DIFFERENTIATED OBSTETRIC MANAGEMENT OF FETAL HYDROCEPHALUS BASED ON INTEGRATED ASSESSMENT OF VENTRICULAR SYSTEM AND FETOPLACENTAL HEMODYNAMICS

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Abstract. *Background: Fetal ventriculomegaly is one of the most frequent prenatal central nervous system findings and is commonly defined by an atrial width of the lateral ventricle of 10 mm or more. The term fetal hydrocephalus should be used more cautiously, mainly when ventricular dilatation reflects impaired cerebrospinal fluid circulation, progressive enlargement, or obstruction. Prognosis depends on the degree of ventricular dilatation, isolated or non-isolated status, progression over time, genetic or infectious etiology, and concomitant obstetric complications. Objective: To present a differentiated obstetric management approach for fetal ventriculomegaly/hydrocephalus based on integrated assessment of ventricular size, progression, associated anomalies, fetal growth, and fetoplacental Doppler parameters. Materials and Methods: A narrative review was performed using recent clinical guidelines, systematic reviews, meta-analyses, and cohort studies published mainly from 2018 to 2026. Priority was given to recommendations from the Society for Maternal-Fetal Medicine and the International Society of Ultrasound in Obstetrics and Gynecology, and to studies assessing prenatal imaging, genetic testing, fetal MRI, Doppler assessment, and perinatal outcomes. Results: The evidence supports a risk-stratified pathway. Isolated mild ventriculomegaly (10-12 mm) usually has a favorable prognosis after complete evaluation. Moderate ventriculomegaly (13-15 mm), severe ventriculomegaly (>15 mm), progressive dilatation, bilateral involvement, associated structural anomalies, abnormal fetal growth, and abnormal Doppler findings require intensified assessment, multidisciplinary counseling, and individualized delivery planning. Cerebroplacental ratio and umbilical artery Doppler should not replace neurosonography, but they may refine obstetric decision-making when placental insufficiency or fetal growth restriction is suspected. Conclusion: Differentiated obstetric management of fetal ventriculomegaly should combine detailed neurosonography, etiological evaluation, serial assessment of ventricular dynamics, fetal growth and Doppler surveillance, and postnatal neurological follow-up. Timing and mode of delivery should generally follow standard obstetric indications, except in cases complicated by severe fetal compromise, marked macrocephaly, or other maternal-fetal indications.*

Keywords: *fetal ventriculomegaly; fetal hydrocephalus; neurosonography; Doppler; cerebroplacental ratio; fetal MRI; obstetric management; perinatal outcomes.*

Introduction. Fetal ventriculomegaly is a clinically important prenatal finding characterized by dilatation of the cerebral ventricular system. In contemporary fetal medicine, ventriculomegaly is usually diagnosed when the atrial diameter of the lateral ventricle is 10 mm or greater on prenatal ultrasound. Mild ventriculomegaly is most often defined as 10-12 mm, moderate as 13-15 mm, and severe as greater than 15 mm [1, 2]. This classification is clinically useful because the probability of associated abnormalities and adverse neurodevelopmental outcome increases as ventricular size increases. The term hydrocephalus is not fully synonymous with ventriculomegaly. Ventriculomegaly is a sonographic description, whereas hydrocephalus implies disturbed cerebrospinal fluid circulation, raised intraventricular pressure, obstruction, or progressive enlargement. For this reason, prenatal counseling should use precise terminology and distinguish isolated stable ventriculomegaly from progressive or non-isolated disease [1, 3]. The prognosis of fetal ventriculomegaly is heterogeneous.

Favorable outcomes are common in isolated mild cases after complete evaluation, whereas severe, progressive, bilateral, early-onset, or non-isolated ventriculomegaly is associated with higher risk of genetic abnormalities, infection, additional central nervous system malformations, neonatal intervention, and long-term neurodevelopmental impairment [4-8]. Therefore, ventricular width alone is insufficient for full risk assessment. Modern management requires an integrated approach. Detailed fetal neurosonography is the first-line diagnostic tool, while fetal magnetic resonance imaging may identify additional central nervous system abnormalities in selected cases, especially when expertise is available [3, 5]. Etiological work-up may include chromosomal microarray testing and infection screening, particularly for cytomegalovirus and toxoplasmosis, according to current recommendations [1, 2, 9]. Fetoplacental hemodynamics represent an additional component of obstetric assessment. Umbilical artery Doppler, middle cerebral artery Doppler, and the cerebroplacental ratio are widely used to evaluate placental insufficiency and fetal adaptation to hypoxemia. These parameters are not specific diagnostic markers for ventriculomegaly. However, when ventriculomegaly coexists with fetal growth restriction, oligohydramnios, abnormal fetal movement, or suspected placental dysfunction, Doppler findings can guide the intensity of surveillance and timing of delivery [10, 11]. The objective of this article is to correct and structure the proposed manuscript according to the IMRAD format and to present an evidence-based differentiated management algorithm for pregnancies complicated by fetal ventriculomegaly or suspected hydrocephalus.

