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Prenatal Ultrasound Diagnosis of Severe Bilateral Ventriculomegaly at 34 Weeks: A Case Report

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ABSTRACT

Fetal cerebral ventricular dilatation, or ventriculomegaly, is a medical condition in which the cerebral ventricles are enlarged due to disruptions in cerebrospinal fluid circulation. It is primarily diagnosed through a routine obstetric ultrasound. Its etiologies are vast and are likely influenced by both genetic and non-genetic factors. It is classified into mild, moderate, or severe forms based on ventricular measurements, hence guiding prognosis and management. This case report details a case of fetal ventricular dilatation identified during routine obstetric ultrasound, when a 25-year-old woman came in for regular checkup of a 34-week pregnancy at the Radiology Department of Kampala International University Teaching Hospital (KIU-TH). Ultrasound was done and found an extensive ventricular dilation of both lateral ventricles (measuring 17.8 mm RT & 16.4 mm on the LT; values far above normal threshold) and the third ventricle, with displacement of brain matter inferiorly. No other structural anomalies were found *in utero*. Ultrasound remains a pivotal tool in the early detection and monitoring of ventriculomegaly. Key diagnostic parameters include lateral ventricle width and frontal sinus horn measurements. For further evaluation, a referral magnetic resonance imaging (MRI) was recommended to determine underlying causes and refine management strategies. Accurate ultrasound measurements are essential for the classification as well as for the management of fetal ventriculomegaly. Additionally, early detection and thorough evaluation improve outcomes, particularly when coupled with follow-up imaging and multidisciplinary care. Continued technological advancements are proving to further refine diagnostic capabilities and optimize patient outcomes.

Keywords: ventriculomegaly, prenatal ultrasound, cerebral ventricular dilatation, MRI, hydrocephalus

INTRODUCTION

Fetal ventricular dilatation, also known as ventriculomegaly, is a condition characterized by the enlargement of the cerebral ventricles in a fetus, often due to an obstruction in the cerebrospinal fluid circulation [1]. Embryologically, the third ventricle, like other regions of the brain's ventricular system, originates from (the rostral part of) the neural tube central canal, which later evaginates into the forebrain/ prosencephalon [2]. Etiologically, fetal cerebral ventricular dilatation involves both genetic and non-genetic factors. Pathogenic mechanisms include midbrain/hindbrain patterning defects, cerebral cytoarchitectonic disorders, hemorrhagic and perfusion failures, and nonspecific causes without apparent obstruction or malformation [1].

Generally, ventricular dilation in the fetus is caused by obstruction to the CSF drainage system, resulting in aqueduct stenosis. Among the causative conditions are Chiari II malformation, Dandy-Walker complex, and agenesis of the corpus callosum [3]. These causes are mostly visualized anatomically using either ultrasound or magnetic resonance imaging (MRI). For instance, ventriculomegaly is typically diagnosed via ultrasound by measuring the atrial width of the ventricles, and MRI can also be used to identify other central nervous system abnormalities when available [3,4]. The severity of the dilatation is classified depending on the size of the fetal ventricle. It is from this measurement that we can classify ventriculomegaly as either mild (when it measures about 10-12 mm), moderate (at 13-15 mm), or severe (above >15 mm). This classification helps clinicians to counsel and manage condition [2].

The prognosis of ventriculomegaly largely depends on its severity and the presence of associated abnormalities, which can highly affect the

neurodevelopment of the fetus. Isolated mild ventriculomegaly often has a favorable outcome with normal neurodevelopment, while severe cases are associated with higher risks of developmental delays of the child's brain and adverse perinatal outcomes [4]. Cases in which this condition was solitary (either stable or regressive ventriculomegaly) generally have a better prognosis [5]. It is important to be aware that not only embryological brain anomalies can cause ventricular dilatation, acquired conditions like intraventricular hemorrhage and infections need to be scrutinized in differential diagnosis when ventriculomegaly is detected in pregnancy.
It is in this regard that we present the case report of a 25-year-old pregnant woman whose fetus has ventricular dilation. Using ultrasound, we assessed its features and severity, which in turn leads to better fetal management.

CASE REPORT

A 25-year-old multiparous [Gravida 2, Parity 1 + 0 (1 alive)] woman came to the Department of Radiology, Kampala International University, Teaching Hospital for a routine obstetric scan. Upon patient examination, she was alert, well-oriented, and in good health. She was taking calcium and iron regularly and reported normal fetal movements. No evidence of pallor, cyanosis, icterus, edema, or palpable lymph nodes was seen. On sonographic scanning, we encountered marked supratentorial hydrocephalic changes with a normal fourth ventricle. A General Electric Medical Systems (Volusion E-8; Zipf-Austria) ultrasound machine with a frequency of 3.5 MHz; a curvilinear-type transducer was used for the sonography. The corresponding sonograms are presented in Figures 1 and 2.

