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Original Research Article

Psychomotor development at 9 months of age in infants with perinatal asphyxia at the Mother and Child University Hospital of Libreville (Gabon) in 2023

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ABSTRACT

Background: Perinatal asphyxia (PNA) is a common condition in neonatology. Objective of the study was to describe the short- and medium-term outcome of newborns presenting with PNA at the Centre Hospitalier Universitaire Mère-Enfant Fondation Jeanne Ebori (CHUME-FJE) in 2022.
Methods: A prospective longitudinal and analytical study was conducted over a 16-month period. Newborns were included, regardless of gestational age, had presented with PNA. The statistical significance threshold was set at $p<0.05$.
Results: 96/464 newborns hospitalized for PNA (20.7%). The sex ratio was 1.26. The mean resuscitation time was 9.1±7.1 min. Neurological complications accounted for 73.3% (n=63), with an AEI classified as Sarnat II (27.0%) and Sarnat III (22.2%). The mean hospital stay was 12.6 days. The overall death rate was 32.6%. During the course of the study, 50.0% of infants recovered to normal weight for their age at 9 months and a proportion of 7.7% presented with PML developmental delay and 11.5% with PCVM taking into account the corrected age for preterm newborns.
Conclusion: APN remains a public health problem in sub-Saharan countries with high neonatal mortality and long-term neurodevelopmental sequelae. Prevention of this condition relies on better monitoring of pregnancy and delivery and a training program for healthcare personnel in newborn resuscitation in the delivery room.

Keywords: Asphyxia, Hypoxia, Hypothermia, Encephalopathy, Libreville

INTRODUCTION

Perinatal asphyxia (PSA) is a severe impairment of uteroplacental exchange leading to severe hypoxia and respiratory and then metabolic acidosis.[1] It is also a respiratory failure that occurs during or immediately after delivery in newborns.[2] According to the World Health Organisarion (WHO), 2.4 million newborns worldwide will die during their first month of life in 2019; this represents around 6,700 newborn deaths per day.[2]

Premature birth, complications of childbirth including (paroxysmal nocturnal dyspnea) PND, infections and congenital malformations are the main causes of neonatal death.[2] In sub-Saharan Africa, the neonatal mortality rate was 27 deaths per 1,000 live births.[2] The cumulative prevalence of advanced practice nurse (APN) in newborns was 15.9% in Central and East Africa in 2020.[3] In the sub-region, in-hospital mortality due to APN was 15.6% in Congo Brazzaville4 and 21.3% in Cameroon in 2018.[5]

In Gabon, according to the EDSG-III (2019-2021), the risk of infant mortality was estimated at 28 deaths per 1,000 live births and the neonatal mortality quotient was estimated at 18%.[6] This condition is responsible for long-term complications. Indeed, anoxic-ischaemic

encephalopathy (AIE) due to APN is one of the main high-risk factors for neurodevelopmental disorders in children.[7] In a 2018-2019 study conducted in Libreville, we obtained a survival rate of 68.0%, and a sequelae rate of 8.0%.[8] The sequelae found were dominated by language and fine motor disorders.[8]

The morbidity and mortality associated with APN remains high in Gabon. APN therefore remains a major public health problem in Gabon. Given the paucity of data, particularly on short- and medium-term trends, we conducted this study in order to improve the morbidity-mortality rate in our context. More specifically, to determine the frequency of APN at the Centre Hospitalier Universitaire Mère-Enfant Fondation Jeanne Ebori (CHUME-FJE), and to describe the short- and medium-term outcome of newborns with APN.

METHODS

Study design

This was a prospective, longitudinal, analytical study conducted over a 16-month period (1 January 2022 to 30 April 2023). The study took place in the neonatal medicine department of CHUME-FJE. This is a third-generation hospital specialising in mother and child care. It is a benchmark in terms of healthcare provision and quality of service in Gabon. It is located in the commune of Libreville, the political and administrative capital of Gabon, with an estimated population of 703,939.[9] From an ethical point of view, authorizations have been obtained from the CHUME-FJE administrative authorities. Informed consent was obtained from the parents. Confidentiality and anonymity were respected.

