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Cerebellar Agenesis: A Very Rare Abnormality of the Posterior Fossa

Najwa Loukili, Amal Benchine, Hanae Chimi, Fatima Hassouni, Mounia El Yousfi, Samir Bargach

Souissi Maternity Hospital, Rabat, Morocco
Email: nloukili729@gmail.com

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Abstract

Introduction: Cerebellar agenesis is an extremely rare condition. It is a descriptive term that implies complete absence of the cerebellum. The posterior fossa includes the brainstem and the cerebellum, the cerebellum plays a significant role in actively controlling body movements, particularly in maintaining balance and posture, and also it plays a role in regulating our emotions. Advanced neuroimaging techniques are essential for diagnosing morphological abnormalities of the cerebellum. An accurate diagnosis is crucial for early treatment, prognosis, and providing guidance to affected children and their families. **Materials and methods:** In this review, we present the case of a woman who is 15 weeks pregnant, who was suspected of having cerebellar agenesis with significant hydrocephalus and who was managed at the gynecology department of the Souissi Hospital of Rabat during the period from January 16th to January 23rd, 2024. **Results:** Our case concerned a 35-year-old patient, who was 15 weeks pregnant, primigravida, without any medical or surgical history. The obstetrical examination was normal. Her most recent ultrasound showed a biparietal diameter (BPD) of 48.6 mm, which is at the 100th percentile, and a cranial circumference of 180 mm, also at the 100th percentile. The coronal sections revealed a complete absence of the cerebellum. We therefore deduced from this examination a cerebellar agenesis with an important hydrocephalus compressing the brain parenchyma above and below tentorial with a facial dysmorphia. The woman opted for medical termination of pregnancy. **Conclusion:** Cerebellar agenesis remains a challenging diagnosis due to its small size and the embryological changes this structure undergoes. Prenatal imaging (ultrasound and MRI) allows for diagnosing this anomaly, although a definitive diagnosis cannot be guaranteed. The prognosis is also complex, ranging from normal development to death.

Subject Areas

Gynecology-Obstetric

Keywords

Agenesis Cerebellar, Cerebellum, Cranial Fossa Posterior, Prenatal Diagnosis, Ultrasound

1. Introduction

First-trimester ultrasound has become a common procedure nowadays. Transvaginal ultrasound is revolutionary and allows for better detection of major morphological anomalies at an early stage, including cerebellar malformations of the posterior fossa. Diagnosis can be supported by fetal MRI, genetic amniocentesis, cell-free fetal DNA testing, and screening for in-utero infections. The definitive diagnostic evidence is a fetal autopsy for patients who elect to terminate a pregnancy.

Posterior fossa malformations are rare [1]. These malformations encompass abnormalities in the development of the cerebellum, brainstem, and surrounding cerebrospinal fluid spaces. They include Dandy-Walker malformations, mega cisterna magna, and Blake's pouch cysts, which can sometimes be difficult to distinguish from each other [2]. Diagnosing cerebellar agenesis via ultrasound during the prenatal period presents significant challenge for clinicians. It concerns a small structure undergoing significant physiological changes during fetal life. The true challenge for the clinician after the diagnosis is to determine the potential significant impact of this anomaly on the unborn child.

2. Case Report

A 35-year-old primigravida was referred to our center at 15 weeks and 3 days of gestation, her date of the last menstrual period was uncertain with suspected abnormality of the fetal posterior fossa. She was in a consanguineous marriage with her first cousin and had not been subjected to toxins. The obstetrical examination was unremarkable, the uterine height corresponded to the gestational age and the fetal heart sounds were positive. Her first ultrasounds were considered normal, however at 15 weeks ultrasound showed a progressing monofetal pregnancy, cardiac activity was present with a cephalic presentation. The ultrasound biometry showed a biparietal diameter (BPD) of 48,6 mm, corresponding to the 100th percentile and a cranial circumference of 180 mm, corresponding to the 100th percentile (**Figure 1** and **Figure 2**). The femoral length and abdominal circumference were normal with an estimated fetal weight of 230 g and a progressing pregnancy estimated at 18 weeks of gestational age (**Figure 1** and **Figure 2**). The morphological examination of brain revealed a significant supratentorial hydrocephalus affecting the lateral ventricles, compressing the brain parenchyma, no dilation of the fourth ventricle (**Figure 3**). On coronal sections, which are the best views for evaluating the cerebellum, there is a complete absence of the cerebellum. The components of

the cerebellum (cerebellar hemispheres and vermis) were completely not visible and not identifiable (Figure 3). Facial ultrasound revealed an inter-orbital enlargement of 10.3 mm in diameter (Figure 4). Extracranial morphological examination, fetal mobility and amniotic fluid volume were normal. In total, a progressing intrauterine pregnancy of 18 weeks and 5 days of amenorrhea was identified and a suspicion of total cerebellar agenesis with a significant hydrocephalus compressing the brain parenchyma both above and below the tentorium. and a facial dysmorphia. The woman opted for medical termination of pregnancy at 19 weeks. After fetal expulsion, fetal pathology analysis was difficult to perform due to limitations of the hospital center.

