


# Anoxo-Ischemic Encephalopathies at the “Marie Curie” Medical Clinic in Bamako, Mali

Traore Ousmane<sup>1,2,3\*</sup>, N'Diaye Mamadou<sup>3</sup>, Diakité Siaka<sup>2</sup>, Dembélé Adama<sup>1</sup>, Sidibé Drissa Mansa<sup>3</sup>, Kouma Alassane<sup>3</sup>, Konaté Moussa<sup>2</sup>, Coulibaly Modibo<sup>1</sup>, Bagayoko Ousmane Lansenou<sup>1</sup>, Diallo Mahamadou<sup>3</sup>, Sidibé Siaka<sup>3</sup>, Keita Adama Diaman<sup>2,3</sup>

<sup>1</sup>Department of Radiology and Medical Imaging, The “Marie Curie” Medical Clinic, Bamako, Mali

<sup>2</sup>Department of Radiology and Medical Imaging, The Point “G” University Hospital Center, Bamako, Mali

<sup>3</sup>Faculty of Medicine and Odontostomatology, University of the Sciences, Techniques and Technologies of Bamako (USSTB), Bamako, Mali

Email: \*ghousno1@yahoo.fr

**How to cite this paper:** Ousmane, T., Mamadou, N., Siaka, D., Adama, D., Mansa, S.D., Alassane, K., Moussa, K., Modibo, C., Lansenou, B.O., Mahamadou, D., Siaka, S. and Diaman, K.A. (2025) Anoxo-Ischemic Encephalopathies at the “Marie Curie” Medical Clinic in Bamako, Mali. *Open Journal of Medical Imaging*, 15, 30-37.  
<https://doi.org/10.4236/ojmi.2025.151002>

**Received:** February 11, 2025

**Accepted:** March 21, 2025

**Published:** March 24, 2025

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## Abstract

**Introduction:** Anoxic-ischemic encephalopathy is an impairment of brain functions occurring before, during, or immediately after birth in the context of perinatal asphyxia during childbirth. The aim of this work was to study the contribution of transfontanellar ultrasound and computed tomography in the diagnosis of anoxic-ischemic lesions. **Methodology:** This was a prospective, cross-sectional study conducted in the radiology department of the Marie Curie Medical Clinic over a period of 8 months. The equipment used was Voluson E8 ultrasound scanners and the Optima 16-bar scanner. The parameters studied were socio-epidemiological data and the appearance of lesions in imaging. **Results:** Our study involved 30 patients, or 4.83% of cases, in 621 examinations carried out during the study period. The male sex dominated with 53.33% of cases. The age group from 0 to 05 months was the most frequent, with an average age of 1.2 months. The delay in psychomotor acquisition was the most frequent clinical information, with 26.6% of cases and 36.6% of cases presenting perilesional cerebral atrophy. Cerebral CT and transfontanellar ultrasound were the two imaging methods used, with 56.66% of cases for ETF and 43.34% of cases seen on CT. The most common lesion found on ETF was hyperechoic thickening of the choroid plexus related to intraventricular hemorrhage in 25.2% of cases. And the most frequent cerebral ischemic lesions were presented as cortico-subcortical hypodensity well systematized in 28.2% of cases. Brain MRI was not performed for financial reasons and the unavailability of this examination. **Conclusion:** Computed tomography and transfontanellar ultrasound play an essential role in the diagnosis of cerebral anoxic-ischemic lesions. However, MRI remains the examination of choice for a detailed and precise assessment of the lesions.

## Keywords

Computed Tomography, Transfontallar Ultrasound, Anoxic-Ischemic Encephalopathy, Bamako, Mali

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## 1. Introduction

Anoxic-ischemic encephalopathy is an impairment of brain functions occurring before, during, or immediately after birth in the context of perinatal asphyxia during childbirth. She refers to the death of brain cells resulting from insufficient oxygen supply (anoxia) with interruption of blood flow (ischemia) to the brain. This encephalopathy can lead to hemorrhage and focal or diffuse ischemic lesions [1]. It is a common pathology, with 20.9% of newborn deaths due to abnormalities related to perinatal hypoxia [2] [3]. The diagnosis of these anoxic-ischemic lesions is made mainly by transfontanellar ultrasound (TFU) and magnetic resonance imaging (MRI), supplemented by computed tomography (CT). TFU is a first-line examination that is less sensitive in full-term newborns than in premature babies due to neuronal necrosis [1]. MRI is the reference examination and better studies neuronal necrosis, but it remains expensive and unavailable in Mali. Hence, CT scans are more available and can help with diagnosis in developing countries. Given the lack of data on the subject in Mali, we initiated this work, the objective of which was to study the contribution of transfontanellar ultrasound and cerebral computed tomography in the diagnosis of anoxic-ischemic lesions at the Marie Curie medical clinic in Bamako, Mali.