The study population consisted of all neonates hospitalized in the neonatal medicine department, regardless of gestational age. We included all neonates who had presented with perinatal asphyxia and for whom parental consent had been obtained. Stillbirths and neonates with congenital malformations (cerebral or nervous system) were not included. Newborns discharged against medical advice (CAM), those lost to follow-up and those whose parents refused to continue the follow-up (withdrawal) were excluded from the study. Sampling was exhaustive, based on all neonates admitted for perinatal asphyxia who met the inclusion criteria.

Data were collected on admission from the medical records of the neonatal medicine department and during follow-up. They were then collected on a pre-established standardized form completed during outpatient follow-up at regular intervals (1 month, 3 months, 6 months, 9 months and 12 months) in the presence of the outpatient paediatrician. The variables studied in the newborn: data at birth (gestational age, sex, Apgar score at 1 and 5 minutes, resuscitation and anthropometric parameters); clinical, paraclinical and therapeutic data during hospitalization and outcome of hospitalization. In the outpatient department, the parameters studied were: staturo-weight growth data (weight/age, height/age and BMI/age) and psychomotor assessment data.

Conduct of the study

The study began in hospital. After obtaining informed consent, data were collected using a standardized form. Follow-up after hospital discharge took place in the outpatient clinic and in the physiotherapy department of the CHUME-FJE at regular intervals according to a provisional calendar and depending on the key stages of psychomotor development. Consequently, 4 appointments were defined at 1 month, 3 months, 6 months and 9 months with the paediatrician in the outpatient department for follow-up visits.

This was based on a physical examination of the newborns, monitoring of the growth curve (checking anthropometric parameters: weight, height) and any pathologies that might arise during their growth. The newborns also benefited from psychomotor assessments with the facility's psychomotor therapist from the age of 3 months.

Evaluation method

To evaluate the growth in height and weight of newborns in relation to their age, we used the following parameters: weight in grams (g), height in centimetres (cm). On admission, the parameters were projected onto Lubchenco curves. At each visit with the paediatrician, we measured weight using a SOEHNLE professional electronic baby scale. Height was measured using a measuring tape. These various anthropometric parameters were then recorded in the health record and projected onto the WHO 2006 growth curves using WHO Anthro software.[10]

We compared each child against the norms for their age and sex. Psychomotor development was assessed by the psychomotor therapist. We used the DF-MOT scale, which is suitable for prospective longitudinal studies, highlighting the sequential aspects of developmental acquisitions as a function of age (in months and days) and making it possible to establish a standardized motor level of motor and visio-manual co-ordination, taking into account the corrected age for premature newborns.[11]

Statistical data entry and analysis

Statistical data were collected and analysed using the following software: Microsoft Excel© 2016, Epi Info© 7.2.5.0, WHO Anthro© 3.2.2 and the online statistical analysis software p value (https://www.pvalue.io/fr/). Categorical variables were expressed as headcounts and percentages. Quantitative variables were expressed as mean (standard deviation). Categorical variables were compared using the Chi2 (Chi^2, X^2) test, and if the test application conditions were not met, a Fisher exact test was performed. For quantitative variables, we performed a non-parametric Mann-Whitney test (Mann-Whitney and

Wilcoxon U test). Frequencies were expressed with a 95% confidence interval calculated using the Miettinnen method. The threshold of statistical significance was set at $p<0.05$.

RESULTS

Frequency

464 newborns were hospitalized, including 96 cases of APN (20.7%). We included 86 cases in the study (10 CAM discharges).

Characteristics of the mothers of the newborns included

Mean age was 29±7 years (extremes 17 and 46 years). The age range was 20-35 years (75%; n=65). They were in a couple (73.8%; n=62). They were unemployed (38.1%; n=32). The pregnancy was twin (11.6%; n=10). The main intercurrent pathologies were pre-eclampsia (11.6%; n=10) and malaria (9.3%; n=8) (Table 1). The caesarean section rate was 51.2% (n=44) and all were performed as emergencies (n=44). General anaesthesia was used in 52.3% (n=23) of cases. The duration of labour was prolonged (34.9%; n=30).