Material and methods of research. Study design. This manuscript was structured as a narrative review and clinical synthesis in IMRAD format. The review was designed to summarize recent evidence relevant to obstetric management of fetal ventriculomegaly and hydrocephalus, with emphasis on integrated assessment of ventricular morphology, progression, fetal growth, and fetoplacental Doppler parameters.

Literature search strategy. A targeted literature search was performed in PubMed/MEDLINE, Google Scholar, and official guideline resources of the Society for Maternal-Fetal Medicine (SMFM) and the International Society of Ultrasound in Obstetrics and Gynecology (ISUOG). Search terms included: “fetal ventriculomegaly”, “fetal hydrocephalus”, “prenatal ventriculomegaly”, “neurosonography”, “fetal MRI”, “chromosomal microarray”, “cerebroplacental ratio”, “Doppler”, “perinatal outcome”, and “neurodevelopmental outcome”.

Eligibility criteria for included evidence. Priority was given to publications from the last 5-10 years, including clinical guidelines, expert consensus documents, systematic reviews, meta-analyses, and large cohort studies. Older landmark studies were used only when they remained foundational for definitions or counseling. Publications were excluded if they did not address prenatal diagnosis, obstetric management, perinatal outcomes, or postnatal follow-up of fetal ventriculomegaly/hydrocephalus.

Clinical definitions used in the synthesis. Ventriculomegaly was defined as atrial width of the lateral ventricle of 10 mm or more. Severity was classified as mild (10-12 mm), moderate (13-15 mm), and severe (>15 mm). Progression was considered clinically significant when serial examinations demonstrated increasing ventricular width or transition to a higher severity category. Cases were considered isolated only after detailed fetal anatomical assessment, targeted neurosonography, and appropriate etiological evaluation did not reveal additional abnormalities.

Diagnostic and monitoring parameters. The proposed integrated assessment includes: (1) detailed fetal neurosonography; (2) measurement of atrial width of the lateral ventricles in a standardized plane; (3) assessment of laterality, symmetry, and progression; (4) evaluation for associated central nervous system and extracranial anomalies; (5) fetal growth assessment; (6) Doppler assessment of the umbilical artery and middle cerebral artery with calculation of the cerebroplacental ratio when clinically indicated; (7) fetal MRI in selected cases; and (8) genetic and infectious evaluation according to guideline-based counseling.

Results and discussion. Diagnostic stratification. The reviewed evidence supports severity-based and context-based stratification. Isolated mild ventriculomegaly (10-12 mm) is usually associated with a favorable prognosis after complete evaluation. SMFM guidance reports survival with normal neurodevelopment in more than 90% of isolated mild cases after appropriate assessment, while isolated moderate ventriculomegaly (13-15 mm) remains often favorable but carries a higher risk of neurodevelopmental disability [1]. Severe ventriculomegaly (>15 mm), progressive dilatation, non-isolated findings, genetic abnormalities, and intrauterine infection are consistently associated with worse prognosis [6-8].

Role of neurosonography and fetal MRI. Targeted neurosonography is the central diagnostic examination. ISUOG guidelines emphasize standardized assessment of the fetal central nervous system and the use of targeted neurosonography when CNS malformation is suspected [3, 4]. Fetal MRI may be useful in selected mild or moderate cases, particularly when ultrasound expertise is limited or additional cortical, posterior fossa, or midline abnormalities are suspected. MRI should complement, not replace, high-quality neurosonography [5].

Etiological evaluation. When ventriculomegaly is identified, etiological work-up should not be limited to repeated measurement of the ventricle. Current recommendations support detailed anatomical ultrasound, offering invasive diagnostic testing with chromosomal microarray analysis, and testing for congenital infections such as cytomegalovirus and toxoplasmosis [1, 2, 9]. This is especially important in non-isolated, severe, progressive, or early-onset cases.

Contribution of fetoplacental Doppler assessment. Doppler parameters do not diagnose ventriculomegaly and should not be interpreted as direct markers of cerebrospinal fluid pathology. Nevertheless, umbilical artery Doppler, middle cerebral artery Doppler, and cerebroplacental ratio can identify coexisting placental insufficiency and fetal adaptation. A low cerebroplacental ratio has been associated with increased risk of emergency cesarean delivery for intrapartum fetal compromise, although its predictive value is heterogeneous and should be interpreted together with the full clinical picture [10]. Thus, Doppler assessment is most useful when ventriculomegaly coexists with fetal growth restriction, abnormal amniotic fluid, reduced fetal movements, maternal disease, or other signs of placental dysfunction.

Differentiated management algorithm. The corrected management approach is summarized in Table 1. The algorithm is based on risk stratification rather than on ventricular with alone.

Table 1.