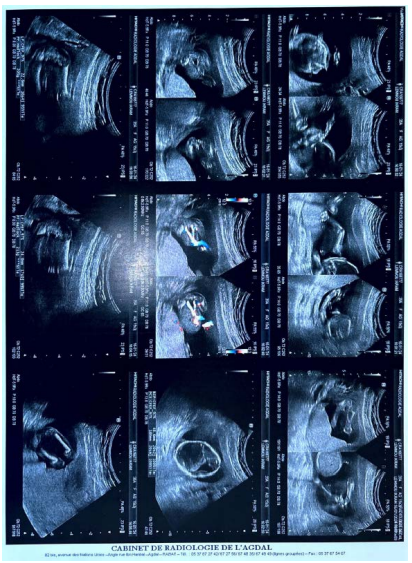

Figure 1. Ultrasound morphology: a section showing cranial biometrics and femoral length.

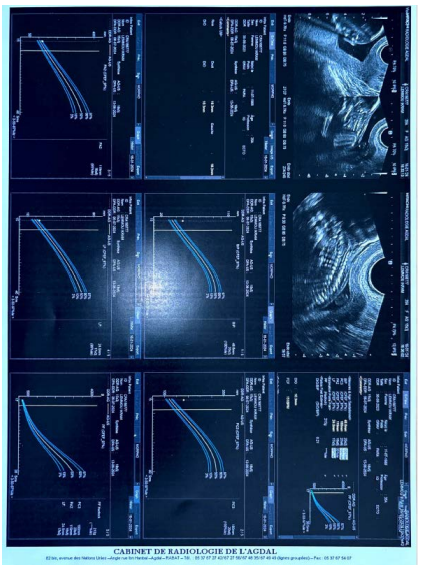

Figure 2. Ultrasound summary and graphs of various ultrasound measurements.

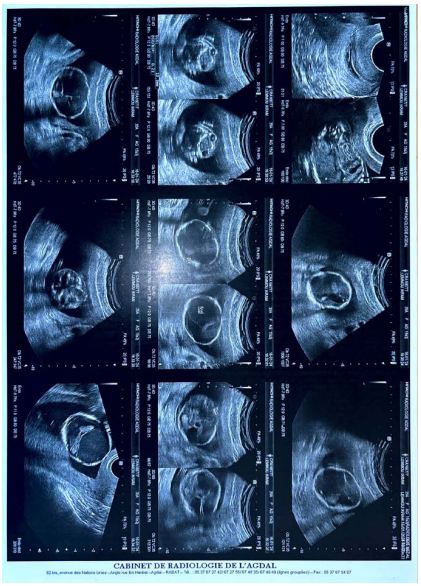

Figure 3. Brain morphology: a section showing cerebellar agenesis and a supratentorial hydrocephalus affecting the lateral ventricles.

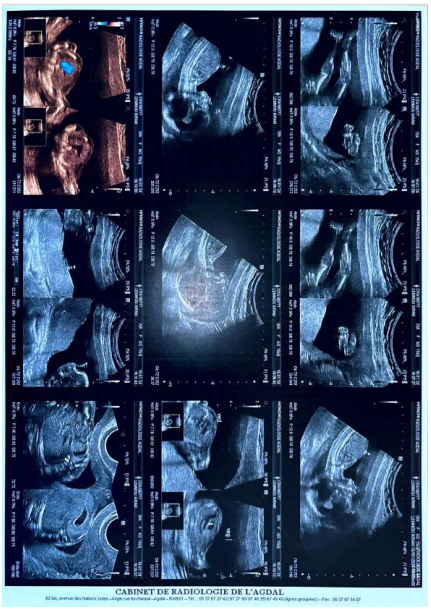

Figure 4. Facial ultrasound: an inter-orbital enlargement of 10.3 mm.