Characteristics of the newborns

The mean gestational age was 34 SA±5 SA (extremes of 22 SA and 42 SA). Prematurity (62.8%; n=54). Sex ratio (1.26). The mean birth weight was 2142.0±1100.0 g (extremes 500.0g and 5000.0g). The average height was 43.1±7.1 cm (extremes 17.0 cm and 55.0 cm). The average CP was 29.9±4.5 cm (extremes 20.0 cm and 38.0 cm). IUGR (26.7%; n=23/86) was disharmonious (56.5%; n=13). The mean resuscitation time was 9.1±7.1 min (extremes 1.0 and 30.0 min and a median of 7.5 min [5.0-10.0]). The duration of resuscitation was >15 minutes (11.6%; n=10). In 60.5% (n=52), resuscitation was performed by a doctor and 39.5% (n=34) by midwives. The main complication was neurological (73.3%; n=63). ETF showed cerebral oedema (61.1%; n=33) and intraventricular haemorrhage (24.1%; n=13).

During hospitalization, renal and hepatic involvement was observed in 45.3% (n=39) and 15.1% (n=13) respectively. ETF was pathological in 62.8% (n=54). The observed abnormalities were cerebral edema (61.1%; n=33), intraventricular hemorrhage (24.1%; n=13), periventricular hyperechogenicity (12.9%; n=7) and hydrocephalus (1.9%; n=1). The observed complications were neurological (73.3%; n=63), metabolic (69.8%; n=60), respiratory (66.3%; n=57) and hematological (43.0%; n=37). Among the neurological complications, the AE was classified as Sarnat I (50.8%; n=32), Sarnat II (27.0%; n=17), and Sarnat III (22.2%; n=14).

The mean hospital stay was 12.6 days (range, 1.0 to 103.0 days). In-hospital mortality was 32.6%; n=28. At discharge, 59 newborns were alive. Among them, 1 died and 6 refused to continue follow-up until the age of 9 months, for a participation rate of 88.1% (n=52). Prematurity during follow-up was 61.5% (n=32).

Changes in staturo-weight growth in newborns monitored

At 1 month, 55.7% (n=30) were severely underweight. This severe underweight persisted at 6 months (13.3%; n=4). At 6 months, 30.7% (n=15) of the infants had a normal weight for age. This normality had improved by 9 months in 50.0% (n=26) of cases (Figure 1).

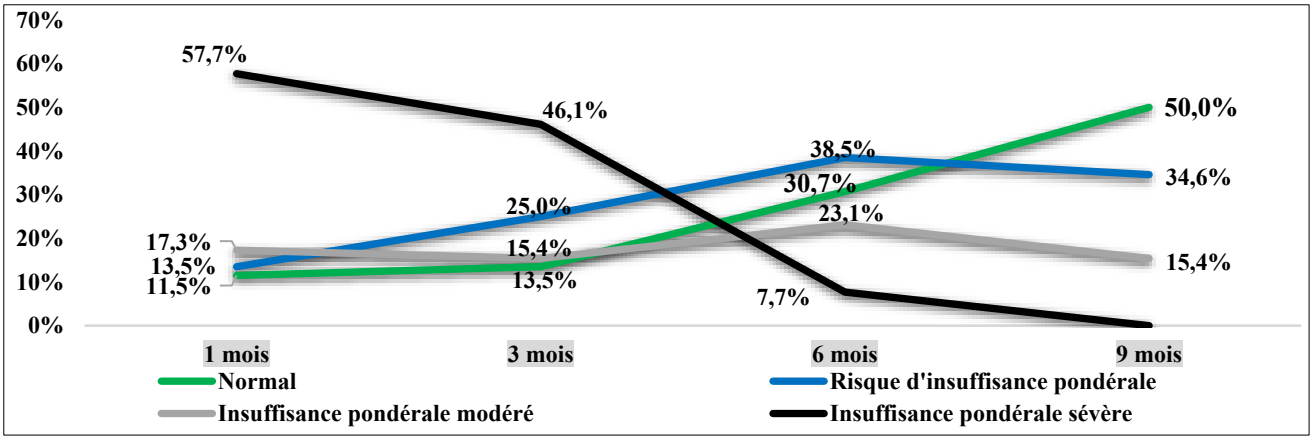

Figure 1: Evolution of weight growth of the newborns monitored.

