic (clinical and paraclinical signs, aetiologies), therapeutic (resuscitation, aetiological treatment) and evolutionary (mortality, complications), relating to the characteristics of the mother and the newborn.

### Data entry and statistical analysis

Data were entered and analysed using SPSS 2019 (IBM Statistics SPSS Version 26) and the XLSTAT 2023.1.2 (1406) add-in for Microsoft Office Excel 2021. Qualitative variables are expressed as percentages and quantitative variables as numbers, means or medians and standard deviations with their ranges. For statistical comparisons, we used Pearson's chi-square ( $\chi^2$ ) test and the p-value (p), with a 95% confidence interval when the p-value was significant (p<0.05), depending on the conditions of application.

## RESULTS

### Epidemiological and sociodemographic data

A total of 101 newborns were included, representing a hospital frequency of 12.74%. The mean maternal age was 25.7 years 15-41 years. The most common maternal age group was between 16 and 25 years. The majority of mothers (67.33%; n=68) were

from the suburbs of Dakar. Most mothers (64.36%; n=64) were married.

### Maternal medical and gynecological-obstetric data

The average gestational age and parity was 2 [4-8]. Primiparous women accounted for 54% of the pregnancies compared with 27% of pauciparous women and 18% of multiparous women. Medical and gynaeco-obstetric histories were found in 3.96% (n=4) of the mothers, including sickle cell disease (2.97%; n=3), uterine myoma (1.98%; n=2) and asthma (0.99%; n=1). A history of neonatal death was found in 5.94% (n=6) of the mothers. Most mothers (54.55%) had undergone at least 4 antenatal visits. Premature Rupture of Membranes, dystocia and anaemia were the main pregnancy-related medical and gynecological-obstetric pathologies, with a respective frequency of 27.72% (n=28) (Table 1).

**Table 1:** Distribution of mothers according to the presence of medical and gynaeco-obstetric pathologies during pregnancy.

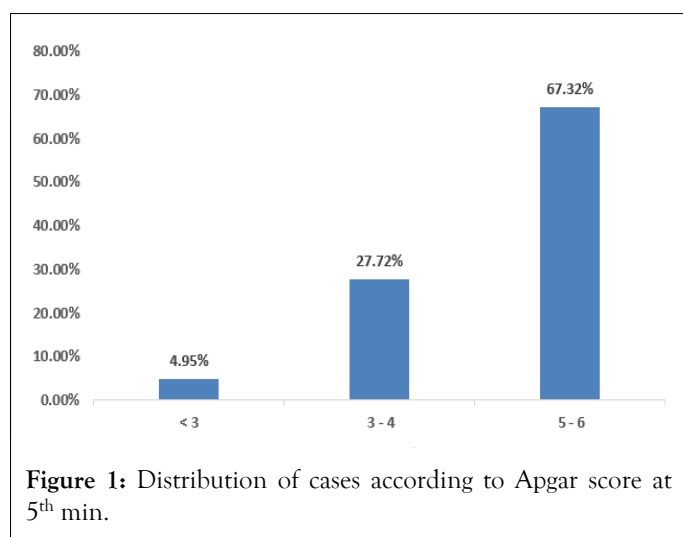
Pathologies during pregnancy	Number (n)	Percentage (%)
Prelabor rupture of the membranes	28	27.72
Dystocia	28	27.72
Anemia	28	27.72
Gestational diabetes	18	17.82
3 <sup>rd</sup> trimester urogenital infections	10	9.90
Pre-eclampsia	9	8.91
Retroplacental haematoma	7	6.93
Eclampsia	6	5.94
Funicular accidents	5	4.95
Placenta praevia	4	3.96
Uterine rupture	3	2.97
Pregnancy-induced hypertension	2	1.98
Hydramnios	2	1.98
Oligoamnios	2	1.98
HELLP (Hemolysis, Elevated Liver enzyme levels and Low Platelet) syndrome	2	1.98
Anamnios	1	0.99
Chorioamnionitis	1	0.99

The appearance of the amniotic fluid was abnormal in 56.17% (n=41) of cases, with meconium fluid (30.14%), greenish-tinged fluid (16.44%) and haematic fluid (9.59%). The presentation was cephalic in the majority of cases (93.18%; n=94).