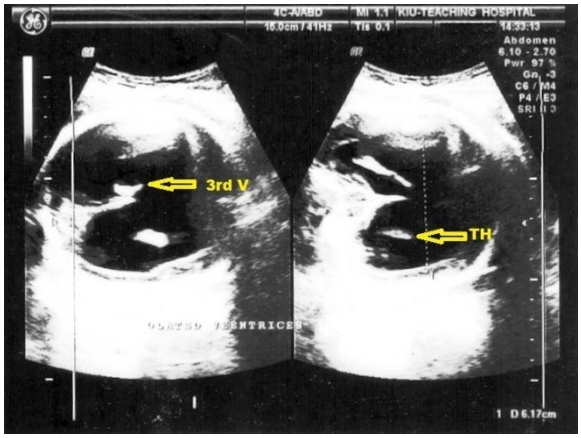

Figure 1: The sonogram shows extensive fetal ventricular dilation with complete displacement of brain matter. The AP diameter of the lateral ventricle measures 6.74 cm. Note the floating part of the tentorium cerebri. Focused trans-ventricular ultrasound indicates the arrowed third ventricular (3rd V) and thalamus (TH).

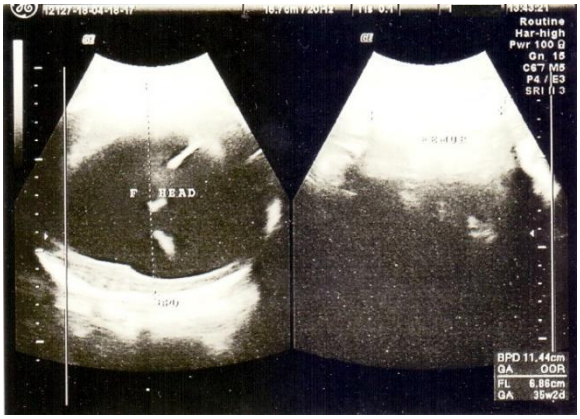

Figure 2: The sonogram shows the transverse view of the fetal head at the level of the third ventricle with total loss of visible landmarks for measuring Bi-Parietal Diameter (BPD), which was 11.4 cm as seen in the lower-left quadrant of the image. The Femoral Length (FL) was 6.86 cm, and the estimated gestational age was 35 weeks and 2 days. Observe the internal echoes and the reverberating dotted hyperechogenic artefact.

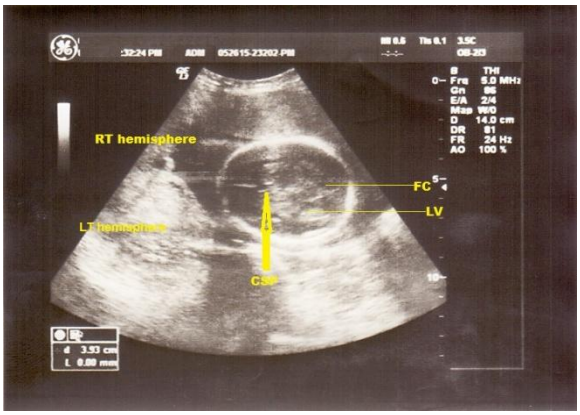

Figure 3: Sonogram of normal second-trimester fetal head circumference. Note the 'freeze' of the oval-shaped cranium. The calipers are placed on the outer edge of both parietal bones to obtain BPD using the ellipse method. Yellow legends: indicate the anechoic and 'diamond-shaped' Cavum of septum pellucidum (CSP), falx cerebri (FC), thalamus (TH), and bilateral choroid plexus (CP). The lateral ventricle (LV), cerebellar vermis (CV), and tracer calculation of the Cephalic-Index (C.I.) above can be seen in more echo-bright settings. It is essential to make sure that the ultrasound techniques used to obtain the image are consistent with standards in sonar diagnosis.

Informed consent from the patient for the documentation of this case was sought, and ethical approval (ERC-KIUTH-00BJ46/22) was granted by Kampala International University Teaching Hospital (KIU-TH), in line with the 1975 Helsinki Declaration on patients' rights and confidentiality. We recommended that she undergo further examination,

particularly magnetic resonance imaging (MRI), to evaluate the cause of this ventricular dilatation/hydrocephalus.

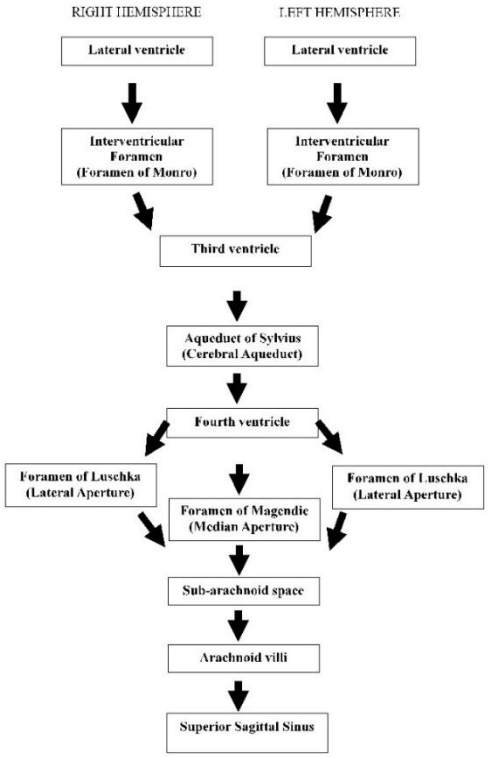

Figure 4: A flow diagram shows cerebrospinal fluid circulation network in the brain [6]; obstruction in any of the cisterns or conduits may result in hydrocephalus, ventriculomegaly, or Dandy-Walker Syndrome, depending on other pathophysiological factors.