Regarding height, at 1 month, 67.3% (n=35) were severely stunted. It persisted at 6 months in 54.3% (n=19/35). At 6 months, 21.2% (n=11) of the infants had normal height for age and 41.8% (n=22) had normal height for age at 9 months (Figure 2).

Evolution of locomotor postural development taking into account the corrected age of premature newborns

At 3 months, 25.5% (n=13) of patients had a delay in PML development. This delay was observed at 6 and 9 months in 11.5 and 7.7% (n=4). Delayed PML development at 9

months was significantly associated with prolonged duration of labour >18 hours in primiparous mothers (p=0.024), duration of resuscitation >15 min (p<0.01), intraventricular haemorrhage (p<0.01) and Sarnat III score (<0.010) as described in Table 1.

Progression of prehension coordination visuomotor development taking into account the corrected age of premature newborns

At 3 months, 36.5% (n=19) of infants had a delay in the development of PCVM. This was observed at 6 and 9 months in 21.2% (n=11) and 11.5% (n=6). There was a relationship between delayed CVP development at 9 months of age and resuscitation time >15 min (p<0.011), intraventricular haemorrhage (p<0.001), Sarnat III score (p<0.01) as described in Table 2.

The variables associated with the evolution of the newborns followed, after a simple logistic regression and a multivariate regression model, we have the variables significantly associated with the APN and the PML and PCVM developments are distributed in Table 3.

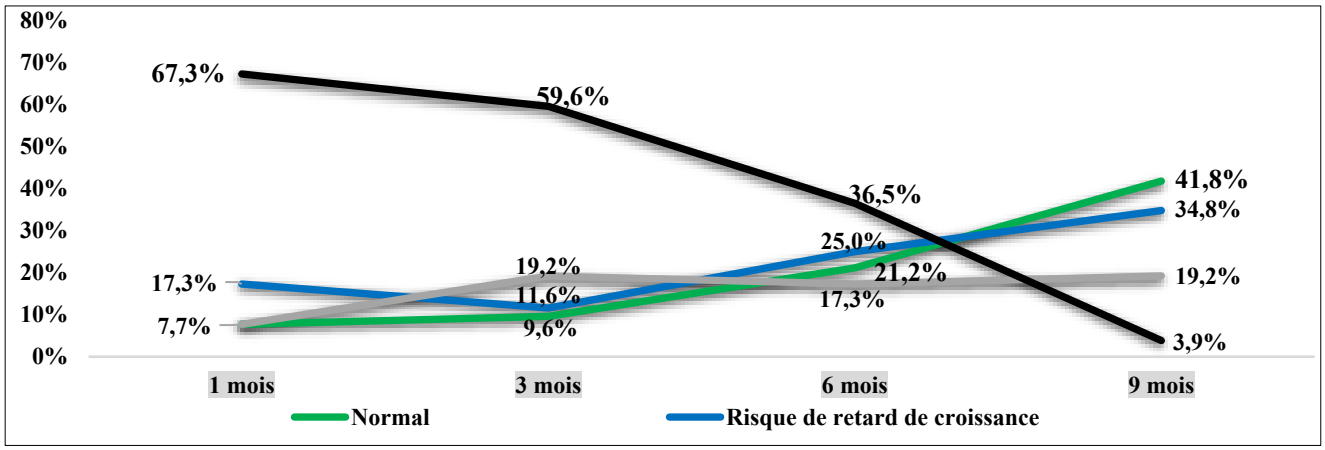

Figure 2: Evolution of the height growth of the newborns monitored.