## 2. Methodology

This was a prospective cross-sectional study carried out in the radiology and medical imaging department of the Marie Curie Medical Clinic over a period of 8 months from October 2023 to May 2024. The equipment used was Voluson E8 and Vivid 7 ultrasound scanners and the Optima 16-strip scanner. The data were collected on a survey form after the examination. Included in our study were all children with brain abnormalities on CT or ultrasound during the study period. The ultrasound scans were performed by 2 sonographers and 2 radiologists with more than 10 years of experience. The CT scans were interpreted by 2 experienced radiologists. The sample included all patients who came for transfontanellar ultrasound, and CT scans to look for anoxic-ischemic lesions. The parameters studied were socio-epidemiological data and the ultrasound and CT aspects of these lesions. All parents of children participating in the study had given their stated consent.

## 3. Results

Our study concerned 30 pathological patients out of all 621 examinations (transfontanellar ultrasound and cerebral CT) carried out during the study period, *i.e.*, a

frequency of 4.83% of cases.

### 3.1. Sociodemographic Data

Male gender dominated with 53.33% of cases against 46.67% of female cases. The age group of 0 to 05 months was the most frequent, with an average age of 1.2 months. (Figure 1)

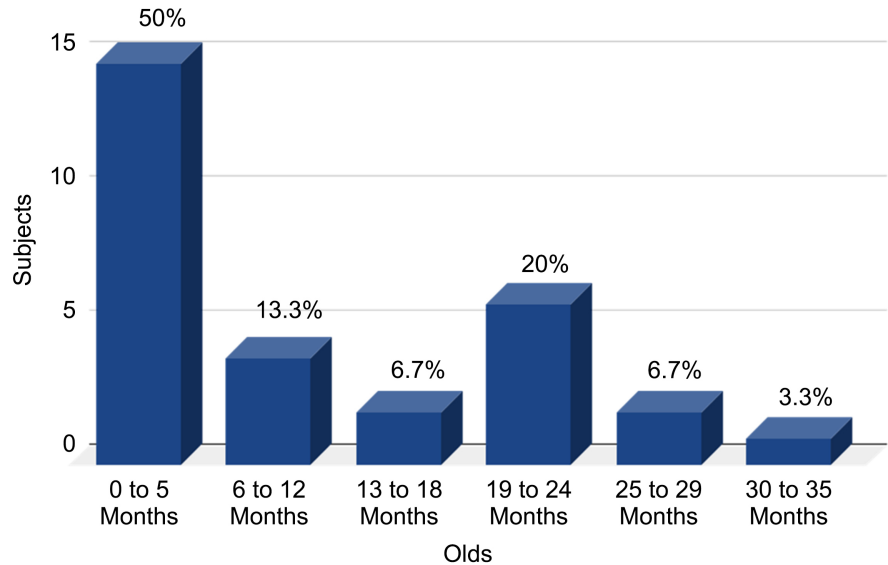


Figure 1. Distribution of patients by age in months.