Delivery was by vaginal route in 55.45% of cases compared with 44.55% by caesarean section. Suction delivery was the only type of instrumental manoeuvre used in 5.94% (n=6) of cases. All the deliveries had taken place in a health facility, with the exception of one (1) case of home delivery.

### Clinical data

All newborns (100%; n=101) had not cried at birth. The majority of newborns (80.19%; n=81) received resuscitation at birth. Resuscitation consisted of suction secretions alone in 9.90% of cases, suctioning secretions and ventilation in 55.46% of cases and ventilation combined with External Cardiac Massage in 15.84% of cases. All newborns had an Apgar score of less than 7/10 at the 5th min. According to the severity of the Apgar score, 4.95% had an Apgar score of less than 3 (Figure 1).



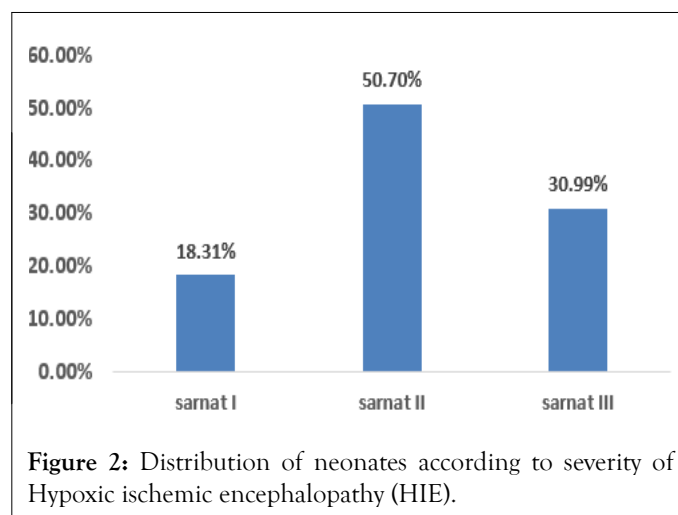
Most of the newborns (59.41%) were born at term, compared with 33.66% premature and 6.93% post-mature. The majority of newborns (71.29%) were eutrophic at birth, compared with 28.71% who were hypotrophic. There were no cases of macrosomia. The sex ratio (M/F) was 1.53. The majority of newborns (92.08%; n=93) had been admitted before 6 hours of life and 16.83% (n=17) had been cared for from the first minute of life.

The majority of newborns (78.21%; n=79) had been born in our centre, compared with 21.78% (n=22) who had been born outside the centre. Regarding transfer conditions, the majority of newborns referred, 63.63% (n=14), were transported by taxi compared with 36.37% (n=8) by ambulance without oxygen. Perinatal asphyxia was associated with maternal-fetal infection and inhalation of amniotic fluid in 31.73% (n=33) of cases respectively (Table 2).

**Table 2:** Distribution of newborns according to other associated pathologies.

Related pathologies	Number (n)	Percentage (%)
Maternal-fetal infection	33	32.67
Inhalation of amniotic fluid	33	32.67
Delayed resorption of pulmonary fluid	16	15.84
Hyaline membrane disease	15	14.85
Obstetrical trauma	25	24.75
Congenital malformations	7	6.93

Hypoxic ischemic encephalopathy (HIE) complicated cases of perinatal asphyxia in 70.30% of cases (n=71). According to severity, Sarnat I HIE was noted in 18.31% of cases, Sarnat II HIE in 50.70% of cases and Sarnat III HIE in 30.99% of cases (Figure 2).



Other clinical complications were dominated by respiratory distress (90.10%; n=91), jaundice (25.74; n=26) and haemorrhagic syndrome (13.86; n=14).