DISCUSSION

Prenatal ultrasound is a primary tool for diagnosing ventriculomegaly, because it is readily available to all health institutions. Its role in this matter weighs highly on measuring the width of the lateral ventricles, particularly the atrial width, which helps in identifying and classifying different forms of ventricular dilatation from mild ones up to severe [4,7]. The ratio of ventricular diameter to hemispheric diameter should be less than 1:3; if more, like in this case (Figures 1 and 2), hydrocephalus will ultimately result from the ventriculomegaly (i.e., Ventricular Diameter / Head Diameter < 0.333) VD/HD = < 1/3. In addition, measuring the width of the frontal sinus' horns is also vital, for it correlates with specific reference values established for different gestational ages (Normal/control) to conclude whether there is (pathological) enlargement or not; as earlier postulated [8].

Hence, anatomical landmarks are crucial in determining which areas to take the fluid (anechoic) measurements. Stenosis along the anatomy of the entire CSF chambers can have far-reaching prenatal and postnatal consequences. From our sonographic documentation during pregnancy, ventriculomegaly can be asymmetric, symmetric, regressive, progressive, or stable. When taking the measurement for lateral ventricles, it is best to try to capture both anterior and occipital horns on the same view in full length. For the measurements often focus on the anterior horn width (AHW), occipital horn width (OHW), and the maximum ventricular length and width [9]. These measurements are critical for diagnosing hydrocephalus and other intracranial abnormalities. Additionally, the thalamo-occipital distance is another important measurement that could aid the examiner in assessing the symmetry in fetal cerebral hemispheres. This measurement often changes with gestational age [9]. On the contrary, other ventricles can be assessed for abnormalities too. For instance, the third ventricle is assessed in midsagittal view with attention to its anatomical boundaries and other biometric landmarks. The measuring boundaries we established in our case report include the inter-thalamic adhesion and the wedge angle formed by the anterior wall and floor of the third ventricle, in line with a published report[10].

Alternatively, Magnetic Resonance Imaging (MRI) can be used to assess these dilatations of the ventricle, complementing the ultrasound findings. MRI provides detailed images with higher resolution than ultrasound, especially in identifying mild disproportionate dilatations of occipital horns and other morphological alterations [11]. While MRI is not easily accessible in remote areas (in sub-Saharan Africa), 3D ultrasound can offer a more reliable volumetric measurement than 2D ultrasound. This greatly diminishes the user variability factor and produces the more accurate ventricular size measurements according to some postulations[12]. However, ultrasound techniques do have some challenges, especially in determining the cause of ventriculomegaly. Henceforth, a thorough examination of the posterior fossa and corpus callosum is crucial for a more accurate diagnosis [3,7]. This report emphasizes the importance of accurate sonographic techniques, knowledge of anatomical landmarks, and serial imaging in guiding clinical decision-making and progress. Our ventriculomegaly case agrees with the documentation[13]; there may be an associated link of fetal ventricular dilatation to trisomies involving the cisterna magna. When ventriculomegaly is detected, further evaluation should include a detailed sonographic assessment, amniocentesis for chromosomal analysis, and testing for infections like cytomegalovirus and toxoplasmosis. The diameter of both anterior and posterior horns of our (hydrocephalic) lateral ventricles, measuring 17.8 mm & 16.4 mm, exceeded the normal range in the same gestational age, averaging between 12.1 mm & 9.9 mm, respectively. It is recommended to schedule a patient follow-up

ultrasound scan to monitor the progression of ventricular dilatation (38th week ultrasound scan), to provide updated information that the clinicians use to adjust the management plan, like maternal counselling, accordingly, as the subsequent level of (post-natal) handicap will vary. Then, after, a patient undergoes a Magnetic resonance imaging (MRI) examination for additional insights, especially in mild to moderate cases [6,7,14]. The broader implication is that others[15,16] have reported that the delivery of fetuses with ventriculomegaly below the term threshold of 40 weeks has been associated with increased incidence of postnatal shunt failures (to drain excessive CSF).

CONCLUSION

Ultrasound plays a vital role in the diagnosis and management of fetal ventricular dilatation. Hence, it is highly recommended that clear anatomical landmarks and technical adjustments be taken carefully to obtain accurate measurement, because the classification of this condition depends highly on it. Therefore, the right measurements are crucial for grading the disease's severity, which in turn affects the prognosis and guides further evaluation and management strategies. Continued research and technological advancements are expected to enhance diagnostic capabilities and improve outcomes for affected fetuses. It can be argued that a worse prognosis can be expected when there is early onset (first or second trimester) of active ventricular dilatation during pregnancy, depending on numerous cofounding factors and pathologic variables, and the ongoing development of the fetal brain throughout gestation.

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