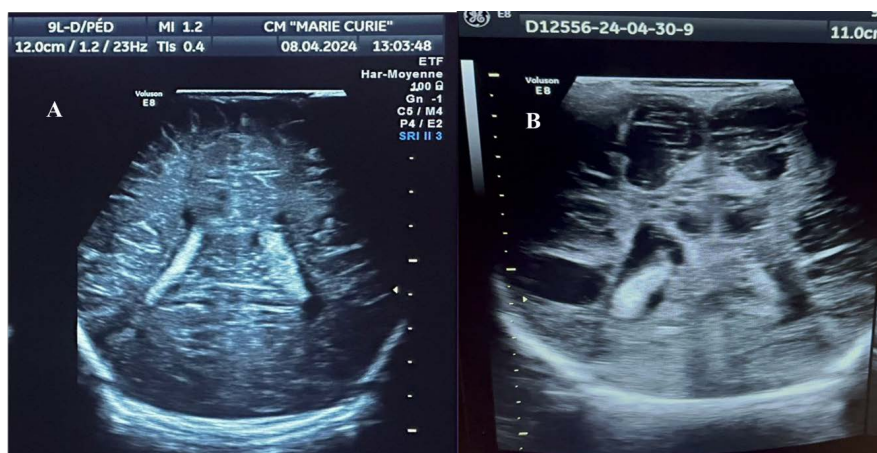
Delayed psychomotor acquisition was the most frequent clinical information, with 26.6% of cases and 36.6% of cases coming for perilesional cerebral atrophy (Table 1).

Table 1. Distribution of patients according to clinical information.

Clinical Information	Staff	Percentage (%)
Psychomotor Retardation	8	26.66
Anoxia	6	20
History of Suffering	4	13.33
Tonic-Clonic Convulsion	4	13.33
Microcephaly	2	6.66
Behavioral Disorder	2	6.66
Axial Hypotonia	2	6.66
Bulging Fontanellar	1	3.33
Craniosynostosis	1	3.33
<b>Total</b>	<b>30</b>	<b>100</b>

### 3.2. Aspects in Imaging

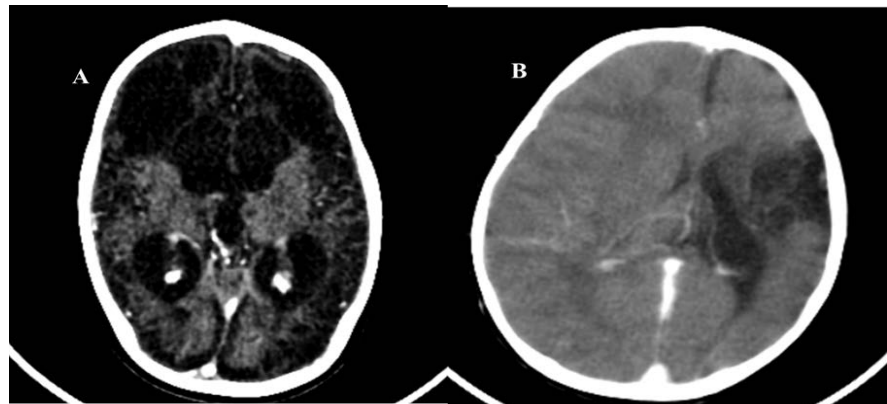
Brain CT and transfontanellar ultrasound were the two imaging methods used during our study. Brain MRI was not performed due to financial reasons and the unavailability of this examination. ETF was the most frequent examination, with 56.66% of cases being examined compared to 43.34% of cases seen on CT. ETF made a satisfactory contribution in confirming the diagnosis. She had found the following aspects: diffuse hyperechogenicity of the brain parenchyma with blurred limits indicating the presence of cerebral edema (13.3% of cases) with focal hyperechogenicity in a well-defined vascular territory which was related to cerebral ischemic lesions (23.3% of cases); hyperechogenic thickening of the choroid plexus related to intraventricular hemorrhage (25.2% of cases). Hyperechogenicity of the cerebral cortex and the subcortical, periventricular SB, and lenticular nuclei and poorly limited hyperechogenicity in heterogeneous range, seat of small cavitations indicating leukomalacia (16%) and ventricular dilatation in 22.2% of cases (**Figure 2**).



