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Case Report

Neuronal Migration Disorders in an Adult with Chronic Epilepsy in Ghana: An Imaging Case Report

Chikumbutso Khomba[1]*, Abdul Rashid Karim[2], Osward Bwanga[3], Asafu Adjaye Frimpong[2], Joseph Abedu Wilson[2] Maxwell Adu[4]

[1]Affidea Diagnostic, Dublin, Ireland
[2]Spectra Health Imaging and Interventional Radiology Centre, Kumasi, Ghana
[3]Midlands University Hospital, Tullamore, Radiology Department, Ireland
[4]Komfo Anokye Teaching Hospital, Kumasi, Ghana

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Abstract: Neuronal migration disorders (NMDs) are congenital brain malformations resulting from disrupted neuronal development, frequently associated with epilepsy and various neurological deficits in at least 26% of affected infants. This represents the highest epilepsy risk among congenital brain malformations. While many cases present during childhood, a subset of cases remain undiagnosed until adulthood, frequently manifesting as refractory epilepsy or other neurological impairments. Although the precise incidence of NMDs remains undefined, they constitute a significant albeit uncommon aetiology of epilepsy across the lifespan. In Ghana, the restricted availability of advanced neuroimaging techniques, including magnetic resonance imaging (MRI) and computed tomography (CT), hinders the timely diagnosis and early detection of neuronal migration disorders (NMD). We present the case of a 39-year-old Ghanaian woman with a 24-year history of epilepsy, whose prior CT imaging at age 15 failed to establish a definitive diagnosis. Subsequently, MRI clarified cerebellar hypoplasia, heterotopia, lissencephaly, and ventricular anomalies consistent with NMD. This case report details the respective diagnostic advantages and limitations of ultrasound, CT, and MRI in assessing congenital brain abnormalities, emphasising the urgent need to expand access to neuroimaging and specialised radiological expertise in resource-limited settings. The case underscores the indispensable role of MRI in providing detailed visualisation of cerebral anatomy, which is crucial for the accurate diagnosis and effective management of neuronal migration disorders.

Keywords: Case Report, Chronic Epilepsy, Computed Tomography, Magnetic Resonance Imaging, Neuronal Migration Disorder.

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INTRODUCTION

Neuronal migration disorders (NMDs) are a group of neurological conditions characterised by structural anomalies of the brain and a range of neurocognitive impairments [1]. These disorders result from atypical neuronal migration processes during brain development, arising from genetic, traumatic, infectious, ischaemic, or idiopathic factors [2]. These disorders pose significant challenges and clinical outcomes, often leading to a spectrum of neurodevelopmental issues, including developmental delays, intellectual disabilities, and epilepsy [3]. Notably, 26% of affected neonates develop neonatal-onset epilepsy, the highest risk compared with other congenital brain malformations, highlighting a strong association with epilepsy [1], their impact on affected individuals and their families can be profound; therefore, early detection cannot be overemphasised [1]. Advancements in medical imaging techniques have significantly improved the likelihood of identifying these conditions, facilitating timely interventions to reduce the severity of associated neurological deficits [4].

Notwithstanding the improvements in medical services in Ghana, the landscape for diagnosing NMDs is characterised by limitations in advanced neuroimaging [5]. Access to magnetic resonance imaging (MRI) remains limited to the major cities, such as the Greater

***Corresponding Author:** Chikumbutso Khomba
Affidea Diagnostic, Dublin, Ireland

Accra region. However, alternative imaging options, including ultrasound and CT, are available [6, 7]. Ultrasound is the mainstay imaging tool in Ghana for prenatal and childhood neuroimaging due to its widespread availability and safety profile. However, it requires experience and often falls short in diagnosing subtle cortical anomalies essential for characterising NMDs [8-10]. Similarly, CT lacks the requisite sensitivity for detecting finer brain malformations, but remains a viable alternative for diagnosing NMD in adults [10].

