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COMPLICATIONS OF FETAL VENTRICULOMEGALY AND THEIR SIGNIFICANCE IN PERINATAL PRACTICE

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Abstract

Fetal ventriculomegaly is an ultrasound finding characterized by dilatation of the atria of the lateral cerebral ventricles to more than 10 mm. This condition is of considerable clinical importance in obstetrics and perinatology, as it may be associated with various neurological, genetic, and structural abnormalities of central nervous system development. The main complications of ventriculomegaly include delayed psychomotor development, motor and cognitive impairments, epileptic seizures, the development of hydrocephalus, and associated congenital brain abnormalities.

The severity of complications depends on the degree of ventricular enlargement, the etiology of the pathological process, the presence of associated congenital anomalies, and the dynamics of changes during pregnancy. Progressive and non-isolated ventriculomegaly are of particular concern, as they are associated with an increased likelihood of adverse neurological and perinatal outcomes.

Timely prenatal diagnosis, comprehensive fetal assessment, and dynamic monitoring make it possible to evaluate the risk of complications, determine the prognosis, and select the optimal pregnancy management strategy.



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Keywords: fetal ventriculomegaly, complications, hydrocephalus, psychomotor developmental delay, neurological disorders, perinatal outcomes, prenatal diagnosis, obstetrics.

Introduction

Fetal ventriculomegaly is one of the relevant issues in modern obstetric practice and perinatal medicine. Advances in ultrasound technology have made it possible to detect this condition increasingly often during the early stages of pregnancy, allowing timely assessment of the anatomical characteristics of the fetal brain and prediction of possible complications.

Ventriculomegaly is characterized by an enlargement of the atrial width of the lateral cerebral ventricles to more than 10 mm. Depending on the degree of enlargement, it is classified as mild (10–12 mm), moderate (13–15 mm), or severe (greater than 15 mm).

The clinical significance of ventriculomegaly is determined by its potential impact on fetal central nervous system development. In some cases, lateral ventricular enlargement is an isolated finding and is not associated with significant functional impairment. However, in the presence of associated brain abnormalities, chromosomal disorders, or intrauterine infections, the risk of adverse outcomes increases considerably.

The study of complications associated with ventriculomegaly is of great importance for obstetricians and gynecologists, maternal-fetal medicine specialists, neonatologists, and pediatric neurologists. A comprehensive assessment of this condition makes it possible not only to determine the level of risk but also to develop an individualized strategy for pregnancy management and subsequent monitoring of the child.

Main Complications of Fetal Ventriculomegaly

Complications of ventriculomegaly may manifest both during the intrauterine period and after birth. Their nature and severity depend on the underlying cause, the degree of ventricular enlargement, and the presence of associated pathological changes.

The most clinically significant complications include:

- Progression of lateral ventricular enlargement.
- Development of hydrocephalus.
- Delayed psychomotor development.
- Motor dysfunction.
- Cognitive and speech impairments.
- Epileptic seizures.
- Visual and hearing impairments.
- Associated congenital abnormalities of the central nervous system.
- Increased risk of adverse perinatal and neurological outcomes.

Neurological Complications of Ventriculomegaly

Delayed Psychomotor Development

One of the most significant complications of ventriculomegaly is delayed psychomotor development in the child. It may manifest as impaired acquisition of motor skills, delayed speech development, reduced learning abilities, and difficulties with social adaptation.

The severity of these impairments depends on the degree of ventriculomegaly and the presence of associated changes in brain tissue.

Children with isolated mild ventriculomegaly generally have a favorable prognosis. However, even in cases of minor ventricular enlargement, the possibility of late-onset functional impairments should be considered.

Cognitive Impairments

Cognitive impairments may include:

- Reduced attention span.
- Memory impairment.
- Delayed intellectual development.
- Difficulties in acquiring speech skills.
- Impaired information perception and processing.

These changes are more frequently observed in cases of non-isolated ventriculomegaly accompanied by structural abnormalities of the brain.

Motor Disorders

Damage to central nervous system structures may lead to impaired motor development.

Clinical manifestations include:

- Muscle hypotonia or hypertonia.
- Impaired motor coordination.
- Delayed acquisition of motor milestones.
- Gait disturbances.
- Spastic motor disorders.

In severe cases, motor impairments resembling the clinical manifestations of cerebral palsy may develop. However, ventriculomegaly alone is insufficient to establish this diagnosis.

Epileptic Seizures

One of the possible neurological complications is the development of epileptic seizures. Their occurrence may be associated with concomitant structural brain

damage, intrauterine hemorrhages, disorders of cortical development, and other pathological processes.

The risk of epileptic manifestations depends primarily on the underlying condition and the nature of the brain tissue injury.

Visual and Hearing Impairments

When ventriculomegaly is associated with other abnormalities of the central nervous system, impairments of visual and auditory functions may occur.

Possible manifestations include:

- Reduced visual acuity.
- Impaired visuomotor coordination.
- Damage to the visual pathways.
- Impaired auditory perception.