3. Discussion

The cerebellum acts as a cerebral coordinator, ensuring, unconsciously, the regulation of balance, muscle tone, and the coordination of voluntary movement. However, for a better understanding of the motor functions of the cerebellum it is important to know its neuroanatomical division and its cortico-nuclear organization [3]. The cerebellum is a neural structure belonging to the brain and representing nearly 10% of the brain's weight, it occupies the majority of the posterior cranial fossa, situated posteriorly to the brainstem with which it is

symmetrically connected by the cerebellar peduncles, this strategic location explains its modes of action on the major nerve pathways [4]. Cerebellar agenesis is an extremely rare condition that can manifest independently or as a component of a more complex cerebral malformation [5]. In our case, cerebellar agenesis was isolated; however, it was associated with significant hydrocephalus, the Dandy-Walker syndrome was ruled out because there were no additional characteristic signs of this syndrome present [6] [7]. Embryologically, cerebellar agenesis results from a defect in the migration of neural cells [8]. The true mechanism responsible for agenesis is still unknown; however, Sellick *et al.* demonstrated that Ptf1a plays a crucial role in cerebellar neurogenesis. Even a minor deletion of Ptf1a could result in cerebellar abnormalities such as cerebellar agenesis and neonatal diabetes mellitus [9] [10]. Cerebellar agenesis affects both males and females equally, the precise frequency and occurrence of the disorder in the general population are not well-established [11]. Cerebellar agenesis remains a relatively rare discovery to this day. Ultrasound is the method of choice for the diagnosis of cerebellar agenesis. It should be noted that since 2007, the International Society of Ultrasound in Obstetrics and Gynecology (ISUOG) has recommended ultrasound as the preferred method for screening and diagnosing malformations of the fetal central nervous system, including other abnormalities of the posterior fossa [12]. MRI plays a crucial role in supporting the diagnosis. It helps refine whether the cerebellar agenesis if is isolated or associated with other **abnormalities.** However, the optimal time to perform it is between 28 and 32 weeks of gestation, usually 6 to 10 weeks after the initial suspicion of cerebellar agenesis. After 36 weeks of gestation, performing an MRI becomes difficult due to the physiological reduction in pericerebral fluid spaces.

In routine screening, ultraso Neuroimaging studies are required for diagnosis, but are variably performed depending on the clinical circumstances and resources available. When neuroimaging studies are performed, cerebellar malformations are often under-recognized. Within the few population-based cohorts, patients diagnosed with cerebellar malformations have the most severe clinical features und images of posterior fossa malformations are obtained in an axial view of the transcerebellar plane. The evaluation focuses on the following aspects in that plane: the cerebellar hemispheres, vermis, cerebellum (transcerebellar diameter, biometry); and the shape and transverse measurement of the cisterna magna [13]. However, Coronal ultrasound of the transcerebellar plane, evaluating the cerebellum (shape, contours, and foliations of the cerebellar hemispheres); the vermis (more highly echogenic structure) [14]. It is important to note that some studies have demonstrated that ultrasound is a method with high sensitivity but low specificity for the diagnosis of cerebellar agenesis, primarily due to its small size and the physiological changes that occur during fetal development. Moreover, maternal factors can also impede clear visualization, such as insufficient amniotic fluid or an unfavorable fetal position. Vaginal probes have the advantage of operating at a higher frequency than do abdominal probes and therefore allow greater definition of anatomical details [13]. In our case, trans-

vaginal ultrasound enabled the diagnosis of cerebellar agenesis with significant hydrocephalus without the need for any additional complementary examination. Symptomatically, the majority of studies have shown that in nearly all cases of cerebellar agenesis, observable symptoms were present, including profound abnormalities in motor skills and its association would worsen the individual's prognosis [15]. This explains the therapeutic decision adopted in our case who presented the multiple fetal anomalies in addition to cerebellar agenesis, including hydrocephalus and facial dysmorphism. Therefore, with the patient's consent and the collaboration of a multidisciplinary team of obstetricians and pediatricians, we decided on therapeutic pregnancy termination at 19 weeks.

4. Conclusion

Malformations of the posterior fossa form a heterogeneous spectrum including cerebellar agenesis, which is a rarely described. In the prenatal period, ultrasound allows for diagnosis of cerebellar agenesis, but the anatomical complexity of the cerebellum makes the diagnosis almost uncertain. It is a true challenge for the practitioner, who must be experienced and up-to-date with the various ultrasound techniques. The prognosis of cerebellar agenesis is complex as it is not uniform, ranging from normal development to death. It's essential to conduct more studies of this type. By gathering more data, it will be possible to improve prenatal counseling and better guide prospective parents.

Consent

Consent was obtained from the patient to publish this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Ethical Approval

This case report is exempt from ethical approval in our institute. Case reports are exempt from ethical approval in our University Hospital.

Conflicts of Interest

The authors declare that they have no competing interests relevant to the content of this article.

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