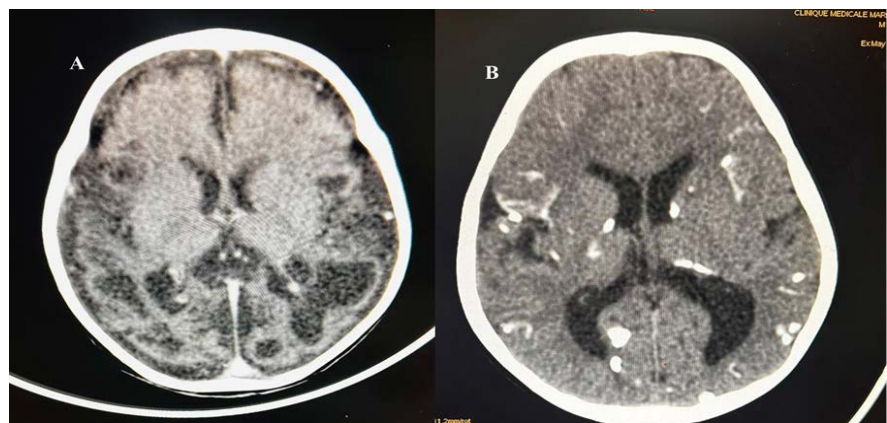
**Figure 2.** ETF ((A) and (B)) show diffuse hyperechoic areas of white matter in favor of an anoxic-ischemic lesion (A) and diffuse hyperechoic areas of white matter with cavitation lesions in favor of leukomalacia (B).

The CT scan showed lesions precisely, and it found the following lesions: cerebral edema, which presented as non-systematized hypodensity in the range without enhancement or diffuse hypodensity of the supratentorial white matter respecting the brainstem with dedifferentiation of white matter/gray matter and erasure of cortical sulci in (20.3% of cases). Cerebral ischemic lesions presented as well-systematized cortico-subcortical hypodensity in (28.2% of cases). There were ventricular dilatations (hydrocephalus) in (26.3% of cases), and intracerebral hemorrhage as spontaneous intraparenchymal or gyriform hyperdensity in 25.2% of cases. (**Figure 3** and **Figure 4**)

The associated lesions in our series observed on CT were numerous, and cerebral atrophy, which widened cortical grooves, was the most frequent associated lesion with 36.66% of cases, followed by microcalcifications presenting as spontaneous nodular hyperdensity in 10% of cases. (**Table 2**)



**Figure 3.** Axial reconstruction CT scan ((A) and (B)): Bilateral hemispheric cortico-subcortical parenchymal hypodensities with formation of porencephalic cavities. This is associated with significant symmetrical and bilateral enlargement of the grooves and the ventricular system with a sequelae appearance in favor of anoxic-ischemic encephalopathy with significant supratentorial cerebral atrophy with a sequelae appearance (A) and cortico-subcortical hypodensity of the same density as the left parietal-temporal CSF not enhanced after injection of PDC in favor of a left parietal-temporal anoxic-ischemic lesion with a sequelae appearance.



**Figure 4.** Axial reconstruction CT scan ((A) and (B)): Area of bilateral symmetrical temporal-parietal-occipital cortico-subcortical hypodensity of sequelae in favor of anoxic-ischemic lesions and bilateral hemispheric subdural effusion related to a hygroma (A) and multiple macro-calcifications at the cortico-subcortical level and central gray nuclei of sequelae appearance (B).

**Table 2.** Distribution of patients according to associated lesions seen on CT scan.

Associated Lesions	Staff	Percentage (%)
Cerebral Atrophy	11	36.6
Microcalcification	3	10
Hemispherical Hygroma	1	3.33
No Injury	15	50
<b>Total</b>	<b>30</b>	<b>100</b>

## 4. Discussion

### 4.1. Socio-Epidemiological Data

Our overall frequency was 4.83% of cases of anoxic-ischemic lesions, this result lower than that of Zanga Soré Moussa *et al.* [2], who found an annual frequency of 77.7 cases of perinatal asphyxia and superimposable to that of Anthonioz in France who reported an annual average of 36 cases [4]. This difference could be explained by the fact that our study took place in the radiology and medical imaging unit of a medical clinic whose children were most referred for imaging exploration assessment by the pediatric unit of the reference health center, which is not as frequent in terms of neonatal. In our study, there was a male predominance with 53.33% of cases with a sex ratio of 1.14, identical results found in the literature with those of Zanga and Nagalo in Burkina Faso and Folquet in Ivory Coast [3] [5] who indicated respective rates of 1.8, 1.2 and 1.6. This male predominance would be related to a supposed biological fragility of male subjects. For Herbst, male sex would be a risk factor for perinatal anoxia [2] [6]. The age group of 0 to 05 months was the most frequent, with an average age of 1.2 months in our series, with results slightly lower than that of Zanga, who had found the most frequent age group of 6 - 8 days, or 32.6%, followed by that of 4 - 5 days, or 31.3%. The average age of the patients was 14 days in his series. And the delay in psychomotor acquisition was the most frequent clinical information, with 26.6% of cases, and 36.6% of cases came for perilesional cerebral atrophy. This result differed from that of Zanga, who had found respiratory distress in 42.9% of cases, followed by prematurity in 15% of cases [2]. This difference could be due to the sampling volume being too small and the origin of our patients in a center that is less equipped for the care of neonatal patients.