Intrauterine infections, particularly cytomegalovirus infection, are of special importance because they can affect the central nervous system and sensory organs.

Hydrocephalus as One of the Most Serious Complications

Hydrocephalus is one of the most important pathological conditions that must be excluded when fetal ventriculomegaly is detected.

It is characterized by an abnormal accumulation of cerebrospinal fluid within the cerebral ventricular system, accompanied by increased intracranial pressure and possible damage to brain tissue.

It is important to emphasize that ventriculomegaly and hydrocephalus are not synonymous terms. Ventriculomegaly is an ultrasound finding indicating ventricular enlargement, whereas hydrocephalus is a distinct pathological

condition that may be accompanied by progressive enlargement of the ventricular system.

The main causes of hydrocephalus include:

1. Cerebral aqueduct stenosis.
2. Impaired cerebrospinal fluid circulation.
3. Congenital abnormalities of brain development.
4. Intraventricular hemorrhage.
5. Inflammatory processes of infectious origin.

In progressive hydrocephalus, enlargement of the fetal head may occur, along with compression of surrounding brain structures and impaired development of nervous tissue.

After birth, some infants may require neurosurgical treatment, including ventriculoperitoneal shunt placement or endoscopic third ventriculostomy.

Structural Complications and Associated Abnormalities of the Central Nervous System

Ventriculomegaly is frequently associated with other congenital brain abnormalities that may significantly worsen the prognosis.

The most clinically significant abnormalities include:

Agenesis of the corpus callosum. This abnormality is characterized by the complete or partial absence of the corpus callosum, which facilitates communication between the cerebral hemispheres. Depending on associated abnormalities, cognitive, motor, and behavioral disorders may develop.

Posterior fossa abnormalities. These may involve impaired development of the cerebellum and other structures of the posterior cranial fossa, potentially affecting motor coordination and neurological development.

Disorders of cortical development. Abnormal cortical development may be associated with delayed intellectual development, epileptic seizures, and motor impairments.

Intracerebral hemorrhages. Hemorrhages may cause brain tissue damage, impair cerebrospinal fluid circulation, and result in secondary ventricular enlargement.

White matter abnormalities. Damage to the white matter may disrupt the formation of neural connections and lead to subsequent motor and cognitive impairments.

Timely identification of these abnormalities is essential for determining an individualized prognosis and selecting an appropriate follow-up strategy.

Genetic and Infectious Complications

Ventriculomegaly may be one of the manifestations of genetic and chromosomal disorders.

Particular attention is given to the following conditions:

- Trisomy 21 (Down syndrome).
- Trisomy 18 (Edwards syndrome).
- Trisomy 13 (Patau syndrome).
- Certain monogenic disorders and genetic syndromes.

The presence of ventriculomegaly requires assessment of genetic risk and consideration of invasive prenatal diagnostic testing with chromosomal microarray analysis.

Among infectious factors, cytomegalovirus infection and toxoplasmosis are of particular importance.

Intrauterine infectious involvement may lead to:

- Inflammatory changes in brain tissue.
- Intracranial calcifications.
- Impaired development of brain structures.
- White matter damage.
- Hearing and visual impairments.
- Delayed psychomotor development.

Therefore, when ventriculomegaly is detected, differential diagnosis should be performed to exclude an infectious or genetic etiology.

Influence of the Degree of Ventriculomegaly on the Development of Complications

The degree of lateral ventricular enlargement is one of the main factors determining the likelihood of an adverse outcome.

Degree of ventriculomegaly	Atrial width	Possible consequences
Mild	10–12 mm	Generally favorable prognosis in isolated cases; possible neurodevelopmental impairments
Moderate	13–15 mm	Increased risk of neurological disorders, particularly in the presence of additional abnormalities
Severe	Greater than 15 mm	Higher risk of developmental delay, hydrocephalus, and severe neurological complications

According to the recommendations of the Society for Maternal-Fetal Medicine (SMFM), following a comprehensive evaluation, the probability of normal neurodevelopment in cases of isolated mild ventriculomegaly exceeds 90%. In moderate ventriculomegaly, the probability of normal neurodevelopment is approximately 75–93%.

In severe cases, the prognosis is less favorable and depends on the etiology, the presence of additional abnormalities, and the progression of the pathological process.

The study by Ali F. et al. (2024), a systematic review and meta-analysis of 23 studies, is of particular importance. The analysis included data from 767 cases of mild isolated ventriculomegaly and 347 cases of severe isolated ventriculomegaly.

The authors found that, compared with mild ventriculomegaly, severe ventriculomegaly was associated with a relative risk of adverse neurodevelopmental outcomes of 4.24, a risk of intrauterine fetal death of 4.46, and a risk of neonatal and postnatal mortality of 6.02. These findings highlight the importance of the degree of ventricular enlargement as a prognostic factor.

Perinatal Complications and Adverse Outcomes

In addition to neurological disorders, ventriculomegaly may be associated with adverse perinatal outcomes.