This case report details the MRI findings from a 39-year-old Ghanaian woman with a longstanding history of epilepsy, illustrating the importance of advanced imaging in the accurate diagnosis of NMDs. MRI revealed significant structural abnormalities, including cerebellar hypoplasia, heterotopia, and lissencephaly, findings that underscored the complexity of her condition. We write this report to emphasise the critical role of MRI in elucidating brain malformations and to highlight the need for enhanced accessibility to MRI services in Ghana to meet local needs for diagnosing and managing congenital brain disorders.

IMAGING CASE PRESENTATION

In February 2025, a 39-year-old female patient visited the Imaging and Interventional Radiology at our facility, having been referred for an MRI examination of the brain. An adequately completed MRI request form indicated that the patient had a long-standing history of seizures spanning 24 years and a sudden increase in seizure episodes over the past year. The patient's clinical history revealed that she was born prematurely to non-consanguineous parents. She had no significant trauma at birth or prior surgical interventions. Throughout her life, she experienced mild cognitive impairment and faced academic challenges, but she demonstrated an exceptional ability to recall past events. Due to her condition, she is unable to work and relies on her family for support.

In 2001, at the age of 15, she experienced her first seizure, which led to clinical investigations, including a CT scan of the brain. She did not have an MRI at that time, as MRI services were not available. The first MRI machine in the country was installed in 2006 at Korle Bu Teaching Hospital, marking a significant milestone in the country's medical imaging services [11, 12]. Due to financial and infrastructural limitations, she did not undergo further neuroimaging.

Although this recent hospital visit lacked records of the patient's original imaging, the patient reported a diagnosis of epilepsy and a prescription for antiepileptic medication. She was referred for an MRI of the brain, a standard neuroimaging exam for patients with epilepsy [13]. The examination was conducted by a skilled team, which included two radiographers, a nurse to assist with intravenous (IV) access, and a radiologist responsible for interpreting the images. Before the examination, the team prepared all required patient positioning aids and antiseptic materials for intravenous access. They also verified the patient's details and that the patient had no contraindications for MRI, such as surgical implants or a history of allergic reaction to contrast media. After discussing the procedure with the patient and her accompanying guardian, informed written consent was secured. The examination was successfully performed on a 1.5T Siemens Magnetom Essenza MRI machine using a 16-channel dedicated head coil.

The MRI examination included the following sequences: 2-dimensional T2, 3-dimensional gradient-echo volumetric T1, Fluid Attenuated Inversion Recovery (FLAIR), Diffusion weighted Imaging (DWI), and post-contrast T1-weighted images. Transverse, sagittal and coronal planes (fig.1) were obtained as recommended in the epilepsy investigation protocol [10].

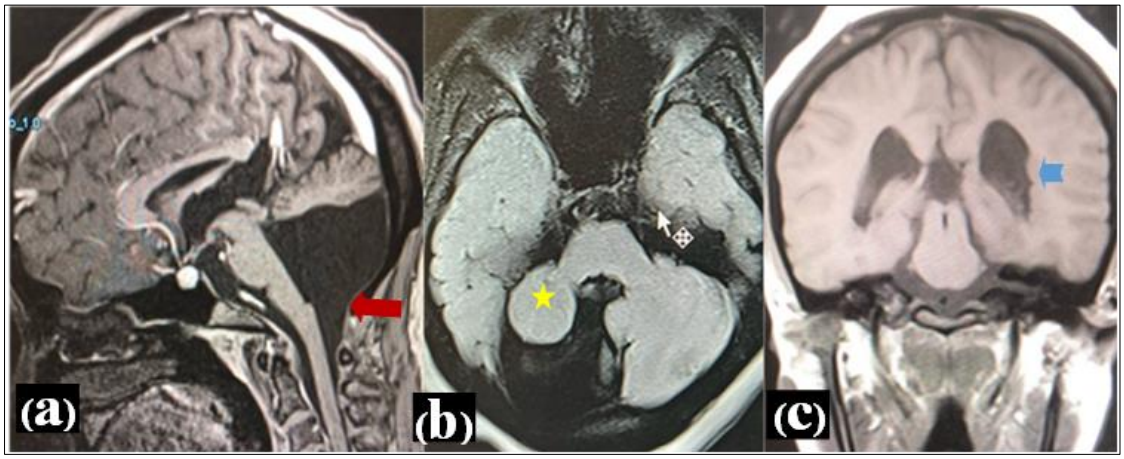

Figure 1: Magnetic resonance images in the case of NMD. (a) Sagittal T1 (b), FLAIR (c), and Coronal T1 showing structural anomalies of the brain

A consultant radiologist reported the scan after the images were transmitted and stored via the hospital's radiology information system (RIS) and picture archiving and communication system (PACS).