### 4.2. Aspects in Imaging

ETF was the most performed examination in our study, with a frequency of 56.66% of cases. This result was slightly lower than that of Zanga in Burkina Faso and much higher than that of N'zonou in Mali, who had respectively found 68.2% of cases and 20.8% of cases of pathological patients in ETF [2] [7]. It was more used because of its easy access, safety, simplicity, and low cost compared to other brain imaging methods, but also very important for the detection of lesions. The lesions found in ETF in our series were multiple, including cerebral edema in 13.3% of cases with cerebral ischemic lesions in 23.3% of cases, intraventricular hemorrhage in 25.2% of cases, leukomalacia in 16% of cases, and ventricular dilatation in 22.2% of cases. These lesions had been found in varying proportions by other authors in Africa. Berrada *et al.* in Morocco found 39% of ventricular dilatations, 32% of intraventricular hemorrhage, 3.9% of periventricular leukomalacia, and 3.9% of ventricular. Konan in Ivory Coast observed 45% of periventricular leukomalacia, 28.3% of ventricular dilatations, and 25% of cerebral hemorrhage [8] [9]. Cerebral hemorrhages and/or intraventricular hemorrhage observed in almost all studies in the literature are among the main lesions most visible on ETF

in newborns and infants. Periventricular leukomalacia was observed in 16% of cases in our series, slightly lower than those found in the Zango study in 26.4% of patients, and constituted the 3rd cerebral lesion and represents the major cause of neurological sequelae, including cerebral palsy [2] [10] [11]. Brain CT was represented in our study in 43.34% of cases. It also observed multiple and varied lesions, including cerebral edema, cerebral ischemic lesions, hydrocephalus, and intracerebral hemorrhage. Brain CT has already been used in the literature to assess cerebral hemorrhages and edema secondary to hypoxic-ischemic damage [12]. In our series, hemorrhages represented 25.2% of cases and cerebral edema 28.2% of cases. MRI, being considered the preferred brain imaging modality, was not used in our study. However, in a comparative study of neuroimaging in newborns, all having undergone CT and MRI, they will have the same sensitivity in detecting anoxic-ischemic lesions such as strokes and white matter lesions [12] [13]. According to a retrospective study from 2014, CT was less likely to detect strokes and lesions of the central gray nuclei, brainstem, and cerebellum [12] [14]. CT uses X-rays, which should be avoided as much as possible in infants. She gives a bad contrast between gray matter and white matter that would have been due to the absence of myelination in the newborn brain [12] [15]. These data could weaken the use of CT in favor of MRI [12] [13]. But, CT would still remain an interesting alternative in cases where MRI would be difficult to access at a high cost or in patients who would be in a state too unstable to undergo a long MRI examination.

## 5. Conclusion

Computed tomography and transfontanellar ultrasound play an essential role in the diagnosis of anoxic-ischemic cerebral lesions in developing countries. They have made it possible to evoke ischemic, hemorrhage, and cerebral sequelae lesions. MRI, however, remains the examination of choice for a detailed and precise evaluation, but CT can be an alternative in diagnostic management in our countries where access to MRI is not yet codified.

## Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

## References

- [1] Adamsbaum, C., Hornoy, P. and Falip, C. (2008) Quel apport pronostique de l'imagerie a la phase precoce? *Journal de Radiologie*, **89**, Article 1515.  
[https://doi.org/10.1016/s0221-0363\(08\)76654-x](https://doi.org/10.1016/s0221-0363(08)76654-x)
- [2] Moussa, Z.S. (2023) Ultrasound Profile of Brain Lesions during Perinatal Asphyxia at the Charles de Gaulle Pediatric University Hospital in Ouagadougou. *African Journal of Medical Imaging*, **15**, Article No. 4.
- [3] Nagalo, K., Dao, F., Tall, F.H. and Yé, D. (2013) Morbidité et mortalité des nouveau-nés hospitalisés sur 10 années à la Clinique El Fateh-Suka (Ouagadougou, Burkina Faso). *Pan African Medical Journal*, **14**, Article 153.  
<https://doi.org/10.11604/pamj.2013.14.153.2022>

- [4] Anthonioz, C., Loisel, D., Delorme, B., Pasco-Papon, A., Aube, C. and Caron, C. (2006) Aspects IRM de l'encéphalopathie anoxo-ischémique du nouveau-né à terme et du prématuré. *Journal de Radiologie*, **87**, 1651-1670. [https://doi.org/10.1016/s0221-0363\(06\)74144-0](https://doi.org/10.1016/s0221-0363(06)74144-0)
- [5] Folquet, A., Kouakou, C., Beni, B. and Houenou, Y. (2007) Risk Factors for Early Neonatal Mortality in Term Newborns in the Pediatric Department of the Cocody University Hospital. *Revue Internationale des Sciences Médicales*, **9**, 28-33.
- [6] Herbst, A., Wolner, P. and Ingemarsson, L. (2003) Neurological Prognosis of Term Infants with Perinatal Asphyxia. *Journal de Gynécologie Obstétrique et Biologie de la Reproduction (Paris)*, **32**, S85-S90.
- [7] Forbes, K.P.N., Pipe, J.G. and Bird, R. (2000) Neonatal Hypoxic-Ischemic Encephalopathy: Detection with Diffusion-Weighted MR Imaging. *American Journal of Neuroradiology*, **21**, 1490-1496.
- [8] Berrada, S., Shihi, M., Aboussad, A., AIT Sad, I., Ghannane, H. and El Fezzazi, R. (2012) Contribution of Transfontannellary Ultrasound in Neonatology. Ph.D. Thesis, Medicine in Morocco.
- [9] Konan, A., Kouadio, B., Taki, Y. and Ngoran, K. (2020) Apport de l'échographie transfontanelle dans la prise en charge des souffrances cérébrales néonatales. *Journal of Neuroradiology*, **47**, 113. <https://doi.org/10.1016/j.neurad.2020.01.040>
- [10] Gold, F., Aujard, Y., Dehan, M. and Jarreau, P.H. (2002) Intensive Care and Resuscitation of the Newborn. Masson.
- [11] Larroque, B., Marret, S., Ancel, P., Arnaud, C., Marpeau, L., Supernant, K., *et al.* (2003) White Matter Damage and Intraventricular Hemorrhage in Very Preterm Infants: The EPIPAGE Study. *The Journal of Pediatrics*, **143**, 477-483. [https://doi.org/10.1067/s0022-3476\(03\)00417-7](https://doi.org/10.1067/s0022-3476(03)00417-7)
- [12] Sorokan, S.T., Jefferies, A.L. and Miller, S.P. (2018) L'imagerie du cerveau du nouveau-né à terme. *Paediatrics & Child Health*, **23**, 329-335. <https://doi.org/10.1093/pch/pxy002>
- [13] Chau, V., Poskitt, K.J., Sargent, M.A., Lupton, B.A., Hill, A., Roland, E., *et al.* (2009) Comparison of Computer Tomography and Magnetic Resonance Imaging Scans on the Third Day of Life in Term Newborns with Neonatal Encephalopathy. *Pediatrics*, **123**, 319-326. <https://doi.org/10.1542/peds.2008-0283>
- [14] Barnette, A.R., Horbar, J.D., Soll, R.F., Pfister, R.H., Nelson, K.B., Kenny, M.J., *et al.* (2014) Neuroimaging in the Evaluation of Neonatal Encephalopathy. *Pediatrics*, **133**, e1508-e1517. <https://doi.org/10.1542/peds.2013-4247>
- [15] Mohan, S., Rogan, E.A., Batty, R., Raghavan, A., Whitby, E.H., Hart, A.R., *et al.* (2013) CT of the Neonatal Head. *Clinical Radiology*, **68**, 1155-1166. <https://doi.org/10.1016/j.crad.2013.06.011>