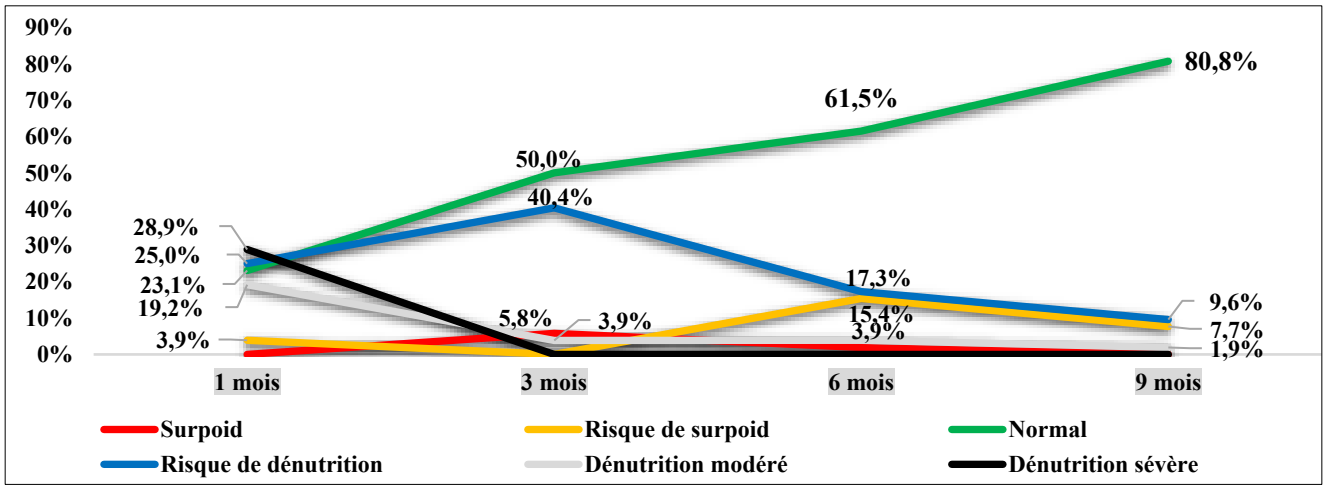

Figure 3: Evolution of height-weight growth (BMI/age) of the cases followed.

Table 1: Distribution of variables associated with PML development.

Characteristics	PML development delay	No PML development delay	n	Test	P value
Duration of work					
Primiparity (hours)					
≤18	0	12	12		
>18	3	7	10	Fisher	0.024
Pauci-multiparity (hours)					
≤12	1	16	17		
>12	0	13	13		

Continued.

Characteristics	PML development delay	No PML development delay	n	Test	P value
Durée of resuscitation					
≤5	1	33	34	Fisher	<0.01
6-15	1	15	16		
>15	2	0	2		
ETF					
Cerebral edema	2	15	17	Fisher	<0.01
HIV	3	0	3		
Hyperechogenicity	0	5	5		
Normal	0	27	27		
Sarnat score					
1	1	24	25	Fisher	<0.010
2	1	4	5		
3	3	0	3		

Table 2: Distribution of variables associated with and development of PCVM.

Characteristics	PML development delay	No PML development delay	n	Test	P value
Apgar à M1					
≤3	6	22	28	Fisher	0.025
4-6	0	24	24		
Duration of resuscitation					
≤5	3	31	34	Fisher	<0.011
6-15	1	15	16		
>15	2	0	2		
ETF					
Cerebral edema	3	14	17		<0.001
HIV	3	0	3		
Hyperechogenicity	1	4	5		
Normal	0	27	27		
Neurological damage					
EAI	7	23	30	Fisher	0.016
No	0	22	22		
Sarnat score					
1	3	22	25	Fisher	<0.01
2	1	4	5		
3	3	0	3		

Table 3: Distribution of variables associated with APN and PML and PCVM developments.

Parameters	P value
PPN	
Professional activity (unemployed)	<0.01
Unemployed versus employed	<0.01
Unemployed versus students	<0.05
PML	
Length of labor in primiparas (18 hours)	0.024
>18 versus ≤18 hours	<0.05
Duration of resuscitation (15 min)	<0.01
>15 mid versus 5-15 mid	<0.001
>15 mid versus ≤5 mid	<0.001
ETF (Intraventricular hemorrhage) results	<0.01
Pathological versus normal	<0.02
Neurological complication (Sarnat III)	<0.01
Sarnat score 3 versus 1	<0.001
3 versus 2	<0.05

Continued.