The MRI findings showed that the right cerebellar hemisphere was dysplastic and smaller than the left (Fig. 1, Yellow star) with a dilated fourth ventricle posteriorly (red arrow Fig. 1). The vermis and the left cerebellar hemisphere were unremarkable. There was bilateral occipital subependymal and left temporal region nodular heterotopia (Blue arrow fig. 1). The left amygdala was bulkier than the right, consistent with some neurodevelopmental anomaly.

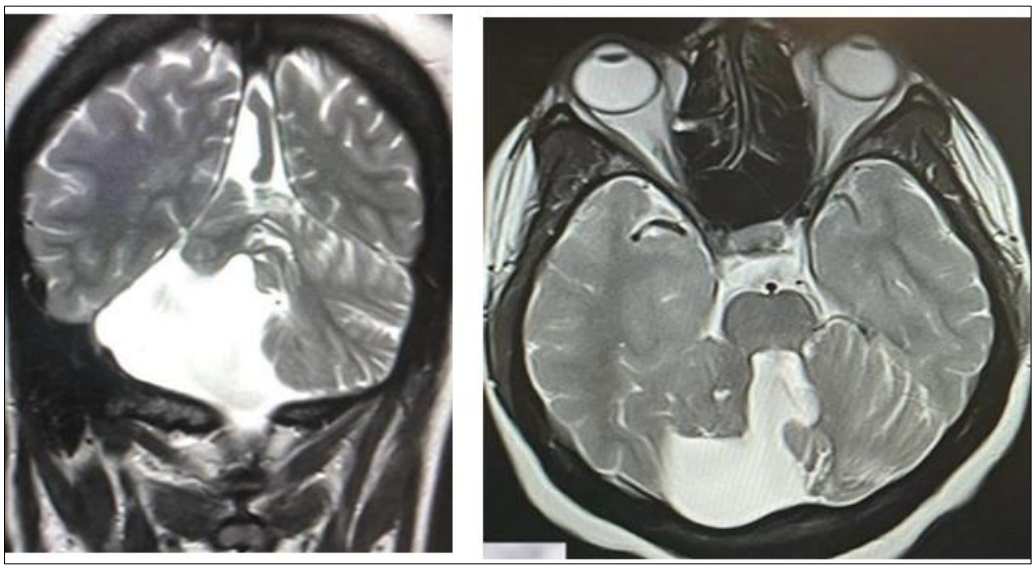

Figure 2: Coronal and axial T2-weighted images showing partial absence of the right cerebellum

In addition, interdigitation of the occipital gyri, atrophic splenium of the corpus callosum, and bilateral colpocephaly were also noted, indicating some corpus callosum anomalies [10]. No abnormal parenchymal enhancement, inflammation or vascular anomalies were observed on the post-contrast images. These imaging findings were in keeping with neuronal migration disorders. The radiologist's recommendations included genetic testing and multidisciplinary evaluation.

Management and Outcome

Based on the MRI findings of NMD, neurosurgical opinion and genetic testing were recommended. The patient was continued on antiepileptic medication and discharged to await neurosurgical review.

DISCUSSION

Neuronal migration disorders (NMD) represent a group of congenital malformations arising from insults to the migrating neuroblast during the third to fifth gestational months [14]. These disorders are closely linked to a range of neurodevelopmental outcomes, including developmental delay, intellectual disability, and epilepsy [3]. Although individual phenotypes are rare, collectively, NMD impact many people globally [2]. Usually, congenital brain abnormalities are detected routinely on prenatal ultrasound, typically performed in the 18^{th} to 24^{th} weeks, a critical time point for possible termination of pregnancy in many countries [10-15]. Likewise, in Ghana, it is the primary method for foetal and neonatal brain assessment due to its affordability, availability and radiation safety profile [8].