### Paraclinical data

Biological abnormalities (43.56%; n=44) were represented by anaemia (21.78%; n=22), predominantly indirect hyperbilirubinaemia (18.81%; n=19), hepatic cytolysis and renal failure in 8.91% (n=9) of cases respectively, dyskalaemia (7.92%; n=8), hypocalcaemia (4.95%; n=5), hypoglycaemia (3.96%; n=4), dysnatremia (1.98%; n=2). The haemogram showed hyperleukocytosis (14.85%; n=15), leukopenia and thrombocytopenia in 4.95% (n=5) of cases respectively. C-Reactive Protein (CRP) was positive in 11.88% of cases (n=12). Transfontanellar Ultrasound (TFUS) was performed in 6 newborns and revealed ischaemic lesions in 5 cases. No

neonates underwent cerebral Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) scans.

### Therapeutic data

Half of the neonates (51.49%; n=52) had received neuroprotection with Magnesium sulphate in most cases (94.34%; n=50) and passive hypothermia (45.32%; n=24). For ventilatory support, home-made bubble Continuous Positive Airway Pressure (bCPAP) was used in almost all cases (97.03%; n=98). Anticonvulsants were administered in 33.66% (n=34) of cases and vasoactive drugs in 18.81% (n=19). Blood transfusion was instituted in 24.75% (n=25) of cases and phototherapy in 21.78% (n=22).

### Progression

The mean length of hospitalisation was  $11.2 \pm 0.8$  days 3-43 days. Mortality was 37.62% (n=38). The majority of deaths (71.05%; n=27) were early neonatal deaths, with 62.96% (n=17) occurring within the first 24 hours of life. The mean age at death was 4 days 16-18 days. Half of the deaths (52.63%, n=20) occurred in newborns with Sarnat III Hypoxic ischemic encephalopathy (HIE). The prognostic factors significantly associated with death in neonates with perinatal asphyxia were Sarnat stage ( $p=0.002$ ), gestational age ( $p<0.0001$ ) and number of antenatal visit  $\leq 3$  ( $p=0.039$ ). The more severe the Sarnat, the higher the death rate. Increasing gestational age and number of antenatal visit were inversely related to death rate (Table 3).

**Table 3:** Factors associated with mortality.

Determinants	Death		p-value
	Yes (%)	No (%)	(IC 95%)
Number of antenatal visit			
≤ 3	23 (48.94)	24 (51.06)	0.039*
>3	15 (27.78)	39 (72.22)	
Pathology during pregnancy			
Absent	12 (35.29)	22 (64.71)	0.829
Present	26 (38.81)	41 (61.19)	
Trophicity at birth			
Eutrophy	25 (34.72)	47 (65.28)	0.371
Hypotrophy	13 (44.83)	16 (55.17)	
Apgar score at 5 <sup>th</sup> min			
>3/10	28 (35.44)	51 (64.56)	0.458
≤ 3/10	10 (45.45)	12 (54.55)	
Sarnat classification			

I	3 (23.08)	10 (76.92)	0.002*
II	7 (19.44)	29 (80.56)	
III	14 (63.64)	8 (36.36)	
Maturity at birth			
Full term	13 (21.67)	47 (78.33)	<0.0001*
Post-maturity	2 (28.57)	5 (71.43)	
Prematurity	23 (67.65)	11 (32.35)	

**Note:** \* significant p-value ( $<0.05$ ).

## DISCUSSION

The hospital incidence of perinatal asphyxia was high in our study, around 12.74%. However, it was much lower than that reported in other studies carried out in Burkina Faso (19.6%), Cameroon (22.9%) and Ethiopia (42.29%) [4-6]. In developed countries, perinatal asphyxia appears to be less common with a prevalence between 0.5% and 6% [7]. This wide variability in frequency could be explained by inadequate monitoring of pregnancies and surveillance of deliveries by partogram.