Risk-stratified obstetric management of fetal ventriculomegaly/hydrocephalus

Risk group	Key diagnostic features	Recommended prenatal management	Delivery and neonatal planning
Low risk	Isolated mild ventriculomegaly 10-12 mm; no progression; normal anatomy, growth, and Doppler	Detailed neurosonography, counseling, infection/genetic testing according to local protocol, repeat ultrasound to assess stability	Timing and mode of delivery according to standard obstetric indications; routine neonatal examination with postnatal imaging when indicated
Intermediate risk	Moderate ventriculomegaly 13-15 mm, bilateral involvement, borderline progression, or uncertain isolation	Targeted neurosonography, fetal MRI when available, chromosomal microarray counseling, infection testing, serial ultrasound every 2-4 weeks	Delivery in a center with neonatology; postnatal cranial ultrasound/MRI depending on neonatal findings

High risk	Severe ventriculomegaly >15 mm, progressive enlargement, associated CNS/extracranial anomalies, suspected hydrocephalus, genetic or infectious etiology	Multidisciplinary counseling with maternal-fetal medicine, neonatology, pediatric neurology/neurosurgery and genetics; serial imaging; individualized surveillance	Delivery at tertiary perinatal center; mode and timing based on obstetric indications, fetal condition, head size, and neonatal surgical needs
Placental-complication subgroup	Any degree of ventriculomegaly plus fetal growth restriction, abnormal UA/MCA Doppler, low CPR, oligohydramnios, maternal hypertensive disease, or reduced fetal movements	Manage ventriculomegaly and placental disease in parallel; intensified fetal surveillance according to severity of placental insufficiency	Delivery timing guided by fetal growth restriction/placental insufficiency protocols and overall maternal-fetal risk

Discussion. The corrected IMRAD structure changes the manuscript from an unsupported observational claim into an evidence-based narrative synthesis. This is important because the original draft stated that ventriculomegaly directly correlated with impaired fetoplacental circulation and that a predictive model showed high sensitivity and specificity, but no dataset, sample size, statistical values, or validation results were provided. Without real clinical data, such statements should not be presented as original results.

The principal clinical message is that ventricular size is necessary but not sufficient for prognosis. The same atrial width may have different implications depending on whether the finding is isolated, progressive, unilateral or bilateral, early or late in gestation, and whether additional anomalies, infection, or genetic abnormalities are present. Therefore, counseling should be based on a structured diagnostic pathway rather than a single ultrasound measurement [1, 6-8].

The role of fetal Doppler should be framed accurately. Doppler assessment is a tool for evaluating fetal oxygenation, placental resistance, and hemodynamic redistribution. It does not define the neurological prognosis of ventriculomegaly by itself. However, it becomes clinically relevant when ventriculomegaly is accompanied by fetal growth restriction or signs of placental insufficiency. In such cases, Doppler findings may influence the frequency of surveillance and timing of delivery [10, 11].

Current recommendations generally do not support cesarean section or early delivery solely for isolated mild or moderate ventriculomegaly. SMFM guidance recommends that timing and mode of delivery should be based on standard obstetric indications [1]. Exceptions may include severe macrocephaly, nonreassuring fetal testing, significant fetal growth restriction, maternal indications, or the need to coordinate delivery with neonatal neurosurgical care.

An important practical component is postnatal follow-up. Neonatal cranial ultrasound, MRI when indicated, pediatric neurology consultation, and developmental surveillance are essential for cases with moderate, severe, progressive, or non-isolated ventriculomegaly. Even in apparently mild isolated cases, parents should be informed about the need for pediatric observation because subtle developmental or behavioral difficulties may become apparent later in childhood [6, 8].

The main limitation of this review is that it provides a clinical synthesis rather than analysis of original patient data. If the manuscript is later converted into an original research article, the Materials and Methods section should include exact study design, sample size, inclusion and exclusion criteria, measurement reproducibility, statistical methods, and ethics approval. The Results section should

then present real numerical findings, including effect sizes, confidence intervals, p values, and model validation indices.

Conclusion. Fetal ventriculomegaly and suspected hydrocephalus require differentiated obstetric management based on an integrated assessment of ventricular size, progression, associated anomalies, genetic and infectious factors, fetal growth, and fetoplacental hemodynamics. Isolated mild cases generally have a favorable prognosis after complete evaluation, whereas moderate, severe, progressive, and non-isolated cases require multidisciplinary counseling and intensified prenatal and postnatal surveillance.

Cerebroplacental ratio and umbilical artery/middle cerebral artery Doppler are useful adjuncts when placental insufficiency or fetal growth restriction is suspected, but they should not replace targeted neurosonography and etiological evaluation. Delivery timing and mode should usually follow standard obstetric indications, with individualization for severe disease, fetal compromise, marked macrocephaly, or the need for tertiary neonatal care.

Practical implications:

1. Use the term “ventriculomegaly” for sonographic ventricular dilatation and reserve “hydrocephalus” for cases with suspected disturbed cerebrospinal fluid circulation or progressive enlargement.
2. Classify severity as mild (10-12 mm), moderate (13-15 mm), and severe (>15 mm).
3. Do not base prognosis on ventricular width alone; evaluate isolation status, progression, associated anomalies, genetic and infectious causes.
4. Use Doppler assessment as an obstetric risk tool, especially when fetal growth restriction or placental insufficiency is suspected.
5. Plan delivery according to standard obstetric indications in isolated mild and moderate cases; refer high-risk cases to tertiary centers.
6. Provide neonatal imaging and developmental follow-up for moderate, severe, progressive, or non-isolated cases.

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