Parameters	P value
PCVM	
Duration of resuscitation (>15 mid)	<0.011
>15 versus 6-15 mid	<0.001
>15 versus ≤5 mid	<0.001
ETF (intraventricular hemorrhage) results	<0.001
Pathological versus normal	<0.01
Neurological complication (Sarnat III)	<0.01
Sarnat score 3 versus 1	<0.001
3 versus 2	<0.05

DISCUSSION

PND is a major cause of neonatal morbidity and mortality and remains a public health problem. The main aim of this study was to describe the short- and medium-term outcome of newborns who presented with APN at the CHUME-FJE in 2022. The single-centre nature of this study could be a limitation. However, this study, although hospital-based, has the advantage of being carried out in a referral hospital dedicated to the care of mothers and children of all ages. It was important to recognize the limitations of the Apgar score, which is an expression of the physiological situation of the newborn for a limited time and includes clinical components that are subjectively assessed by healthcare staff.

Nevertheless, the criteria for the Apgar score are well defined in the literature.[12,13] And the delivery room staff at the CHUME-FJE are well trained to establish a correct Apgar score at birth. However, the biological markers of foetal metabolic acidosis (pH of the cord, base deficit, lactate), which are necessary objective measurements for the diagnosis of APN, are not yet routine in our context.

Frequency

The prevalence is 20.7%. It is lower than that found in Gabon in 2014 (24.5%).[14] This difference is explained by the retrospective nature and longer duration of the Kuissi et al study and the type of facility. It is comparable to that found in the DRC (19.4%), Cameroon (22.9%), Mali (21.9%) and Italy (21.5%).[5,15-17] These results are linked to the almost identical type of methodology and the study setting (reference hospitals). A high prevalence of 32.8% was found in Ethiopia.[18] The reasons for the high prevalence are the low attendance of mothers at antenatal visits and qualified assistance at delivery.[19] In West Africa, D'Almeida and Coulibally found 4.5% and 6.4% respectively.[20,21] This low prevalence is justified by the fact that newborns are at term (≥37SA).

Evolution of staturo-weight growth in infants

In this study, we observed that weight growth went from severe underweight at 1 month (57.7%) to normal weight growth at 9 months (50.0%). Concerning statural growth, newborns with severe growth retardation at 1 month (67.3%) had normal statural growth at 9 months (41.8%). In short, weight growth recovered more quickly than statural growth. Newborns with APN regain their weight from the 6th month. This observation was made by Mabiala et al, where the weight of children born with a PPN recovered at the age of 6 months.[22] These growth anomalies are due to the difficulties encountered in feeding newborns during the acute phase of asphyxia. Parental education and household income influence the nutritional status of infants. According to some authors, this reduces the risk of low birth weight (LBW) and the risk of underweight during growth.[19] The start of dietary diversification is recommended at 6 months of age by European and French learned societies, as this promotes weight gain from this age.[23]

Psychomotor development of patients

For psychomotor evaluation, 52 newborns, including 32 premature newborns, were monitored by the psychomotor therapist. We observed that the delay in PML development was 7.7% and 11.5% for PCVM at 9 months of age. Patients with a Sarnat I score were catching up, while 1 in 5 infants with a Sarnat II score had severe psychomotor delay. And all patients with a Sarnat III score showed severe psychomotor delay (PML and PCVM) with convulsions. Developmental delay was more common in PCVM than in PML.

These disorders were also found by Koum et al, who observed delays in language acquisition (27.0%) and walking (14.0%).[5] Padayachee et al followed 29.0% (n=113/390) of newborns until an average age of 5.9±5 months. And, 20.4% of cases had presented with delayed psychomotor development with 11.5% with cerebral palsy.20 Perinatal asphyxia remains the main cause of psychomotor delay and cerebral palsy.[24] The risk factors significantly associated with these disorders were labour in primiparous women >18 hours, duration of resuscitation >15 min, intraventricular haemorrhage at ETF and neurological complication classified as Sarnat III.

CONCLUSION

Perinatal asphyxia remains a public health issue in our context. It is one of the causes of neonatal mortality in the world and can have a serious impact on the functional prognosis of newborns through its serious complications, such as multivisceral failure and EAI. The hospital

incidence rate was 20.7%. Over the course of the disease, 50.0% of infants regained a normal weight for their age at 9 months, while 7.7% showed a delay in PML development and 11.5% in PCVM, taking into account the corrected age for preterm infants. Numerous therapies are recommended to reduce the neurological effects of EAI, which is one of the main complications of APN. In our context, the best strategy should be based on prevention through better monitoring of pregnancy, delivery and a training programme for nursing staff in resuscitation of the newborn in the delivery room.

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