As reported in other studies conducted in Africa, the most common maternal age group was between 16 years and 35 years [8,9]. Most of the mothers were from the suburbs of Dakar. This could be explained by the CHNP's geographical location, which facilitates faster access to emergency obstetric and neonatal care. As reported in other studies carried out in Senegal, in the sub-region and elsewhere in the world, perinatal asphyxia was more frequent in primiparous women. Primiparity is linked to a lack of knowledge and experience of pregnancy and childbirth, which can affect the progress of labour and therefore expose the foetus to dystocic delivery, foetal distress and hypoxia at birth [9-12]. Hence the importance of ensuring optimal education of pregnant women during monitoring of the pregnancy about potential complications in order to reduce the risk of asphyxia at birth. With regard to pregnancy monitoring, most of the mothers had received at least 4 antenatal visits, results similar to those reported in other studies [4,8,13]. Regular monitoring of pregnancy by qualified staff enables early detection of risk factors and causes that may lead to perinatal asphyxia. As reported in the literature, the main obstetric complications associated with the occurrence of perinatal asphyxia were premature rupture of membranes, dystocia, gestational diabetes, maternal infection, pre-eclampsia and vascular pathologies. These pathologies lead to disruption of maternal-fetal uteroplacental exchanges, resulting in placental hypoperfusion and consequent fetal hypoxaemia and asphyxia [4,5,8,14,15]. Fetal presentation was predominantly cephalic [8,9,13]. As regards the route of delivery, vaginal delivery was predominant in our study, in contrast to the study carried out in Ziguinchor (Senegal) where caesarean section was more common [13]. The predominance of vaginal delivery in our study could therefore be explained by a delay in the decision to perform surgical extraction, secondary to a poor assessment of fetal well-being or,



when a caesarean section is indicated, a lack of access to the operating theatre, which is not always available and is often busy with other surgical emergencies. The amniotic fluid was meconium in most cases. Coloured amniotic fluid can be explained by the relaxation of the anal sphincter in the event of foetal distress, with a deviation of foetal perfusion in favour of the noble organs and to the detriment of other organs such as the intestine. This leads to a risk of inhalation [16]. In the literature, there is a significant association between the intrauterine release of meconium and perinatal asphyxia, in contrast to our study [10,14,17,18]. This demonstrates the importance of good monitoring of labour for signs predictive of foetal distress such as greenish-tinted amniotic fluid or meconium.

The absence of a cry at birth is a major clinical criterion of perinatal asphyxia. All newborns did not cry at birth and the majority (80.19%) were resuscitated. Similar proportions were found in a study conducted in Senegal in 2017 [8]. It was not possible to record the notion of resuscitation in all the newborns who did not cry at birth because of poorly completed health records and/or transfer forms. Adaptation to life outside the womb is assessed retrospectively using the Apgar score at 5 min and 10 min of life. In our series, all newborns had an Apgar score of less than 7/10 at 5 min of life. In other studies, the proportions varied between 42.6% and 100% [4,13]. Depending on the severity of the Apgar score, it has been shown that a score  $\leq 3$  at 5 min of life was associated with a 1460-fold increase in the risk of neonatal death [19]. In our work, only 4.95% had a score  $<3$  at 5 min of life. Blood gases make a considerable contribution to the clinical diagnosis of a perinatal hypoxic-ischaemic episode. However, no newborns were able to benefit from it because it was not available in our facility. As regards the sex ratio, there was a clear predominance of males. This predominance is consistent in the literature [5,8,15,20]. It would appear that sex hormones, particularly estrogens, protect against anoxic-ischaemic lesions and that the neonatal brain is also influenced by these hormones [21]. As found in the literature, most newborns (59.41%) were born at term. This supports the hypothesis that term and near term neonates are at greater risk of perinatal asphyxia [3,15]. Intrauterine growth retardation has been noted in a third of newborns. A study carried out in Uganda and sub-Saharan Africa in 2021 showed that low birth weight was significantly linked to perinatal asphyxia. Intrauterine growth retardation is therefore thought to be secondary to chronic foetal suffering leading to chronic hypoxia, which threatens cerebral development and therefore leads to asphyxia [12,14]. Almost all the newborns (92.08%) were admitted before 6 hours of life, which is the mandatory time for the introduction of therapeutic hypothermia. Hypothermia limits neurological disorders and the cascade of excitotoxic reactions by reducing energy expenditure and limiting neuronal death or apoptosis [22]. This rate is significantly higher than that found in a previous study conducted in Senegal in 2017 (34%) [8]. This difference could be explained by the fact that the majority of newborns were born at our facility, compared with 100% of births outside the facility in the above-mentioned study. Consequently, the reference delay, increased by the lack of medical evacuation means, would lead to a delay in care. Although the majority of newborns were born in our facility,