These include:

Intrauterine fetal death. This outcome may occur in severe forms of ventriculomegaly, particularly in the presence of associated congenital abnormalities, genetic disorders, and severe infectious involvement.

Neonatal mortality. The risk of neonatal death increases in cases of significant structural abnormalities of the central nervous system and severe associated conditions.

Need for intensive care. Newborns with significant neurological impairments may require treatment in a neonatal intensive care unit, as well as specialized neurosurgical care.

Prolonged hospitalization. In the presence of hydrocephalus, neurological disorders, and other congenital abnormalities, prolonged inpatient treatment may be necessary.

It should be noted that adverse perinatal outcomes are determined not only by ventricular enlargement itself but also by the underlying pathological process responsible for the condition.

Diagnosis of Complications and Prediction of Outcomes

Comprehensive prenatal assessment is necessary for the timely identification of potential complications.

The main diagnostic methods include:

1. **Ultrasound examination.** Allows assessment of lateral ventricular dimensions, detection of progressive ventriculomegaly, and identification of associated structural abnormalities.
2. **Expert neurosonography.** Provides a detailed assessment of fetal brain anatomy.
3. **Magnetic resonance imaging.** Allows identification of additional changes in brain tissue, disorders of cortical development, and intracranial hemorrhages.
4. **Genetic testing.** Includes karyotyping and chromosomal microarray analysis when indicated.
5. **Infectious disease assessment.** Includes testing for cytomegalovirus infection and toxoplasmosis.
6. **Postnatal assessment.** After birth, neurosonography is performed, and MRI of the brain and neurological examination are carried out when necessary.

Dynamic monitoring of lateral ventricular dimensions plays a particularly important role. Progression of ventricular enlargement, especially an increase in

atrial width of 2 mm or more or progression to a more severe category, requires repeat expert assessment and reassessment of the prognosis.

Prevention and Management of Pregnancy

There is no specific method for preventing all forms of ventriculomegaly, since its causes are diverse. However, timely screening of pregnant women and identification of risk factors can reduce the likelihood of delayed diagnosis of associated pathological conditions.

The main strategies for preventing adverse outcomes include:

- Timely performance of routine prenatal ultrasound examinations.
- Early diagnosis of intrauterine infections.
- Medical genetic counseling when indicated.
- Expert fetal neurosonography.
- Use of fetal MRI when necessary.
- Dynamic monitoring of fetal condition.
- Planning delivery according to the potential needs of the newborn.

When severe ventriculomegaly is detected, pregnancy should be monitored by maternal-fetal medicine specialists. In cases of significant hydrocephalus or other serious abnormalities, arrangements should be made in advance to ensure access to specialized neonatal and neurosurgical care.

It is important to emphasize that isolated ventriculomegaly alone is not an indication for preterm delivery or cesarean section. The timing and mode of delivery are determined according to standard obstetric indications.

Discussion

Complications of fetal ventriculomegaly represent an important challenge in modern perinatology, as this condition may have different clinical manifestations and variable long-term consequences.





An analysis of current scientific literature indicates that the most significant factors associated with an adverse prognosis include severe lateral ventricular enlargement, progressive disease, and the presence of associated abnormalities of the central nervous system.

Predicting neurological development in children with isolated ventriculomegaly remains particularly challenging. Even in the absence of additional structural abnormalities, subsequent monitoring of motor, cognitive, and speech development is necessary.

The findings of systematic reviews and meta-analyses indicate more favorable outcomes in mild isolated ventriculomegaly compared with severe forms. Severe ventriculomegaly is associated with an increased risk of adverse neurological and perinatal outcomes.

Differential diagnosis between ventriculomegaly and hydrocephalus is of considerable importance. Although these conditions are related, they have different diagnostic and clinical characteristics, which must be considered when determining the prognosis and selecting an appropriate management strategy.

Thus, comprehensive fetal assessment, including ultrasound examination, neurosonography, MRI, and genetic testing, is essential for the timely identification of complications and improvement of the quality of perinatal care.

Conclusion

Fetal ventriculomegaly is an important marker of potential abnormalities in central nervous system development and requires particular attention in obstetric and perinatal practice.

The main complications of this condition include delayed psychomotor development, cognitive and motor impairments, epileptic seizures, hydrocephalus, and associated structural and genetic abnormalities.





The severity of complications is determined by the degree of lateral ventricular enlargement, the etiology of the pathological process, the presence of additional congenital malformations, and the dynamics of changes during pregnancy.

The most favorable prognosis is observed in cases of isolated mild ventriculomegaly following the exclusion of associated structural, genetic, and infectious abnormalities. Severe and progressive forms require more thorough diagnostic evaluation and multidisciplinary monitoring.

Therefore, early diagnosis, comprehensive assessment of fetal condition, and subsequent monitoring of the newborn are of fundamental importance for the timely identification of neurological complications, prediction of outcomes, and improvement of the quality of medical care provided to both mother and child.

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