Two studies conducted in 2024 indicated that Ghana had at least 135 hospital-based and 190 diagnostic centre-based ultrasound services, respectively [9-14]. This helped the country achieve an impressive prenatal ultrasound utilisation rate of 93.8%, second only to Nigeria with 98.3% in West Africa [9-14]. Another study that assessed the perception of Ghanaian primigravidae undergoing their first antenatal ultrasonography showed that 53.9% of the women scanned were to check for foetal abnormalities [16]. This was not the case 39 years ago when this was born. Suitable training, however, is essential for efficient perinatal and neonatal ultrasound to evaluate suspected NMD. Moreover, the effectiveness of ultrasound in identifying gyral and sulcal maldevelopment, a key feature in diagnosing NMD such as lissencephaly, is significantly hindered by its operator dependency compared to advanced modalities such as MRI [10].

The patient reported in this imaging case report underwent a CT scan of the Brain that resulted in the patient being put on an antiepileptic regimen. While being cognisant of the potential risks associated with CT, this imaging modality has proven to be invaluable in the diagnosis and management of neurological disorders and epilepsy worldwide [13]. Since its inception in Ghana in 1994, the population has dramatically benefited from its enhanced diagnostic capabilities [17]. CT can detect gross structural abnormalities, and is relatively

accessible and affordable in Ghana, with over 35 CT units nationwide. This makes it a more convenient option for many referring clinicians for patients with neurodevelopmental issues than MRI. Nonetheless, routine CT for diagnosing malformations of cortical development (MCD) is not recommended due to radiation exposure concerns, even though they can provide detailed images [10-18]. MRI remains the gold standard according to the International League against Epilepsy Neuroimaging (ILAE) [13].

In this present case, MRI played a crucial role in achieving the NMD diagnosis and its association with the patient's epileptic condition. It offered superior multiplanar soft tissue detail, enabling accurate assessment of the brain parenchyma, including the presence of cerebellar hypoplasia (Fig. 2a), nodular heterotopia (Fig. 2c), and other gyri malformations, which are conclusive indicators of NMD [10-19]. Although the number of MRI machines in Ghana has increased since the installation of the first unit, to 22 MRI units in 2025, several challenges, including maldistribution and equipment breakdown, still hinder access to MRI services [5].

A significant challenge in the country is the shortage of specialised MRI radiographers, which limits the use of prenatal MRI for assessing congenital abnormalities such as NMD. This is primarily because undergraduate training is insufficient for competent MRI examinations, and there is a lack of postgraduate training programs [20]. Furthermore, the limited number of radiologists complicates the interpretation of MRI. A 2022 survey by Kawooya *et al*., found that Ghana had 60 radiologists and only four institutions offering radiology fellowship programs, compared to Nigeria, which has 27 institutions and 688 radiologists, respectively [6]. To overcome these challenges, we recommend establishing specialised MRI courses, modelled after successful programs at institutions like the Cape Peninsula University of Technology in South Africa and the Kenya Medical Training College [21, 22]. Additionally, there is a need to increase the number of enrolled student radiologists to meet the rising demand for radiology services in the country.

CONCLUSION

Neuronal migration disorder diagnosed in adult patients is rare and challenging for both the patient and the clinician, as symptoms and presentation vary widely. While it is possible to diagnose NMD in utero via ultrasound and MRI, many cases in Ghana remain undiagnosed due to factors such as limited access to prenatal imaging and other systemic factors. CT has been used to detect gross brain developmental abnormalities within its limitations. In this imaging case report, we highlight the use of MRI in evaluating cortical maldevelopment in an adult patient with chronic seizures, which revealed cerebellar hypoplasia and nodular heterotopia, definitive indicators of neuronal migration disorder.

Consent for Publication

The patient gave written informed consent for publishing this case report and related images. Furthermore, the hospital granted an ethical waiver for using the images in this report.

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