only 16.83% were cared for in the first minute of life by qualified health personnel from the neonatology unit. This would be linked to their inconsistent presence in the delivery room despite a good collaboration between pediatrician and obstetrician. Respiratory distress was the main extra-neurological impact. It was present in almost all newborns (90.10%). In the literature, it is the most frequently found complication [8,23]. In fact, in the case of hypoxia, there is a return to fetal circulation with exclusion of the pulmonary territory due to increased pulmonary vascular resistance, persistence of the patency of the ductus arteriosus and the establishment of metabolic acidosis by anaerobic conditions [24]. This respiratory distress could also be linked to an underlying pathology responsible for perinatal asphyxia. In our series, two-thirds of the newborns had a clinically diagnosed HIE according to the Sarnat and Sarnat classification, as paraclinical investigations were not always feasible. Moderate HIE (Sarnat II) was the most common. This result is comparable to that observed in Congo, Burkina Faso and Tunisia [4,23,25]. On the other hand, other authors in Senegal and Morocco had reported a predominance of mild HIE (Sarnat I) [8]. In addition, the high proportion of moderate and severe HIE in our study could be explained by the unavailability of adequate technical platforms for the management of this complication. Indeed, therapeutic hypothermia devices that provide whole-body or cephalic pole hypothermia are not available in our structures. Therefore, newborns meeting the criteria had benefited from magnesium sulfate-like neuroprotection and passive hypothermia (not warming the baby) combined with other supportive care. As found in our work, there is evidence of dysfunction in another organ system in most newborns with moderate to severe HIE [26]. Mortality was high in our study in the range of 37.62%, similar to that of other studies, [8,13,23,27]. Prognostic factors significantly associated with death in newborns with perinatal asphyxia were Sarnat stage ( $p=0.002$ ), gestational age ( $p<0.0001$ ) and number of prenatal visits  $\leq 3$  ( $p=0.039$ ). Indeed, the more severe the HIE, the higher the death rate.

## CONCLUSION

The increase in gestational age and the number of prenatal visits was inversely proportional to the rate of death. Hence the interest in ensuring optimal monitoring of the pregnancy and adequate resuscitation in the delivery room in order to minimize the complications and sequelae related to perinatal asphyxia. The presence of qualified personnel and the availability of adequate technical equipment at each birth remains necessary to reduce neonatal morbidity and mortality related to perinatal asphyxia.

## AUTHOR CONTRIBUTIONS

**Contribution in discussion:** Diallo Moussa, Diouf Abdoul Aziz (Department of Obstetrics and Gynecology, National Hospital, Dakar, Senegal).

**Contribution in study design:** Faye Papa Moctar (Department of Pediatrics, Albert Royer National Children's Hospital, Dakar, Senegal), Ndiaye Ousmane, Gueye Modou, Sylla Assane (Department Pediatrics, Abass Ndao National Hospital, Dakar, Senegal).

**Contribution in data collected:** Sarr Ndeye Fatou, Kane Adiaratou Fatou (Department of Pediatrics, Pikine National Hospital, Dakar, Senegal).

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